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Tahun 2004-2008 (355 judul)

Maria Soledad Gomez-Conde, Ana Perez de Rozas, Ignacio Badiola, Luis Perez-Alba, Carlos de Blas, Rosa Carabano, Javier Garcia, Effect of neutral detergent soluble fibre on digestion, intestinal microbiota and performance in twenty five day old weaned rabbits, Livestock Science, Volume 125, Issues 2-3, November 2009, Pages 192-198, ISSN 1871-1413, DOI: 10.1016/j.livsci.2009.04.010.
(http://www.sciencedirect.com/science/article/B7XNX-4WD1172-1/2/21caaa09dd7be5c89563725a19e1a556)
Abstract:
The effect of neutral detergent soluble fibre (NDSF) level on digestibility, fermentation traits, intestinal microbiota and performance was studied in weaned rabbits. A control diet (DA) containing 103 g NDSF/kg DM included dehydrated alfalfa as the main source of fibre. Another diet (B-AP) was formulated by replacing half of the dehydrated alfalfa with a mixture of beet and apple pulp resulting in 131 g NDSF/kg DM. A third diet (OH) was obtained by substituting half of the dehydrated alfalfa with a mix of oat hulls and a soybean protein concentrate and contained 79 g NDSF/kg DM. All diets contained similar levels of total fibre (NDSF + neutral detergent fibre), starch and protein (446, 208, and 199 g/kg DM, respectively). Forty-two rabbits (14/diet) weaned at 25 days were used to determine faecal digestibility from 32 to 35 days of age. This group, plus another nine rabbits/diet (23/diet), were used to determine weight of stomach and caecum and their contents, caecal fermentation traits and similarity rate (SR) of intestinal microbiota. Another 105 and 245 weaned rabbits were used to determine growth traits and mortality, respectively. From 25 to 39 days of age, rabbits were fed the experimental diets and from 39 to 60 days they were fed a commercial diet, including robenidine hydrochloride in all diets. Drinking water was supplemented with apramicine sulfate and tylosine tartrate throughout the experimental period. Faecal and energy digestibility increased linearly by 8% and NDF digestibility by 43% between extreme diets with NDSF inclusion ($P < 0.001$). Weight of total gastrointestinal tract decreased linearly and quadratically with NDSF reduction ($P = 0.008$ and $P = 0.089$, respectively). Stomach pH decreased linearly with increasing levels of NDSF ($P <= 0.041$). Weight of caecal contents increased linearly between animals fed OH and B-AP diets ($P < 0.001$). Level of inclusion of NDSF had no effect ($P >= 0.12$) on pH, VFA concentration and VFA molar proportions in caecal contents. Treatments appeared to influence the SR of caecal microbiota but a lesser effect was observed on ileal microbiota. Post weaning feed efficiency (25-39 days) increased linearly ($P < 0.001$) with NDSF inclusion by 10% between extreme diets, and by 3% in the whole fattening period ($P = 0.027$). Average feed intake during the post weaning (25-39 days) and the whole fattening period increased with NDSF reduction ($P <= 0.079$). No effect of NDSF was detected on average daily gain ($P >= 0.15$). Mortality decreased linearly with increasing levels of NDSF in the post weaning and in the whole fattening period ($P = 0.086$ and 0.016, respectively).
Keywords: Neutral detergent soluble fibre; Performance; Digestion; Intestinal microbiota; Growing rabbits

S. Le Bouquin, J.L. Jobert, G. Larour, L. Balaine, F. Eono, S. Boucher, A. Huneau, V. Michel, Risk factors for an acute expression of Epizootic Rabbit Enteropathy syndrome in rabbits after weaning in French kindling-to-finish farms, Livestock Science, Volume 125, Issues 2-3, November 2009, Pages 283-290, ISSN 1871-1413, DOI: 10.1016/j.livsci.2009.05.010.
(http://www.sciencedirect.com/science/article/B7XNX-4WFPPPK-1/2/77f6189f32757e6fef2fc517bb514ff2)
Abstract:

Epizootic Rabbit Enteropathy (ERE) is a severe clinical syndrome of rabbits causing high economic losses for farmers. ERE first appeared in France in 1996. A retrospective case-control survey was carried out to identify the risk factors of acute expression of ERE, after weaning, in 96 kindling-to-finish rabbit farms in western France during 2001 and 2002. Farm status was defined according to the expression of clinical signs of ERE and mortality rates in the last five broiler rabbit batches. Comparisons of structural characteristics, rearing conditions and herd management showed that the risk factors for acute ERE expression were late weaning (rabbit age at weaning >= 35 days, RR = 4.44, 95% CI [1.36-21.71]), transfer of young rabbits at weaning (young rabbit transfer or combined practice RR = 2.83, 95% CI [1.16-9.33]), and high volume of the fattening room (air volume/rabbit weight in fattening room at weaning >= 0.14m3/kg, RR = 2.98, 95% CI [1.29-8.42]) and a high mortality rate in young rabbits before weaning (i.e. rate >= 10.5%; RR = 2.18, 95% CI [1.20-3.53]).
Keywords: Epizootic Rabbit Enteropathy; Risk factors; Logistic regression

Jun Liu, Steve Mullen, Qinggang Meng, John Critser, Andras Dinnyes, Determination of oocyte membrane permeability coefficients and their application to cryopreservation in a rabbit model, Cryobiology, Volume 59, Issue 2, October 2009, Pages 127-134, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2009.06.002.
(http://www.sciencedirect.com/science/article/B6WD5-4WHFD8F-1/2/a086a7aefaafa5ccf3c0ce9fecf5fa4a)
Abstract:
Having an effective means to cryopreserve human oocytes would offer more flexibility in healthcare services for infertility patients, and obviate cryopreservation of preimplantation embryos. It is essential to establish good animal models for human oocyte cryopreservation and the rabbit is a good candidate. Attempts to improve oocyte cryopreservation are often empirical, with results often being irreproducible. Cryopreservation protocols may be optimized by modeling the changes in oocyte volume and the associated damages incurred during the addition and dilution of cryoprotective agents (CPA). The objectives of the current study were to determine cryobiological properties of rabbit oocytes, including the isotonic volume, osmotically inactive cell fraction (Vb), hydraulic conductivity (Lp), permeability (Ps) to dimethylsulfoxide (Me2SO), ethylene glycol (EG), and glycerol (GLY) and to examine the correlation between cell volume excursions and viability. This has led to the development of the accumulative osmotic damage (AOD) model associated with the processes of CPA addition/dilution. Mature rabbit oocytes were perfused with 15% (V/V) CPA medium (dissolved in 1x PBS). The osmotic responses of the oocytes were videotaped. A two-parameter model was fit to the experimental data to determine the values of Lp and Ps. Oocyte volumes reached upon equilibration with 285, 600, 900, and 1200 mOsm (milliosmolal) solutions of non-permeating compounds were plotted in a Boyle van't Hoff plot. The average radius of rabbit oocytes in an isotonic solution was determined to be 55.7 +/- 1.2 [mu]m (n = 16). The rabbit oocyte exhibited an 'ideal' osmotic response in the range from iso-osmolity to 1200 mOsm. The Vb was determined to be 20% of the isotonic value with r2 = 0.97. The values of Lp were determined to be 0.79 +/- 0.26, 0.82 +/- 0.22, and 0.64 +/- 0.16 [mu]m min-1 atm-1 and the Ps values were determined to be 2.9 +/- 1.3, 2.7 +/- 1.3, and 0.27 +/- 0.18 x 10-3 cm min-1 for Me2SO, EG and GLY, respectively. There were no significant differences ($p > 0.05$) between values for Lp and PS in the presence of the Me2SO and EG. However, these values were significantly different from the values in presence of GLY. We calculated the AOD values of those oocytes that experienced the process of CPA additions/dilutions and found that these values were highly correlated to the development rates of these oocytes after parthenogenetic activation ($r = -0.98$).
Keywords: Membrane permeability; Cryobiology; Oocyte cryopreservation

Alessandro Zotti, Tommaso Banzato, Bruno Cozzi, Cross-sectional anatomy of the rabbit neck and trunk: Comparison of computed tomography and cadaver anatomy, Research in Veterinary Science, Volume 87, Issue 2, October 2009, Pages 171-176, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2009.02.003.
(http://www.sciencedirect.com/science/article/B6WWR-4VVW4TH-2/2/c3f53278bcfbafa2ca6c758d67e48004)
Abstract:
Computed tomographic images of the neck, thorax and abdomen in four healthy adult rabbits were obtained with a conventional CT using a slice-thickness of 5 mm. CT images were obtained with the animals positioned in sternal recumbency on a removable plastic support directly laying on the CT-table. At the end of the CT session, each rabbit was euthanized and, while carefully maintaining the same position on the plastic support, the animal was moved into a -20 [degree sign]C freezer until completely frozen. Each cadaver was then sectioned at 10 mm slices, with the first section starting at the tip of the nose, respecting the imaging protocol. The frozen sections were cleaned and then photographed on each side. Anatomic structures were identified and labeled first on each side of the frozen section and then on the corresponding CT image with the aid of the available literature. Results from our study provide an atlas of normal cross-sectional gross and CT anatomy of the rabbit neck, thorax and abdomen, useful in the interpretation of any cross-sectional imaging modality in this species.
Keywords: Normal cross-sectional rabbit anatomy; Neck; Thorax; Abdomen; Computed tomography

Andre M. Almeida, Alexandre Campos, Sofia van Harten, Luis Alfaro Cardoso, Ana Varela Coelho, Establishment of a proteomic reference map for the gastrocnemius muscle in the rabbit (Oryctolagus cuniculus), Research in Veterinary Science, Volume 87, Issue 2, October 2009, Pages 196-199, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2009.02.011.
(http://www.sciencedirect.com/science/article/B6WWR-4VXCG32-1/2/8defd01a10a87f6f3b2c67b01bde3365)
Abstract:
In several laboratory and production species, the establishment of a proteome reference map of a specific tissue has been accomplished. The rabbit is widely used as both a production and experimental animal. A lot of physiology research involving the gastrocnemius muscle of rabbit is described, although no reference proteome map is available. In this work, the first reference map of the rabbit's gastrocnemius muscle using 2D gel electrophoresis and the identification of proteins through peptide mass fingerprinting (PMF) was established. A total of 45 proteins were localized and identified with three major roles: cell structure and contractile apparatus; metabolic and cell defense proteins. A reference map of major proteins expressed is described enabling possible comparisons with other physiological studies.
Keywords: Rabbit; Gastrocnemius; 2D reference map

Matthew C. Leach, Sandra Allweiler, Claire Richardson, John V. Roughan, Ruediger Narbe, Paul A. Flecknell, Behavioural effects of ovariohysterectomy and oral administration of meloxicam in laboratory housed rabbits, Research in Veterinary Science, Volume 87, Issue 2, October 2009, Pages 336-347, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2009.02.001.
(http://www.sciencedirect.com/science/article/B6WWR-4VW4VC3-1/2/fbf2501f6d067bf206326273f75a66e5)
Abstract:
This study aimed to develop a behaviour-based pain assessment system for rabbits following ovariohysterectomy. Behaviour was analysed to assess the severity and duration of pain induced and determine the effects of administration of meloxicam. The results suggest that pain associated with ovariohysterectomy induced changes in the frequency and duration of a number of

behaviours. The most indicative was inactive pain behaviour, which was observed very infrequently prior to surgery compared to very frequently immediately following surgery. This strongly suggests that this increase is a direct response to the surgical pain and/or stress. The frequency of inactive pain behaviour also decreased over the four days post-surgery suggesting that pain is decreasing during this time. High dose meloxicam (initial 1 mg/kg followed 0.5 mg/kg/day) induced some degree of analgesia. However, higher doses of meloxicam or in combination with an opioid may be required to provide consistent analgesia in rabbits following soft-tissue surgery.
Keywords: Rabbit; Ovariohysterectomy; Behaviour; Pain; Meloxicam

A.V. Sirotkin, J. Rafay, J. Kotwica, Leptin controls rabbit ovarian function in vivo and in vitro: Possible interrelationships with ghrelin, Theriogenology, Volume 72, Issue 6, 1 October 2009, Pages 765-772, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2009.05.011.
(http://www.sciencedirect.com/science/article/B6TCM-4WSR0MG-1/2/66555c6af8638e2b00866da49dcf8212)
Abstract:
The aim of these in vivo and in vitro studies was to examine the role of leptin in the control of plasma hormone concentrations, reproduction, and secretory activity of ovarian granulosa cells.
In in vivo experiments, 15 female European domestic rabbit (Oryctolagus cuniculus) were treated with leptin (5 [mu]g animal-1 d-1 for 1 wk before induction of ovulation with 25 IU equine chorionic gonadotropin and 0.25 IU human chorionic gonadotropin), and 15 females constituted the control group (treated with phosphate-buffered saline). Plasma concentrations of progesterone (P4), testosterone (T), estradiol (E2), estrone sulfate (ES), and insulin-like growth factor I (IGF-I) were determined at the estimated day of ovulation by radioimmunoassay (RIA), and number, viability, and body weight of newborns were recorded at parturition. In in vitro experiments, granulosa cells were isolated from periovulatory ovarian follicles of five control and five females treated with ghrelin (10 [mu]g animal-1 d-1 for 1 wk before induced ovulation). Isolated cells were cultured for 2 d with and without leptin (0, 1, 10, or 100 ng/mL medium). Secretion of P4, T, E2, IGF-I, and prostaglandin F (PGF) was assessed in culture medium by RIA.
In in vivo experiments, leptin administrations reduced plasma P4, T, E2, ES, and IGF-I levels. Leptin treatments did not affect ovarian weight or total number and body mass of newborns, but the proportion of pregnant females and number of live newborns were significantly higher in leptin-treated females than that in control females. In in vitro experiments, leptin significantly decreased (at 1 and 10 ng/mL) or increased (at 100 ng/mL) P4 secretion, promoted E2 and IGF-I (both at 100 ng/mL) secretion, and reduced T (at 1 and 10 ng/mL) and PGF (at 10 ng/mL) secretion. Granulosa cells from ghrelin-treated animals secreted less P4, T, E2, and PGF, but not IGF-I, than that secreted by granulosa cells from control animals. Furthermore, pretreatment of animals with ghrelin suppressed or even reversed subsequent leptin effects on P4, T, E2, IGF-I, and PGF secretion by cultured granulosa cells.
These observations (1) show for the first time that leptin can increase the number of live newborns in rabbits, (2) confirm previous data on the ability of leptin to control ovarian secretory activity both directly and via upstream mechanisms, (3) demonstrate the involvement of ghrelin in the control of rabbit ovarian secretory functions, and (4) suggest an antagonistic interrelationship between leptin and ghrelin in the rabbit.
Keywords: Granulosa; Hormones; Rabbit; Leptin; Ovary

M. Arias-Alvarez, R.M. Garcia-Garcia, P.G. Rebollar, L. Revuelta, P. Millan, P.L. Lorenzo, Influence of metabolic status on oocyte quality and follicular characteristics at different postpartum periods in primiparous rabbit does, Theriogenology, Volume 72, Issue 5, 15 September 2009, Pages 612-623, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2009.04.017.

(http://www.sciencedirect.com/science/article/B6TCM-4WH0JN7-1/2/9233cbb23a6fc10cfc65dab0ad6dcd93)
Abstract:
Low reproductive performance of high-yield primiparous animals is closely associated with the metabolic stress caused by a simultaneous gestation and lactation. The aim of this work was (1) to analyze body composition and metabolic environment at three time points along lactation (at parturition time; in the lactation period [Day 11 postpartum]; and in the postweaning period [Day 32 postpartum]) of primiparous rabbit does (Oryctolagus cuniculus) and (2) to investigate the ovarian status at insemination time and the possible link with metabolic environment and with their reproductive performance. To this end, does were either submitted to a semi-intensive reproductive rhythm (Group S, inseminated on Day 11 postpartum) or an extensive rhythm (Group E, inseminated on Day 32 postpartum). Body energy ($P < 0.05$) and protein content ($P < 0.001$) as well as serum leptin ($P < 0.05$) and protein concentrations ($P < 0.001$) increased significantly along the postpartum period. At parturition, body lipid content was significantly lower and serum nonesterified fatty acids concentrations were significantly higher than that on Days 11 postpartum and 32 postpartum. Concerning ovarian status at insemination time, no significant differences were found in mean follicular stages, serum estradiol, progesterone, and prolactin (PRL) concentrations or in prolactin receptor (PRL-R) immunostaining. However, follicles in Group S showed a significantly higher apoptosis index than that of Group E ($P < 0.001$). The nuclear and cytoplasmic oocyte maturation rates of Group S were also significantly lower than that in Group E. In addition, conception rate and prolificacy were improved in Group E ($P < 0.001$ and $P < 0.05$, respectively). In conclusion, in the early postpartum period, metabolic status seems to impact negatively on ovarian follicle and oocyte quality leading to a poor reproductive outcome in primiparous rabbit does.
Keywords: Follicular atresia; Metabolism; Oocyte maturation; Postpartum; Rabbit

M.P. Viudes De Castro, C. Cortell, E. Moce, F. Marco-Jimenez, T. Joly, J.S. Vicente, Effect of recombinant gonadotropins on embryo quality in superovulated rabbit does and immune response after repeated treatments, Theriogenology, Volume 72, Issue 5, 15 September 2009, Pages 655-662, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2009.04.022.
(http://www.sciencedirect.com/science/article/B6TCM-4WM04W6-3/2/15be46428b33cda3536e23ffe5976482)
Abstract:
This study aimed first to evaluate the effect of recombinant human FSH (rhFSH) with and without recombinant human LH (rhLH) on fresh and frozen-thawed embryo development and also to analyze the immune response of rabbit does (Oryctolagus cuniculus) subjected to repeated rhFSH treatments. Nulliparous New Zealand White does were used. In Experiment 1, 120 does were superovulated with 25 IU rhFSH alone or in combination with 5% or 10% rhLH (1.25 IU or 2.50 IU rhLH). A total of 1116 embryos at the compacted morula stage were cultured at 38.5 [degree sign]C, 5% CO2, and saturated humidity for 48 h. The embryo development to hatching blastocyst was significantly lower for the group with 10% rhLH versus that of the control group (65.6 vs. 79.5 for rhFSH + 10% rhLH vs. control, respectively). However, no significant difference was found in development to hatching blastocyst for the control, rhFSH alone, and rhFSH + 5% rhLH groups. The developmental potential of frozen-thawed embryos obtained from all groups was similar, with an 83.5% in vitro development rate until the expanded blastocyst stage. To detect anti-FSH antibodies, in Experiment 2, does were subject to four superovulation treatments. The hormone administration had a significant effect on immune response in the superovulation group after two treatments (0.14 +/- 0.074 and 0.15 +/- 0.076 vs. 0.46 +/- 0.078 and 0.50 +/- 0.078 optical density for the first, second, third, and forth cycles, respectively). Nevertheless, none of the treated does had an immune response in both the first and second treatments; on the contrary, a significant increase in the antibody levels was observed in these females at the moment of the third and

fourth superovulation treatments. In conclusion, rhFSH superovulation treatments increase the reproductive potential of rabbit does.
Keywords: Doe rabbit; Embryo viability; Immune response; Recombinant human FSH; Superovulation

R.M. Garcia-Garcia, M. Arias-Alvarez, P.G. Rebollar, L. Revuelta, P.L. Lorenzo, Influence of different reproductive rhythms on serum estradiol and testosterone levels, features of follicular population and atresia rate, and oocyte maturation in controlled suckling rabbits, Animal Reproduction Science, Volume 114, Issue 4, September 2009, Pages 423-433, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2008.10.007.
(http://www.sciencedirect.com/science/article/B6T43-4TRCYD2-1/2/2dc9bf96289ef1146e600cb40b64b117)
Abstract:
The aim of the current work was to analyze the features of ovarian follicular population and their quality in New Zealand white rabbit does synchronized by 24-h controlled doe-litter separation before artificial insemination (AI) during all their reproductive cycles. Synchronized animals were allocated systematically in two groups. A total of 73 rabbit does (group A) were submitted to a 35-day intensive rhythm (AI on day 4 post-partum [pp] and weaning at 25 days of lactation), and 108 rabbit does (group B) were submitted to a 42-day semi-intensive rhythm (AI on day 11 pp and weaning at 35 days of lactation) during 9 months. At the mid-end of their reproductive life, a total of 26 does (5.4 parturitions), under intensive (n = 15) or semi-intensive rhythm (n = 11) were either treated in each group with 25 IU eCG 48 h before laparotomy to recover their ovaries (n = 7 for group A and n = 6 for group B) (according to the Bioethics Committee of the University) or not synchronized with the hormonal treatment (n = 8 for group A and n = 5 for group B). Blood samples were collected at the moment of ovary recovery; morphometrical parameters, number of total follicles and number of follicles >=1 mm in size in the ovarian surface were recorded. Oocytes from follicles of one ovary were recovered and matured in TCM 199 supplemented with 10 ng/ml EGF, 100 ng/ml IGF-I and 10% FCS. The counterpart ovaries were fixed in paraformaldehyde solution for histological studies. Detection of cell apoptosis was determined using the terminal deoxynucleotidyl transferase-mediated dUTP nick-end-labelling (TUNEL) technique. Reproductive performance was affected by the rhythm used, with lower reproductive parameters in the intensive group. The average ovary height and width, the mean number of >=1 mm follicles and the number of total follicles were similar between groups. Serum concentrations of estradiol (E2) and testosterone (T) were significantly lower in group A vs. B (E2: 232.4 +/- 56.1 vs. 399.7 +/- 53.0 pg/ml; P < 0.05 and T: 1.07 +/- 0.10 vs. 1.68 +/- 0.23 ng/ml; P < 0.05). No significant differences were found in follicular population or in the mean follicular apoptosis index between groups. Metaphase II rate was significantly lower in group A vs. B (48.5 +/- 3.3 vs. 67.6 +/- 3.7%; P < 0.01), as well as the migration rate of cortical granules (12.7 +/- 2.7 vs. 38.2 +/- 6.6%; P < 0.001). On the other hand, neither follicular population, nuclear maturation rate nor apoptosis rate were affected by the eCG treatment, but cytoplasmic maturation was higher in animals treated with eCG in group A (29.2% vs. 5.5%; P < 0.01). In conclusion, rabbit does under transient litter separation during their reproductive life have both their serum estradiol and testosterone concentrations and oocyte quality influenced by the intensive rhythm, leading to a decrease in reproductive parameters. Also, both intensive and semi-intensive rhythms seem to be less receptive to eCG treatment than expected.
Keywords: Biostimulation; Follicular population; Oocyte maturation; Apoptosis; eCG

Pedro Bullon, Jose L. Quiles, Juan M. Morillo, Corrado Rubini, Gaia Goteri, Sergio Granados-Principal, Maurizio Battino, MCarmen Ramirez-Tortosa, Gingival vascular damage in atherosclerotic rabbits: Hydroxytyrosol and squalene benefits, Food and Chemical Toxicology,

Volume 47, Issue 9, September 2009, Pages 2327-2331, ISSN 0278-6915, DOI: 10.1016/j.fct.2009.06.026.
(http://www.sciencedirect.com/science/article/B6T6P-4WK48DD-1/2/210b1b5db722a425a67758e37896833b)
Abstract:
Cardiovascular alterations and periodontal disease have been associated, although cardiovascular disease treatments have not yet been tested against periodontal alterations. We investigated effects of squalene, hydroxytyrosol and coenzyme Q10 on gingival tissues of rabbits fed on an atherosclerotic diet. Forty-eight rabbits were distributed in six groups. Control group was fed on standard chow for 80 days. The rest were fed with an atherogenic diet for 50 days. After that, a group was sacrificed and the rest were subjected for another extra 30 days on commercial chow alone or supplemented with coenzyme Q10, squalene or hydroxytyrosol. Atherosclerotic rabbits had higher fibrosis and endothelial activation and lower cellularity in gingival mucosa than controls ($P < 0.05$). Hydroxytyrosol reduced endothelial activation ($P < 0.05$) and squalene additionally decreased fibrosis ($P < 0.05$). Results suggest that gingival vascular changes after the atherosclerotic diet have been reversed by hydroxytyrosol and squalene, natural products from the minor fraction of virgin olive oil.
Keywords: Anti-oxidants; Cardiovascular disease; Coenzyme Q10; Fibrosis; Oral disease; Virgin olive oil

M.C. Carrilho, M. Lopez, M.M. Campo, Effect of the fattening diet on the development of the fatty acid profile in rabbits from weaning, Meat Science, Volume 83, Issue 1, September 2009, Pages 88-95, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2009.04.004.
(http://www.sciencedirect.com/science/article/B6T9G-4W26GFN-2/2/6d4449f30627114303696da80e7eac2d)
Abstract:
The effect of the fattening diet on the intramuscular fatty acid composition was studied on a total of 96 hybrid rabbits. Animals were slaughtered at weaning, at 1.6 kg after the consumption for three weeks of various diets containing low (14.28%), medium (18.04%) and high (20.48%) fibre content, and at 2 and 2.30 kg after the consumption of a common non-medicated concentrate, as occurs commercially. Weight had an effect on the percentage of intramuscular fat that decreased as weight increased, as well as on the percentage of most fatty acids except for saturated fatty acids. The percentage of monounsaturated fatty acids increased from weaning whereas polyunsaturated fatty acids subsequently decreased due to a reduction of n-6 fatty acids. In general, diet affected the fatty acid profile in rabbits slaughtered at 1.6 kg, which the rabbits were having exclusively one of the three fattening diets. The finishing common diet seems to reduce most differences due to the growing diet which, if rich in fibre, would produce a more favourable final n-6/n-3 ratio.
Keywords: Rabbits; Feeding; Slaughter weight; Fatty acids

Carla Lazzaroni, Davide Biagini, Carola Lussiana, Fatty acid composition of meat and perirenal fat in rabbits from two different rearing systems, Meat Science, Volume 83, Issue 1, September 2009, Pages 135-139, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2009.04.011.
(http://www.sciencedirect.com/science/article/B6T9G-4W4CWTC-1/2/5ce10a4e4771390ba0a9a899ba4544f5)
Abstract:
To evaluate the effect of different rearing systems and sex on the fatty acid composition of rabbit meat and perirenal fat, the fat content and fatty acid composition of Longissimus lumborum and perirenal fat were determined by gas chromatography on 40 rabbits (20 males and 20 females) of the Carmagnola Grey breed reared from 9 to 16 weeks of age in individual California type cages (0.12 m2) or in group ground pens (0.25 m2/head). Ether extract percentage of muscle was

significantly influenced by the housing system while, both sex and rearing method affected the fatty acid composition with a decrease in monounsaturated fatty acid (MUFA) and an increase in polyunsaturated ones (PUFA) in penned and male rabbits. The same trends were observed in the fatty acid composition of the perirenal fat, gender only had a significant affect on the saturated fatty acid (SFA) content in the perirenal fat. Indices relating to human health showed the PUFA/SFA ratio to be over the minimum recommendation for rabbits reared in pens and for males, while only the n6/n3 ratio was above the maximum recommendation for caged rabbits. Atherogenic index (AI) of perirenal fat was affected by gender, but no differences were observed in trombogenic index (TI) in either muscle or perirenal fat.
Keywords: Rabbit; Housing systems; Fatty acid; Human health

Ana Patricia Fontes-Sousa, Claudia Moura, Catarina Santos Carneiro, Armando Teixeira-Pinto, Jose Carlos Areias, Adelino F. Leite-Moreira, Echocardiographic evaluation including tissue Doppler imaging in New Zealand white rabbits sedated with ketamine and midazolam, The Veterinary Journal, Volume 181, Issue 3, September 2009, Pages 326-331, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2008.02.022.
(http://www.sciencedirect.com/science/article/B6WXN-4SCTVSB-1/2/44a089ebbf8b9ea3b1fc5a7f2e1d46b0)
Abstract:
Limited data are available on the use of more recent echocardiographic parameters in the rabbit. Echocardiographic examination, including conventional echocardiography and tissue Doppler imaging (TDI), was performed on 26 male New Zealand white rabbits under ketamine-midazolam sedation. Particular emphasis was placed on the more recent systolic and diastolic parameters, such as myocardial performance index (Tei index) and mitral annular motion (from septal and lateral sides of the left ventricle) obtained using pulsed TDI.
Parameters that assessed systolic and diastolic function (fractional shortening, Tei index, and maximal mitral E- and A-wave velocities) were comparable to those reported in the literature for rabbits in the awake state. The less cardiodepressive anaesthetic protocol could offer a good alternative in performing echocardiographic evaluation whenever such caution is necessary. TDI is feasible in healthy rabbits and potentially suitable for the investigation of left ventricle systolic and diastolic function.
Keywords: Doppler echocardiography; Tissue Doppler Imaging; Reference value; Rabbit; Anaesthesia

A.M. King, F. Cranfield, J. Hall, G. Hammond, M. Sullivan, Radiographic anatomy of the rabbit skull, with particular reference to the tympanic bulla and temporomandibular joint. Part 2: Ventral and dorsal rotational angles, The Veterinary Journal, In Press, Corrected Proof, Available online 29 August 2009, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2009.07.022.
(http://www.sciencedirect.com/science/article/B6WXN-4X3VM38-1/2/c2d5384c94833e6548fcae8f59ec9dd8)
Abstract:
This is the second part of a two-part study to document rabbit skull radiographic anatomy with particular reference to the temporomandibular joint (TMJ) and tympanic bulla (TB), and identify views that allowed their optimal visualisation. Equipment was used that allowed repeatable positioning of skulls at known rotational angles in ventral (rostrocaudal to ventrodorsal) with the mouth closed and open, and dorsal (rostrocaudal to dorsoventral position) directions. The views were repeated with lead markers attached to anatomical features and cadaver heads. The TBs were visible between 40[degree sign] and 90[degree sign] from rostrocaudal in both directions, but opening the mouth did not improve visualisation. The TMJs were visible until 40[degree sign] in a ventral direction, but only 20[degree sign] in a dorsal one. Opening the mouth slightly altered the regions of the joint being skylined, but did not otherwise enhance imaging of this region.

Keywords: Rabbit; Anatomy; Tympanic bulla; Temporomandibular joint; Radiography

Monika Pogany Simonova, Andrea Laukova, Michaela Haviarova, Pseudomonads from rabbits and their sensitivity to antibiotics and natural antimicrobials, Research in Veterinary Science, In Press, Corrected Proof, Available online 27 August 2009, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2009.07.010.
(http://www.sciencedirect.com/science/article/B6WWR-4X3DS20-1/2/025b38511217fde0ad7054ce2acd60d7)
Abstract:
The sensitivity/resistance of Pseudomonas spp. isolated from rabbits gastrointestinal tract and faeces to antibiotics, enterocins and herbal extracts was tested in this study. The counts of Pseudomonas-like bacteria were higher in faeces (3.23-6.16 log10 CFU/mL/g) than in caecum (1.36-4.08 log10 CFU/mL/g). Nineteen isolates (16 faecal, 3 caecal) were oxidase positive. The strains were allotted by phenotypization to Pseudomonas spp., Brevundimonas diminuta and Brevundimonas vesicularis. High percentage of resistant strains was observed to all antibiotics. The tested strains were more susceptible to natural substances, mainly to plant extracts oregano (95%) and sage extracts (58%). Comparing the antibacterial effect of antibiotics and enterocins against rabbits pseudomonads, enterocins were more effective; the strongest inhibitory activity was determined in the case of partially purified enterocins PPBs EF2019, EK13 and EF55.
Keywords: Antibiotics; Bacteriocins; Plant extracts; Pseudomonas

C. Romero, N. Nicodemus, P. Garcia-Rebollar, A.I. Garcia-Ruiz, M.A. Ibanez, J.C. De Blas, Dietary level of fibre and age at weaning affect the proliferation of Clostridium perfringens in the caecum, the incidence of Epizootic Rabbit Enteropathy and the performance of fattening rabbits, Animal Feed Science and Technology, Volume 153, Issues 1-2, 26 August 2009, Pages 131-140, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2009.05.005.
(http://www.sciencedirect.com/science/article/B6T42-4WFPPGN-2/2/3a3982ab28cf069285123fadb826c9b4)
Abstract:
An experiment was conducted to investigate the effects of dietary fibre content and weaning age on Clostridium perfringens proliferation in the caecum and fattening mortality in growing rabbits farmed in a facility having Epizootic Rabbit Enteropathy. The experiment consisted in a 2 x 2 factorial arrangement with two weaning ages (28 days vs. 42 days) and two levels of dietary neutral detergent fibre assayed with a heat stable amylase and expressed exclusive of residual ash (aNDFom; 330 g/kg vs. 425 g/kg). Controls were made during two consecutive experimental periods that differed in hygienic environmental conditions by modifying the intensity of cleaning and disinfection in the farm previous to the trial. An interaction ($P<0.001$) was detected among the independent variables studied on Cl. perfringens enumeration in the caecal contents, as minimal values for this trait were obtained in non-medicated animals reared in a clean environment, and especially when they were weaned at a later age and fed the diet with the lower fibre content. The treatments studied also led to a variation in fattening mortality (from 4.7% to 34.0%), which was highly and positively correlated ($P<0.001$) to the average Cl. perfringens caecal counts in each combination of treatments. The results of the current study indicate that high counts of Cl. perfringens in the caecum can be used as an indicator of Epizootic Rabbit Enteropathy, and suggest that strategies designed to control its proliferation in the caecum might help to limit fattening mortality in rabbit fed diets not-medicated with antibiotics.
Keywords: Epizootic Rabbit Enteropathy; NDF level; Weaning age; Fattening mortality; Caecum microbiota; Rabbits

Sz. Metzger, Zs. Szendro, M. Bianchi, I. Hullar, H. Febel, L. Maertens, C. Cavani, M. Petracci, I. Radnai, E. Biro-Nemeth, Effect of energy restriction in interaction with genotype on the

performance of growing rabbits: II. Carcass traits and meat quality, Livestock Science, In Press, Corrected Proof, Available online 25 August 2009, ISSN 1871-1413, DOI: 10.1016/j.livsci.2009.07.004.
(http://www.sciencedirect.com/science/article/B7XNX-4X30CB4-1/2/dadb22b76b5b083ab0b80c5eff5d5ae1)
Abstract:
In this experiment the effect of digestible energy (DE) restriction on carcass traits and meat quality of rabbits selected divergently for body fat content was studied. Using a 2 x 3 factorial arrangement, Pannon White rabbits selected for high (HFAT) or low (LFAT) total body fat content were fed isocaloric diets between 4 and 12 weeks of age. Energy restriction was achieved by reducing the daily feed intake by 10% (M) and 20% (L) compared to the ad libitum fed group (H). Proportional to the reduction of feed intake the nutrient density of diets M and L was increased. Thus, the DE intake was reduced while the nutrient intake remained stable among the 3 dietary groups. Effect of genetic group on carcass traits and on meat quality parameters was less marked than DE restriction. Selection for high body fat content improved the dressing out percentage (58.3 and 57.3% in HFAT and LFAT respectively; $P < 0.01$), and reduced the percentage of the full gastrointestinal tract to slaughter weight (13.7 and 14.3% in HFAT and LFAT respectively; $P < 0.05$). Reduction of DE intake decreased the body weight and the weight of the chilled and reference carcass ($P < 0.001$), while it had no effect on dressing out percentage. In group H the percentage of fore part to reference carcass was higher (29.7 vs 29.0%; $P < 0.01$) while that of the hind part was lower than in group L (37.0 vs 38.2%; $P < 0.001$). The Longissimus lumborum meat from HFAT rabbits exhibited a lower content of moisture (76.1 and 76.5% in HFAT and LFAT respectively; $P < 0.01$) as well as lower L* (53.5 and 54.4 in HFAT and LFAT respectively; $P < 0.05$) and b* (0.42 and 0.81 in HFAT and LFAT respectively; $P < 0.05$) colour values. When compared with ad libitum fed rabbits, those restricted at 20% (L) exhibited a higher content of moisture (76.9 vs 75.8%; $P < 0.01$), as well as higher pHu (5.87 vs 5.73; $P < 0.01$) associated with lower cooking loss (17.8 vs 19.1%; $P < 0.05$). L rabbits also produced lower values of redness (a*, 2.21 vs 3.35; $P < 0.01$) and yellowness (b*, 0.23 vs 0.91; $P < 0.01$). No effect of the divergent selection for body fat content on the total lipid percentage and on most of the fatty acids in the meat of the hind leg was found. DE restriction resulted in lower SFA (L: 32.1 vs H: 35.8%; $P < 0.01$) and MUFA (L: 21.0 vs H: 28.6; $P < 0.01$) but higher PUFA contents (L: 45.5 vs H: 34.9%; $P < 0.01$) in the hind leg meat.
Keywords: Rabbit; Genetic group; DE intake; Carcass traits; Meat quality

C. Casteleyn, A.M.C. Broos, P. Simoens, W. Van den Broeck, NALT (nasal cavity-associated lymphoid tissue) in the rabbit, Veterinary Immunology and Immunopathology, In Press, Accepted Manuscript, Available online 19 August 2009, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2009.08.011.
(http://www.sciencedirect.com/science/article/B6TD5-4X1SB56-4/2/4cd67c475080fda6a690c2361b8822e3)
Abstract:
Due to its many advantages, interest in intranasal vaccination of domestic mammals and humans is currently increasing. Successful stimulation of the immune system by intranasal vaccines requires, however, the presence of lymphoid tissue in the nasal cavity. This nasal cavity-associated lymphoid tissue (NALT) has already been described in humans and many laboratory rodents, but data about rabbits are very scarce. For this purpose, histological sections of the nasal cavities of 10 female adult New Zealand White rabbits were examined for the presence of lymphoid tissue. Primary (I) and secondary (II) lymphoid follicles divided by interfollicular regions were mainly present at the bottom of the ventral nasal meatus and the nasopharyngeal meatus from 1 to 3.3 cm from the tip of the nose. In this region intraepithelial and lamina propria lymphocytes, and isolated lymphoid follicles (ILF's) were additionally seen at the dorsal and

dorsolateral sides of the nasopharyngeal meatus and within the mucosae of the nasal conchae and the lateral nasal walls. Intraepithelial and lamina propria lymphocytes, and ILF's were, just like in humans, randomly distributed along the entire nasal mucosa. The rabbit NALT is more voluminous compared to rodents in which lymphoid tissue is only present at the bottom of the nasopharyngeal meatus. Since the relative volume of the rabbit nasal cavity is also similar to that of humans, the rabbit could be a valuable research model not only for animal but also for human intranasal vaccine development.
Keywords: Histology; Lymphoid tissue; Nasal cavity; Rabbit; Vaccine

Hua Wei Liu, Francesco Gai, Laura Gasco, Alberto Brugiapaglia, Carola Lussiana, Kai Jun Guo, Jian Ming Tong, Ivo Zoccarato, Effects of chestnut tannins on carcass characteristics, meat quality, lipid oxidation and fatty acid composition of rabbits, Meat Science, In Press, Accepted Manuscript, Available online 7 August 2009, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2009.08.003.
(http://www.sciencedirect.com/science/article/B6T9G-4WY6K31-2/2/5d19f68e0d6f5c039f47bd5151dc35a9)
Abstract:
Seventy two male Bianca Italiana rabbits were used to study the effects of the inclusion (0%, 0.5%, and 1.0%) of a natural extract of chestnut wood (Silvafeed ENC) in the diet on productive traits, carcass characteristics, meat quality, lipid oxidation and fatty acid composition of rabbit meat. Results showed ENC had no significant effect on live weight, productive traits, hot carcass weight, dressing percentage, skin weight, pH, cooking losses, shear force and colour. The iron content was higher in Longissimus thoracis et lumborum (LTL) muscle of rabbit fed the ENC 1.0% diet than the control group. TBARS average values in the group ENC 0.5% were significantly lower ($P < 0.05$) than in the control and ENC 1.0% groups. Myristic acid (C14:0; $P<0.01$), palmitoleic acid (C16:1 cis-9; $P<0.05$) and pentadecanoic acid (C15:0; $P<0.01$) contents were lower in LTL muscle of rabbits fed the ENC 1.0% diet, whereas the palmitic acid (C16:0) content was higher ($P<0.05$) in the rabbits of this group. Moreover, the rabbits fed with the ENC 0.5% diet had lower ($P<0.01$) levels of trans-vaccenic acid (C18:1 trans-11) compared to rabbits fed with the control diet. No significant differences were observed in saturated (SFA), monounsaturated (MUFA), polyunsaturated (PUFA) fatty acids, as well as in PUFA/SFA and n-6/n-3 ratios among the groups.
Keywords: chestnut tannins; lipid oxidation; fatty acids; meat quality; rabbits

M. D'Agata, G. Preziuso, C. Russo, A. Dalle Zotte, E. Mourvaki, G. Paci, Effect of an outdoor rearing system on the welfare, growth performance, carcass and meat quality of a slow-growing rabbit population, Meat Science, In Press, Accepted Manuscript, Available online 7 August 2009, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2009.08.005.
(http://www.sciencedirect.com/science/article/B6T9G-4WY6K31-4/2/e90daef2f8d99408c067af5ef38d581c)
Abstract:
The effect of Outdoor or Indoor housing systems on the growth, welfare and carcass and meat quality of a local rabbit population was investigated. The slaughter age was 103+/-2 days. Open field tests showed an effective capacity of the Outdoor group to combat stressors. Compared to Indoor rabbits, Outdoor rabbits showed better growth performance and higher slaughter weight (SW) (2535 vs 2137 g; $P<0.01$). Outdoor housing conditions increased the physical activity of rabbits and their hind legs were more developed (36.1%vs34.9%; $P<0.01$). Slaughter yield was lower in Outdoor rabbits (57.8% vs58.4% SW; $P<0.05$) due to the higher skin proportion (17.2% vs15.6% SW; $P<0.05$). Outdoor rabbit meat showed lower L* value (L. lumborum:55.6 vs59.2 $P<0.01$; B. femoris:53.0 vs55.5 $P<0.01$) and cooking loss (L. lumborum: 15.9% vs18.1%; $P<0.05$). Outdoor rabbit hind leg meat was characterized by lower water (74.5% vs 75.1%; $P<0.01$) and higher protein (22.9% vs 22.6%; $P<0.01$) and fat (1.4% vs 1.1%; $P<0.01$) contents; lipids were

lower in SFA and higher in MUFA. Outdoor rearing seems to be a possible alternative housing system that allays the ethical concerns of modern consumers while also providing good meat quality.
Keywords: rabbit; outdoor rearing system; antioxidant enzymes; meat quality; fatty acid profile

Z. Volek, M. Marounek, Whole white lupin (Lupinus albus cv. Amiga) seeds as a source of protein for growing-fattening rabbits, Animal Feed Science and Technology, Volume 152, Issues 3-4, 6 August 2009, Pages 322-329, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2009.05.003.
(http://www.sciencedirect.com/science/article/B6T42-4WFPPGN-1/2/89e7ce3c9ff79aeae15aaefa7a2d6b23)
Abstract:
The purpose of this study was to evaluate the effect of substituting 100 g soybean meal (SBM) for 150 g whole white lupin seeds (WL, Lupinus albus cv. Amiga) or 170 g sunflower meal (SFM)/kg diet as protein source for growing-fattening rabbits. The SFM diet contained more cellulose and lignin, and less digestible energy than the other diets whereas the WL diet contained more oligosaccharides of the raffinose series. In the performance trial, 90 weaned Hyplus rabbits (30 per treatment) were individually housed and fed one of the three experimental diets for 42 days (37-79 days of age). At the end of the trial period, 18 rabbits per treatment were slaughtered and used for the evaluation of carcass traits. In addition, the coefficient of total tract apparent digestibility (CTTAD) of the diets and caecal traits were determined from 48 to 52 days of age in 13 rabbits per treatment. Diet did not affect weight gain or feed conversion ratio but feed intake was higher with the SFM diet ($P<0.05$). Dressing-out percentage was higher in rabbits fed the WL diet than in rabbits fed the other diets ($P=0.006$). Diet did not affect CTTAD of organic matter, crude protein or ether extract. Rabbits fed the SFM diet had lower neutral detergent fibre digestibility ($P<0.05$) and tended to have lower gross energy and acid detergent fibre digestibility than rabbits fed the other diets. In addition, pH, volatile fatty acid and ammonia concentration in the caecum were not affected by diet; however, lactic acid concentration was increased with WL feeding ($P<0.05$). It is concluded that whole white lupin seeds can replace satisfactorily soybean meal and sunflower meal in diets for growing-fattening rabbits.
Keywords: Growing-fattening rabbits; Protein source; Digestion; Fermentative activity; Growth performance

M. Hayashi, H. Tsuchiya, T. Otoi, B. Agung, N. Yamamoto, K. Tomita, Influence of freezing with liquid nitrogen on whole-knee joint grafts and protection of cartilage from cryoinjury in rabbits, Cryobiology, Volume 59, Issue 1, August 2009, Pages 28-35, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2009.04.002.
(http://www.sciencedirect.com/science/article/B6WD5-4W1JW3D-2/2/27daceab5640ccad1cf8b976986ff5dc)
Abstract:
Improving survival rates for sarcoma patients are necessitating more functional and durable methods of reconstruction after tumor resection. Frozen osteoarticular grafts are utilized for joint reconstruction, but the joint may develop osteoarthritic change. We used a frozen autologous whole-rabbit knee joint graft model to investigate the influence of freezing on joint components. Thirty rabbit knee joints that had been directly immersed into liquid nitrogen (L) or saline (C) without use of cryoprotectants were re-implanted. Histological observations were made after 4, 8, and 12 weeks. Both groups had bone healing. In group L, despite restoration of cellularity to the menisci and ligaments, no live chondrocytes were observed and cartilage deterioration progressed over time. It was concluded that cryoinjury of chondrocytes caused osteoarthritic change. Then we tested whether a vitrification method could protect cartilage from cryoinjury. Full-thickness articular cartilage of rabbit knee was immersed into liquid nitrogen with and without vitrification. Histology, ultrastructure, and chondrocyte viability were examined before and after 24 h of culture. Vitrified

cartilage cell viability was >85% compared with that of fresh cartilage. Transmission electron microscopy revealed preservation of original chondrocyte structure. Our vitrification method was effective for protecting chondrocytes from cryoinjury. Since reconstructing joints with osteoarticular grafts containing living cartilage avert osteoarthritic changes, vitrification method may be useful for storage of living cartilage for allografts or, in Asian countries, for reconstruction with frozen autografts containing tumors.
Keywords: Malignant bone and soft tissue tumor; Limb salvage; Reconstruction; Frozen autograft; Articular cartilage; Vitrification

A. Kart, Y. Cigremis, H. Ozen, O. Dogan, Caffeic acid phenethyl ester prevents ovary ischemia/reperfusion injury in rabbits, Food and Chemical Toxicology, Volume 47, Issue 8, August 2009, Pages 1980-1984, ISSN 0278-6915, DOI: 10.1016/j.fct.2009.05.012.
(http://www.sciencedirect.com/science/article/B6T6P-4W9XG98-7/2/c5e7abd1c64f5f1347281e007546725f)
Abstract:
Protective effect of caffeic acid phenethyl ester (CAPE) on ovary ischemia/reperfusion (IR) injury was investigated in this study. Twenty four New Zealand rabbits were divided into 4 groups as follows: group S served as sham. Group C was intraperitoneally injected with CAPE (8.5 mg/kg). In groups E + IR and C + IR, 1% ethanol and CAPE was given intraperitoneally before torsion, respectively. Then, the ovaries were subjected to IR in both groups. Ovary reduced glutathione (GSH) level and glutathione peroxidase (GSH-Px) activity in group E + IR were significantly reduced compared to that of group S. GSH level and GSH-Px activity was significantly increased in group C + I/R. Thiobarbituric acid reactive substances (TBARS) and catalase (CAT) activity in group E + I/R was significantly higher than in group S. CAT activity was decreased to normal levels by CAPE treatment in group C + I/R, while TBARS in group C + IR was significantly reduced compared to that of E + IR. According to histopathological examination, severe congestion, hemorrhage, edema and leukocyte infiltration were observed in E + I/R group. CAPE prominently reduced degenerative effects of IR injury thus it alleviates free radical damage.
In conclusion, CAPE which is able to prevent IR-induced injury in the ovaries may be of therapeutic value before the surgical correction.
Keywords: Ischemia/reperfusion; CAPE; Ovary; GSH; CAT; GSH-Px

M. Arias-Alvarez, R.M. Garcia-Garcia, P.G. Rebollar, N. Nicodemus, L. Revuelta, P. Millan, P.L. Lorenzo, Effects of a lignin-rich fibre diet on productive, reproductive and endocrine parameters in nulliparous rabbit does, Livestock Science, Volume 123, Issues 2-3, August 2009, Pages 107-115, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.10.013.
(http://www.sciencedirect.com/science/article/B7XNX-4V0VH6X-2/2/4407cc154a260dce7ec0d28224f8b791)
Abstract:
In rabbits, modifications in dietary composition may be associated with reproductive benefits. However, the influence of nutrition on ovarian function and embryo development is poorly known in this species. The goal of this work was to study the short-term effects of feeding high-fibre diets with different levels of lignin during the rearing period on productive, endocrine and reproductive parameters of nulliparous rabbit does. A total of 95 New Zealand x California 11-week-old nulliparous white rabbits were randomly allocated in two experimental groups fed ad libitum fibre-rich diets with a high lignin content (HL group: NDF 49.6% of DM, LAD 15.8% of DM; n = 48) or a standard lignin content (SL group: NDF 40.9% of DM, LAD 4.9% of DM; n = 47). All animals were artificially inseminated (AI) at 16 weeks of age. Daily feed intake and live body weight (LBW) were recorded during the rearing period. Conception rate and prolificacy were also determined. In addition, in ten animals of each group, body composition, serum estradiol 17[beta] (E2), progesterone (P4) and leptin levels, as well as reproductive parameters including ovary weight,

follicular population, ovulation rate, in vitro oocyte maturation (IVM), blastocyst recovery rate and in vitro embryo development were studied at AI time. Animals fed the HL diet had a significantly higher feed intake until the first AI ($P < 0.003$) and during the first pregnancy ($P < 0.03$). At 16 weeks of age, animals fed the HL diet had a lower content of lipids ($P < 0.05$) and crude energy ($P < 0.05$) than those fed the SL diet, but average LBW of does, ovary weight, and ovulation rate per doe were similar between HL and SL treatments. No significant differences were found in P4 levels. However, the HL group had elevated E2 serum levels ($P < 0.003$) compared to those fed with the SL diet, whereas antral follicular population was similar between groups. Both nuclear and cytoplasmic IVM measured as metaphase II and cortical granule migration rates were also similar between both groups. In addition, no differences in blastocyst recovery rate or in prolificacy were found. However, mean serum leptin levels ($P < 0.05$), in vitro embryo development ($P < 0.03$), and fertility rate ($P < 0.02$) were higher in the SL group compared to the HL group. In conclusion, the HL diet enhanced feed intake of does, but reduced serum leptin levels at AI time, in vitro embryo survival and conception rate.
Keywords: Rabbit; Oocyte; Embryo; Leptin; Fibre; Lignin

Antonio Santaniello, Ludovico Dipineto, Laura Rinaldi, Lucia Francesca Menna, Giuseppe Cringoli, Alessandro Fioretti, Serological survey of Encephalitozoon cuniculi in farm rabbits in Italy, Research in Veterinary Science, Volume 87, Issue 1, August 2009, Pages 67-69, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2008.12.008.
(http://www.sciencedirect.com/science/article/B6WWR-4VGW54S-4/2/a6a6a1b8e33d474abded65c2763585d7)
Abstract:
Rabbit sera (n = 1600) from 40 commercial farms were submitted to a serological screening for Encephalitozoon cuniculi by an enzyme-linked immunosorbent assay (ELISA) and a carbon immunoassay (CIA test). Antibodies anti-Encephalitozoon cuniculi were found in 505/1600 (31.6%) sera analysed, and all the farms (100%) resulted positive. Rabbits older than 4 months showed a significantly higher seropositivity for E. cuniculi (chi-squared test: $p < 0.0001$) than rabbits under 4 months, E. cuniculi sero-prevalence showed an increasing trend in rabbits within the farm along with the increase in the 'number of rabbits on the farm'; however, this trend was not significant (Spearman's correlation: $p = 0.073$).
The findings of the present study confirm that rabbit is the main reservoir of E. cuniculi; they are of epidemiological relevance and immediate public health importance because of the recognized infectivity in humans by the microsporidium.
Keywords: Encephalitozoon cuniculi; Farm rabbits; Carbon immunoassay; Enzyme-linked immunosorbent assay; Zoonosis

F. Koc, M. Ozturk, Y. Kadioglu, E. Dogan, L.E. Yanmaz, Z. Okumus, Pharmacokinetics of florfenicol after intravenous and intramuscular administration in New Zealand White rabbits, Research in Veterinary Science, Volume 87, Issue 1, August 2009, Pages 102-105, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2008.10.010.
(http://www.sciencedirect.com/science/article/B6WWR-4V2PSWN-3/2/1428ecc609827508c63dd4fa280e7bc9)
Abstract:
The pharmacokinetic disposition and bioavailability of florfenicol (FF) were determined after single intravenous (i.v.) and intramuscular (i.m.) administrations of 25 mg/kg b.w. to ten healthy New Zealand White rabbits. Plasma FF concentrations were determined by high-performance liquid chromatography (HPLC). The plasma pharmacokinetic values for FF were best described by a one-compartment open model. The elimination half-life (t1/2[beta]) was different ($p < 0.05$) however, the area under curve (AUC) was similar ($p > 0.05$) after i.v. and i.m. administrations. FF was rapidly eliminated (t1/2[beta] 1.49 +/- 0.23 h), slowly absorbed and high (F, 88.75 +/- 0.22%)

after i.m. injection. In addition, FF was widely distributed to the body tissues (Vss 0.98 +/- 0.05 L/kg) after i.v. injection. In this study the time that plasma concentration exceeded the concentration of 2 [mu]g/mL was approximately 6 h. For bacteria with MIC of 2 [mu]g/mL, frequent administration at this dose would be needed to maintain the concentration above the MIC. However, it is possible that rabbit pathogens may have MIC values less than 2 [mu]g/mL which would allow for less frequent administration. Further studies are necessary to identify the range of MIC values for rabbit pathogens and to identify the most appropriate PK-PD parameter needed to predict an effective dose.
Keywords: Pharmacokinetic; Florfenicol; Rabbit; Plasma

G. Macchia, E. Topo, N. Mangano, E. D'Aniello, R. Boni, dl-Aspartic acid administration improves semen quality in rabbit bucks, Animal Reproduction Science, In Press, Corrected Proof, Available online 30 July 2009, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2009.07.009.
(http://www.sciencedirect.com/science/article/B6T43-4WWG340-1/2/8a054260c45c8f4b8a339c0836cea604)
Abstract:
Recently, d-aspartic acid (d-Asp) has been suggested as being involved in mechanisms regulating reproduction activity in animals and human. In this study we analyzed the effects of dl-Asp oral administration on sperm production in the rabbit. Bucks from 60, bred in a genetic centre and used for semen production, were divided in 2 subgroups of 6 individuals. The treated group was fed with a concentrate containing dl-Asp which assured a daily administration of 1.3 g dl-Asp/head; the control group was fed with the same concentrate without dl-Asp. The treatment was carried out for 2 wk and animals were monitored weekly, from 1 wk before the start of the treatment to 3 wk after the end of the treatment. Through the experimental period there were no significant variations in semen volume between the two groups. A significant increase in both sperm concentration and kinetic parameters, i.e., the overall percentage of motile spermatozoa, the average path velocity, the percentage of progressively motile spermatozoa, etc., was found in the supplemented group. l-Asp values in blood serum and seminal plasma did not vary through the experimental period. d-Asp concentration in blood serum increased more than 4-fold than baseline ($P < 0.01$) at the end of the treatment and was maintained at higher than baseline values for up to 3 wk after the end of the treatment. d-Asp concentration in seminal plasma was higher than in blood serum before the start of the treatment (13.7 +/- 1.6 nM vs 3.5 +/- 3.3 nM; $P < 0.01$) which suggests an elective storage of d-Asp in the male genital tract. Baseline values of d-Asp concentration in seminal plasma significantly increased following treatment and were back to initial values 1 wk after the end of the treatment. In conclusion, dl-Asp administration improved sperm quality in bucks and the high d-Asp content in seminal plasma suggests a primary role for this d-amino acid in regulatory mechanisms of reproductive activity.
Keywords: d-Aspartic acid; Sperm quality; Rabbit; CASA

Carlos Rouco, Miguel Delibes-Mateos, Sacramento Moreno, Evidence against the use of fecal pellet size for age determination in European wild rabbits, Acta Oecologica, In Press, Corrected Proof, Available online 11 July 2009, ISSN 1146-609X, DOI: 10.1016/j.actao.2009.06.006.
(http://www.sciencedirect.com/science/article/B6VR3-4WRD6CT-2/2/8c015ef60fdd36a72ed759be9aab472e)
Abstract:
Techniques for estimating the age of wild animals are crucial to many aspects of the study of population biology. Accurate estimates of the proportion of different age classes in wild rabbit populations would be very useful, and the possibility that it could be obtained from the pellet size holds great appeal. However, this suggestion has created controversy in the literature as this technique has not been validated. This study involved assessment of whether threshold fecal pellet diameters could be used to differentiate adult and juvenile rabbits. The proportion of adults

in four wild rabbit populations living in semi-natural conditions was compared with the proportion of animal pellets greater than threshold diameters of 6 mm and 4 mm. Our results suggest that inferring a relationship between the proportion of pellets >6 mm diameter and the proportion of adults in a population is not applicable to European wild rabbits, and that the use of this method could produce erroneous interpretations. The use of a 4 mm pellet diameter threshold appeared to produce even more inaccurate results. Studies that use this technique should include validation, as the results can vary greatly among individuals and populations.
Keywords: Aging methodology; Oryctolagus cuniculus; Pellet count; Rabbit capture

Jacqueline Csokai, Anja Joachim, Andrea Gruber, Alexander Tichy, Akos Pakozdy, Frank Kunzel, Diagnostic markers for encephalitozoonosis in pet rabbits, Veterinary Parasitology, Volume 163, Issues 1-2, 7 July 2009, Pages 18-26, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2009.03.057.
(http://www.sciencedirect.com/science/article/B6TD7-4W1JW4K-1/2/dec00c0bfeab59cc0efe636115f027b9)
Abstract:
Encephalitozoonosis is a common disease in pet rabbits, routinely diagnosed in vivo by serological examination or post mortem by histopathology. Recently molecular techniques have become increasingly important as diagnostic tools. The application of different diagnostic markers for in vivo and post mortem determination of E. cuniculi in naturally infected pet rabbits were compared. The examined population was divided into 33 rabbits with symptoms of encephalitozoonosis (group I) and 38 animals without symptoms (group II) which were all tested by serological analysis (Indirect Immunofluorescence Test), histological examination including special spore staining (Ziehl-Neelsen, acid-fast trichrome) and conventional and nested PCR (organs, body fluids). Additionally, in group III lens material (n = 10) of animals (n = 9) with phacoclastic uveitis were examined by conventional PCR. Infections with E. cuniculi could be determined post mortem in 78.8% of the rabbits of group I and in 57.9% of group II by histological examination combined with spore staining. In group I 69.7% and in group II 50.0% showed seroconversion. Conventional PCR was only sufficiently sensitive in samples of eyes with phacoclastic uveitis (n = 10; 100%). Therefore nested PCR was performed in tissue samples, urine and cerebrospinal fluid (CSF) with positive results in 63.6% of group I and 42.1% of group II. Positive results in serology, pathohistology (spore detection and histological changes in the brain and/or kidneys) and nested PCR were obtained in 52.1% of the rabbits (group I and II, n = 71), whereas 31.0% showed negative results in all three diagnostic techniques. 5.6% of the rabbits were positive in two methods and 11.3% in one method. In 37 rabbits (group I and II) with positive results in nested PCR, E. cuniculi DNA could be detected more frequently in the brain (91.9%) than in the kidney (54.1%). Furthermore nested PCR of urine revealed positive results in 29.7% of the rabbits (n = 37) with seroconversion and/or confirmed E. cuniculi infection by spore detection. All 25 samples of CSF tested negative in nested PCR. Conventional PCR of eyes with phacoclastic uveitis was an excellent diagnostic marker in living rabbits, while nested PCR of urine or CSF was not reliable. Histological examination combined with special staining was the most sensitive method in post mortem diagnostics. Nested PCR appears to be a good post mortem method to investigate organs, especially brains, of chronically infected animals.
Keywords: Encephalitozoon cuniculi; Rabbit; Diagnosis; Serology; Histology; PCR

G. Brecchia, R. Cardinali, E. Mourvaki, G. Collodel, E. Moretti, A. Dal Bosco, C. Castellini, Short- and long-term effects of lipopolysaccharide-induced inflammation on rabbit sperm quality, Animal Reproduction Science, In Press, Corrected Proof, Available online 27 June 2009, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2009.06.016.
(http://www.sciencedirect.com/science/article/B6T43-4WMDHJP-1/2/8a4a3d5e8c9fde3a01fb3a765d0e2aeb)
Abstract:

Infections and resulting inflammation are widely known to cause transient or permanent male infertility. The objectives of this study were (1) to provide a suitable animal model of a sub-acute inflammatory state by intraperitoneally inoculating bacterial lipopolysaccharides (LPS) and (2) to define the short- and long-term effects of this state on the sperm quality of rabbit bucks. Two series of experiments were performed to accomplish these objectives. In experiment 1, 15 healthy New Zealand White rabbit bucks were divided into five homogeneous groups, receiving 25, 50, 100 and 150 [mu]g/kg body weight (b.w.) of E. coli LPS dissolved in 2 ml of sterile saline or only saline (control), respectively. White blood cells (WBC), rectal temperature, feed intake and mating ability were observed for 3 consecutive days following inoculation. Inoculation of 50 [mu]g/kg b.w. produces a reversible inflammation-like state that lasts for about 3 days, with minimal distress to the animals, and therefore it was used in our experiment. The major symptoms were fever and anorexia. Changes in WBC count and a moderate reduction in reproductive activity also occurred. In experiment 2, two groups of five rabbit bucks each were treated with 50 [mu]g/kg b.w. E. coli LPS diluted in 2 ml of saline or only saline (controls), respectively. Semen samples were collected weekly up to 56 days after inoculation and the changes in semen characteristics were examined. During the first 3 days, semen volume and concentration decreased in both experimental groups, probably due to the high collection frequency. Sperm membrane integrity and the number of necrotic sperm were seriously affected 30 days after the LPS challenge, reaching a maximum at the end of the spermatogenic cycle (56 days). These results suggest that a sub-acute inflammation may cause infertility by compromising sperm membrane integrity which decreases a month after LPS-treatment. In addition, the rabbit could be a useful LPS animal model for further study of the effects of inflammation and the underlying mechanisms on sperm characteristics.
Keywords: Rabbit buck; Sperm; Inflammation; Lipopolysaccharide

Claudia S. Meier-Trummer, Kurt Tobler, Monika Hilbe, James P. Stewart, Jane Hart, Iris Campbell, David M. Haig, Daniel L. Glauser, Felix Ehrensperger, Mathias Ackermann, Ovine herpesvirus 2 structural proteins in epithelial cells and M-cells of the appendix in rabbits with malignant catarrhal fever, Veterinary Microbiology, Volume 137, Issues 3-4, 12 June 2009, Pages 235-242, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2009.01.030.
(http://www.sciencedirect.com/science/article/B6TD6-4VFK7WJ-5/2/12e2b1148d2c47d25dd80af03dc16da8)
Abstract:
Sheep-associated malignant catarrhal fever (MCF), caused by Ovine herpesvirus 2 (OvHV-2), is a usually fatal disease of various ruminants and swine. A system for propagation of OvHV-2 in vitro has not yet been identified, although persistently infected cells have been derived from diseased animals and used to establish an animal model in rabbits. OvHV-2 structural proteins have not been detected in diseased animals and the pathogenesis of OvHV-2 infection is poorly understood.
Recently, the genomic sequence of OvHV-2 has been determined, which allowed to predict the amino acid sequences of putative OvHV-2 structural proteins. Based on those predictions, we have generated antisera against two putative structural proteins (ORF43 and ORF63) of OvHV-2 in order to detect sites of active virus replication in experimentally OvHV-2-infected rabbits with signs of MCF. Although histological lesions typical of MCF were detected in multiple tissues, those sera detected viral capsid and tegument antigens exclusively in the appendix but not in other tissues of rabbits with MCF. More specifically, those viral proteins were detected in epithelial cells as well as in M-cells. However, in situ hybridization revealed that ORF63 mRNA was present in epithelial cells of infected rabbits but not in M-cells. Our data suggest that active OvHV-2 replication takes place in certain tissues of animals with MCF and that M-cells may play a role in the pathogenesis of MCF.
Keywords: Ovine herpesvirus 2; Malignant catarrhal fever; Structural protein; Rabbit

Lin Zhan, Chen-Yi Chu, Shu-Qing Zuo, Xiao-Ming Wu, J. Stephen Dumler, Na Jia, Bao-Gui Jiang, Hong Yang, Wu-Chun Cao, Anaplasma phagocytophilum and Borrelia burgdorferi in rabbits from southeastern China, Veterinary Parasitology, Volume 162, Issues 3-4, 10 June 2009, Pages 354-356, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2009.03.003.
(http://www.sciencedirect.com/science/article/B6TD7-4VTVR4J-3/2/d34cc4665d14c388ec895aaaaa33c89c)
Abstract:
A total of 54 wild rabbits captured from southeastern China were examined for Anaplasma phagocytophilum and Borrelia burgdorferi sensu lato by polymerase chain reaction (PCR) assays. One and three samples were positive for A. phagocytophilum and B. burgdorferi, respectively. Sequence analyses of PCR products identified a variant of A. phagocytophilum and a B. garinii genotype. This is the first detection of the two tick-borne agents in Chinese rabbits, the role of which in the maintenance of the agents deserve further investigations.
Keywords: Anaplasma phagocytophilum; Borrelia burgdorferi; Rabbit; Host; Gene variation

Dominique Licois, Comments on the article of Ming-Hsien Li and Hong-Kean Ooi 'Fecal occult blood manifestation of intestinal Eimeria spp. infection in rabbit' [Vet. Parasitol. 161 (2009) 327-329], Veterinary Parasitology, In Press, Corrected Proof, Available online 9 June 2009, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2009.05.031.
(http://www.sciencedirect.com/science/article/B6TD7-4WGMBBB-1/2/941842d73a2fcf242dd0918b41b552e0)
Keywords: Coccidia; Rabbit

Eileen M. Johnson, Kelly E. Allen, Roger J. Panciera, Sidney A. Ewing, Susan E. Little, Experimental transmission of Hepatozoon americanum to New Zealand White rabbits (Oryctolagus cuniculus) and infectivity of cystozoites for a dog, Veterinary Parasitology, In Press, Corrected Proof, Available online 8 June 2009, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2009.05.028.
(http://www.sciencedirect.com/science/article/B6TD7-4WGF16W-2/2/db9e4474ca18b02793b82e4bd187b50d)
Abstract:
Inflammatory lesions containing parasitic cystozoites developed in multiple organs and tissues of laboratory-raised Oryctolagus cuniculus that were administered approximately 100 sporulated oocysts of Hepatozoon americanum (Oklahoma isolate, GenBank accession AF176836) orally. The predominantly granulomatous inflammatory lesions were detected histologically 8 weeks after exposure to oocysts. Cystozoites, recognized by cresent-shaped, uninucleated bodies surrounded by an accumulation of globular, PAS-positive polysaccharide material, were evident within macrophages as monozoic and dizoic cysts. Neither meronts nor gamonts were detected in any of the laboratory-raised lagomorphs during the 24-week observation period. Nested PCR assay of rabbit tissues for a 488 bp fragment of the 18S rRNA Hepatozoon spp. gene was positive at 8 and 24 weeks post-exposure. The sequence was 97.1% similar with sequence from the H. americanum carrier used to infect ticks. A Hepatozoon-free dog fed tissues from the 24-week post-exposure rabbit principal developed American canine hepatozoonosis. Gamonts were first detected 5 weeks after the dog ingested the rabbit tissues containing cystozoites. PCR assay of blood from the dog was positive for the Hepatozoon spp. gene fragment. Sequencing confirmed that the parasite in the dog was H. americanum.
Keywords: Cystozoite; Hepatozoon americanum; Paratenic host; Oryctolagus cuniculus; Domestic rabbit; Predation

Y.K. Youssef, M. Baselga, M.H. Khalil, M.E. Omara, M.L. Garcia, Crossbreeding effects for post-weaning growth traits in a project of Spanish V-line with Baladi Red Rabbits in Egypt, Livestock

Science, Volume 122, Issues 2-3, June 2009, Pages 302-307, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.09.014.
(http://www.sciencedirect.com/science/article/B7XNX-4TX18CW-1/2/b5f25700f4bfe1d02f4c91e464b7f733)
Abstract:
A four-year crossing scheme involving Spanish V line (V) and Egyptian Baladi Red (B) rabbits was carried out to produce five genetic groups: V, B, 1/2B1/2V(F1), (1/2B1/2V)2(F2), and ((1/2B1/2V)2)2. The last genetic group was considered a new line, named APRI. Body weights (BW) and daily gains in weight (DG) from four to twelve weeks were evaluated for 13,383 rabbits produced by 330 sires and 1074 dams. An animal model was used to estimate heritabilities and common litter effects and a generalized least squares procedure was used to estimate direct additive effects, and direct and maternal heterosis.
Heritabilities for growth traits were mostly moderate, ranging from 0.075 to 0.240 for BW and from 0.020 to 0.104 for DG. The V line was heavier and had better gains at each weighing than B rabbits. The F2 and APRI were also lower in most post-weaning growth performance measures than V line rabbits. APRI rabbits were significantly lighter by 39, 26, 46, 64, and 50 g at ages of 4, 6, 8, 10, and 12 weeks, respectively, relative to the purebred V line, while APRI was significantly heavier by 36 and 127 g relative to the B line at 4 and 12 weeks. The V line, in general, had a higher DG than B line. The differences were 3.15, 7.91 and 1.95 g/d at age intervals of 8-10, 10-12 and 4-12 weeks. Differences in direct additive effects between the two lines were in favor of V line rabbits reaching 15.0% (76 g) at 4 weeks and 13.3% (195 g) at 12 weeks. Direct additive effects for DG were significant during most age intervals reaching 35.7% (7.19 g/d) in the interval of 10-12 weeks. All estimates of direct heterosis were positive and ranged from 4.9 to 16.7% for BW and 14.4 to 29.5% for DG, but the estimates for maternal heterosis were, in most cases, significantly negative and ranging from - 4.5 to - 15.2% for BW and from 20.6 to - 36.9% for DG. If the results are confirmed at commercial farms, the APRI line could be reared in heat stress conditions.
Keywords: Rabbits; Crossbreeding; Synthetic line; Growth; Additive effects; Heterosis

Carla Lazzaroni, Davide Biagini, Carola Lussiana, Different rearing systems for fattening rabbits: Performance and carcass characteristics, Meat Science, Volume 82, Issue 2, June 2009, Pages 200-204, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2009.01.011.
(http://www.sciencedirect.com/science/article/B6T9G-4VD9X9W-1/2/daa1bed29eb1e7ec6cef737034f2cbf8)
Abstract:
To evaluate the effect of different rearing systems and sex on productive performance and carcass composition and quality, 80 rabbits (40 males and 40 females) of Carmagnola breed were reared from 9 to 16 weeks of age in individual California type cages (0.12 m2) or in group ground pens (0.25 m2/head). The animals were kept in standard and uniform environmental conditions and fed the same ad libitum pellet feed. Data on live weight and feed intake were recorded. At the end of the fattening period 10 animals per group were slaughtered and data provided in the World Rabbit Science Association (WRSA) standard method were collected, as well as pH and meat colour. Animals reared in ground pens showed lower productive performances, while, as to slaughtering performances, rabbits reared in cages showed the highest slaughtering weight and also the highest weights for most body parts. Gender slightly affected productive and slaughtering performances: females showed higher feed consumption and higher perirenal fat weight than males. Meat colour parameters showed significant differences in Longissimus lumborum and Biceps femoris due to housing systems and gender effects. In both muscle, rearing system affected pH only 24 h after slaughter.
Keywords: Rabbit; Housing systems; Productive performance; Carcass composition

E. Jeklova, L. Leva, P. Knotigova, M.Faldyna, Age-related changes in selected haematology parameters in rabbits, Research in Veterinary Science, Volume 86, Issue 3, June 2009, Pages 525-528, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2008.10.007.
(http://www.sciencedirect.com/science/article/B6WWR-4V1FBWG-1/2/cccd51366915cd162b4fb090f9fbc38a)
Abstract:
Even though there is an abundance of information on the reference values of haematological parameters in adult rabbits, a little is known about the changes in haematology in newborn rabbits or during their postnatal development. Therefore, the aim of our study was to investigate changes in red blood cells (RBC), white blood cells (WBC) and differential leukocyte counts in SPF New Zealand White rabbits from the age of one day to 20 weeks. Significant age-related changes during the first four weeks of life were detected. These included an increase of RBC and WBC, reversal of the neutrophil/lymphocyte ratio and increase of total counts of eosinophils and basophils. From the age of six weeks of life, all of the studied haematological parameters were comparable to those of adult rabbits.
Keywords: Lagomorphs; Postnatal development; Haematology; Differential leukocyte counts

Jian-Min Lv, Min-li Chen, Li-Chun Qian, Hua-Zhong Ying, Jian-Xin Liu, Requirement of crude protein for maintenance in a new strain of laboratory rabbit, Animal Feed Science and Technology, Volume 151, Issues 3-4, 26 May 2009, Pages 261-267, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2009.01.001.
(http://www.sciencedirect.com/science/article/B6T42-4VJS6TF-1/2/d13c64d4c33288ac3fe56ba06965357f)
Abstract:
A new strain of laboratory rabbit, produced from Japanese White rabbit but characterized by its black eye and higher antibody titer, was used in a series of nitrogen (N) balance trials to investigate the requirement of crude protein (CP) for maintenance. The N balance was determined for growing (6-12 weeks) and finishing period (13-17 weeks). Thirty rabbits were used in each period. The rabbits in both periods were divided into five equal groups and fed the diets with equal digestible energy but different contents of CP (120, 140, 160, 180 and 200 g/kg DM). The N requirements for maintenance were estimated from the relationship between the N retention and N intake. Following the above series of N balance tests, 20 rabbits of 16 of age weeks were used with a N-free diet. The rabbits were divided into five groups and offered the N-free diet at levels of 55, 45, 35, 25 and 0 g/day, respectively. Net protein utilization ranged from 0.45 to 0.50 and increased with the advancing age of rabbits, but no significant difference was found between different contents of dietary CP. The estimated N requirement for maintenance was, on average, 485 mg/kg BW0.75 per day, equivalent to 3.03 g CP/kg BW0.75. The result from the trial with the N-free diet showed that N requirement for maintenance was 486 mg/kgBW0.75 per day, confirming the results obtained in the series of N balance tests. The lower intake of the N-free diet resulted in more N excretion suggesting that protein catabolism may occur in the body of rabbit to meet maintenance requirements for N when the dietary N intake was very low.
Keywords: Crude protein; Requirement for maintenance; Nitrogen balance; Rabbit

M. Garcia-Tomas, J. Sanchez, M. Piles, M.T. Mitjavila, Line and birth season effects on plasma testosterone and oxidative stress parameters in testis of maturing rabbits, Animal Reproduction Science, In Press, Corrected Proof, Available online 13 May 2009, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2009.05.005.
(http://www.sciencedirect.com/science/article/B6T43-4W8VW2G-1/2/c22a993e0a9293b1c14de74231aceb1e)
Abstract:

Oxidative stress plays a key role in the male reproductive function. Differences between rabbit breeds have been found for testis size, seminiferous tubule diameter, number and size of interstitial and germ cells, etc. Traits related to the redox system could also be affected by genetic factors. It is likely that differences between breeds for these traits would lead to differences in reproductive maturation and fertility.
We have investigated in the present paper the age-related changes of the plasma testosterone (TST) concentration, superoxide anion (O2-) radical formation, superoxide dismutase (SOD) activity, catalase (CAT) activity and thiobarbituric acid-reactive substances (TBARs) level in testis of rabbits in two breeds selected for different aptitudes (Caldes for growth rate and Prat for litter size). The effect of birth season for these traits was also assessed.
Major changes in parameters related to oxidative stress were observed at an early age and most probably can be explained by the concomitant changes in testicular structure and function. Both lines showed similar developmental profiles and levels for all the variables studied. There was no interaction between line and birth season, consequently environmental conditions affected both lines in the same manner. Significant differences between males born in different seasons were found for O2- (4.84 +/- 0.19 RLU/mg tissue min versus 5.67 +/- 0.19 RLU/mg tissue min), SOD (6.12 +/- 0.11 U/mg protein versus 7.09 +/- 0.11 U/mg protein) and CAT (0.058 +/- 0.002 K/mg protein versus 0.040 +/- 0.002 K/mg protein). Future studies should take into account differences between seasons for a more precise analysis.
Keywords: Rabbit testis; Testosterone; Superoxide dismutase; Catalase; TBARs; Development

Ming-Hsien Li, Hong-Kean Ooi, Fecal occult blood manifestation of intestinal Eimeria spp. infection in rabbit, Veterinary Parasitology, Volume 161, Issues 3-4, 12 May 2009, Pages 327-329, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2009.01.009.
(http://www.sciencedirect.com/science/article/B6TD7-4VFC833-3/2/04797fdd62a39dc46273aedd42aaa2d2)
Abstract:
The relationship between oocysts production and fecal occult blood manifestation was studied in rabbits experimentally infected with a single species of Eimeria. Pure single Eimeria species infection in non-infected rabbits for 6 species of Eimeria, namely: Eimeria media, Eimeria magna, Eimeria perforans, Eimeria coecicola, Eimeria piriformis, and Eimeria exigua were produced using a single oocyst. Fecal samples from these single Eimeria species infected rabbits were collected daily from day 1 through day 23 post-infection (DPI) to observe for oocysts shedding and also to test for presence of fecal occult blood (FOB). Rabbits infected with E. perforans were positive for FOB test (FOBT) reaction when their OPG exceeded 2.2 x 105 at 11 and 12 DPI. FOBT positive reactions were also seen in naturally infected rabbits with concurrent infections, of E. perforans and E. media as well as of E. perforans and E. magna. Thus, E. perforans was observed to cause intestinal hemorrhage during the period of massive oocyst shedding. This phenomenon was not seen in the other Eimeria species that we had examined. This is also the first report on the association of E. perforans infection with intestinal hemorrhage in rabbit.
Keywords: Rabbit; Coccidiosis; Eimeria; Fecal occult blood test

A. Dalle Zotte, Z. Princz, Sz. Metzger, A. Szabo, I. Radnai, E. Biro-Nemeth, Z. Orova, Zs. Szendro, Response of fattening rabbits reared under different housing conditions. 2. Carcass and meat quality, Livestock Science, Volume 122, Issue 1, May 2009, Pages 39-47, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.07.021.
(http://www.sciencedirect.com/science/article/B7XNX-4T9BXS6-1/2/33c54a0d37552b4ec61866347c09760f)
Abstract:
This 2 x 2 x 2 factorial experiment was conducted to study the effects of housing system (pair caged - cage - : 2 rabbits/0.122 m2 vs open top pen housed - pen - : 13 rabbits/0.86 m2; same

stocking density), floor type (wire mesh vs plastic net), and environmental enrichment (with vs without gnawing stick) on the meat quality of Pannon White growing rabbits (n = 64). The housing system significantly influenced slaughter weight (2590 vs 2531 g in cage or pen, respectively; $P < 0.01$), reference carcass (RC) weight (1266 vs 1234 g; in cage or pen, respectively; $P < 0.05$), and the hind leg meat to bone ratio (6.11 vs 5.62 in cage or pen, respectively, $P < 0.001$). The animals reared in pens showed paler meat with lower pHu than that of those reared paired in cages. Hind leg meat dry matter and protein content were also influenced by the housing system (26.3 vs 25.9%, 21.9 vs 21.6%; in cage or pen, respectively; $P < 0.05$). Pen housed rabbits had significantly heavier femur and tibia bone weight and higher fracture toughness than pair caged rabbits. Floor type affected the fore part/RC weight ratio (29.2 vs 29.6% of the RC on plastic net or wire mesh, respectively). Gnawing stick presence increased slaughter yield (59.0 vs 58.3%; $P < 0.05$), RC weight (1266 vs 1236 g; $P < 0.05$) and the forepart/RC ratio (29.6 vs 29.2% RC; $P < 0.05$) while significantly reducing the meat colour b* value and increasing m. Longissimus dorsi shear force (0.60 vs 0.50 kg/cm2; $P < 0.01$). The hind leg meat fatty acid profile was only slightly influenced by experimental factors. Although this study showed pair caged rabbits to have increased carcass weight with better meatiness and other meat quality traits, hind leg bone strength was shown to be higher in pen housed rabbits.
Keywords: Rabbits; Housing system; Floor type; Gnawing stick; Meat quality

ShangangLi, Xuejin Chen, Jianjun Shi, Yi Guo, Chunguang Yin, Lixin Du, Hui Z. Sheng, Cloning rabbits from fetal fibroblasts, Livestock Science, Volume 122, Issue 1, May 2009, Pages 77-80, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.07.019.
(http://www.sciencedirect.com/science/article/B7XNX-4T71B2R-2/2/7e955f427ae173bca67c12efb4e90182)
Abstract:
Live rabbits were generated through nuclear transfer using adult cells as nuclear donors. We showed that, in addition to adult cell nuclei, cultured fetal rabbit fibroblasts could support full-term embryonic development following nuclear transfer to enucleated oocytes. Following nuclear transfer, 24.4% (21/86) of resulting embryos developed to the blastocyst stage, and 289 embryos were transferred to oviducts of 11 recipient mothers, resulting in 6 pregnancies. Three mothers carried the pregnancy to term, and three newborn rabbits were subsequently delivered by caesarian, one of which survived for more than 4 months. DNA analyses confirmed that all 3 rabbits were genetically identical to fetal donor cells. This study demonstrated that rabbits could be cloned from fetal fibroblasts, although at a lower frequency than when using adult somatic cells as nuclear donors.
Keywords: Rabbit; Nuclear transfer; Fetal fibroblast; Reproduction

Heiko G. Rodel, Anett Starkloff, Martin W. Seltmann, Geraldine Prager, Dietrich von Holst, Causes and predictors of nest mortality in a European rabbit population, Mammalian Biology - Zeitschrift fur Saugetierkunde, Volume 74, Issue 3, May 2009, Pages 198-209, ISSN 1616-5047, DOI: 10.1016/j.mambio.2008.04.003.
(http://www.sciencedirect.com/science/article/B7GX2-4SS8CM7-1/2/2d73db90fd4150b6a581d005a8fa3766)
Abstract:
We conducted a study on nest mortality of an individually marked population of European rabbits (Oryctolagus cuniculus L., 1758) living in a field enclosure. Over 4 years, we determined maternities and quantified pup mortality during the nest period of 703 pups born in subterranean breeding burrows. Overall, pup mortality occurred in 42.7% of the litters, whereas 32.4% of all born pups were affected. Mortality was highest during the first few postnatal days. In about 50% of the cases, we managed to quantify different causes of mortality such as malnutrition, flooding, cooling of the pups, infanticide, or predation. The pups' body mass on postnatal day 1, the thermal

environment and the number of litter mates were the most important predictors of nest mortality. Litter mortality risk decreased with increasing soil temperature around the subterranean nests. A comparatively higher average pup body mass lowered the nest mortality risk of a litter, whereas this effect was more pronounced when soil temperatures were low. Furthermore, mortality was lowest in medium-sized litters, most probably due to the balance between the thermal benefits of huddling with litter siblings and the costs of having them due to the lower share of milk obtained by the individual pups in larger litters. In addition, nest mortality depended on characteristics of the mother; mortality was increased in litters of low-ranking females and of mothers with lower body mass. In conclusion, our study highlights multiple causes and the effects of different environmental and social factors on nest mortality of this small mammal.
Keywords: Oryctolagus cuniculus; Litter size; Maternal characteristics; Siblings; Thermal environment

M.C. Carrilho, M.M. Campo, J.L. Olleta, J.A. Beltran, M. Lopez, Effect of diet, slaughter weight and sex on instrumental and sensory meat characteristics in rabbits, Meat Science, Volume 82, Issue 1, May 2009, Pages 37-43, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2008.11.018.
(http://www.sciencedirect.com/science/article/B6T9G-4V3HHK3-3/2/dff635f662823b7c42314f23d124a4f3)
Abstract:
The effect of the fattening diet, slaughter weight and sex on meat quality was studied in a total of 156 hybrid rabbits. After weaning, rabbits were divided into three groups of 52 animals each (50% male and 50% female), that were allocated for three weeks to one of three commercial diets containing low (14.28%, A), medium (18.04%, B) and high (20.48%, C) fibre content with decreasing energy levels. Animals were slaughtered at 2.0 and 2.3 kg after the consumption of a common pre-slaughter non-medicated concentrate and pH, colour, water-holding capacity (WHC), Warner-Bratzler shear test and sensory analysis were all measured. Meat from animals fed with low fibre and high energy was the least luminous. Rabbits slaughtered at 2.0 kg showed more yellowness than at 2.3 kg at 0 min. In both traits, these differences did not prevail after 15 min of blooming. Globally, meat from males was more coloured than that of the females, both at 0 and 15 min of blooming. No significant differences were found for pH, WHC or shear test for the individual effects. In the sensory analysis, rabbit and grass odours were more intense at 2.0 kg than at 2.3 kg of slaughter weight.
Keywords: Rabbit; Meat quality; Fibre diet; Weight; Sex

G. Liste, M. Villarroel, G. Chacon, C. Sanudo, J.L. Olleta, S. Garcia-Belenguer, S. Alierta, G.A. Maria, Effect of lairage duration on rabbit welfare and meat quality, Meat Science, Volume 82, Issue 1, May 2009, Pages 71-76, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2008.12.005.
(http://www.sciencedirect.com/science/article/B6T9G-4V74VMP-1/2/0fcedbcb92fb76cc7bc496e5a59ec929)
Abstract:
This study determined whether short (2 h) or long (8 h) lairage at an abattoir had an effect on plasma stress indicators (haematocrit, glucose, lactate, creatine phosphokinase and corticosterone), instrumental meat quality (pH24, water holding capacity, colour, raw and cooked texture) and sensory meat quality (using a trained sensory panel) in rabbits. The effect of the position of the animals on a multifloor rolling cage stand during lairage was also assessed. Lairage time had a significant effect on blood stress indicators, but only a slight effect on meat quality traits. A lairage duration of 6-8 h is recommended.
Keywords: Rabbit; Animal welfare; Meat quality; Lairage

M. Carmen Marca, Alejandro Gomez-Quintero, Carmen Vinuales, M. Jesus Rodriguez-Yoldi, Changes in plasma hormone levels following lipopolysaccharide injection in rabbits, The

Veterinary Journal, Volume 180, Issue 2, May 2009, Pages 213-220, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2007.11.013.
(http://www.sciencedirect.com/science/article/B6WXN-4RGG2SR-1/2/58b2f965c22867cd03f1fff8cb9a5c04)
Abstract:
Lipopolysaccharide (LPS) is an endotoxin comprising part of the cell wall of Gram-negative bacteria. It is able to induce a septic state and the release of several pro-inflammatory cytokines that are known to be responsible for hormonal changes in humans and animals. The aim of this study was to evaluate changes in plasma adrenocorticotrophic hormone (ACTH), corticosterone and cortisol levels in a rabbit model in which sepsis was induced by the intravenous administration of LPS. The possible involvement of several protein kinases, namely protein kinase A (PKA), C (PKC) and mitogen-activated protein kinases (MAPKs), and proteasome was also assessed. The results indicated that LPS induced significant increases in plasma ACTH, corticosterone and cortisol concentrations in rabbits. Moreover, protein kinases and proteasome seemed to mediate the hormone response to LPS as treatment with specific inhibitors prior to LPS administration was able to reduce, delay, or, in some cases, inhibit the hormone increases. The findings may help to construct strategies to protect and treat animals with endotoxaemia.
Keywords: ACTH; Corticosterone; Cortisol; LPS; Rabbit

M.J. Villamide, R. Carabano, L. Maertens, J. Pascual, T. Gidenne, L. Falcao-E-Cunha, G. Xiccato, Prediction of the nutritional value of European compound feeds for rabbits by chemical components and in vitro analysis, Animal Feed Science and Technology, Volume 150, Issues 3-4, 14 April 2009, Pages 283-294, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2008.09.007.
(http://www.sciencedirect.com/science/article/B6T42-4TXDXHM-1/2/4f3a50b4d745d3351a613dae4aa03347)
Abstract:
Chemical composition and in vitro analyses were used to predict the nutritional value of 164 experimental rabbit diets evaluated in six European Laboratories under standardised conditions. The equations were mainly developed by stepwise regression analysis with over two third of the samples (111) used as calibration set. The other third (53) was used as validation set, and a study of the residues was undertaken to calculate the error of validation. Twenty three different equations have been proposed to predict the nutritional value (mainly gross energy digestibility, GEd; and digestible energy, DE) of rabbit diets, as a function of the available variables. Acid detergent fibre (ADFom) was the chemical variable most closely related to GEd and DE (R2 = 0.49 and 0.43, respectively, RSD = 0.033 and 0.62, for GEd and DE, respectively), but the in vitro DM digestibility (DMdinv) predicted the energy value with greater accuracy (R2 = 0.7, 0.52, for GEd and DE, respectively) and lower standard error (RSD = 0.025, 0.58 for GEd and DE, respectively). The latter equations were improved (R2 = 0.81, 0.74 for GEd and DE, respectively) when ether extract (EE) and Lignin (sa) were included. The use of additive equations that predict the DE from the main constituents that supply energy (protein, ether extract and carbohydrates) did not increase the precision, nor decrease the validation error respect to the simplest ones. Digestible Energy was predicted with a similar accuracy and validation errors than GEd. Crude protein digestibility (CPd) was better predicted from chemical analysis (Lignin (sa), R2 = 0.49) than for DMdinv. The further inclusion of CP slightly increased its coefficient of determination (0.53). The error of validation was relatively low (0.050 as average) and of the same magnitude than the RSD of the equations.
Keywords: Chemical composition; In vitro digestibility; Nutritional value; Prediction; Rabbit feeds

C.M. Guedes, J.L. Mourao, S.R. Silva, M.J. Gomes, M.A.M. Rodrigues, V. Pinheiro, Effects of age and mannanoligosaccharides supplementation on production of volatile fatty acids in the caecum

of rabbits, Animal Feed Science and Technology, Volume 150, Issues 3-4, 14 April 2009, Pages 330-336, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2008.10.004.
(http://www.sciencedirect.com/science/article/B6T42-4TYPJB7-1/2/a2b0ab537f1dcae1d0e1832c6b3058db)
Abstract:
This trial studied the effect of including mannanoligosaccharides (MOS, Bio-Mos(R), Alltech Inc., USA) in the diet on the caecal volatile fatty acids (VFA) and pH of rabbits from 34 to 90 days of age. Three experimental diets were compared: control diet, zinc bacitracin (ZnBac) diet (control diet with 0.1 g ZnBac/kg feed) and MOS diet (control diet with 2.0 g MOS/kg feed). Rabbits were slaughtered at 34, 48, 69 and 90 days of age and caecal contents were collected and analyzed for dry matter, pH and VFA concentration. The empty caecum and caecal contents weights relative to live weight were also determined.
Age affected (P<0.0001) VFA concentration and pH values in the caecum. The pH decreased with age whereas VFA concentration increased. Rabbits fed MOS had higher (P<0.05) VFA and tended (P=0.098) to had lower pH in the caecum than rabbits fed ZnBac and control diets. Acetic, propionic and butyric acids concentrations in the caecum increased with MOS but its molar proportions were similar among diets. Diet had no effect on empty caecum weight and caecal contents weight and dry matter concentration. There was no interaction effect between diet and age. From 34 to 90 days of age, VFA production was higher (P<0.05) in the caecum of rabbits fed MOS than in those fed ZnBac diet and control diet.
The addition of MOS to the diet increased the VFA concentration in the caecum of growing rabbits from 34 to 90 days of age.
Keywords: Mannanoligosaccharides; Volatile fatty acids; Caecum; Rabbits

Fabrizio Agnoletti, Tiziana Ferro, Angela Guolo, Barbara Marcon, Monia Cocchi, Ilenia Drigo, Elena Mazzolini, Luca Bano, A survey of Clostridium spiroforme antimicrobial susceptibility in rabbit breeding, Veterinary Microbiology, Volume 136, Issues 1-2, 14 April 2009, Pages 188-191, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2008.10.020.
(http://www.sciencedirect.com/science/article/B6TD6-4TSTY8K-4/2/573d762a9da51fd453db6c9a0026b8a7)
Abstract:
Rabbit meat breeding may be heavily affected by enterotoxaemia due to Clostridium spiroforme. Data on its antimicrobial susceptibility are insufficient, presumably because of difficulties in cultivating and identifying the pathogen. Our aim is therefore to provide this information to veterinary practitioners by focusing on a panel of therapeutics used in intensive rabbit units. Lincomycin was also checked in order to investigate the origin of resistance to macrolides. Minimal inhibitory concentrations (MICs) were determined with the agar dilution method according to the CLSI M11-A7 protocol (2007). MIC50 and MIC90 were, respectively, 64 and 64 [mu]g/ml for tiamulin, 32 and 32 [mu]g/ml for norfloxacin, 0.063 and 0.125 [mu]g/ml for amoxicillin, and 8 and 16 [mu]g/ml for doxycycline. MIC50 and MIC90 were 256 [mu]g/ml for sulphadimethoxine, spiramycin and lincomycin. Our results have shown that intrinsic or acquired antimicrobial resistances are diffuse in the C. spiroforme population and suggest focusing on prevention rather than on treatment of clostridial overgrowth, by reducing risk factors and using antimicrobials prudently.
Keywords: Clostridium spiroforme; Minimal inhibitory concentration (MIC); Drug susceptibility; Rabbit

Wan-hua GUO, Zi-lin GU, Kun-peng WEI, Ya-juan LIU, Zeng-li WANG, Effect of Humulus scandens for Traditional Fiber Sources on Digestion, Diarrhea, and Performance of Growing Rabbits, Agricultural Sciences in China, Volume 8, Issue 4, April 2009, Pages 497-501, ISSN 1671-2927, DOI: 10.1016/S1671-2927(08)60238-2.

(http://www.sciencedirect.com/science/article/B82XG-4W4TVWV-K/2/fb70715743871b4f0fd679f9c57fdb03)
Abstract:
This work was to determine which concentration of a mixture of fresh Humulus scandens (HS) and fresh alfalfa could be included in diets for rabbits. The fresh forage of three experimental diets is composed of 100% alfalfa, 50% alfalfa+50% HS, 100% HS, respectively. 30 rabbits [(1.42+/-0.056) kg] were used to determine nutrient digestibility. A feeding trial was carried out using 90 weaning rabbits [35 d of age; (512 +/- 6.5) g]. Increasing content of HS in the diet did not affect digestibility of DM (dry matter), CF (crude fiber), CP (crude protein), GE (gross energy), and EE (ether extract). But diarrhea decreased markedly (P <0.01) compared with the diets that had no HS. ADFI (average daily feed intake) increased by 4.3% (P < 0.05) and 3.6% (P < 0.05) when rabbits fed the diet with 100% HS of fresh forage compared with the diets containing 0 and 50% HS, respectively. Feed efficiency improved significantly (P <0.05) by 2.07 and 5.30% when rabbits fed 0 and 50% HS of fresh forage, respectively, compared with 100% HS. There was no effect on ADG (average daily weight gain). In conclusion, the mixture (50:50) of HS and alfalfa constitutes an alternative source of fiber for fattening rabbits and prevents diarrhea effectively.
Keywords: Humulus scandens; digestion; growth; diarrhea; rabbit; alfalfa

E.A.M. Amorim, C.A.A. Torres, J.K. Graham, L.S. Amorim, L.V.L. Santos, The hypoosmotic swelling test in fresh rabbit spermatozoa, Animal Reproduction Science, Volume 111, Issues 2-4, April 2009, Pages 338-343, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2008.02.015.
(http://www.sciencedirect.com/science/article/B6T43-4RXJYP6-2/2/b476f4089bf00dc4110a050f389d272f)
Abstract:
The hypoosmotic swelling test (HOST) has proved to be a good tool for evaluating the membrane integrity of spermatozoa of various domestic animals including cattle, horses, and swine. However, the best approach for using this technique in rabbit semen has not been tested. The present study aimed to establish the best hypoosmotic solution (HS) for testing membrane integrity in fresh rabbit semen. Sucrose solutions with the following osmolarities were used: 50, 60, 75, 100, 125 and 150 mOsm/L. Semen samples (n = 30) were collected from five mature White New Zealand rabbits (six collections per rabbit) at 72 h intervals. After macroscopic evaluation, 10 [mu]L of semen was immediately added to 2 mL of each solution and incubated for 1 h at 37 [degree sign]C. Sequentially, 20 [mu]L of semen diluted in HS were evaluated with oil immersion using a phase-contrast microscope. A total of 200 spermatozoa were counted in at least five different fields, and sperm tails were classified as non-coiled, coiled, and strongly coiled. The respective percentages of spermatozoa with coiled tails (coiled plus strongly coiled) in the six solutions listed above were 54.8, 65.2, 54.3, 53.9, 38.9 and 29.4%. Percentage of strongly coiled spermatozoa was: 40.2, 51.0, 43.2, 41.5, 32.7 and 26.9 for the six solutions, respectively. According to total and strong coiling 60 mOsm/L was superior to others treatments (P < 0.05). Results suggest that the 60 mOsm/L solution would be most desirable for use in HOST in fresh rabbit spermatozoa.
Keywords: Hypoosmotic swelling test; Rabbit; Sperm; Tail

Cecilia Mugnai, Alessandro Dal Bosco, Cesare Castellini, Effect of different rearing systems and pre-kindling handling on behaviour and performance of rabbit does, Applied Animal Behaviour Science, Volume 118, Issues 1-2, April 2009, Pages 91-100, ISSN 0168-1591, DOI: 10.1016/j.applanim.2009.02.007.
(http://www.sciencedirect.com/science/article/B6T48-4VT17JV-1/2/cf680f4c0f9010df0f888457ae9f9ba7)
Abstract:
The aim of this study was to ascertain how collective cage and pre-kindling handling (training does to go into their own nest) practices, in comparison to standard housing (single cage rearing),

modify the behaviour and the performance of rabbit does. To this aim, 40 nulliparous New Zealand White does were artificially inseminated, where the pregnant ones were assigned to three groups with the following treatments: eight does, kept in single standard cages (group S); eight does kept in two colony cages and trained to recognise their own nest (group TC); eight does kept in two colony cages, but not trained to recognise their own nest (group UC). Performance and behaviour, with particular attention to the social relationships of animals, were evaluated for one year. The housing system and training practice affected the behaviour of animals. Does kept in colony cages showed a wider behavioural repertoire, as well as fewer stereotyped and social behaviours. However, the interactions between animals were not always friendly; in particular, the UC group showed the highest incidence of aggressiveness: attack (26.61% vs. 13.55%) and dominance (12.98% vs. 8.81%) and lower allo-grooming (4.16% vs. 19.56%) in comparison to TC does. Negative correlation values between feeding and moving behaviours were obtained (-0.37 and -0.28) for TC and UC does, respectively. UC does showed significant correlation coefficients between stereotyped, moving and static behaviours (0.50 and -0.61, respectively). Different correlation values between moving and social interactions were shown for TC (-0.44) and UC does (0.48). In UC does, stereotypies were also correlated with social relationships (0.40) and, in particular, with attack (0.57; data not shown). Smelling one other was one of the major social activities, but while animals in the UC group exhibited a stable trend in the days close to kindling, in the TC group, the values increased from 20% (3 days before partum) to 75% (3 days after partum). Dominant and submissive features in TC does showed the same trends and decreased to about 0% after kindling; in contrast, in the UC group, dominant behaviours were performed even after kindling (4.8%) and submissiveness reached values similar to that of the first day of observation (about 35%). Reproductive performance and productivity of colony does were lower than S does. This reduction was lessened if does were trained to recognise their own nest. In the UC group, does had very low sexual receptivity (49.8%) and fertility rates (40.8%), a higher annual replacement of does (83.3%) and low rabbits sold/year/doe (17.7), probably due to the higher social pressure and aggressiveness, as confirmed by the percentage of does replaced due to severe injury (8.3%).
In conclusion, breeding does in a colony cage, without the training to recognise their own nest, renders the animals disagreeable to social encounters, does not assure adequate welfare or a productive performance and increases the possibility of suffering from injuries caused by attacks from other does.
Keywords: Does; Colony cage housing; Behaviours; Performance

Hong Xu, Hong-can Shi, Wang-fu Zang, Dan Lu, An experimental research on cryopreserving rabbit trachea by vitrification, Cryobiology, Volume 58, Issue 2, April 2009, Pages 225-231, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2008.12.009.
(http://www.sciencedirect.com/science/article/B6WD5-4V88FS5-1/2/782f749391c7202bfd872b0113ddcb6a)
Abstract:
Vitrification is a promising alternative to tissue preservation, in which the tissue is permeated with cryoprotective agents (CPAs) in order to circumvent the hazardous effects associated with ice formation. In this study, we evaluate the effect of vitreous cryopreservation of rabbit trachea, by comparing vitrification procedure with conventional computer-programmed slow freezing approaches. Harvested rabbit trachea were tailored and divided into groups and cryopreserved by vitrification and programmed freezing, respectively. The morphology and ultrastructure of the thawed tracheal fragments including HE dyes, terminal deoxynucleotidyl transferase-mediated dUTP-digoxigenin nick end-labeling (TUNEL) staining, transmission electron microscopy (TEM) and scanning electron microscopy (SEM) were studied to assess the integrity of the tracheal fragments. Morphological studies demonstrated that both cryopreservation procedure retained the integrity of trachea, both epithelial cells, cilia and cartilage cells were in good shape. Compared

with slow freezing methods, vitrification was less detrimental to cartilage cells and had a higher survival rate of chondrocytes and coverage of epithelium and cilia. Therefore, vitrification procedure can be a more satisfactory method to preserve trachea and the survival of chondrocytes in situ in cartilage tissue is adequate and respiratory epithelium is soundly present.
Keywords: Trachea; Vitrification; Cryopreservation; Cryoprotective agents (CPAs); Slow cooling; Cryoinjury

Alexander V. Sirotkin, Jan Rafay, Jan Kotwica, Krzysztof Darlak, Francisco Valenzuela, Role of ghrelin in regulating rabbit ovarian function and the response to LH and IGF-I, Domestic Animal Endocrinology, Volume 36, Issue 3, April 2009, Pages 162-172, ISSN 0739-7240, DOI: 10.1016/j.domaniend.2008.12.003.
(http://www.sciencedirect.com/science/article/B6T62-4VF4SD8-1/2/95a54475091f2240b80c703eee99d5cc)
Abstract:
The aim of these in vivo and in vitro studies was to examine the role of ghrelin in the control of plasma hormone concentrations, the proliferation, apoptosis and secretory activity of ovarian granulosa cells and the response of these cells to hormonal treatments. Female rabbits were injected with ghrelin (10 [mu]g/animal/day for one week before ovulation induced by 25 IU PMSG and 0.25 IU LHRH). On the day of ovulation, blood samples were collected and analyzed for concentrations of progesterone (P4), testosterone (T), estradiol (E2), estrone-sulphate (ES), insulin-like growth factor I (IGF-I) and leptin (L) by RIA. Some control and ghrelin-treated animals were killed in the periovulatory period, their ovaries were weighed and granulosa cells were isolated and cultured for 2 d. Cell proliferation (expression of PCNA) and apoptosis (expression of TdT) were evaluated by immunocytochemistry and TUNEL respectively. Secretion of P4, T, E2, IGF-I, and prostaglandin F (PGF) by granulosa cells cultured with and without LH or IGF-I (1, 10 or 100 ng/ml medium) was assessed by RIA. The remaining control and treated animals were kept until parturition, while the number, viability and body weight of pups were recorded.
Ghrelin treatment increased rabbit plasma T and decreased ES concentrations but did not influence P4, E2, IGF-I or L. Granulosa cells from ghrelin-treated animals showed higher expression of PCNA and lower expression of TdT, than those from control animals. They also secreted less P4, T, E2, IGF-I and PGF than granulosa cells from untreated animals. Treatment of cultured granulosa cells with ghrelin (1, 10 or 100 ng/ml medium) either increased (at 1 ng/ml) or decreased (at 10 ng/ml) P4 secretion, increased (at 100 ng/ml) or decreased (at 10 ng/ml) IGF-I secretion, decreased T (at 1 and 10 ng/ml) and OT (at 1 ng/ml) secretion, and increased (at 100 ng/ml) PGF secretion.
LH treatment of cells from control animals stimulated P4 (at 1 and 10 ng/ml), E2, and IGF-I (both at 10 and 100 ng/ml), but not T secretion. IGF-I stimulated P4 (all concentrations) and PGF (at 100 ng/ml) but suppressed T (all concentrations) and E2 (at 1 and 10 ng/ml) secretion. Pre-treatment of animals with ghrelin stimulated, suppressed or even reversed subsequent LH and IGF-I effects on hormone secretion by cultured granulosa cells. Ghrelin injections did not affect ovarian weight or the number and body mass of pups born, although pup mortality was significantly lower in ghrelin-treated than in control mothers.
These observations suggest that ghrelin is involved in the control of ovarian cell proliferation, apoptosis and secretion of hormones, as well as in the response of these cells to physiological stimulators such as LH and IGF-I.
Keywords: Ghrelin; Proliferation (PCNA); Apoptosis (TdT, Bax); Hormone (progesterone, testosterone, estradiol, estradiol sulphate, LH, IGF-I, leptin); Ovary; Rabbit

P.G. Rebollar, M.A. Perez-Cabal, N. Pereda, P.L. Lorenzo, M. Arias-Alvarez, P. Garcia-Rebollar, Effects of parity order and reproductive management on the efficiency of rabbit productive

systems, Livestock Science, Volume 121, Issues 2-3, April 2009, Pages 227-233, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.06.018.
(http://www.sciencedirect.com/science/article/B7XNX-4T72K6G-1/2/de0d0ba0b8ec74665d2c664d7e26cfac)
Abstract:
The aim of this work was to study the effect of parity order and reproductive management systems on rabbit production performance. A total of 73 rabbit does (I group) were submitted to a 35-day intensive rhythm [artificial insemination (AI) on day 4 post-partum (pp) and weaning at 25 days of lactation], and 108 rabbit does (SI group) were submitted to a 42-day semi-intensive rhythm (AI on day 11 pp and weaning at 35 days of lactation) during 9 months. Primiparous does had the lowest live body weight at parturition ($P < 0.0001$) and at 21 days of lactation ($P < 0.0001$). They also had lower milk production ($P < 0.0001$) than does with later parities. I group animals needed a higher number of AI than SI group to become pregnant (1.70 +/- 0.03 vs. 1.39 +/- 0.03; $P < 0.0001$: especially after the third). Prolificacy was not affected by the management system. Parturition interval (PI) was longer than expected in both groups [56.0 +/- 1.4 and 50.9 +/- 1.38 days in I and SI groups, respectively ($P < 0.05$)]. Mean productivity, estimated as number of weaned rabbits per female and year, was 12 kits higher in rabbit does of the SI group ($P < 0.05$). From the third parturition onward, an increase in live body weight of kits at different ages was observed. At 21 ($P < 0.05$) and 25 days of age ($P < 0.01$), kits from the I group rabbit does weighed more than those from the SI group; however, the latter showed a higher weight at 35 ($P < 0.05$) and 60 days of age ($P < 0.05$). Rabbit does with two or three parturitions had higher litter size at 21 and 25 days of age ($P < 0.0001$ and $P < 0.001$, respectively). Kit mortality between 21 and 25 days of age and between 35 and 60 days of age was not affected by treatments but was higher in the I group between 25 and 35 days (18.2 vs. 5.03% in the I and SI groups, respectively; $P < 0.0001$) and as age of does increased ($P < 0.05$). In light of these results, we could conclude that long term doe reproductive performance is negatively affected and litter viability decreased when using intensive compared to a semi-intensive reproductive management.
Keywords: Insemination; Litter growth; Parturition interval; Productive parameters; Reproductive rhythms

T.M. Gliozzi, L. Zaniboni, A. Maldjian, F. Luzi, L. Maertens, S. Cerolini, Quality and lipid composition of spermatozoa in rabbits fed DHA and vitamin E rich diets, Theriogenology, Volume 71, Issue 6, 1 April 2009, Pages 910-919, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2008.10.022.
(http://www.sciencedirect.com/science/article/B6TCM-4V936J4-1/2/288b0290c5b751a5f59eac9534817976)
Abstract:
The effects of fish oil (FO) and vitamin E (vE) dietary supplementation on semen quality, sperm susceptibility to lipid peroxidation, tocopherols content and fatty acid profiles were studied in rabbits. Fifty-two rabbit bucks randomly divided in four groups received a control diet and enriched diets containing either FO (1.5%, w/w), vE (200 mg/kg) or both. Semen volume, concentration, motility and viability were analysed at various time-points and the lipid composition was assessed on sperm cells. The phospholipid fatty acid profile was determined: n-6 PUFA were the major fatty acids found, with a proportion of 42%, whereas the n-3 PUFA accounted for nearly 1%, mainly represented by C22:6n-3 (docosahexaenoic acid, DHA). FO supplementation produced a seven-fold increase in the content of DHA in sperm phospholipids and a comprehensive rearrangement of the phospholipid fatty acid composition, while an unexpected negative effect of feeding high level of vE on the proportion of total PUFA was found. Despite the remarkable changes observed in sperm lipid composition, semen quality parameters were not affected by the dietary treatments and the interaction between the two dietary supplements had a significant effect only on sperm concentration. An increase in semen production by ageing and a concomitant rise in sperm

susceptibility to in vitro peroxidation was found. [alpha]- and [delta]-tocopherol, present in rabbit sperm in similar amount, were not affected by dietary treatment. [delta]-tocopherol content had a significant linear negative regression with age and showed a significant negative correlation with the susceptibility to peroxidation values.
Keywords: Rabbit; Sperm quality; Diet; n-3 fatty acids; Vitamin E

Eva Skrivanova, Zuzana Molatova, Vera Skrivanova, Milan Marounek, Inhibitory activity of rabbit milk and medium-chain fatty acids against enteropathogenic Escherichia coli O128, Veterinary Microbiology, Volume 135, Issues 3-4, 30 March 2009, Pages 358-362, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2008.09.083.
(http://www.sciencedirect.com/science/article/B6TD6-4TMSNTM-3/2/5e466edb6af754bbc26baa4ca46221d2)
Abstract:
Colibacillosis represents a major cause of diarrhea in young rabbits. In order to elucidate protective effect of milk, in vitro and in vivo experiments were carried out. In the in vitro experiment, rabbit milk treated with lipase significantly decreased the number of viable cells in cultures of Escherichia coli, O128 serotype, from 10.3 to 6.2-7.3 log10/(cfu ml). The lipase effect was the same with heat-treated (100 [degree sign]C/10 min) and raw milk. Raw milk without lipase decreased the number of E. coli only marginally. In the in vivo experiment, weaned rabbits received feed contaminated with the same bacterium. The course of the infection was moderate, only 2 out of 36 infected rabbits died. Seven days after inoculation, caprylic acid at 5 g/kg feed and triacylglycerols of caprylic and capric acid at 10 g/kg feed decreased faecal output of E. coli from 10.2 log10/(cfu g) to 5.8 and 6.1 log10/(cfu g), respectively. The number of E. coli in faeces of non-infected rabbits averaged 4.0 log10/(cfu g). The growth of infected rabbits was slow for 2 weeks after infection. In the third week a compensatory growth was apparent. At the end of the experiment, average body weights of rabbits receiving caprylic acid and those of non-infected rabbits were not significantly different. It can be concluded that (i) lipids rather than proteins seem to be responsible for the antimicrobial activity of rabbit milk; and (ii) this activity was lipase-dependent. Caprylic acid or oils with high a concentration of it may be used as feed supplements for weanlings.
Keywords: Rabbit milk; Milk fat; Antimicrobial activity; Escherichia coli; EPEC

A. Muller, J. Freitas, E. Silva, G. Le Gall-Recule, F. Zwingelstein, J. Abrantes, P.J. Esteves, P.C. Alves, W. van der Loo, J. Kolodziejek, N. Nowotny, G. Thompson, Evolution of rabbit haemorrhagic disease virus (RHDV) in the European rabbit (Oryctolagus cuniculus) from the Iberian Peninsula, Veterinary Microbiology, Volume 135, Issues 3-4, 30 March 2009, Pages 368-373, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2008.09.057.
(http://www.sciencedirect.com/science/article/B6TD6-4TGXPCV-4/2/e7ee66a974651cce633cc25be6f4e989)
Abstract:
To date information on rabbit haemorrhagic disease virus (RHDV) in Spain and Portugal has been scarce, although the disease is endemic and continues to have a considerable impact on species conservation and hunting industry. We analysed RHDVs obtained between 1994 and 2007 at different geographic locations in Portugal (40 samples), Spain (3 samples) and France (4 samples) from wild European rabbits (Oryctolagus cuniculus) that succumbed to the disease. Phylogenetic analyses based on partial VP60 gene sequences allowed a grouping of these RHDVs into three groups, termed 'Iberian' Groups IB1, IB2 and IB3. Interestingly, these three Iberian groups clustered separately, though not far from earlier RHDVs of Genogroup 1 (containing e.g., strain 'AST89'), but clearly distinct from globally described RHDV strains of Genogroups 2-6. This result, supported by a bootstrap value of 76%, gives rise to the hypothesis that the virus evolved independently since its introduction to wild rabbit populations on the Iberian Peninsula, with the

Pyrenees acting as a natural barrier to rabbit and hence to virus dispersal. No differences were observed in RHDV sequences obtained from geographic regions where the rabbit subspecies O. c. algirus prevails compared with those obtained from O. c. cuniculus.
Keywords: RHDV; Phylogeny; Iberian Peninsula; Oryctolagus cuniculus; Wild rabbit

David Fouchet, Jacques Le Pendu, Jean-Sebastien Guitton, Micheline Guiserix, Stephane Marchandeau, Dominique Pontier, Evolution of microparasites in spatially and genetically structured host populations: The example of RHDV infecting rabbits, Journal of Theoretical Biology, Volume 257, Issue 2, 21 March 2009, Pages 212-227, ISSN 0022-5193, DOI: 10.1016/j.jtbi.2008.11.021.
(http://www.sciencedirect.com/science/article/B6WMD-4V34DG5-3/2/f449cd71365990768fa146b1c9a3efae)
Abstract:
Several studies have shown that classical results of microparasite evolution could not extend to the case where the host species shows an important spatial structure. Rabbit haemorrhagic disease virus (RHDV), responsible for rabbit haemorrhagic disease (RHD), which recently emerged in rabbits, has strains within a wide range of virulence, thus providing an interesting example of competition between strains infecting a host species with a metapopulation structure. In addition, rabbits may show a genetic diversity regarding RHDV susceptibility. In the present paper we use the example of the rabbit-RHDV interaction to study the competition between strains of a same microparasite in a host population that is both spatially and genetically structured. Using metapopulation models we show that the evolution of the microparasite is guided by a trade-off between its capacity to invade subpopulations potentially infected by other strains and its capacity to persist within the subpopulation. In such a context, host genetic diversity acts by reducing the number of hosts susceptible to each strain, often favouring more persistent--and generally less virulent--strains. We also show that even in a stochastic context where host genes regularly go locally extinct, the microparasite pressure helps maintain the genetic diversity in the long term while reinforcing gene loss risk in the short term. Finally, we study how different demographic and epidemiologic parameters affect the coevolution between the rabbit and RHDV.
Keywords: Evolution of virulence; Metapopulation; Stochastic model; Matching-allele model

Rose G. Mage, Immunoglobulin allotype-defined pedigreed rabbits and genes of immunological interest in 2x rabbit genome assemblies (workshop), Veterinary Immunology and Immunopathology, Volume 128, Issues 1-3, Special Issue: The 8th International Veterinary Immunology Symposium (8th IVIS), 15 March 2009, Page 217, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2008.10.019.
(http://www.sciencedirect.com/science/article/B6TD5-4VPG66R-J/2/732a47beef635a33cf032fb401da8478)
Keywords: Pedigreed NIAID rabbits; Immunoglobulin allotypes; 2x to 7x coverage; Genome assemblies

Paula A. Fontana, Carolina N. Zanuzzi, Leonardo A. Chinchilla, Claudio G. Barbeito, Eduardo J. Gimeno, Enrique L. Portiansky, Enzootic calcinosis: Effects on organs and cells of the immune system in experimentally intoxicated rabbits, Veterinary Immunology and Immunopathology, Volume 128, Issues 1-3, Special Issue: The 8th International Veterinary Immunology Symposium (8th IVIS), 15 March 2009, Pages 308-309, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2008.10.210.
(http://www.sciencedirect.com/science/article/B6TD5-4VPG66R-7C/2/853378306ae247680e3dca73d3fec7b9)
Keywords: Enzootic calcinosis; Solanum glaucophyllum; Hypervitaminosis D; Immune system; Rabbits

Miguel Delibes-Mateos, Carlos Rouco, Rafael Villafuerte, Can adult and juvenile European rabbits be differentiated by their pellet sizes?, Acta Oecologica, Volume 35, Issue 2, March-April 2009, Pages 250-252, ISSN 1146-609X, DOI: 10.1016/j.actao.2008.11.002.
(http://www.sciencedirect.com/science/article/B6VR3-4V34RR5-2/2/b3809a80e09a10dbff1de74f53538150)
Abstract:
Recently, a new method for differentiating juvenile and adult rabbits based on faecal pellet size was published. According to this method, pellets >6 mm diameter are inferred to be deposited by adults, while those <6 mm are inferred to be from juveniles or kittens. In this study, we designed a simple experiment to test the accuracy of this methodology. Twelve adult rabbits were housed in individual outdoor cages and their pellets were removed every day for 10 consecutive days. Pellets were separated using a sieve according to their size and counted. Results showed that adult rabbits produce pellets >6 mm diameter in the same proportion as those <6 mm. We also observed a strong influence of the individual rabbit on pellet size; some rabbits produce a high proportion of pellets >6 mm, whereas others deposit mostly pellets <6 mm in size. Our findings demonstrate that pellet size is unsuitable for aging wild rabbits. Field biologists should therefore be cautious when employing the pellet size method of age determination in other wild animals in the absence of validating studies.
Keywords: Aging methodology; Oryctolagus cuniculus; Pellet count

Z. Princz, A. Dalle Zotte, Sz. Metzger, I. Radnai, E. Biro-Nemeth, Z. Orova, Zs. Szendro, Response of fattening rabbits reared under different housing conditions. 1. Live performance and health status, Livestock Science, Volume 121, Issue 1, March 2009, Pages 86-91, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.05.018.
(http://www.sciencedirect.com/science/article/B7XNX-4T0NGMB-1/2/efcfba90ccb9e70d74328cc7763df107)
Abstract:
In a 2 x 2 x 2 factorial experiment the effects of housing system (pair caged (cage): 2 rabbits/0.122 m2 vs open top pen housed (pen): 13 rabbits/0.86 m2; same stocking density), floor type (wire mesh vs plastic net) and environmental enrichment (with vs without gnawing stick) were studied on live performance, health status and welfare (ear lesions) of growing rabbits (n = 176). The housing system significantly influenced the body weight at 11 weeks of age (2630 vs 2557 g; in cage or pen, respectively) and the feed conversion (3.12 vs 3.38 g/g; in cage or pen, respectively). Floor type did not affect the traits tested. Gnawing stick consumption affected the body weight at 11 weeks of age (2553 vs 2622 g; without or with gnawing stick, respectively), the percentage of ear lesions (18.5 vs 1.20%; without or with gnawing stick, respectively). Some of the live performance traits of rabbits reared in pens was slightly lower. The presence of gnawing stick, especially in pens, reduced the aggressive behaviour and improved the welfare.
Keywords: Growing rabbits; Cage; Pen; Floor type; Gnawing stick

N. Soultos, Z. Tzikas, E. Christaki, K. Papageorgiou, V. Steris, The effect of dietary oregano essential oil on microbial growth of rabbit carcasses during refrigerated storage, Meat Science, Volume 81, Issue 3, March 2009, Pages 474-478, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2008.10.001.
(http://www.sciencedirect.com/science/article/B6T9G-4TMBPY4-2/2/674ce146f7de27be4789d0ce6f35d006)
Abstract:
The effect of dietary supplementation with oregano essential oil on microbial growth of rabbit carcasses during refrigerated storage was investigated. A total of 45 weaned rabbits were separated into three equal groups with three subgroups each. One group was given the basal diet and served as control and the other two groups were administered diets supplemented with

oregano essential oil at levels of 100 and 200 mg/kg diet, respectively (OR100 and OR200 groups). Total viable counts, Pseudomonas spp., lactic acid bacteria, Brochothrix thermosphacta, Enterobacteriaceae and yeast and mould counts, as well as off-odours and appearance of slime were all assessed on rabbit carcasses stored at 3 +/- 1 [degree sign]C for 12 days. The results showed that performance parameters were not affected ($p > 0.05$) whereas the dietary supplementation with oregano essential oil resulted in lower ($p < 0.05$) average microbial counts on the carcasses, compared to controls, throughout storage. Dietary supplementation with oregano essential oil at 200 mg/kg was more effective in inhibiting microbial growth compared with 100 mg/kg. Sensory evaluation scores indicated that the carcasses obtained from OR100 and OR200 groups gave a noticeable putrid odour after days 8 and 10, respectively, whereas the control carcasses developed off-odours after the 6th day of storage. Slime formation in the controls was observed after day 6, while the OR100 and OR200 groups were just beginning to show slime after days 8 and 10, respectively.
Keywords: Oregano essential oil; Rabbit carcasses; Refrigerated storage; Microbial growth

Lei Qu, Xueyi Yang, Xin Wang, Ming Zhao, Shengli Mi, Zhongying Dou, Huayan Wang, Reconstruction of corneal epithelium with cryopreserved corneal limbal stem cells in a rabbit model, The Veterinary Journal, Volume 179, Issue 3, March 2009, Pages 392-400, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2007.10.009.
(http://www.sciencedirect.com/science/article/B6WXN-4R70K76-3/2/775a51a9feeaf0c4234addebc8d7aa44)
Abstract:
The integrity and transparency of the cornea plays a key role in preserving vision. This paper reports a procedure to create an artificial sheet of corneal epithelium from cryopreserved limbal stem cells (LSCs) and to use this for corneal transplantation. Corneal LSCs were isolated from biopsy specimens of rabbit limbal lamellar and cryopreserved in liquid nitrogen at 2-4 passages. The cells were grown in culture medium for 12-14 days on top of a cell-free human amniotic membrane framed on a nitrocellulose sheet. The corneal epithelium generated was transplanted into the right eyes of 14 LSC deficient (LSCD) rabbits (seven experimental animals, seven controls) with corneal damage. The seven LSCD rabbits in the experimental group were transplanted with a corneal epithelial sheet generated from the cryopreserved corneal LSCs. Four LSCD rabbits were used as the vehicle control and were transplanted with a cell-free amniotic membrane, and the remaining three LSCD rabbits were negative controls without transplantation. Over a 2-month recovery period, 2/7 animals in the experimental group recovered completely, four recovered partially and one did not respond. In the control groups, three negative controls and three vehicle controls lost their vision completely, and one of the vehicle controls partially recovered transparency of the cornea Following treatment, corneal transparency of the experimental rabbits was significantly improved compared to controls ($P < 0.05$). The results indicated that cryopreserved corneal LSCs can repair damaged rabbit cornea, suggesting a possible new clinical approach to reconstruction of corneal epithelium.
Keywords: Amniotic membrane; Cornea; Cryopreservation; Limbal stem cells; Rabbit

M. Garcia-Tomas, J. Sanchez, M. Piles, Post-natal sexual development of testis and epididymis in the rabbit: Variability and relationships among macroscopic and microscopic markers, Animal Reproduction Science, Volume 110, Issues 3-4, February 2009, Pages 347-355, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2008.01.019.
(http://www.sciencedirect.com/science/article/B6T43-4RSJDTT-2/2/397d82d48497d4af071560df452005f4)
Abstract:
The present work was performed to examine the existence of some relationships between macroscopic and microscopic traits of testis and epididymis in rabbit. The variables studied were

live weight (LW), testis length (TL), testis width (TWh), testis weight (TW), testis volume (TV), epididymis length (EL), epididymis width (EWh), epididymis weight (EW), epididymis volume (EV), percentage of seminiferous tubules with presence of lumen (STL), percentage of seminiferous tubules with presence of elongated spermatids (STES), percentage of seminiferous tubules with presence of spermatozoa (STS) and diameter of seminiferous tubules (STD). Measurements began after weaning and continued until males reached 33 weeks of age.
Phenotypic correlations between testis and epidydimis traits and the principal component analysis were estimated as the residual correlation from an analysis of variance, including the effects of line, birth-season, age, and the double interactions line x age and birth-season x age.
Four principal components (PCs) explained 79% of the total variation. The predominant variables defining the first PC were TL, TW and TV. Epididymis width and STS were located in the second PC. Epididymis weight and EV were important in the definition of the first and third PC. Tubular diameter seems important in the definition of the fourth PC.
It has been not found correlation between traits related to either testis or epididymis size and variables related to active spermatogenesis. Therefore, TW and/or TV seemed not to be good markers of maturity.
Keywords: Rabbit; Correlation; Principal components; Testis; Maturation; Development

Cynthia M. Verwer, Geert van Amerongen, Ruud van den Bos, Coenraad F.M. Hendriksen, Handling effects on body weight and behaviour of group-housed male rabbits in a laboratory setting, Applied Animal Behaviour Science, Volume 117, Issues 1-2, February 2009, Pages 93-102, ISSN 0168-1591, DOI: 10.1016/j.applanim.2008.12.004.
(http://www.sciencedirect.com/science/article/B6T48-4VF4YKF-2/2/e4e21a94031ae9094f2d59eab2ac5a63)
Abstract:
In the study described in this paper we focus on the behaviour of male rabbits under modified housing conditions. We investigated whether handling has an effect on the behavioural stress response and whether this response is related to the coping strategy of the rabbits. Furthermore we studied the effect of handling from birth onwards on body weight and dominance.
To assess the rabbit's coping strategy we performed a tonic immobility test, human-approach test, open-field test and a novel-object test. The results are that handling has no effect on body weight during the experimental period. Handling led to a more social and stable hierarchy among rabbits. Handled animals are less sensitive to tonic immobility, approached and made contact with the novel object and test-person's hand more often and longer, and moved around more freely in the open field than non-handled rabbits. This suggests that handled animals are proactive copers, while non-handled animals are reactive copers. However, in the second tonic immobility test handling depressed the tonic immobility response to such a level that nearly all handled animals did not react in a pro- or reactive manner at all.
Altogether we provide evidence that handling pups form birth onwards, independent of nursing time, can be very effective in providing tame, less emotional and more cooperative animals.
Keywords: Rabbit; Handling; Coping; Tonic immobility; Human-approach; Novelty

S.R. Silva, C.M. Guedes, J.L. Mourao, A. Pio, V.M. Pinheiro, The value of in vivo real time ultrasonography in assessing loin muscularity and carcass composition of rabbits, Meat Science, Volume 81, Issue 2, February 2009, Pages 357-363, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2008.08.013.
(http://www.sciencedirect.com/science/article/B6T9G-4TCR1WB-2/2/c06623084083d3cb3752e9335ca68e43)
Abstract:
Sixty nine growing rabbits were scanned over the lumbar region using a real time ultrasonography (RTU) machine to estimate loin muscularity and carcass composition. Longissimus thoracis et

lumborum muscle (LM) depth, width and area were taken. Animals were weighed (LW), slaughtered and carcass composition was determined. Equivalent measurements to those taken by RTU in vivo were taken on the carcass and muscularity indices were calculated on carcass and in vivo. Simple correlations between the two types of measurements were determined and carcass composition was estimated by simple and multiple regressions.
The LW varied from 1200 to 3410 g. The simple correlations between carcass and in vivo RTU LM measurements were high ($P < 0.001$) and the LM area was the trait with the highest correlation ($r = 0.92$). Simple correlations between muscularity indices measured by RTU and in carcass were significant ($P < 0.001$).
In vivo RTU measurements explained a large amount of the variation of the carcass meat weight (MW) and bone weight ($r2$ range from 0.49 to 0.77; $P < 0.001$). Using multiple regression equations to estimate carcass composition, the best fit was obtained with the LW and one or more in vivo RTU measurement. The LW explained 90.6% of the variation of MW in the carcass.
In vivo RTU is able to estimate loin muscularity and carcass composition of rabbits with accuracy. The usefulness of in vivo RTU and LW to predict carcass composition of rabbits using multiple regressions was also shown.
Keywords: Real time ultrasound; Muscularity; Carcass composition; Rabbits

J.M. Rosell, L.F. de la Fuente, Culling and mortality in breeding rabbits, Preventive Veterinary Medicine, Volume 88, Issue 2, Special Section: Schwabe Symposium 2007 - Field Disease Investigation and Population Health - A Symposium Honoring the Legacy of Dr. Clive C. Gay, Professor Emeritus from Washington State University, 1 February 2009, Pages 120-127, ISSN 0167-5877, DOI: 10.1016/j.prevetmed.2008.08.003.
(http://www.sciencedirect.com/science/article/B6TBK-4TM9N9W-1/2/c52504fdc520083f39c4f7a07939ad10)
Abstract:
In this study, we determined culling and mortality in adult breeding rabbits on 130 commercial farms in Spain during 2000-2005. The median size of the farms was 595 does (minimum to maximum: 131-5500 does). The median culling age per doe was 14.9 months old and 6 kindlings. The median monthly removal risk (MMR) in does was 9.3%, with 3.4% dead and 5.7% culled (including euthanized does). The MMR was negatively correlated with the degree of intensification of the reproductive rhythm ($r = -0.37$), age at first mating ($r = -0.31$) and kindling interval ($r = -0.36$). The MMR in males was 5.8% (1.2% dead and 4.2% culled or euthanized).
Our estimation of the causes of culling does was based on a population of 82,352 does, 50,834 of which were culled or euthanized. The highest causes, calculated using the median of the monthly cumulative incidence (MCI), were 1.3% low productivity (0.9% infertility and 0.4% other causes), 0.5% mastitis, 0.5% poor body condition and 0.3% sore hocks. The causes of culling males were estimated based a population of 6514 males, 5313 of which were culled. The highest causes were 2.0% MCI low productivity (0.9% infertility and 0.5% no libido); 0.3% abscesses, 0.3% sore hocks and 0.2% poor body condition. The mortality and culling risks after first kindling were 8.7% and 7%, respectively. The highest risks of mortality and culling in does occurred during the first three kindlings, but remained stable thereafter. The gestation stage affected mortality; the risk of mortality per day increased as pregnancy progressed. There was a bimodal distribution with a peak of dead females between days 10 and 15 of gestation (0.1-0.2% mortality risk per day (MD)) and another larger peak between days 25 and 33 (0.3% MD). In 1046 on-farm necropsies performed on females we found alterations of the respiratory and digestive tracts compatible with being causes of death in 29.4% and 27%, respectively.
Keywords: Rabbit; Welfare; Culling; Mortality; Disease prevention

Antonella Dalle Zotte, Zoltan Princz, Zsolt Matics, Zsolt Gerencser, Szilvia Metzger, Zsolt Szendro, Rabbit preference for cages and pens with or without mirrors, Applied Animal Behaviour Science,

Volume 116, Issues 2-4, 31 January 2009, Pages 273-278, ISSN 0168-1591, DOI: 10.1016/j.applanim.2008.08.011.
(http://www.sciencedirect.com/science/article/B6T48-4THB48Y-2/2/6fdb3fa67146cdf5b45033ac7a0b5cac)
Abstract:
Five-week-old Pannon White rabbits were housed in a closed climatized rabbitry and randomly assigned to either pens (56 rabbits) having a basic area of 1 m2 with a stocking density of 16 and 12 rabbits/m2 or to 18 individual cages (0.24 m2/cage). The pens and the cages were divided into two halves and animals could move freely between the two halves through swing doors. The walls of one half of the pens and cages were completely covered with mirrors while the other half was covered with white plastic panels. A 24 h video recording was made twice a week using infrared cameras and the number of rabbits in each pen and cage was counted every 15 min. The duration of the trial was 6 weeks. The lighting period was 16L/8D. In each half of the cage or pen, a feeder and nipple drinkers were available and feed intake was measured separately. Throughout the entire rearing period, 72% of the individually caged rabbits showed a preference for the cage half enriched with mirrors ($P < 0.001$). This preference decreased slightly with increasing age. Preference toward the cage half provided with mirror walls was independent of the time of day; in other words, during the active period (23:00-05:00) corresponding to the dark part of the day, rabbits continued to prefer the mirrored half even if the vision of the reflected image was reduced. The presence of conspecifics at different stocking densities (12 vs. 16 rabbits/m2) did not reduce this interest in mirrors: averaging the ages, 66% of animals living at 16 rabbits/m2 stocking density and 63% of those living at 12 rabbits/m2 density were found in the half pen with mirrors ($P < 0.001$). Group-penned rabbits showed a marked preference toward mirrors during the active period (73-76% for 12 and 16 rabbits/m2 stocking densities, respectively; $P < 0.001$). The results suggest that the presence of mirrors offers advantages perhaps related to comfort and welfare, and therefore might be used as environmental enrichment for fattening rabbits and advised for rabbits caged individually for long periods.
Keywords: Growing rabbits; Preference test; Mirrors; Individually caged; Group-penned

V. Pinheiro, C.M. Guedes, D. Outor-Monteiro, J.L. Mourao, Effects of fibre level and dietary mannanoligosaccharides on digestibility, caecal volatile fatty acids and performances of growing rabbits, Animal Feed Science and Technology, Volume 148, Issues 2-4, 16 January 2009, Pages 288-300, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2008.03.010.
(http://www.sciencedirect.com/science/article/B6T42-4SCTSP0-2/2/76ddf61db5178e698d39988b8b247c2d)
Abstract:
The current experiment with 3 trials aimed to study the effect of two levels of dietary fibre - high fibre (HF; 323 g aNDFom/kg) and low fibre (LF; 248 g aNDFom/kg) - and the effect of mannanoligosaccharides (MOS) addition (1 g/kg) to the LF diet (LFM) on the performances and health status of growing rabbits, digestibility and caecal fermentative characteristics. In the growth trial 132 rabbits of both sexes were used (11 cages with 4 rabbits per treatment) from weaning (32 days of age) to slaughter (67 days of age). Rabbits fed HF diet showed a significantly higher weight gain and live weight at 67 days than rabbits fed LF diet (2032 g vs. 1935 g) ($P<0.05$). Feed and digestible energy intake increased with dietary fibre level ($P<0.05$). During the growing period rabbits fed HF diet had a feed intake 26% higher than those fed LF diet. Feed efficiency ratio was worse in HF animals (0.334 vs. 0.385; $P<0.05$). Addition of MOS to LF diet did not affect growth performance parameters ($P>0.05$). Mortality and morbidity rate were not affected by treatments. In the digestibility 24 rabbits from 46 to 51 days of age trial were used. The HF diet resulted in a significant ($P<0.05$) decrease in digestibility of dry matter, organic matter and protein while the aNDFom digestibility was not significantly different between diets ($P>0.05$). Supplementation with MOS had no effects on digestibility ($P>0.05$). In the 3rd trial the caecal traits were measured in 30

rabbits with 46 days of age that received the experimental diets in the previous 14 days. Caecal production of total volatile fatty acids (VFA), acetate and propionate were significantly higher (P>0.05) on rabbits fed HF diets than on rabbits fed LF diets. The total VFA concentration increased 64% (from 5.01 to 8.20 mmol/100 ml) and acetate increased 73% (from 3.73 to 6.44 mmol/100 ml). Butyrate production was not different between diets (P>0.05). Fibre level did not affect proportions of VFA and caecal contents and caecal weights. Addition of MOS to LF diet did not affect any caecal trait (P>0.05). It was concluded that the reduction of dietary fibre level increases feed digestibility but worsens rabbit growth performances. Supplementation of low fibre diet with 1 g MOS/kg is not enough to reduce its negative effects on growth performances.
Keywords: Rabbits; Volatile fatty acids; Digestibility; Fibre; Mannanoligosaccharides; Growth

M. Garcia-Tomas, J. Sanchez, M. Piles, Postnatal sexual development of testis and epididymis in the rabbit: Growth and maturity patterns of macroscopic and microscopic markers, Theriogenology, Volume 71, Issue 2, 15 January 2009, Pages 292-301, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2008.07.021.
(http://www.sciencedirect.com/science/article/B6TCM-4TCXG9D-1/2/d2c9885455b6590fd388cd61bc5a2f6d)
Abstract:
We examined the macroscopic variables related to the size of testis and epididymis, and the microscopic variables related to the tissue composition of testis to determine the onset of the male reproductive activity.
The present work was carried out using two genetic lines of rabbits showing different reproductive aptitudes to assess the effects of genetic line and birth season on age-related changes of the testes and epididymis.
The Caldes and Prat genetic lines showed similar developmental profiles for most of the variables studied. The main changes in the development pattern were observed at younger ages. The Caldes genetic line presented a greater live weight and a smaller testicular volume that the Prat genetic line at any age. No differences in the studied microscopic variables were found between the two genetic lines, except in the variable percentage of seminiferous tubules with presence of lumen.
A significant effect of the birth season was found in live weight, testis volume, epididymis volume, percentage of seminiferous tubules with presence of elongated spermatids and diameter of seminiferous tubules. The absolute values and the values relatives to its own value at the adult stage of the variables live weight, testis volume, epididymis volume and in variables related to the functional maturity were lower in animals born in the summer season. Volume growth for both testis and epididymis was delayed in animals born in the summer season.
Keywords: Rabbit; Testes; Epididymis; Development; Macroscopic traits; Microscopic traits

Eva Moce, Jose S. Vicente, Rabbit sperm cryopreservation: A review, Animal Reproduction Science, Volume 110, Issues 1-2, January 2009, Pages 1-24, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2008.08.015.
(http://www.sciencedirect.com/science/article/B6T43-4T72WV5-1/2/ac09ecfa1e9a3e221a65f18737efce1c)
Abstract:
Sperm cryopreservation is a great challenge, since many sperm are irreversibly damaged or present altered functionality after the whole process. Although components of extenders for sperm cryopreservation are quite similar between species, sperm from each of the species present peculiarities that force researchers to optimize the extenders and protocols for each particular species. In this review, information related to rabbit sperm cryopreservation is compiled. The topics discussed include the extenders and protocols developed for rabbit sperm cryopreservation, as well as fertility data obtained after artificial insemination with cryopreserved sperm and factors

that may have an impact on the results obtained. In addition, suggestions for improving the results after cryopreservation of rabbit sperm are also proposed.
Keywords: Rabbit; Sperm; Cryopreservation; Sperm quality; Fertility

A. Gruber, A. Pakozdy, H. Weissenbock, J. Csokai, F. Kunzel, A Retrospective Study of Neurological Disease in 118 Rabbits, Journal of Comparative Pathology, Volume 140, Issue 1, January 2009, Pages 31-37, ISSN 0021-9975, DOI: 10.1016/j.jcpa.2008.09.009.
(http://www.sciencedirect.com/science/article/B6WHW-4V402RG-1/2/413ac3075996fc34e2044494c695cde3)
Abstract: Summary
A retrospective pathological study of 118 rabbits presenting with neurological disease was conducted. Diagnoses were categorized on the basis of aetiopathogenesis as inflammatory, vascular, traumatic, metabolic-toxic, neoplastic, degenerative or idiopathic. Central nervous system (CNS) lesions were present in 85 (72.0%) of the rabbits and in most of these cases (70.3%) a causative agent was identified. The majority of animals (n = 78, 66.1%) had disease of an inflammatory nature and 71 of these 78 rabbits had one of two zoonotic infectious diseases: encephalitozoonosis (n = 69, 58.5%) and herpes simplex virus (HSV) encephalitis (n = 2). Infections with zoonotic potential are therefore a major cause of CNS disease in the rabbit.
Keywords: encephalitozoonosis; herpes simplex virus encephalitis; neurological disease; rabbit; zoonosis

Antonio Fasanella, Silvia Scasciamacchia, Giuliano Garofolo, The behaviour of virulent Bacillus anthracis strain AO843 in rabbits, Veterinary Microbiology, Volume 133, Issues 1-2, 1 January 2009, Pages 208-209, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2008.06.012.
(http://www.sciencedirect.com/science/article/B6TD6-4STB0F4-2/2/1819e319da79c50a4bd6ca995674e289)
Keywords: Bacillus anthracis; Rabbit model; Sterne vaccine

H. Garreau, G. Bolet, C. Larzul, C. Robert-Granie, G. Saleil, M. SanCristobal, L. Bodin, Results of four generations of a canalising selection for rabbit birth weight, Livestock Science, Volume 119, Issues 1-3, December 2008, Pages 55-62, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.02.009.
(http://www.sciencedirect.com/science/article/B7XNX-4S69HDC-1/2/ab2556f8046e668ba17c6f4d94c555e8)
Abstract:
A divergent selection experiment based on the homogeneity of birth weight in rabbit was carried out at the INRA experimental farm of Auzeville. The two lines were created by selecting breeding does and bucks from the female strain AGP22 bred at the Grimaud Freres Selection company for environmental variability of birth weight. This involved a new model incorporating a genotypic value for the mean and a genotypic value for the environmental variance. There was a selection response with a significant difference in the within-litter standard deviation of birth weight between the lines after four generations of selection (6.93 g vs. 8.13 g). The mortality of kits at birth and from birth to weaning was lower in the 'homogeneous' line than in the 'heterogeneous' line (16.6% vs. 18.6% and 17.7% vs. 32.7%, respectively). The litter size at weaning was higher in the 'homogeneous' line (7.22 vs. 5.39). The selection on the homogeneity of birth weight had no significant influence on the other traits. It was concluded that selection for reduced environmental variance of birth weight improved young rabbit survival without reducing the mean of birth weight.
Keywords: Divergent selection; Rabbit; Birth weight; Canalising selection; Environmental variance

P.G. Peiretti, G. Meineri, Effects on growth performance, carcass characteristics, and the fat and meat fatty acid profile of rabbits fed diets with chia (Salvia hispanica L.) seed supplements, Meat

Science, Volume 80, Issue 4, December 2008, Pages 1116-1121, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2008.05.003.
(http://www.sciencedirect.com/science/article/B6T9G-4SH0Y57-1/2/88bdbc1330607d7afbb5b4e1f2eeb52b)
Abstract:
The effects of three levels (0%, 10%, or 15%) of chia (Salvia hispanica L.) seed (SHS) included in the diet on the growth performance, some carcass characteristics and fatty acid profile of rabbit meat and perirenal fat was studied. At the end of the experiment, there were no significant differences among the groups in live weight, live weight gain, feed consumption, feed efficiency, carcass yield or the percentages of edible organs. The percentage values of hind legs, fore legs, loin and abdominal wall, breast and ribs, skin and limbs, and head were not affected by the inclusion level of SHS. The polyunsaturated fatty acid (PUFA) concentration in the longissimus dorsi muscle and perirenal fat was significantly increased with increasing SHS inclusion, while the saturated fatty acid (SFA) decreased. The n - 6/n - 3 PUFA ratio of the rabbit meat decreased from 4.55 in the control group, to 1.03 in the 15% SHS group.
Keywords: Rabbit; Meat quality; Salvia hispanica; Fatty acid

S.K. Kritas, C. Dovas, P. Fortomaris, E. Petridou, A. Farsang, G. Koptopoulos, A pathogenic myxoma virus in vaccinated and non-vaccinated commercial rabbits, Research in Veterinary Science, Volume 85, Issue 3, December 2008, Pages 622-624, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2008.03.008.
(http://www.sciencedirect.com/science/article/B6WWR-4SDFS7R-1/2/1a87a3e9ca1ff0d47ef2f4d689be8d0f)
Abstract:
A case of a myxoma virus strain in vaccinated and non-vaccinated rabbits is described, and genetic identification of that strain was performed in this study. In two commercial farms being 150 km apart, myxomatosis has been occurred after the import of animals from a common supplier. The disease was manifested firstly in the existing non-immune population of does and fatteners, and later in all vaccinated animals, being 2-3 months immune at the time of first symptoms. Morbidity was almost 100% with nasal discharge, listlessness, fever, eyelid swelling, eye and nasal purulent discharge, papules in the ears, facial oedema, and swelling of the anagenital region, with result always the death of the animals. Examination by PCR had shown the presence of a 492-bp specific product in all the symptomatic animals tested from both farms, having 100% nucleotide sequence identity with the homologous region of the myxoma virus Lausanne strain. The simultaneous occurrence of myxomatosis in the vaccinated and non-vaccinated rabbits of both farms, suggests that the supplier was possibly the source of a viral isolate with increased virulence.
Keywords: Myxomatosis; Rabbit; PCR

Katherine L. Gailbreath, Naomi S. Taus, Cristina W. Cunha, Donald P. Knowles, Hong Li, Experimental infection of rabbits with ovine herpesvirus 2 from sheep nasal secretions, Veterinary Microbiology, Volume 132, Issues 1-2, 25 November 2008, Pages 65-73, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2008.04.035.
(http://www.sciencedirect.com/science/article/B6TD6-4SF3044-2/2/993b84a2989d507b9f848296a175ca62)
Abstract:
Malignant catarrhal fever (MCF) is a generally fatal disease that primarily occurs in ruminants and is caused by a group of gammaherpesviruses. Outside of Africa MCF is mainly caused by ovine herpesvirus 2 (OvHV-2) which is carried subclinically by sheep. Cell-free virus is present in nasal secretions of shedding sheep and aerosol is the primary mode of transmission. Although OvHV-2 has never been propagated in vitro, experimental infection involving intranasal nebulization with

nasal secretions from shedding sheep has been used to induce MCF in cattle and bison. This method of inoculation has never been tested in rabbits, which are the primary small animal model. The objectives of this study were to determine whether rabbits become infected with OvHV-2 after intranasal nebulization with cell-free virus from sheep nasal secretions and whether they develop MCF with consistent gross and histologic lesions. Five of eight rabbits became infected, showed clinical signs and developed histologic lesions typical of MCF including multisystemic vasculitis and perivascular lymphoid accumulation. These lesions are similar to those reported in rabbits infected by intravenous injection with tissues from clinically affected animals containing cell-associated virus. Viral DNA and mRNA transcripts of a structural viral protein were present in tissues from affected rabbits suggesting that viral replication occurred, although the significance in terms of pathogenesis is unknown. This work demonstrates that OvHV-2 infection of rabbits by intranasal nebulization is a potentially useful model that mimics the natural route of infection and may be used to study viral replication and pathogenesis.
Keywords: Ovine herpesvirus 2; Malignant catarrhal fever; Rabbits; Experimental infection

R. Kohler, G. Krause, L. Beutin, R. Stephan, C. Zweifel, Shedding of food-borne pathogens and microbiological carcass contamination in rabbits at slaughter, Veterinary Microbiology, Volume 132, Issues 1-2, 25 November 2008, Pages 149-157, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2008.04.020.
(http://www.sciencedirect.com/science/article/B6TD6-4SBY4TK-3/2/e8bb3c99bb6e0e65b1e2d9ab5acc45cf)
Abstract:
To obtain microbiological data from rabbits at slaughter, 500 fecal samples and 500 carcasses samples were examined. All samples tested negative for Listeria and Salmonella. Campylobacter were detected in two fecal samples. Of the 500 fecal samples, 45.8% tested positive for eae (intimin), 1.2% for stx (Shiga toxin), and 1.8% for both eae and stx. By colony hybridization, 56 eae positive Escherichia coli strains were isolated. Among them, 27 strains (48.2%) were of the serotypes O178:H7 and O153:H7, whereas 15 strains (26.8%) belonged to a serogroup that has not yet been described (O(CB10681):H7). All strains possessed intimin [beta]1 and the translocated intimin receptor (tir) capable of being tyrosine phosphorylated. None of the strains harbored the genes for Shiga toxins, EAST1 (astA), bundlin (bfpA), or the EAF plasmid. Slaughter rabbits therefore constitute a reservoir for certain atypical enteropathogenic Escherichia coli. On rabbit carcasses, average total bacterial counts accounted for 3.3 log CFU cm-2. Enterobacteriaceae and coagulase positive staphylococci (CPS) were detected on 118 (23.6%) and 153 (30.6%) carcasses, respectively. Enterobacteriaceae and CPS counts of positive samples were mainly <1.5 log CFU cm-2. Among 153 selected CPS isolates, 98.7% were identified as Staphylococcus aureus. None of the 151 isolated strains harbored the gene for methicillin resistance (mecA). Genes for staphylococcal enterotoxins (SE) were detected in 102 strains. The combinations of seg and sei (53 strains) and sed, seg, sei, and sej (27 strains) dominated.
Keywords: Rabbit; Fecal shedding; Enteropathogenic Escherichia coli; Staphylococcus aureus; Carcass contamination

Ikuo Kobayashi, Yoichiro Horii, Gastrointestinal motor disturbance in rabbits experimentally infected with Strongyloides papillosus, Veterinary Parasitology, Volume 158, Issues 1-2, 25 November 2008, Pages 67-72, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2008.08.017.
(http://www.sciencedirect.com/science/article/B6TD7-4TC351S-2/2/9592a82a1814816f8f4e083a457d17af)
Abstract:
Strongyloides papillosus is a common nematode in ruminants, and the rabbit is the only susceptible experimental animal that has been identified to date. It is known that heavy infection with S. papillosus causes death in a number of animals. However, even though a number of fatal

cases have been reported, the mechanism by which S. papillosus infection leads to death remains unknown. In this study, the pathogenic effect of S. papillosus infection on gastrointestinal motility in infected rabbits was investigated by radiographic means. Gastrointestinal motility in rabbits experimentally infected with S. papillosus was assessed by contrast radiography after oral administration of barium sulfate on days 11 (group A) and 13 (group B) of infection. Body weight, food intake, fecal weight and egg count per gram of feces (EPG) were examined in order to investigate the effect of infection on gastrointestinal motility. Seven rabbits from each S. papillosus-infected and uninfected group were examined. Significant declines in body weight, daily food intake, and fecal weight, as well as gastrointestinal motor disturbances, were observed in association with elevated EPG counts in infected rabbits. This was only observed during the intestinal phase of S. papillosus infection. These results suggest that gastrointestinal motor disturbances underlie the anorexia, weight loss and subsequent death observed in rabbits infected with adult stage S. papillosus.
Keywords: Anorexia; Weight loss; Gastrointestinal motor disturbance; Rabbit; Strongyloides papillosus

Marta Rueda, Salvador Rebollo, Lucia Galvez Bravo, Age and season determine European rabbit habitat use in Mediterranean ecosystems, Acta Oecologica, Volume 34, Issue 3, November-December 2008, Pages 266-273, ISSN 1146-609X, DOI: 10.1016/j.actao.2008.03.007.
(http://www.sciencedirect.com/science/article/B6VR3-4T2S01G-3/2/bd9634aaad62879973ce07f37c7d33ac)
Abstract:
Knowledge about the factors determining habitat use is especially interesting for herbivores living under seasonal climates as they have to deal with food shortage during the drought season. In this context, different-aged individuals are expected to respond differently to seasonal variations because nutritional requirements and predation risk can vary with age. We investigated adult and juvenile European rabbit (Oryctolagus cuniculus) habitat use in a Mediterranean ecosystem of central Spain, during spring, summer and winter. Relationships between adult and juvenile rabbit pellet abundances and 11 environmental variables related to food availability and refuge density were analysed by means of multiple regression, and evaluated using information theory to identify the set of models best supported by the data. Density of warren entrances was the more constant predictor of habitat use for juvenile rabbits in all the seasons. Herbaceous vegetation volume had a negative influence and was the strongest predictor for adult rabbit habitat use in spring and winter. In summer, green vegetation cover became the strongest positive habitat use predictor. These results suggest that adults prefer to forage in low volume swards ensuring a wide sensory range for the detection of approaching predators. However, the arrival of summer and its associated food depletion forces them to shift toward more open productive areas where green vegetation persists, but at the expense of higher predation risk. Seasonal variation induces minor changes in juvenile habitat use due to their strong dependence on warrens. Thus, our results show that rabbit habitat use is influenced by animal age and seasonal variations in resources.
Keywords: Central Spain; Different-aged rabbits; Habitat use; Mediterranean climate; Oryctolagus cuniculus; Pellet count; Seasonal variation

Zoltan Princz, Istvan Radnai, Edit Biro-Nemeth, Zsolt Matics, Zsolt Gerencser, Istvan Nagy, Zsolt Szendro, Effect of cage height on the welfare of growing rabbits, Applied Animal Behaviour Science, Volume 114, Issues 1-2, November 2008, Pages 284-295, ISSN 0168-1591, DOI: 10.1016/j.applanim.2008.01.006.
(http://www.sciencedirect.com/science/article/B6T48-4S02JR4-1/2/6fc279a213c84f2e71f85e1c9efaa189)
Abstract:

The objective of this study was to analyze the preference of rabbits for cages of various heights, their production and occurrence of ear lesions. Experiments were conducted at the University of Kaposvar with Pannon White rabbits. In experiments 1 and 2 (preference test) growing rabbits (n = 112) - weaned at 5 weeks of age - were housed in cage blocks (16 or 12 rabbits/m2) having a basic area of 2 m2. The cage block consisted of four equal size (0.5 m2) cages and the rabbits could move freely among the cages through swing doors. The cages only differed in their height: in trial 1 the height of the cages was 20, 30, 40 cm or open top, in trial 2 the height of two cages was 30 cm and 40 cm, respectively. The rabbits had a low preference for open top cages, the least number of rabbits chose this cage type independently of the stocking density, age and part of the day (11.7-20.4% vs. 22.0-38.7%; $p < 0.001$). In trial 1 among the closed cages most of the rabbits stayed in the 40 cm and 20 cm high cage during the active and resting period, respectively independently of the stocking density ($p < 0.001$). In trial 2 preference for the 30 and 40 cm high cages was the same. In trial 3 the rabbits (n = 156) were kept between the ages 5 and 11 weeks in wire net floor pens having a basic area of 0.86 m2 (13 rabbits/pen). Similarly to trial 1 the height of the pens was 20, 30 and 40 cm or open top. The cage height had no effect on the rabbits' production. The frequency of the ear lesions connected with aggressive behaviours was the smallest and the greatest in the 30 cm and 20 cm high cages, respectively ($p < 0.05$). Examining the rabbits' preference, ear lesions connected to aggressive behaviour and production (indicators of well being) it can be concluded that the commonly used 30-35 cm high cages are satisfactory for the growing rabbits.
Keywords: Growing rabbits; Cage height; Behaviour; Welfare; Production

A.M. Al-Saef, M.H. Khalil, A.H. Al-Homidan, S.N. Al-Dobaib, K.A. Al-Sobayil, M.L. Garcia, M. Baselga, Crossbreeding effects for litter and lactation traits in a Saudi project to develop new lines of rabbits suitable for hot climates, Livestock Science, Volume 118, Issue 3, November 2008, Pages 238-246, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.01.025.
(http://www.sciencedirect.com/science/article/B7XNX-4S1BXBP-2/2/1d09a8fbaaced08207718b0955a8e7a8)
Abstract:
A five-years crossing scheme involving the Spanish V line (V) and Saudi Gabali (S) rabbits was practiced to produce 14 genetic groups: V, S, 1/2V1/2S, 1/2S1/2V, 3/4V1/4S, 3/4S1/4V, (1/2V1/2S)2, (1/2S1/2V)2, (3/4V1/4S)2, (3/4S1/4V)2, ((3/4V1/4S)2)2, ((3/4S1/4V)2)2, Saudi 2 (a new synthetic line) and Saudi 3 (another new synthetic line). A total of 3496 litters from 1022 dams were used to evaluate litter size at birth (LSB) and weaning (LSW), litter weight at birth (LWB), litter weight at 21 d (LW21) and litter weight at weaning (LWW), pre-weaning litter mortality (PLM), milk yield at lactation intervals of 0-7 d (MY07), 0-21 d (MY021), 0-28 d (TMY) and milk conversion ratio as g of litter gain per g of milk suckled during 21 d of lactation (MCR021). A generalized least squares procedure was used to estimate additive and heterotic effects (direct, maternal, and grand-maternal).
The comparison among V, S, Saudi 2 and Saudi 3 showed a complementarity between V and S. Line V was superior for LSB, LSW, LWB, PLM, MY07, MY021 and TMY, while line S was superior for the other traits (LW21, LWW and MCR021). Saudi 2 and Saudi 3 had the means equal to or higher than the founder lines (V or S) for all traits. Saudi 2 showed better values in litter size and pre-weaning litter mortality compared to Saudi 3 with no significant differences for the other traits. Concerning crossbreeding parameters, direct additive effects were significant for all traits, ranging between 12.3% and 31.8% relative to the average of the means of V and S. All estimates for direct heterosis except LWB and MCR021 were significant and ranged from 5.3% to 27.5%. No estimates for maternal additive effects and grand-maternal additive and heterotic effects were significant. Only estimates for maternal heterotic effects of LSB and LSW were significant (8.6% and 10.6%, respectively).

Keywords: Rabbits; Crossbreeding; Synthetic lines; Litter traits; Lactation; Additive effects; Heterosis

M. Kouba, F. Benatmane, J.E. Blochet, J. Mourot, Effect of a linseed diet on lipid oxidation, fatty acid composition of muscle, perirenal fat, and raw and cooked rabbit meat, Meat Science, Volume 80, Issue 3, November 2008, Pages 829-834, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2008.03.029.
(http://www.sciencedirect.com/science/article/B6T9G-4S62RSK-2/2/0ab47f3cc73ca2b3baf3de175574f1b7)
Abstract:
Forty Californian x New Zealand rabbits (1 kg initial body weight) were fed a control or a linseed isoenergetic diet containing 30 g of extruded linseed/kg. Twenty rabbits for each dietary treatment were slaughtered at 11 weeks of age, at 35 days after the start of the experiment. Feeding the linseed diet increased ($P < 0.005$) the content of 18:2n-3 in muscles, perirenal fat, and raw and cooked meat. The long chain n-3 polyunsaturated fatty acid (PUFA) contents were also increased ($P < 0.01$) in the meat. The linseed diet produced a robust decrease in the n-6/n-3 ratio. Cooking did not alter n-3 PUFA more than saturated fatty acids (SFA) or monounsaturated fatty acids (MUFA). However, n-6 PUFA were altered by cooking. The oxidative stability of Longissimus dorsi was not affected by the linseed diet, even after 300 min of forced-oxidation. Inclusion of linseed in rabbit diets is a valid method of improving the nutritional value of rabbit meat.
Keywords: Rabbits; Linseed; Fatty acids; Meat quality

Sylvie Combes, Ignacio Gonzalez, Sebastien Dejean, Alain Baccini, Nathalie Jehl, Herve Juin, Laurent Cauquil, Beatrice Gabinaud, Francois Lebas, Catherine Larzul, Relationships between sensory and physicochemical measurements in meat of rabbit from three different breeding systems using canonical correlation analysis, Meat Science, Volume 80, Issue 3, November 2008, Pages 835-841, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2008.03.033.
(http://www.sciencedirect.com/science/article/B6T9G-4S80XNB-1/2/f2b39eec5e5a8ef3bd06035b4eb898b1)
Abstract:
Meat from rabbits reared either according to a standard (STAND) or a high quality norm (LABEL) or a low growth breeding (RUSSE) system were submitted to a sensory evaluation and to a large set of physicochemical measurements (weight of retail cuts, colour parameters, ultimate pH, femur flexure test, Warner-Bratzler shear test, water holding capacities and cooking losses). STAND rabbit meat exhibited the most juicy meat in back and in leg ($p < 0.01$). Leg tenderness significantly decreased ($p < 0.001$) in the rank order STAND > LABEL > RUSSE. Canonical correlation analysis showed strong correlations between physicochemical and sensory variables ($R2 = 0.73$ and 0.68 between the two first pairs of canonical variates). Especially, sensory tenderness and WB shear test variables assessed on raw longissimus muscle (LL) were correlated. Fibrous attribute in back was correlated with cooking loss in LL. When analysed separately only RUSSE rabbits exhibited the same relations between variables as those calculated in whole dataset.
Keywords: Rabbit meat quality; Canonical correlation analysis; Sensory attributes

Yong-Hua Du, Ren-Yong Jia, Zhong-Qiong Yin, Zhong-Hui Pu, Jiao Chen, Fan Yang, Yu-Qun Zhang, Yang Lu, Acaricidal activity of extracts of neem (Azadirachta indica) oil against the larvae of the rabbit mite Sarcoptes scabiei var. cuniculi in vitro, Veterinary Parasitology, Volume 157, Issues 1-2, 20 October 2008, Pages 144-148, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2008.07.011.
(http://www.sciencedirect.com/science/article/B6TD7-4T2638F-3/2/fb91e00dbffc7c1922f3891118902d45)

Abstract:
The acaricidal activity of the petroleum ether extract, the chloroform extract and the acetic ether extract of neem (Azadirachta indica) oil against Sarcoptes scabiei var. cuniculi larvae was tested in vitro. A complementary log-log (CLL) model was used to analyze the data of the toxicity tests. The results showed that at all test time points, the petroleum ether extract demonstrated the highest activity against the larvae of S. scabiei var. cuniculi, while the activities of the chloroform extract and the acetic ether extract were similar. The activities of both the petroleum ether extract and the chloroform extract against the larvae showed the relation of time and concentration dependent. The median lethal concentration (LC50) of the petroleum ether extract (1.3 [mu]L/mL) was about three times that of the chloroform extract (4.1 [mu]L/mL) at 24 h post-treatment. At the concentrations of 500.0 [mu]L/mL, the median lethal time (LT50) of the petroleum ether extract and the chloroform extract was 8.4 and 9.6 h, respectively.
Keywords: Sarcoptes scabiei; Acaricidal activity; Neem oil; In vitro

Nandakumar Puliyath, Satyajit Ray, Jacqueline Milton, Rose G. Mage, Genetic contributions to the autoantibody profile in a rabbit model of systemic lupus erythematosus (SLE), Veterinary Immunology and Immunopathology, Volume 125, Issues 3-4, 15 October 2008, Pages 251-267, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2008.05.020.
(http://www.sciencedirect.com/science/article/B6TD5-4SMWF7M-2/2/5cb5829ea431c5977fe9b7827514e002)
Abstract:
For the development of rabbit models of Systemic Lupus Erythematosus (SLE), immunoglobulin allotype-defined pedigreed rabbits from the National Institute of Allergy and Infectious Diseases rabbit resource more closely approximate human populations due to their non-inbred pedigreed structure. In an initial study from this laboratory, peptides (SM and GR) from the spliceosomal Smith (Sm) and the NMDA glutamate receptor NR2b, on branched polylysine backbones (BB) elicited antinuclear and anti-dsDNA autoantibodies typical of SLE, as well as seizures and nystagmus sometimes observed as neurological manifestations in SLE patients. This suggested the feasibility of further selective breeding to develop a more reproducible rabbit model for investigations of SLE. Here we report the results of GR-MAP-8 and control BB immunization on autoantibody responses in a group of 24 rabbits specifically bred and developed from parents and ancestors tested for autoantibody responses. The changes in hematological profile and blood chemistry in the experimental rabbits were evaluated along with autoantibody responses. Elevations of total white blood cell (WBC), monocyte, eosinophil and basophil counts that developed following immunizations were moderately influenced by litter and presence of the antibody heavy chain allotype VH1a1. Autoantibody development followed a sequential pattern with anti-nuclear antibodies (ANA) followed by anti-dsDNA and subsequently anti-Sm and anti-RNP similar to SLE patients. High autoantibody levels to one autoantigen were not always associated with antibody response to another. Female rabbits had higher prevalence and levels of autoantibodies similar to human SLE. Higher autoantibody levels of anti-dsDNA and -ANA were observed among some full sibs and the presence of high responder ancestors in the pedigree was associated the augmented responses. We observed significant association between highest antibody responses to GR-MAP-8 and highest anti-dsDNA levels. Naturally occurring autoantibodies were found in some pre-immune sera and some unique ANA fluorescent staining patterns within the experimental group were observed. Background immunofluorescence in pre-immune sera, distinct patterns of programmed autoantibody responses unique among individual rabbits may have been modulated by genetic constitution, gender and environmental factors including exposure to antigens. The high incidence and intensity of autoantibody responses among descendants of high responders suggest that there may be an additive mode of inheritance with high heritability. It is conceivable that further rigorous pedigree selection for autoantibody

responses could lead to development of rabbit models with spontaneous occurrence of SLE like serology and disease phenotypes.
Keywords: Rabbits; Autoantibodies; Antibody heavy chain allotypes; Genetics; Lupus

Long-sheng YANG, Jia-bin XUE, Yuan-liang HU, Fang WANG, De-yun WANG, Wei-zhong XU, Enhancement of the Immune Response to Rabbit Hemorrhagic Disease Vaccine in Young Rabbits by Advanced Vaccination and Chinese Herbal Adjuvants, Agricultural Sciences in China, Volume 7, Issue 10, October 2008, Pages 1274-1280, ISSN 1671-2927, DOI: 10.1016/S1671-2927(08)60175-3.
(http://www.sciencedirect.com/science/article/B82XG-4TSKFY5-J/2/a70d1411f1f85d874c5f6912d5e3bc0e)
Abstract:
Experiments were conducted to determine the effects of advanced vaccination and Chinese herbal adjuvants (CHA), containing astragalus polysaccharides (APS) and ginsenosides (GS) on the immune response to rabbit hemorrhagic disease (RHD) vaccine in young rabbits. In experiment 1, 5 New Zealand rabbits of each group at 30, 35, 40, or 45 days of age were injected with 2 mL of inactivated RHD vaccine, respectively. The dynamic changes of antibody titers were tested by the hemagglutination inhibition (HI) method. In experiment 2, 30 New Zealand rabbits at 35 days of age were randomly assigned to 5 treatment groups, representing inoculation with 3 mL of non-adjuvant RHD vaccine, CHA-RHD vaccine, CHA-HA vaccine (half dose antigen), aluminium adjuvant-RHD vaccine, and PBS, respectively. The dynamic changes of peripheral lymphocyte proliferation and serum antibody titers were tested by the MTT method and the HI method. The results showed that the titer of maternal HI antibody in the 35-day-old rabbits was lower than the protective level of 3 log2, while on days 7 to 49 after the vaccination, the antibody titers were higher than 3 log2. The CHA promoted the lymphocyte proliferation and enhanced the serum antibody titer ($P < 0.05$). These findings from the two experiments suggested that advanced vaccination and Chinese herbal adjuvants significantly enhanced the immune response to vaccine against RHD, and effectively protected the young rabbits against RHD challenge.
Keywords: rabbit hemorrhagic disease; Chinese herbal adjuvants; antibody titer; lymphocyte proliferation

Cs. Eiben, A. Bonanno, K. Godor-Surmann, K. Kustos, Effect of controlled nursing with one-day fasting on rabbit doe performance, Livestock Science, Volume 118, Issues 1-2, October 2008, Pages 82-91, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.01.007.
(http://www.sciencedirect.com/science/article/B7XNX-4RTKMYS-2/2/cf14be968246fb4f2a48360743593d59)
Abstract:
This work studied whether the expected better subsequent reproduction for permanent controlled nursing versus free nursing could be further improved by a caloric biostimulation with temporary fasting and re-feeding of does before artificial insemination (AI) and how it influences the development of current litters. A total of 240 females were randomly assigned at first day of lactation to one of three groups each with 80 does in a balanced manner according to the number of kits, litter weight, newborn kit weight after adjusting to 8 rabbits per litter, doe body weight and parity. Rabbits in the control group (C) were fed ad libitum and nursed freely up to weaning at 35 days of age. In the group of local farm practice (F) females also received a diet ad libitum but controlled nursing was used. That meant once a day nursing for the first 14 days of lactation (8 am to 9 am) with using a metal-sheet for doe-litter separation and free nursing afterwards. In the biostimulated group (B) does were subjected to a 24-h fasting between days 8 and 9 (i.e. only drinking was possible between 10 am Monday and 10 am Tuesday) with a 48-50 h ad libitum re-feeding before AI (at 11 days, between 10 am and 12 am Thursday) and similar controlled nursing regime to F group. This biostimulation reduced the ratio of does having turgid vulva by 16.9%

(46.7 vs. 63.6 and 48.1% for the B, F and C groups, respectively; P < 0.05) and the kindling rate by 6.8% (78.7 vs. 85.5 and 71.1%; P < 0.05) when compared with merely controlled nursing (F). However, biostimulation tended (P = 0.152) to increase the total-born by one kit per litter (11.2 vs. 10.2 and 10.3). Individual kit weights and litter weights at weaning were reduced in response to controlled nursing (944, 966 vs. 1033 g; P = 0.001 and 7179, 7451 vs. 7900 g; P = 0.001). Biostimulation led to 17% lower total weight of 70-day-old rabbits per doe (14.54 vs. 17.53, 17.51 kg; P = 0.009) compared to F and C groups due to poorer 35-70 day growth (36.1 vs. 40.5, 40.8 g/day; P = 0.001) and higher mortality than for C group (12.3 vs. 7.9%; P < 0.01). In conclusion, this biostimulation worsened the subsequent reproductive performance of does and the development of current litter. Further research is required about the presumable interaction between the nursing system and feeding strategy of does.
Keywords: Rabbit; Nursing; Fasting; Reproduction; Nutrition; Growth

Zs. Szendro, Sz. Metzger, H. Febel, I. Hullar, L. Maertens, M. Bianchi, C. Cavani, M. Petracci, E. Biro-Nemeth, I. Radnai, Effect of energy restriction in interaction with genotype on the performance of growing rabbits I: Productive traits, Livestock Science, Volume 118, Issues 1-2, October 2008, Pages 123-131, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.01.003.
(http://www.sciencedirect.com/science/article/B7XNX-4RTTM2M-1/2/7b83384cc3fb52c8557c7b5c279811a1)
Abstract:
The aim of this experiment was to study the effect of genotypes (rabbits selected for high or low body fat content) and level of DE intake (high, medium or low) at constant CP, CF, and EE intake on the performance of growing rabbits, separately and their interactions. Pannon White rabbits selected for high (HFAT) or low (LFAT) total body fat content were weaned at 4 weeks of age and fed one of three isocaloric diets (11.72, 11.60 and 11.66 MJ DE/kg diet, respectively). Diet one was fed ad libitum (treatment H), while diets 2 (treatment M) and 3 (treatment L) were fed at 90% and 80%, respectively of the ad libitum intake. Proportional to the reduction of feed intake the nutrient density of diets was increased (e.g. crude protein: 17.5, 19.8 and 21.9%; crude fibre: 12.9, 13.4 and 14.7%, respectively for the 3 diets). Genotype had a significant effect on feed conversion (3.26 and 3.02 g/g; P < 0.001; in groups HFAT and LFAT, respectively). With the reduction of the DE intake the daily weight gain and the body weight at 12 weeks of age decreased significantly (40.7, 38.5 and 33.7g/day, P < 0.001 and 2917, 2799 and 2527 g, P < 0.001; in groups H, M and L, respectively). On the contrary, the energy reduction had a positive effect on the feed conversion and on the mortality rate (3.29, 3.17 and 3.11 g/g, P < 0.05, and 29.5, 28.1 and 4.8%, P < 0.05; respectively). It is concluded that the genotype influenced mainly the feed conversion with higher nutrient demand for building fat than for muscle. The performance (weight gain, body weight and feed conversion) was determined by the digestible energy intake, independently of nutrient intake. The effect of reductions of DE intake was independent of the genotype (rabbits with higher or lower body fat content).
Keywords: Growing rabbits; DE intake; Body fat content; Production

P.G. Peiretti, G. Meineri, Effects of diets with increasing levels of Spirulina platensis on the performance and apparent digestibility in growing rabbits, Livestock Science, Volume 118, Issues 1-2, October 2008, Pages 173-177, ISSN 1871-1413, DOI: 10.1016/j.livsci.2008.04.017.
(http://www.sciencedirect.com/science/article/B7XNX-4SSGCTN-3/2/664e18c3d54e7ca3df4e9ecb5bd8f14b)
Abstract:
The efficiency of diets with the inclusion of Spirulina platensis (SP) for rabbit growing has been tested. The trial was carried out on 40 crossbred rabbits that were randomly allocated to four groups each with ten animals (five male and five female rabbits each), kept in individual cages. Three isoproteic and isoenergetic diets were formulated with an increasing level of SP (5%, 10%

and 15%); the diets were tested against a control diet without microalgae. The experimental period lasted 24 days and the faeces were collected during the last week. No obvious health problems were encountered during the experiment and no rabbits died during the feeding trial. The measured parameters were growth performance and digestibility of dry matter (DM), organic matter (OM), crude protein (CP), crude fibre (CF), ether extract (EE), neutral detergent fibre (NDF), acid detergent fibre (ADF) and gross energy (GE). The results show that the final weight, weight gain and feed efficiency did not differ significantly ($P > 0.05$) among the dietary treatments, but an SP inclusion level of 10% gave the highest feed intake. The DM, OM, CP, GE, NDF and ADF digestibilities of the control diet were higher than those of the SP-containing diets.
Keywords: Microalgae; Growth performance; Digestibility; Rabbit; Acid insoluble ash

Murat Kanbur, Oznur Atalay, Anil Ica, Gokhan Eraslan, Yucel Cam, The curative and antioxidative efficiency of doramectin and doramectin + vitamin AD3E treatment on Psoroptes cuniculi infestation in rabbits, Research in Veterinary Science, Volume 85, Issue 2, October 2008, Pages 291-293, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2007.10.005.
(http://www.sciencedirect.com/science/article/B6WWR-4R8M5DH-1/2/9c2873ac67fecb7d451adf6596f0bc2a)
Abstract:
In the present study, the efficiency of the administration of doramectin (DOR) and DOR + vitamin AD3E (VIT), and the influence of these agents on oxidative stress parameters in rabbits infested by Psoroptes cuniculi (P. cuniculi) were investigated. DOR (200 [mu]g/kg) and DOR (200 [mu]g/kg) + VIT AD3E were administered to infested rabbits intramuscularly (IM). The administration of DOR and DOR + VIT improved the healing of ear lesions on day seven. Increase in the plasma malondialdehyde (MDA) level and erythrocyte catalase (CAT) activity, and decrease in glutathione peroxidase (GSH-Px) and superoxide dismutase (SOD) activities were determined in infested rabbits. In the rabbits which were administered DOR + VIT, plasma MDA levels decreased, and erythrocyte GSH-Px and SOD activities increased on day seven. In conclusion, DOR and DOR + VIT combination were effective against P. cunuculi infestation. Infestation stimulated oxidative stress. VIT treatment resulted in antioxidant activity against oxidative stress induced by P. cuniculi infestation.
Keywords: Doramectin; Vitamin AD3E; Psoroptes cuniculi; Treatment; Oxidative stress

Alena Jelinkova, Dominique Licois, Michal Pakandl, The endogenous development of the rabbit coccidium Eimeria exigua Yakimoff, 1934, Veterinary Parasitology, Volume 156, Issues 3-4, 1 October 2008, Pages 168-172, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2008.06.008.
(http://www.sciencedirect.com/science/article/B6TD7-4SSND9G-4/2/99fdfa0244ac0d3fe45b4981aaa31bf2)
Abstract:
The coccidium Eimeria exigua from the tame rabbit (Oryctolagus cuniculus) has been neglected so far since it was considered to be an invalid species. Indeed, little is known about this coccidium. We have studied its endogenous development in domestic rabbits by means of light and electron microscopy. The first meronts appeared 72 h post-inoculation (h.p.i.), but a total of four asexual generations developed from 72 to 144 h.p.i. Meronts and gamonts were localized in the small intestine and the asexual stages successively moved from the duodenum to ileum. All parasite stages were found exclusively in the epithelium of the walls and tops of the villi. Two types of meronts developing in parallel during the asexual phase were observed from at least the 2nd generation. As in other rabbit coccidia, these forms corresponded to type A, which usually develops two polynucleate merozoites where endomerogony occurs, and type B, characterized by more numerous uninucleate merozoites arising by ectomerogony. This report is the first description of the endogenous stages of E. exigua.
Keywords: Eimeria exigua; Tame rabbit (Oryctolagus cuniculus); Endogenous development

Melanie Gallois, Thierry Gidenne, Juan Orengo, Cecile Caubet, Christian Tasca, Alain Milon, Severine Boullier, Testing the efficacy of medium chain fatty acids against rabbit colibacillosis, Veterinary Microbiology, Volume 131, Issues 1-2, 18 September 2008, Pages 192-198, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2008.03.004.
(http://www.sciencedirect.com/science/article/B6TD6-4S2MHWP-1/2/a8ed9a80829ffe1040ae10d87fb260dd)
Abstract:
Enteropathogenic Escherichia coli (EPEC) represents a major cause of lethal diarrhea in young mammals. Although the pathogenicity mechanisms of EPEC are now well understood, the intrinsic and environmental factors that control the expression of EPEC virulence remain largely unknown. In the rabbit, suckling reduces pups' sensitivity to EPEC infection. Hence, we have hypothesized that uncharacterized factors present in doe milk may mediate this protection. Medium chain fatty acids (MCFA), known to possess antimicrobial properties, are highly abundant in doe milk. We demonstrate that caprylic acid exhibits a clear bacteriostatic effect in vitro against the rabbit EPEC strain E22 (O103:H2:K-), in a dose-dependent manner. In vivo, the dietary inclusion of triglycerides of MCFA did not however reduce the sensitivity of young rabbits challenged with this EPEC strain. The mortality and fecal excretion of EPEC were not reduced, and the bacterial adhesion to ileum was not inhibited. Amount of MCFA reaching the ileal level might have been too low and/or their association to other milk antimicrobials may have been required to observe a positive effect on disease evolution in a context of a highly virulent challenge.
Keywords: Enteropathogenic E. coli (EPEC); Milk; Rabbit; Medium chain fatty acids (MCFA); Diarrhea

G.E. Eriyamremu, S.E. Ojimogho, S.O. Asagba, V.E. Osagie, Palm oil induced changes in ocular tissue lipid peroxidation, antioxidant enzymes and ATPases of rabbits in cadmium toxicity, Food and Chemical Toxicology, Volume 46, Issue 9, September 2008, Pages 3155-3158, ISSN 0278-6915, DOI: 10.1016/j.fct.2008.06.088.
(http://www.sciencedirect.com/science/article/B6T6P-4SXYG27-1/2/9fdd9c84bd0996a97474b5c1be198075)
Abstract:
This study determined the effect of supplementing rabbit diet with palm oil (PO) on lipid peroxidation, antioxidant enzymes and ATPases of different sections of the eyes in ocular cadmium toxicity. Twenty male New Zealand rabbits were randomly assigned to 4 groups of 5 rabbits in a study that lasted for 4 weeks. The control was given deionised water as eye drops and the other groups of rabbits were given eye drops of solution of 2 mg kg-1 body wt cadmium (as 3CdSO4 [middle dot] 8H2O). One test group was fed with the normal chow alone and the other test groups were fed with the chow fortified with either 5% or 10% palm oil. Ocular treatment of rabbit with cadmium significantly ($P < 0.05$) reduced their weight compared with the control. Feeding the animals with palm oil (PO) improved the weights of the animals and decreased cadmium accumulation in the eye tissues. Lipid peroxidation level was raised by cadmium in the cornea, lens and retina with palm oil supplementation of the animal diet significantly ($P < 0.05$) reducing the level of lipid peroxidation of the retina. Cadmium significantly ($P < 0.05$) reduced antioxidant enzymes and ATPases in the eye tissues compared with the control. Feeding the rabbits with PO significantly ($P < 0.05$) increased the activities of these enzymes in the retina to levels comparable with the control, with the 10% supplementation producing a more pronounced effect. The study shows that PO can alter cadmium accumulation, antioxidant enzymes and ATPases in ways which suggest that it offers protection of the eyes from ocular exposure to cadmium.
Keywords: Cadmium; Cornea; Lens; Retina; Lipid peroxidation; Superoxide dismutase; ATPase

Muammer Elmas, Enver Yazar, Kamil Uney, Ayse Er (Karabacak), Bunyamin Tras, Pharmacokinetics of enrofloxacin and flunixin meglumine and interactions between both drugs after intravenous co-administration in healthy and endotoxaemic rabbits, The Veterinary Journal, Volume 177, Issue 3, September 2008, Pages 418-424, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2007.05.021.
(http://www.sciencedirect.com/science/article/B6WXN-4P6TH6G-3/2/ef8a35684c47f3d466ae3469aa81e1dd)
Abstract:
The purpose of this study was to determine the pharmacokinetics and possible interactions of enrofloxacin (ENR) and flunixin meglumine (FM) in healthy rabbits and in rabbits where endotoxaemia had been induced by administering Escherichia coli lipopolysaccharide (LPS). Six male adult New Zealand White rabbits were used for the study. In Phase I, FM (2.2 mg/kg) and ENR (5 mg/kg) were given simultaneously as a bolus intravenous (IV) injection to each healthy rabbit. After a washout period, Phase II consisted of purified LPS administered as an IV bolus injection, then FM and ENR. LPS produced statistically significant increases in some serum biochemical concentrations. After the drugs were co-administered, the kinetic parameters of FM were not significantly different in healthy compared to endotoxaemic rabbits. It is concluded that ENR and FM could be co-administered to rabbits to treat endotoxaemia as no negative interaction was observed between the pharmacokinetics of both drugs.
Keywords: Endotoxaemia; Enrofloxacin; Flunixin meglumine; Pharmacokinetics; Rabbits

A.V. Makarevich, P. Chrenek, L. Olexikova, M. Popelkova, Z. Turanova, A. Ostro, J. Pivko, Post-thaw survival, cell death and actin cytoskeleton in gene-microinjected rabbit embryos after vitrification, Theriogenology, Volume 70, Issue 4, 1 September 2008, Pages 675-681, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2008.04.043.
(http://www.sciencedirect.com/science/article/B6TCM-4SPSHBF-1/2/83fa3373fbaa5680a95070d878f0b366)
Abstract:
The aim of this study was to compare two vitrification procedures (VPs), using either ethylene glycol (EG) in combination with dimethylsulfoxide (DMSO, vitrification protocol (VPI)) or Ficoll 70 (vitrification protocol II (VPII)), for rabbit embryo cryopreservation based on their post-thaw survival, cell death and actin cytoskeleton. The pronuclear stage eggs were flushed from the oviducts of the slaughtered New Zealand White rabbit does 19-20 h post coitum (hpc) and randomly divided into two groups: intact (control) and microinjected (Mi). Mi embryos or intact embryos were cultured for up to 72 hpc (morula stage), and then vitrified using either VPI (VPI + Mi, VPI) or VPII (VPII + Mi, VPII). After 2-3 days at -196 [degree sign]C, the embryos were thawed and cultured until 96-100 hpc to assess their development to blastocyst, apoptotic rate (TUNEL assay) and state of actin cytoskeleton (phalloidine-TRITC).
Mi procedure reduced blastocyst yield, but it was higher than in either vitrified (VPI) or Mi vitrified (VPI + Mi) embryos. VPI compromised, whereas VPII did not significantly affect blastocyst development compared to intact embryos. Mi and VP both affected the embryo quality increasing TUNEL-index and decreasing the ratio of embryos with high quality actin cytoskeleton compared to control. A higher apoptotic index was recorded in VPI group. A combination of Mi and VP induced an increase in apoptotic rate (10.35% and 7.54% for VPI + Mi and VPII + Mi, respectively) as compared to Mi alone (5.7%). Ratio of embryos belonging to best actin quality (grade I) was different among groups and most of the embryos with grade I actin were in intact (84%), Mi (71%) or VPII (70%) groups. A significantly lower number of embryos with grade I actin quality was observed in VPI (58%), VPI + Mi (54%) or VPII + Mi (66%).
These observations indicate that of the vitrification schemes tested, the VPII using EG and ficoll 70 as cryoprotectants, was less harmful than VPI (EG combined with DMSO in vitrification medium).
Keywords: Rabbit; Embryo; Vitrification; Microinjection; Apoptosis; Actin cytosleketon

Bruno Patris, Guy Perrier, Benoist Schaal, Gerard Coureaud, Early development of filial preferences in the rabbit: implications of nursing- and pheromone-induced odour learning?, Animal Behaviour, Volume 76, Issue 2, August 2008, Pages 305-314, ISSN 0003-3472, DOI: 10.1016/j.anbehav.2008.01.017.
(http://www.sciencedirect.com/science/article/B6W9W-4SJR2HS-1/2/77d7c0d474e58645e6df1903e8b1e757)
Abstract:
Newborn rabbits, Oryctolagus cuniculus, discriminate between different categories of adult conspecifics on the basis of their abdominal odour cues. Whether these cues can support the development of filial preferences has not been adequately tested. Using a two-choice paradigm, we assessed the ability of 3-8-day-old pups to orient selectively to the mother versus an unfamiliar female, either spontaneously or after odour conditioning. In experiment 1, nonconditioned pups roamed indifferently over the mother and an unfamiliar female. In experiment 2, pups conditioned to a neutral odorant while nursing or with the mammary pheromone became attracted by the odorant. In experiment 3, pups that had learned the odorant while nursing oriented for longer to any female carrying it, but the unscented mother and a scented unfamiliar female were equally attractive. Finally, in experiment 4, pups that had learned the odorant paired with the mammary pheromone showed a preference for their scented mother, but not systematically for a scented unfamiliar female; furthermore, they were equally attracted by the unscented mother and a scented unfamiliar female. In sum, pups did not spontaneously evince an olfactory preference for the mother when opposed to an unfamiliar female, although they seemed able to detect individual maternal odours. In fact, they appeared to react to both species-specific cues and individual cues that they had learned, and their responses depended on their degree of familiarity with the cues and on the context. The mammary pheromone by itself might act as both a releasing and a reinforcing signal in these early socially oriented behaviours.
Keywords: learning; mammary pheromone; mother-young relationship; Oryctolagus cuniculus; rabbit; recognition

H.Y. Chao, F.C. Li, Effect of level of fibre on performance and digestion traits in growing rabbits, Animal Feed Science and Technology, Volume 144, Issues 3-4, 15 July 2008, Pages 279-291, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2007.10.007.
(http://www.sciencedirect.com/science/article/B6T42-4S3P87P-1/2/dcba75d2f687b5492e6300dd1ed484c5)
Abstract:
An experiment was conducted to determine the effects of level of fibre on production performance, gastrointestinal tract development, caecum fermentation and fibrolytic activity in weaner to 2-month-old New Zealand rabbits. One hundred weaner rabbits were allocated in individual cages for five treatments in which they were fed each diet with ADF at 130 (NDF, 274.1; ADL, 39.7; CP, 158.4; EE, 26.8; starch, 252.5 g/kg), 160 (NDF, 292.9; ADL, 41.9; CP, 160.3; EE, 25.6; starch, 249.4 g/kg), 190 (NDF, 312.4; ADL, 50.5; CP, 157.6; EE, 24.2; starch, 218.2 g/kg), 220 (NDF, 343.9; ADL, 51.2; CP, 158.5; EE, 22.2; starch, 217.6 g/kg), and 250 g/kg (NDF, 375.7; ADL, 66.0; CP, 156.9; EE, 22.4; starch, 220.8 g/kg) original matter basis, respectively. The results were: ADG and F/G deteriorated with increasing fibre ($P<0.05$); ADI increased with increasing dietary ADF ($P=0.002$). The stomach relative weight (g/kg LW), small intestine relative weight (g/kg LW), caecum weight, caecum content weight and caecum relative weight (g/kg LW) all increased with increasing ADF ($P=0.003$, 0.007, 0.002, 0.010 and <0.001, respectively). Quadratic effects of level of ADF on the villus height, villus height/crypt depth of the duodenum and the villus height/crypt depth of the jejunum were obtained; cubic effects of level of ADF on the crypt depth of the jejunum and the villus height/crypt depth of the ileum were obtained. Cubic effects of level of ADF on the pH, the butyric acid (% total VFA) and C2/C4 were obtained. The NH3-N concentration dropped

and the acetic acid (% total VFA) increased when the dietary ADF increased (P<0.001). The fibrolytic activity measured in the caecal contents increased when the dietary ADF increased (P<0.001). Providing a ration consisting mainly of clover meal, wheat straw and peanut hulls, the optimum dietary ADF content for weaner to 2-month-old growing meat rabbits was shown to be 190 g/kg feed.
Keywords: New Zealand rabbit; Acid detergent fibre (ADF); Growth performance; Production performance; Gastrointestinal tract development; Caecum fermentation; Fibrolytic activity

Philip Stott, Comparisons of digestive function between the European hare (Lepus europaeus) and the European rabbit (Oryctolagus cuniculus): Mastication, gut passage, and digestibility, Mammalian Biology - Zeitschrift fur Saugetierkunde, Volume 73, Issue 4, 15 July 2008, Pages 276-286, ISSN 1616-5047, DOI: 10.1016/j.mambio.2007.07.002.
(http://www.sciencedirect.com/science/article/B7GX2-4PGH4G3-2/2/3485e9d913bfd490fb7c37859437b308)
Abstract:
The European hare Lepus europaeus and the European rabbit Oryctolagus cuniculus are sympatric in many areas of the world. They are medium-sized herbage-feeding lagomorphs and trophic competitors. Both species feed on twigs under extreme and perhaps limiting conditions. To ascertain whether fine niche separation mechanisms occur, several comparative tests of digestive function were undertaken on samples of animals drawn from sympatric populations. The weights of the organs constituting the abdominal alimentary canal, the rates of passage and the extent of trituration of dietary markers intended to mimic twigs, and the digestibility of fibre, protein, and fat were compared. Both the stomach and the caecum of the hare were significantly smaller as a proportion of body weight, and this would result in a higher power-weight ratio. Both species rapidly passed the digestive marker, but passage was significantly faster in the hare. The rabbit chewed twig-like material with a scissor cutting and crushing action, whereas the action of the hare included a stripping action that would more efficiently access soluble carbohydrates stored in vascular rays. Both species were poor digesters of fibre, but digestibility of hemicelluloses was significantly greater in the rabbit. The faeces of both species of lagomorphs contain nutrients that can be attractive to more efficient fermenters of plant fibre, and consumption of those faeces may confound lagomorph population surveys that rely on dung counts.
Keywords: Cellulose; Digestion; Dung counts; Hemicellulose; Twigs

K. Murakata, A. Sato, M. Yoshiya, S. Kim, M. Watarai, Y. Omata, H. Furuoka, Infection of Different Strains of Mice with Lawsonia intracellularis Derived from Rabbit or Porcine Proliferative Enteropathy, Journal of Comparative Pathology, Volume 139, Issue 1, July 2008, Pages 8-15, ISSN 0021-9975, DOI: 10.1016/j.jcpa.2008.03.001.
(http://www.sciencedirect.com/science/article/B6WHW-4SH1J3W-2/2/74e0117f57e52a39b02b2305c475471d)
Abstract: Summary
This report describes intestinal lesions in five strains of mice infected orally with Lawsonia intracellularis-infected tissue homogenates from rabbits or pigs (RLI and PLI). BALB/cA, C3H/HeJ, C57BL/6J and ICR mice were susceptible to infection with RLI, whereas only C3H/HeJ, C57BL/6J and ICR strains were susceptible to PLI. In susceptible mice, crypt epithelial hyperplasia occurred in association with an inflammatory reaction, as in proliferative enteropathy (PE) in other species. The intestinal changes in the infected mice varied from mild to severe. Unlike rabbit or porcine PE, in which the changes are confined to the ileum, the lesions in mice were located in the caecum. Immunolabelling of L. intracellularis antigen was abundant in early infection when the epithelial hyperplasia was mild or absent. When the hyperplasia had become severe, however, immunolabelling was weak. For this reason, it is suggested that transitory infection of the epithelium induces epithelial hyperplasia. Genetic differences between mouse strains appeared to

play an important role in the response to L. intracellularis infection. Moreover, the susceptibility of BALB/cA mice to RLI but not to PLI suggests that there are significant biological differences between L. intracellularis isolates from rabbit PE and porcine PE.
Keywords: bacterial infection; Lawsonia intracellularis; mouse strains; pig; proliferative enteropathy; rabbit

R. Cardinali, A. Dal Bosco, A. Bonanno, A. Di Grigoli, P.G. Rebollar, P.L. Lorenzo, C. Castellini, Connection between body condition score, chemical characteristics of body and reproductive traits of rabbit does, Livestock Science, Volume 116, Issues 1-3, July 2008, Pages 209-215, ISSN 1871-1413, DOI: 10.1016/j.livsci.2007.10.004.
(http://www.sciencedirect.com/science/article/B7XNX-4R2XD3B-1/2/21714012f63cd521e213a9d4224877e9)
Abstract:
Body condition scoring (BCS) is widely used to evaluate the nutritional status of livestock (cows, ewes, sows). In intensive systems, rabbit does are generally inseminated 11 days post partum and, due to a hormonal antagonism and an energy deficit caused by concurrent lactation and pregnancy, they show low fertility. The aim of this investigation was to assess an in vivo method for scoring the body condition of does by verifying the association with the body fat depots, the chemical composition of body tissues, the ovarian status, the hormonal response and the reproductive performance. The evaluation of BCS, involving 66 multiparous lactating does inseminated at 11 days post partum, was based on the test of bone protrusions and fullness of muscle of the loin, rump and hind leg. The traits were subjectively scored using 0, 1 and 2 for poor, intermediate and good condition, respectively. For calculating an aggregate BCS, the hind leg score was omitted, because it is less correlated with the real body condition. Adding the respective score (0-2) of the loin and rump regions, 5 classes of BCS were obtained (0-4). This aggregate BCS was highly correlated with the body fat depots (r = 0.79), the ether extract content of muscle samples of Obliquus abdominis (r = 0.87) and Biceps femoris (r = 0.84), and the ether extract of the empty body (r = 0.84). There was a lower correlation with the body weight (r = 0.45). The increase of BCS corresponded to higher lipid content in the body parts considered, especially the Obliquus abdominis (from 2.0 to 10.0%) and fat depots (from 10.6 to 107.7 g/doe). BCS was not related to ovulation rate or embryo production, but was correlated with sexual receptivity and fertility.
Plasma FSH and LH concentrations were determined by RIA, 48, 24, 0 h before and 1 h after GnRH administration and artificial insemination. Animals with extreme body condition scores (BCS <= 1 or BCS = 4) showed lower plasma FSH levels (20.0 vs. 34.5 ng/mL) than does with optimal body condition (2 <= BCS <= 3) and their preovulatory LH surge, released after GnRH administration, was less evident (16.9 vs. 20.3 ng/mL). The poor reproductive performance of does with extreme BCS could be explained by this pituitary activity. On day 11 post-partum, a high number of does (71.2%) had extreme BCS and showed a lower sexual receptivity (37.2% vs. 80.0%) and fertility rate (50.9% vs. 86.6%) than does in optimal condition. On these results, the possibility of applying an in vivo method for scoring the body condition of lactating rabbit does appears promising for use in on-farm reproductive management.
Keywords: Rabbit doe; Body condition score; Body composition; Fertility; Ovary; FSH; LH

Zoltan Princz, Antonella Dalle Zotte, Istvan Radnai, Edit Biro-Nemeth, Zsolt Matics, Zsolt Gerencser, Istvan Nagy, Zsolt Szendro, Behaviour of growing rabbits under various housing conditions, Applied Animal Behaviour Science, Volume 111, Issues 3-4, June 2008, Pages 342-356, ISSN 0168-1591, DOI: 10.1016/j.applanim.2007.06.013.
(http://www.sciencedirect.com/science/article/B6T48-4PB15XK-2/2/460057ae4ebabe6ed00f658e3bdd5717)
Abstract:

The aim of this research was to assess the effects of environmental variables (group size, stocking density, floor type, environmental enrichment) on behaviour - as a welfare indicator - of growing rabbits. Two experiments were carried out with Pannon White rabbits. In experiment 1, 5-week-old rabbits (n = 112) were placed in cage blocks (2 m2) with a stocking density of 16 or 12 rabbits/m2. The cages (0.5 m2) differed in the floor type (wire or plastic net) and in the presence or absence of gnawing sticks (white locust). The animals could move freely among the four cages through swing doors. Infrared video recording was performed once a week, the number of rabbits in each cage was counted every half an hour (48 times/day) during the 24 h video recording. Between ages 5 and 11 weeks the rabbits showed a preference towards the plastic net floor (16 rabbits/m2, 62.5%; 12 rabbits/m2, 76.5%; $P < 0.001$). Gnawing stick application significantly affected cage preference: 54.1% (16 rabbits/m2) or 53.1% (12 rabbits/m2) of the rabbits choose the enriched cages ($P < 0.001$). In experiment 2, the 5-week-old rabbits were placed either in cages (2 rabbits/0.12 m2, n = 72) or pens (13 rabbits/0.86 m2, n = 104) with 16 rabbits/m2. The floor types were wire or plastic net, with the presence or absence of gnawing sticks on the walls. Video recordings were made at 6.5 and 10.5 weeks of age between 11:00 a.m. and 5:00 p.m. and between 11:00 p.m. and 05:00 a.m. Compared to cages, the rabbits housed in pens spent less time with resting (58% versus 67%) and more time with locomotion (6.7% versus 3.8%) but the frequency of aggressive behaviour (measured by the number of ear lesions) was also higher (0.14% versus 0.01%). In pens the application of gnawing sticks significantly decreased the frequency of ear injuries (0.05% versus 0.22%). The floor type did not affect any behavioural pattern (eating, drinking, movement, resting, comfort, social, investigatory) significantly. The main results showed that growing rabbits have a preference for plastic net floor and cages provided with gnawing sticks. The resting, locomotive and aggressive behaviour was modified by the housing system and the presence of gnawing sticks decreased the frequency of physical injuries.
Keywords: Rabbit; Behaviour; Group size; Stocking density; Floor type; Gnawing stick

J.S. Vicente, R. Lavara, F. Lavara, F. Marco-Jimenez, M.P. Viudes-de-Castro, Rabbit reproductive performance after insemination with buserelin acetate extender, Livestock Science, Volume 115, Issues 2-3, June 2008, Pages 153-157, ISSN 1871-1413, DOI: 10.1016/j.livsci.2007.07.011.
(http://www.sciencedirect.com/science/article/B7XNX-4P8R7SF-4/2/0b00ddd9192060ff345564f8f4cd8031)
Abstract:
Rabbit farmers and insemination centres have established new requirements relating to males (genetic, nutritional and environmental factors) and rabbit insemination techniques. The aim of this study was to evaluate buserelin acetate on the reproductive performance of nulliparous, multiparous lactating and multiparous non-lactating does inseminated on three commercial farms. Two thousand two hundred and three commercial crossbred does belonging to three commercial farms were inseminated with pooled semen from males of two selected meat lines; R line (UPV rabbit selection centres, Spain) in farms 1 and 2, and PS Hyplus 59 line (Grimaud Frere, France) on farm 3. Ejaculates from 12-20 males from each line were pooled and diluted to twelve million sperm per millilitre by adding TRIS-citrate-extender. Diluted semen from each male line was split into two fractions, the first without buserelin acetate added to semen (Control group) and the second fraction was supplemented with 10 [mu]g of buserelin acetate per millilitre (Buserelin group). Receptive females (red colour of vulvar lips) were inseminated with 0.5 mL using a standard plastic curved pipette. Artificial insemination with semen extended with buserelin resulted in lower pregnancy and kindling rates irrespective of the physiological status of females or the farm (78.7% and 76.0% vs 85.8% and 83.4%, buserelin extender group and control respectively, $P < 0.01$), although does from both treatment groups had a similar litter sizes (10.4 and 9.6 total and alive born, respectively). This study opened up new prospects for changing rabbit insemination procedures.
Keywords: Buserelin; Semen extender; Rabbit; Artificial insemination

G.R. Ozalp, K. Seyrek-Intas, C. Caliskan, A. Wehrend, Mid-gestation pregnancy termination in rabbits by the progesterone antagonist aglepristone, Theriogenology, Volume 69, Issue 9, June 2008, Pages 1056-1060, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2008.01.016.
(http://www.sciencedirect.com/science/article/B6TCM-4S69S2J-1/2/a8e66d82daf115947e666451d7759569)
Abstract:
The efficacy of aglepristone treatment to induce abortion in does 15 and 16 days after mating was investigated. The pregnant does were randomly allocated into two groups: For group I, aglepristone was injected twice (10 mg/kg, subcutaneously) on days 15 and 16 after mating (n = 10); for group II the does got no treatment but the same volume of 0.9% sodium chloride solution was subcutaneously injected at the same days of pregnancy (n = 5). Results: group I, termination of pregnancy was successful in all does. The mean interval between the first administration of aglepristone and the beginning of vaginal discharge was 32.4 +/- 5.6 h (range 19-72 h). Complete expulsion of all fetuses was observed in four does with first occurrences of vaginal discharge on the same day. The duration between the first occurrence of vaginal discharge to expulsion of all fetuses ranged between 21 and 130 h (mean 70.2 +/- 12.2 h). As important side effects, decrease in food consumption during abortion time and irregular mating behaviour (52.3 +/- 2.0 days/range 46-63) were recorded. But after this time all does were mated again, 8/10 became pregnant and they whelped normal and live kittens. Group II, all does gave birth to live kittens after a mean pregnancy length of 31.2 +/- 0.37 days (range 30-32 days). The mean serum progesterone (P4) concentrations were significantly different between control and treated does after day 20 of pregnancy ($P < 0.05$). The results indicate that aglepristone treatment is effective to induce abortion in does and causes no serious negative effects on further fertility except a short non-receptive period after abortion and short time decrease in food consumption.
Keywords: Rabbit; Pregnancy termination; Aglepristone

A. Valencakova, P. Balent, E. Petrovova, F. Novotny, L. Luptakova, Encephalitozoonosis in household pet Nederland Dwarf rabbits (Oryctolagus cuniculus), Veterinary Parasitology, Volume 153, Issues 3-4, 31 May 2008, Pages 265-269, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2008.01.047.
(http://www.sciencedirect.com/science/article/B6TD7-4RXJYW4-1/2/a120f9e9a67237969c9162db01d5915e)
Abstract:
The paper presents the results of examination of 32 domestically bred rabbits, the breed Nederland Dwarf of Oryctolagus cuniculus, for the presence of Encephalitozoon cuniculi microsporidian species. The results of serological tests for E. cuniculi in 32 rabbits are reviewed along with other follow-up studies of clinical cases. Blood samples were taken from 7 asymptomatic rabbits and 25 rabbits showing neurological and ocular signs suggestive of encephalitozoonosis. In the asymptomatic group, 5 out of 7 rabbits were seropositive (71%). 16 rabbits with clinical diseases showed neurological sings, including torticollis, circus-like movements, loss of weight; 6 of them also showed ataxia, anorexia, asthenia of hind-limbs and 3 showed ocular signs. All 25 rabbits were seropositive. The spores of E. cuniculi were isolated from the faecal samples or kidneys and brain of an animal and subsequently were used for DNA isolation and PCR analysis.
Keywords: Encephalitozoon cuniculi; Spontaneous encephalitozoonosis; Rabbit; Nederland Dwarf; Diagnostics

Edita Jeklova, Lenka Leva, Jan Matiasovic, Kamil Kovarcik, Hana Kudlackova, Zora Nevorankova, Ivan Psikal, Martin Faldyna, Characterisation of immunosuppression in rabbits after infection with

myxoma virus, Veterinary Microbiology, Volume 129, Issues 1-2, 25 May 2008, Pages 117-130, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2007.11.039.
(http://www.sciencedirect.com/science/article/B6TD6-4RBYFXX-1/2/b96560601874c307f927b02a3670a839)
Abstract:
Myxoma virus (MXV) causes the systemic disease myxomatosis in the European rabbit. Despite many in vitro studies on the function of MXV immunomodulatory proteins and detailed molecular knowledge of virus, little is known about the dynamics of interaction of the virus with the integrated host-immune system during infection. In this study changes in haematological profile, changes in lymphocyte subset distribution and non-specific proliferation activity of lymphocytes from different lymphoid compartments on the 2nd, 4th, 6th, 9th and 11th day after experimental infection of rabbits with MXV strain Lausanne was characterised. The relationship between alterations of immune parameters and dynamic of virus dissemination through the body was investigated. Haematological changes included moderate leucopenia with significant lymphopenia, neutrophilia, monocytosis and eosinopenia. A decrease of T cells including CD4+ and CD8+ and increase of CD79[alpha]+ were observed in draining popliteal lymph node 4 days after virus inoculation. From day 6, comparable changes were seen in collateral popliteal lymph node, spleen and peripheral blood. From day 9, the mentioned lymphocyte subsets tended to reach their original state in all of these lymphocyte compartments except draining popliteal lymph node. In thymus, MXV infection affected mainly CD4+CD8+ double positive thymocytes. On the other hand, proliferation activity of lymphocytes determined by the proliferation assay with plant-derived mitogens was significantly reduced from day 4 or 6 and remained reduced until the end of experiment in all observed lymphoid organs. Presence of MXV in respective lymphoid compartments preceded changes in lymphocyte subset distribution or lymphocyte activity.
Keywords: Myxomatosis; Lymphocyte subsets; Lagomorphs; Flow cytometry

Claudia M. Dellafiore, Juan B. Gallego Fernandez, Sara Munoz Valles, Habitat use for warren building by European rabbits (Oryctolagus cuniculus) in relation to landscape structure in a sand dune system, Acta Oecologica, Volume 33, Issue 3, May-June 2008, Pages 372-379, ISSN 1146-609X, DOI: 10.1016/j.actao.2008.02.002.
(http://www.sciencedirect.com/science/article/B6VR3-4S69SDN-1/2/4b7b2b40555d7de7fb6d831caa9c7f52)
Abstract:
Several conservation efforts are being made to recover European rabbit populations (Oryctolagus cuniculus) on the Iberian Peninsula. Some of them focus on burrow management; others involve building different types of warren. A few studies have examined site selection for warren building, and these studies have considered only warren placement within sites and not the broader area surrounding these locations. The objective of this study was to evaluate how landscape pattern determines habitat selection by rabbits for warren building at different spatial scales. Landscape, home range scale, and microhabitat were the spatial scales used in this study. Warrens were not uniformly distributed over the study area but, rather were concentrated in areas with a high abundance and cover of Retama monosperma and high vegetation cover. Rabbits preferred digging warrens in areas with low fragmentation and where patches are few, large, and contiguous. Based on our results, we suggest that a study of landscape structure should be carried out before design habitat management, recovery or translocation programs. Such studies will need to take into account the physiognomy and size, shape, and continuity of patches in fragmented landscapes. Rabbit conservation programs must address areas that provide not only the maximum potential rate of intake, but also good soil and vegetation cover conditions for warren building and suitable surrounding areas.
Keywords: Habitat management; Landscape; Geographic information system; (GIS); Warren building

David Val-Laillet, Raymond Nowak, Early discrimination of the mother by rabbit pups, Applied Animal Behaviour Science, Volume 111, Issues 1-2, May 2008, Pages 173-182, ISSN 0168-1591, DOI: 10.1016/j.applanim.2007.06.003.
(http://www.sciencedirect.com/science/article/B6T48-4P5RKKF-3/2/43051012b34453daf5b2ec3448df61e5)
Abstract:
Recognition of the mother by altricial neonates is assumed to emerge only once the dam and her young leave the nest and encounter, for the first time, other family units. Knowing that newborn rabbit pups can be easily conditioned with artificial odours, the aim of this study was (1) to measure their discriminative ability between their mother and an alien doe at the same stage of lactation and (2) to compare the behaviour of pups when exposed to cues from the ventral and dorsal body areas of the mother. Rabbit pups were submitted to a two-choice test at 1, 7 and 14 days after birth in a testing apparatus consisting of two chambers (test 1: mother versus empty chamber and test 2: mother versus alien doe) and in two testing situations (pups tested with exposure to either ventral or dorsal body parts of the does). When opposed to an empty chamber, the mother was preferred at all ages and for both ventral and dorsal exposure ($P <= 0.05$), except for the pups tested under the ventrally exposed does on day 1. Olfactory cues as well as thermal cues are probably responsible for this preference. Discrimination between the mother and an alien doe only appeared on day 7 ($t = 2.189$, $P = 0.043$) when rabbit pups were tested under the mother (i.e. ventrum). Our results show that the responses of the pups were dependent on the body parts to which they were exposed. Our demonstration also opens the way for further studies by suggesting that pups could recognize their own mother via individual olfactory and/or thermal cues emanating from her ventrum, well before their emergence from the nest.
Keywords: Rabbit pups; Mother discrimination; Olfactory cues

M. Pla, A comparison of the carcass traits and meat quality of conventionally and organically produced rabbits, Livestock Science, Volume 115, Issue 1, May 2008, Pages 1-12, ISSN 1871-1413, DOI: 10.1016/j.livsci.2007.06.001.
(http://www.sciencedirect.com/science/article/B7XNX-4P53RVM-2/2/1e0ab4468d3be2c52357736e4b36fb16)
Abstract:
In order to compare the meat of conventionally and organically produced rabbits for possible future sale, two groups of 50 rabbits from the same genetic type were reared under conventional or Spanish organic conditions and were slaughtered at 63 or 90 days respectively. Differences were found in most of the characteristics studied. In some of the traits the differences were related to age, as in the case of the liveweight (2209 vs. 2488 g), the weight of the different parts of the carcass, texture variables of meat, meat redness (a* 5.51 vs. 7.49), carcass redness (a* 2.92 vs. 3.70), or pH (5.82 vs. 5.76) in conventionally and organically reared rabbits, respectively. However, in other cases the variations were not age related. Organic rabbits had a higher carcass length to circumference ratio (2.22 vs. 1.97). Their carcasses were leaner (13.9 vs. 27.3 g fat/kg carcass) and had a lower meat to bone ratio (5.18 vs. 5.84) than in conventional rabbits. The organic meat had less protein (210 vs. 213 g/kg meat) and fewer lipids (19 vs. 39 g/kg meat). It had less saturated FA (41.3 vs. 42.6 g/100 g total FA) and less monounsaturated FA (29.4 vs. 35.6) but more polyunsaturated FA (28.9 vs. 21.9), n-6 FA (25.3 vs. 19.4) and n-3 FA (2.7 vs. 2.4). The ratio of polyunsaturated:saturated FA was higher (0.7 vs. 0.5) in the organic meat and, as such, was better from the nutritional perspective, but the n-6: n-3 ratio was higher (9.3 vs. 8.1) and poorer. The proteins in the organic meat were richer in methionine (12.78 vs. 4.33 mg/100 g meat) and cystine (4.47 vs. 1.71) although these results require further study. The organic rabbit meat had a reduced aniseed (0.23 vs. 0. 79) and grass flavour (0.44 vs. 0.56), but higher liver flavour (1.49 vs. 1.02) than conventional rabbit meat.

Keywords: Rabbit; Organic system; Carcass traits; Meat quality

A. Belenguer, J. Balcells, M. Fondevila, L. Abecia, E. Solanas, Alternative methodologies to estimate ingestion of caecotrophes in growing rabbits, Livestock Science, Volume 115, Issue 1, May 2008, Pages 13-19, ISSN 1871-1413, DOI: 10.1016/j.livsci.2007.06.002.
(http://www.sciencedirect.com/science/article/B7XNX-4P6MC5S-1/2/0ff3376df08aee252d63e3e5de13a8fb)
Abstract:
This study was carried out in order to estimate caecotrophe intake in growing rabbits by three existing procedures: caecotrophes collection after collar fitting, urinary purine derivatives (PD) excretion and microbial 15N-lysine incorporation. In a first experiment sixteen New Zealand White male rabbits were divided in three groups receiving the same diet, but supplemented with 15NH4Cl in the first group (T1: 6 rabbits). The second group (T2: 6 rabbits) was also fed the labelled diet but only during the last ten days of the fattening period when animals were fitted a neck collar to prevent caecotrophy. The third group (T3: 4 animals) received the basal diet and was used as control. In two additional trials the daily contribution to urinary excretion of endogenous purine compounds (469 +/- 50.8 [mu]mol/W0.75) and creatinine excretion (807 +/- 127.6 [mu]mol/W0.75) were determined. The highest estimation of microbial nitrogen recycling was obtained by the urinary PD method (0.79 +/- 0.096 g/d), whereas caecotrophes collection and 15N-lysine incorporation methods showed similar values (0.49 +/- 0.049 and 0.45 +/- 0.015 g/d, respectively). Our results seem to indicate an overestimation of microbial nitrogen recycling in growing rabbits by PD methodology, while neck collar fitting procedure gave similar results, although more variable than microbial 15N-lysine incorporation.
Keywords: Rabbits; Caecotrophy; Purine derivatives; 15N-lysine

Jean-Sebastien Guitton, Sebastien Devillard, Michel Guenezan, David Fouchet, Dominique Pontier, Stephane Marchandeau, Vaccination of free-living juvenile wild rabbits (Oryctolagus cuniculus) against myxomatosis improved their survival, Preventive Veterinary Medicine, Volume 84, Issues 1-2, 17 April 2008, Pages 1-10, ISSN 0167-5877, DOI: 10.1016/j.prevetmed.2007.10.001.
(http://www.sciencedirect.com/science/article/B6TBK-4R7CYH7-1/2/eed317c0ef09b494af3749f833864048)
Abstract:
For several decades, the populations of the European wild rabbit (Oryctolagus cuniculus) have declined, which is partly due to myxomatosis. Vaccination against this disease is expected to contribute to restoration of rabbit populations but the actual impact of myxomatosis is not well known and vaccination might have some negative effects. We analyzed the capture-mark-recapture data obtained in a 4-year field experiment (1991-1994) in a park near Paris, France wherein 300 out of 565 seronegative juvenile rabbits were vaccinated at first capture against myxomatosis with the nontransmissible Dervaximyxo SG33(c) vaccine. After accounting for weight at first capture, age-class (juvenile/adult), 'trap-happiness' and season (spring/autumn) of the capture event, vaccinated rabbits had 1.8-fold greater odds of surviving than the unvaccinated rabbits. The average summer survival risk for vaccinated juveniles was 0.63 (+/-0.08 S.E.) whereas it was 0.48 (+/-0.08 S.E.) for unvaccinated juvenile rabbits.
Keywords: Infectious diseases; Capture-mark-recapture; Population management

P. Chavatte-Palmer, P. Laigre, E. Simonoff, P. Chesne, M. Challah-Jacques, J.-P. Renard, In utero characterisation of fetal growth by ultrasound scanning in the rabbit, Theriogenology, Volume 69, Issue 7, 15 April 2008, Pages 859-869, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2007.12.013.

(http://www.sciencedirect.com/science/article/B6TCM-4S02JSM-1/2/36dd1563987e3f056903b85df35c7fba)
Abstract:
Fetal development is an important factor influencing the susceptibility of adults to metabolic diseases. In order to study the influence of fetal growth on further development in animal models like the rabbit, methods of measurement of fetal and placental size and viability must be established and validated. In this study, 42 New Zealand does bred naturally (N = 12) or transferred with in vivo produced embryos (2, 4 or 6 embryos/doe) have been scanned every 2-3 days with a 7.5 MHz transabdominal probe from Day 7 post-coitum until term to measure fetal and placental growth. Vesicle, placental, fetal length and head size have thus been determined according to number of fetuses and time. In late gestation, the fetuses that were transferred in limited numbers to the uterus of does were significantly larger than their natural breeding counterparts probably due to reduced litter size.
Keywords: Fetus; Ultrasound; Placenta; Rabbit; Development

Edita Jeklova, Lenka Leva, Zoran Jaglic, Martin Faldyna, Dexamethasone-induced immunosuppression: a rabbit model, Veterinary Immunology and Immunopathology, Volume 122, Issues 3-4, 15 April 2008, Pages 231-240, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2007.11.011.
(http://www.sciencedirect.com/science/article/B6TD5-4R8WJPX-1/2/ac3a4a972719f9206b113a9e066610b0)
Abstract:
Rabbits are often used as animal models for experimental purposes; in many cases steroid-induced immunosuppression is necessary. The aim of this study was to characterise a model of immunosuppression in rabbits, based on changes in the lymphocyte subset distribution, changes in proliferative capacity of lymphocytes and activity of neutrophils 1, 3 and 7 days after the administration of 2 mg/kg dexamethasone phosphate (DXP) three times at 6-h intervals. In peripheral blood, neutrophilia and lymphopenia together with eosinopenia, monocytopenia and basopenia in the absence of leukocytosis was detected. One day after DXP administration the absolute numbers of all lymphocyte subsets decreased in the blood, whereas in bone marrow, absolute numbers of all lymphocyte subsets increased significantly, except CD79[alpha]+ cells that increased only in relative numbers. The effect of DXP on lymphocytes from the spleen, mesenteric and popliteal lymph nodes was less pronounced. In the thymus, DXP led to a marked reduction of the relative and absolute numbers of CD4+CD8+ thymocytes. The proliferative capacity of lymphocytes after concanavalin A stimulation was lower in the peripheral blood and spleen only on day 1, no changes were detected in lymph nodes or in bone marrow. A marked increase in proliferative capacity was detected in the thymus. Spontaneous production of reactive oxygen metabolites by neutrophils was reduced on days 1 and 3 after DXP administration. The present results demonstrate clearly that this DXP application protocol is useful for the experimental induction of relatively short-lasting immunosuppression in rabbits.
Keywords: Glucocorticoid; Lymphocyte subsets; Lagomorphs; Flow cytometry

Charlotte L. Roy Nielsen, Sarah M. Wakamiya, Clayton K. Nielsen, Viability and patch occupancy of a swamp rabbit metapopulation at the northern edge of its distribution, Biological Conservation, Volume 141, Issue 4, April 2008, Pages 1043-1054, ISSN 0006-3207, DOI: 10.1016/j.biocon.2008.01.016.
(http://www.sciencedirect.com/science/article/B6V5X-4S1BR2H-2/2/223696918f374bee1f900118f373d575)
Abstract:
Swamp rabbits (Sylvilagus aquaticus) are state-endangered in Indiana, USA, and population decline has been attributed to habitat loss. We conducted pellet surveys as part of a long-term survey effort that has been conducted at approximate 10-year intervals over the last 40 years. We

modeled patch occupancy and conducted a spatially-explicit population viability analysis (PVA). Although occupancy of individual patches varied over time, occupancy rate has been constant for the last 30 years, and Indiana swamp rabbits exist as a metapopulation that appears to be stable. Metapopulation dynamics were best characterized as being stationary, but area was an important factor in extinction rates; occupied patches (142 +/- 37 ha) were significantly larger (P = 0.01) than unoccupied patches (79 +/- 20 ha). We did not find strong support for models with colonization rates as a function of distance to neighboring patches, nor was distance to contiguous patches of habitat significantly different (P = 0.12) for occupied and unoccupied sites. Population viability analysis corroborated our findings based on occupancy modeling, and evaluation of the PVA model using occupancy data for the period 1985-2006 resulted in predictions that nearly matched our field observations (33% observed patch occupancy vs. 25% predicted patch occupancy). Population viability was most sensitive to reductions in survival and fecundity rates, but was otherwise robust to changes in parameters such as initial abundance and carrying capacity. Our findings provide novel insights into a poorly studied member of Sylvilagus and into species metapopulation dynamics at the edge of the range.
Keywords: Bottomland hardwood forest; Pellet surveys; Population viability analysis; Sylvilagus aquaticus

Oluseyi O. Oduguwa, Mojisola O. Edema, Ayodeji O. Ayeni, Physico-chemical and microbiological analyses of fermented corn cob, rice bran and cowpea husk for use in composite rabbit feed, Bioresource Technology, Volume 99, Issue 6, April 2008, Pages 1816-1820, ISSN 0960-8524, DOI: 10.1016/j.biortech.2007.03.036.
(http://www.sciencedirect.com/science/article/B6V24-4NR646R-2/2/9c705a5253b72ec4c4a145b386353210)
Abstract:
An experiment was conducted to evaluate the effect of fermentation on the proximate composition of corn cob, rice bran and cowpea husk for use in composite rabbit feed formulations. The test ingredients were moistened with tap water and allowed to ferment naturally at room temperature. During fermentation, samples of the fermenting materials were extracted at zero, 24 and 48 h for physico-chemical and microbiological analyses using standard procedures. The microorganisms associated with the fermenting materials were identified as Rhizopus oligosporus, Aspergillus oryzae, Aspergillus niger, Rhodotorula, Geotrichum candidum, Candida albicans, and Saccharomyces cerevisiae. Two (R. oligosporus and S. cerevisiae) out of microorganisms present were used as starter cultures to ferment the test ingredients and the fermented products were then analyzed. From the results obtained S. cerevisiae enhanced the protein and fat contents while R. oligosporus was able to degrade the fiber significantly.
Keywords: Fermentation; Corncob; Rice bran; Cowpea husk; Proximate composition

M.J. Argente, M.A. Santacreu, A. Climent, A. Blasco, Effects of intrauterine crowding on available uterine space per fetus in rabbits, Livestock Science, Volume 114, Issues 2-3, April 2008, Pages 211-219, ISSN 1871-1413, DOI: 10.1016/j.livsci.2007.05.008.
(http://www.sciencedirect.com/science/article/B7XNX-4P00SHN-1/2/ac82de7003f4b44797c3a35fb6809ff7)
Abstract:
The aim of this study was to examine the effects of uterine crowding on available uterine space per fetus and fetal development at 18 days of gestation in unilaterally ovariectomized and intact does from the sixth generation of a divergent selection experiment on uterine capacity. Uterine capacity was estimated as litter size in unilaterally ovariectomized (ULO) does. Records from 37 ULO and 26 intact does were used. All does were slaughtered on d 18 of gestation. Ovulation rate per side in ULO does was almost twice as much as intact does (12.41 ova vs. 6.47 ova, P < 0.001). ULO does showed higher intrauterine crowding at implantation than intact does (9.36

implanted embryos/uterine horn vs. 5.31 implanted embryos/uterine horn, P < 0.001) and a lower available uterine space per live fetus (3.60 cm vs. 4.44 cm, P < 0.001). The available uterine space per embryo decreased quadratically with the number of implanted embryos (b1 = - 2.46 +/- 0.18, b2 = 0.13 +/- 0.01), and showed a negative linear regression coefficient with number of dead fetuses (- 0.18 +/- 0.08). The available uterine space affects quadratically the development of the maternal placenta, and to a lesser extent is linearly related to the development of the fetus and its fetal placenta. The coefficients of these regressions were higher in ULO does than intact does, due to the higher degree of uterine overcrowding in these females.
Although the fetal position within the uterus did not affect the proportion of dead embryos, the uterine position could affect the survival of fetuses with a lower available uterine space. A poor blood supply had a negative effect on survival of the fetus and its development. Probability of death for fetuses with placenta receiving less than 3 blood vessels was higher than those receiving more than 3 blood vessels in both ULO and intact does (75.61% vs. 7.32%). Probability of survival asymptotically increases with available uterine space, as a result of the greater availability of uterine space which allows more blood vessels to reach each implantation site. The uterine overcrowding of ULO does was therefore associated with less uterine space and blood supply available at each implantation site, which could be related to higher fetal mortality in these females. Blood supply also affects fetal development. The implantation sites receiving less than 3 blood vessels showed lighter placentas (1.31 g vs. 1.41 g, P < 0.05) and fetuses (2.02 g vs. 2.12 g, P < 0.05) than those receiving more than 3 blood vessels in both ULO and intact does. These results suggest that available uterine space is a limitation component of fetal survival, which is related to an adequate vascular supply for nutrient exchange from the maternal to fetal blood streams and an adequate surface area for development of the placenta.
Keywords: Blood vessels; Fetal development; Placenta; Rabbit; Uterine horn

M. Pascual, M. Pla, Changes in collagen, texture and sensory properties of meat when selecting rabbits for growth rate, Meat Science, Volume 78, Issue 4, April 2008, Pages 375-380, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2007.07.009.
(http://www.sciencedirect.com/science/article/B6T9G-4P6M66N-3/2/ed6f9faab11634b796e47509e8903283)
Abstract:
The consequences of selection for growth rate and the associated decrease of maturity at slaughter in rabbits on collagen content, collagen solubility, meat texture (Warner-Bratzler shear device) and the sensory properties of the m. Longissimus were studied. Sixty rabbits from the 7th generation of a line selected for growth rate (group C) were compared to 60 rabbits from the 23rd generation of the same line (group S). Both groups were contemporarily reared and slaughtered at 2000 g. No changes on collagen content were found, but group S had a higher (5%) collagen solubility. Shear force, shear firmness and area or total work needed to cut the sample were not different between groups, and hardness evaluated in the panel test was not relevantly changed. Most of the sensory properties studied did not differ relevantly between groups. Group S had 8% less aniseed odour and 10% more juiciness.
Keywords: Selection; Collagen; Texture; Sensory analysis; Rabbit; Bayesian analysis

P. Hernandez, V. Cesari, A. Blasco, Effect of genetic rabbit lines on lipid content, lipolytic activities and fatty acid composition of hind leg meat and perirenal fat, Meat Science, Volume 78, Issue 4, April 2008, Pages 485-491, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2007.07.018.
(http://www.sciencedirect.com/science/article/B6T9G-4P7R8D5-2/2/d9ab49b563edbd959bc3e9e575ac637e)
Abstract:
The influence of genetic origin on lipid content, lipolytic activities and fatty acid composition of rabbit leg meat and perirenal fat was studied and changes in free fatty acids and oxidative

parameters during refrigerated storage evaluated. Three rabbits lines were used, line R selected for growth rate and lines V and A selected for litter size at weaning. Line R had higher fat contents and higher lipolytic activities in the meat of the hind leg than lines A and V. Differences between lines were found in the fatty acids of the meat and perirenal fat. Lower SFA and higher PUFA percentages were found in line A. Free fatty acids and oxidative parameters were little influenced by rabbit line. Animals were measured at the same stage of maturity, thus it can be considered that differences found between lines are genetic differences and not differences due to the degree of maturity.
Keywords: Rabbits; Breeds; Lipids; Fatty acids; Lipolysis; Oxidation

R. Rodriguez-De Lara, C. Cedillo-Pelaez, F. Constantino-Casas, M. Fallas-Lopez, M.A. Cobos-Peralta, C. Gutierrez-Olvera, M. Juarez-Acevedo, L.A. Miranda-Romero, Studies on the evolution, pathology, and immunity of commercial fattening rabbits affected with epizootic outbreaks of diarrhoeas in Mexico: A case report, Research in Veterinary Science, Volume 84, Issue 2, April 2008, Pages 257-268, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2007.04.018.
(http://www.sciencedirect.com/science/article/B6WWR-4P2B43M-1/2/ed6c80ad8de0d4337f337613b21f61f8)
Abstract:
Epizootic outbreaks of diarrhoeas have emerged and disseminated in different rabbit farms in Mexico causing great economical losses, during the past years. Seven, 5-weeks-old New Zealand White (NZW) rabbits chosen at random from 35 ill animals that were remitted for postmortem, histopathology, and ultrastructural examinations were studied. Bacteriological and parasitological studies were carried out in three additional ill rabbits of same age. In a field trail 45, 5-weeks-old apparently healthy NZW rabbits were observed daily for sanitary status for a 5-week period. Some of the rabbits did not response to the preventive drug treatment and were therefore, used to study the development of the disease. Clinical signs, gross lesions, and mortality throughout the fattening period were recorded. Eight, 8-weeks-old NZW rabbits who survived an outbreak were assessed for gamma-globulins in serum of the total protein fraction during a 3-week period. Gamma-globulins were also measured in eight free-disease healthy rabbits of same breed and age. Lesions of the small intestine consisted of mucoid enteropathy, lymphocytic plasmocytic enteritis with atrophy and fusion of villi, and hyperplasia of globet cells. Serosal edema was present. Ultrastructural examinations of jejunum and ileum from 3/7 diseased rabbits, revealed enterocytes in apoptosis, mixed with degenerative and/or necrotic changes together with infiltration of lymphocytes, macrophages, neutrophils, and loss of microvillus. There were electron dense structures suggestive of virus particles inside the nuclei and cytoplasm of some enterocytes. There was lymphoid spleen atrophy and proliferation of reticuloendothelial cells in 7/7 rabbits. Interstitial pneumonia in 4/7 rabbits was found. Encephalitozoon cuniculi was detected in the brain of 1/7 rabbits. Escherichia coli were detected in 3/3 cases and Eimeria spp. in 2/3 cases. Mortality rate in the field study was 51.1% and the spread of the disease occur in 9/9 cages. The proportion of gamma-globulins in rabbits who survive an outbreak was much lower (P = 0.0001) than free-disease healthy rabbits (8.1 +/- 1.0 and 14.0 +/- 1.0, respectively). The disease was multifactorial and consisted of sub-acute mucoid enteropathy probably induced by viral infection and aggravated by the proliferation of opportunistic pathogens common to rabbits. This may explain the severe degenerative and necrotic changes observed in the small intestine of diarrhoeic rabbits.
Keywords: Mucoid enteropathy; Escherichia coli; Virus-like particles; Hypogammaglobulinemia; Rabbits

S. Devillard, J. Aubineau, F. Berger, Y. Leonard, A. Roobrouck, S. Marchandeau, Home range of the European rabbit (Oryctolagus cuniculus) in three contrasting French populations, Mammalian Biology - Zeitschrift fur Saugetierkunde, Volume 73, Issue 2, 15 March 2008, Pages 128-137, ISSN 1616-5047, DOI: 10.1016/j.mambio.2007.01.003.

(http://www.sciencedirect.com/science/article/B7GX2-4NYSHBK-2/2/0923bed49a759ae9706b9dbc83db3f3b)
Abstract:
Despite their pest status in numerous areas throughout the World, the populations of European rabbits (Oryctolagus cuniculus) have strongly decreased in South Western Europe since the mid-20th century. Such a decrease constitutes a major threat on top predators and calls for a better understanding of its mechanisms to provide suitable management responses. Infectious diseases have been invoked as the main responsible factors, but they cannot by themselves explain the magnitude of this decrease. Habitat fragmentation may indeed act as a synergetic factor, and habitat use studies are needed to better understand the impact of fragmentation on rabbit population dynamics. We investigated the variability of home range size with respects to age, sex and season in three wild populations of rabbits using telemetry. Home ranges were smaller in the highest density populations (7333 and 6878 vs. 20,492 m2) suggesting differences in habitat quality between the populations. In addition, home range sizes were larger during the reproductive season for both sexes, and adults tended to have smaller home ranges than juveniles. Clearly, the home range sizes reported here were smaller than those previously reported in rabbits.
Keywords: Oryctolagus cuniculus; European rabbits; Home range; Habitat heterogeneity; Fragmentation

Susana Mendez, Christine L. Hatem, Anup K. Kesavan, Javier Lopez-Molina, M. Louise M. Pitt, Arthur M. Dannenberg Jr., Yukari C. Manabe, Susceptibility to tuberculosis: Composition of tuberculous granulomas in Thorbecke and outbred New Zealand White rabbits, Veterinary Immunology and Immunopathology, Volume 122, Issues 1-2, 15 March 2008, Pages 167-174, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2007.11.006.
(http://www.sciencedirect.com/science/article/B6TD5-4R53R7W-1/2/0398828803f4c4d5cbd7c3a994a3b93d)
Abstract:
We sought to characterize the lung cellular immune responses to inhaled Mycobacterium tuberculosis (Mtb) of the susceptible inbred Thorbecke rabbit (the genomically sequenced strain, now unavailable) and compare it to outbred, Mtb-resistant, New Zealand White rabbits. Using Mtb CDC1551, we confirmed that the inbred rabbits allowed establishment of infection with this low virulence strain, compared to poor establishment in outbred rabbits. With a more virulent strain, Mtb Erdman, that establishes infection well in both rabbit strains, we analyzed granulomas from rabbit lungs 5 weeks after aerosol infection. The lung granulomas of inbred rabbits had significantly higher frequencies of cells expressing MHC Class II and CD11b, and lower frequencies of CD8+ T cells than the outbred controls. Macrophage-sized cells expressing MHC Class II in inbred rabbit granulomas showed significantly decreased intensity of expression, suggesting impaired maturation. Although the inbred dermal tuberculin reactions were decreased, the in vitro IFN-[gamma] mRNA responses of hilar node lymphocytes to tuberculin were higher than those of outbred rabbits. Further delineation of the outbred rabbit's resistant immune response to Mtb infection is warranted.
Keywords: Tuberculosis; Rabbit; Host susceptibility; Animal model; Dendritic cell

D. Zapletal, A. Pavlik, The effect of lecirelin (GnRH) dosage on the reproductive performance of nulliparous and lactating rabbit does, Animal Reproduction Science, Volume 104, Issues 2-4, 3 March 2008, Pages 306-315, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2007.02.008.
(http://www.sciencedirect.com/science/article/B6T43-4N3WYJJ-4/2/029a3956b476c6d7e64ee7c77b7b5a53)
Abstract:
The present study attempted to evaluate the effect of different doses of lecirelin intramuscularly administered at the moment of insemination on parameters such as the conception rate, the total

number of rabbits per litter, the number of stillborns per litter and the abortion rate in nulliparous and lactating crossbred rabbit does. The experiment was performed with 295 crossbred female rabbits Hyplus strain PS 19 that were housed in a rabbit farm. Six days before insemination, the light-dark cycles were as follows: 16-h light (70 lx and more):8-h dark, and all does were subcutaneously injected with 25 IU of eCG 48 h before insemination. The doses of lecirelin were as follows: 0.05, 0.1, 0.2, 0.3, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, and 4.0 [mu]g/doe, and were tested in both nulliparous and lactating female does; the doses were applied at the moment of insemination. The conception rate in nulliparous does ranged significantly from 10.0% (0.05 [mu]g) to 89.5% (1.5 [mu]g). The conception rate in lactating does was the lowest at a dose of 0.05 [mu]g (10.0%), as compared with the doses starting from 0.3 [mu]g, and was confirmed statistically significant. The lowest number of rabbits per litter was found at a lecirelin dose of 0.1 [mu]g (6.64). This finding was statistically significant, as compared with doses equal to or exceeding 0.3 [mu]g. No statistical differences were found for doses ranging from 0.3 to 4.0 [mu]g in nulliparous does (9.06 versus 10.29, respectively). The lowest number of rabbits per litter in lactating does was found at a dose of 0.05 [mu]g (8.28) while the highest number of rabbits was detected at a dose of 4.0 [mu]g (10.73), without statistically significant differences among individual doses. Generally, the number of rabbits per litter in lactating rabbit does was higher than that in nulliparous does ($P < 0.05$). One negative finding is that abortions occurred in lactating does at the intramuscular application of a dose equal to or exceeding 1.5 [mu]g, and in nulliparous does at a dose equal to or exceeding 2.0 [mu]g.

Keywords: Rabbit; Lecirelin; GnRH; Artificial insemination; Reproduction performance

P.G. Rebollar, A. Bonanno, A. Di Grigoli, G. Tornambe, P.L. Lorenzo, Endocrine and ovarian response after a 2-day controlled suckling and eCG treatment in lactating rabbit does, Animal Reproduction Science, Volume 104, Issues 2-4, 3 March 2008, Pages 316-328, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2007.02.018.
(http://www.sciencedirect.com/science/article/B6T43-4N56BS1-3/2/717902f49bb1c2861e875c5aa22c3fd5)

Abstract:
Synchronization methods are used to obtain higher fertility when artificial insemination (AI) is applied to lactating rabbit does. The most common methods are eCG administration or temporary doe-litter separation. Nevertheless, drawbacks have been reported, such as negative side effects of hormonal treatment in the doe and low litter growth due to absence of suckling, respectively. Recently, improved reproductive performance (without visible consequences on young rabbit growth), has been obtained by applying a 2-day controlled nursing method before AI, by allowing for a 10 min nursing of the litter 24 h of separation. The present study was undertaken to examine the pituitary (PRL, LH, FSH) and the ovarian response (follicle size and number) to those methods. A total of 442 lactating does inseminated on day 11 post-partum were distributed in three experimental groups: 2CN (closing of nest box on day 9, controlled nursing on days 10 and 11), eCG (20 IU administered on day 9 post-partum) and CONTROL (untreated). Blood samples were obtained from 10 does per group at 48, 24 and 0 h before AI, and 1 h after AI. Both 2CN and eCG treatments similarly improved sexual receptivity (76.3, 77.5 and 58.2%, respectively; $P < 0.001$) and fertility (63.1, 64.1 and 48.4%, respectively; $P < 0.05$) in lactating does, compared to the CONTROL group. Similar plasma FSH levels in all groups of does and sampling times were observed. Due to the absence of suckling, plasma concentration of PRL on day 10 post-partum in the 2CN group was lower than in the CONTROL group ($P < 0.05$); this endocrine change in PRL levels could explain the better reproductive performances obtained with 2CN treatment. At 1 h after exogenous administration of GnRH (at the moment of AI) a high LH response was observed in all groups ($P < 0.001$).
Ovaries from 20 rabbits treated in the same way but uninseminated (2CN, $n = 10$; eCG, $n = 5$; CONTROL, $n = 5$ does) were obtained on day 11 post-partum in order to check the morphometric

status (weight, width and height) and to make histological and immunohistochemical studies to detect growth hormone receptor (GH-R). As a result, synchronization methods did not show any significant difference in relation to the CONTROL group. However, a small increase in the number of primary follicles was evidenced in the 2CN group with respect to the eCG group, similarly to the CONTROL group (23.0 +/- 3.7, 9.4 +/- 4.9 and 14.8 +/- 4.92 primary follicles, respectively; P = 0.1). GH-R immunostaining-presence was more evident in the 2CN and the eCG groups, including primordial follicles and oocytes themselves. Thus, there could have been some direct effects of GH on follicular development, as described in other species. Some ovarian parameters described open new ways to study intra-ovarian mechanism of follicular development in the post-partum period of rabbit does.
Keywords: Rabbit; Lactation; Synchronization; Ovary; Follicles; GH; FSH; LH; PRL

Luca Bonfanti, Giovanna Ponti, Adult mammalian neurogenesis and the New Zealand white rabbit, The Veterinary Journal, Volume 175, Issue 3, March 2008, Pages 310-331, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2007.01.023.
(http://www.sciencedirect.com/science/article/B6WXN-4NBXVS4-2/2/87458e8657d5da9e8881eb2ce188f4eb)
Abstract:
Although the central nervous system is unable to undergo spontaneous repair and is hostile to the integration of exogenously delivered cells, various examples of adult structural plasticity have been shown to occur. It is now widely accepted that endogenous proliferative activity leading to the production of new neurons exists, at least within two restricted brain sites: the hippocampal dentate gyrus and the forebrain subventricular zone. A substantial insight into spontaneous neurogenesis within these allocortical regions in rodents has been obtained, but less is known regarding its occurrence in other mammalian brain regions. In this review, differences in the structural and temporal characteristics of protracted neurogenesis in mammals will be considered. Attention will be focused on the rabbit cerebrum and cerebellum, where unexpected features of structural plasticity have been found to occur despite the relative closeness of the Orders Lagomorpha and Rodentia.
Keywords: Adult neurogenesis; Stem cells; Astrocyte; Radial glia; Chain migration

David Fouchet, Jean-Sebastien Guitton, Stephane Marchandeau, Dominique Pontier, Impact of myxomatosis in relation to local persistence in wild rabbit populations: The role of waning immunity and the reproductive period, Journal of Theoretical Biology, Volume 250, Issue 4, 21 February 2008, Pages 593-605, ISSN 0022-5193, DOI: 10.1016/j.jtbi.2007.10.037.
(http://www.sciencedirect.com/science/article/B6WMD-4R29FT7-5/2/846fa4a2b55d81a97f0ef3442f415027)
Abstract:
Many diseases are less severe when they are contracted in early life. For highly lethal diseases, such as myxomatosis in rabbits, getting infected early in life can represent the best chance for an individual to survive the disease. For myxomatosis, early infections are attenuated by maternal antibodies. This may lead to the immunisation of the host, preventing the subsequent development of the lethal form of the disease. But early infection of young individuals requires specific demographic and epidemiological contexts, such as a high transmission rate of the pathogen agent. To investigate other factors involved in the impact of such diseases, we have built a stochastic model of a rabbit metapopulation infected by myxomatosis. We show that the impact of the pathogen agent can be reduced by early infections only when the agent has a long local persistence time and/or when the host subpopulations are highly connected. The length of the reproductive period and the duration of acquired immunity are also important factors influencing the persistence of the pathogen and thus, the impact of the disease. Besides confirming the role of classical factors in the persistence of a pathogen agent, such as the size of the subpopulation or

the degree of connectivity, our results highlight novel factors that can modulate the impact of diseases whose severity increase with age.
Keywords: Maternal immunity; Infectious diseases; Stochastic model; Metapopulation; Critical community size

Lidija Habjanec, Beata Halassy, Valerija Vdovic, Maja Lang Balija, Jelka Tomasic, Comparison of mouse and rabbit model for the assessment of strong PGM-containing oil-based adjuvants, Veterinary Immunology and Immunopathology, Volume 121, Issues 3-4, 15 February 2008, Pages 232-240, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2007.09.014.
(http://www.sciencedirect.com/science/article/B6TD5-4PT7WW0-C/2/a9366113fe98b779b6fb42062ba872a8)
Abstract:
Peptidoglycan monomer (PGM) is an adjuvant active molecule with potential for use in human and veterinary vaccine. PGM's action is short-lived in mammals hence its effects might be limited. Novel PGM-containing oil-based formulations have been developed recently by incorporation of PGM into Montanide(TM) ISA720 and ISA206 adjuvants with the aim to prolong and improve immunostimulating activities of PGM. In the present work we studied the efficacy of such novel adjuvant formulations using two different antigens, ovalbumin and snake venom, respectively. Novel formulations were also tested in two experimental models, mice and rabbits. In rabbits the incorporation of PGM into oil-based adjuvants led to overall improvement of antigen-specific IgG response. However, in the mouse model, under experimental conditions used, it was not possible to distinguish differences in antigen-specific IgG response among several strong oil-based adjuvant formulations.
Keywords: Peptidoglycan monomer; ISA adjuvants; Mice; Rabbits

P.G. Ferreira, M. Dinis, A. Costa-e-Silva, A.P. Aguas, Adult rabbits acquire resistance to lethal calicivirus infection by adoptive transfer of sera from infected young rabbits, Veterinary Immunology and Immunopathology, Volume 121, Issues 3-4, 15 February 2008, Pages 364-369, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2007.09.005.
(http://www.sciencedirect.com/science/article/B6TD5-4PT7WW0-2/2/a251c6c683287c325fe40885e0d7fb0f)
Abstract:
Calicivirus infection of adult rabbits induces the so-called rabbit haemorrhagic disease (RHD) that kills 90% or more of the infected animals; in contrast, young rabbits (up to 8-week-old animals) are resistant to the same infectious agent. We report that calicivirus inoculation of young rabbits induced moderate titres of antiviral antibodies. When these rabbits reached adulthood, a second calicivirus inoculation resulted in resistance to RHD and boosting of antibody titres in half of the rabbits. Adoptive transfer of sera from calicivirus-infected young rabbits to naive adult rabbits conferred resistance to RHD. We conclude that calicivirus infection of young rabbits induces specific anti-calicivirus antibodies that will protect them from RHD when they reach adulthood.
Keywords: RHDV; Antibody; Passive immunity; Serum; ELISA

Frank Kunzel, Andrea Gruber, Alexander Tichy, Renate Edelhofer, Barbara Nell, Jasmin Hassan, Michael Leschnik, Johann G. Thalhammer, Anja Joachim, Clinical symptoms and diagnosis of encephalitozoonosis in pet rabbits, Veterinary Parasitology, Volume 151, Issues 2-4, 14 February 2008, Pages 115-124, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2007.11.005.
(http://www.sciencedirect.com/science/article/B6TD7-4R53WJ0-2/2/b4967ad43a470c2ba1919525c7abd898)
Abstract:
Infections with Encephalitozoon cuniculi in rabbits are observed at increasing frequency and are known as opportunistic infections in immunocompromised humans. 191 pet rabbits with suspected

encephalitozoonosis, presented at the Animal Hospital of the Veterinary University of Vienna (Austria), were included in this study. Rabbits were serologically examined for antibodies against E. cuniculi (144 positive out of 184 rabbits with suspected encephalitozoonosis compared to 14 positive out of 40 clinically healthy rabbits tested as part of a standard health check) and Toxoplasma gondii (8 positive out of 157). Of the 144 seropositive rabbits with clinical signs, 75% showed neurological symptoms, 14.6% demonstrated phacoclastic uveitis and 3.5% suffered from renal failure. 6.9% of the animals had combined symptoms. Vestibular disease dominated within the rabbits that showed neurological symptoms. Polymerase chain reaction (PCR) could not detect parasite DNA in urine or cerebrospinal fluid (CSF), but did so in 4 out of 5 samples of liquefied lens material in cases with phacoclastic uveitis due to lens capsule rupture. Additionally further diagnostic procedures, such as inspection of the external ear canal (N = 69), radiography of the tympanic bullae (N = 65) were performed to rule out differential diagnosis. 54.2% of the patients exhibiting neurological symptoms recovered within a few days, while 87.5% of the rabbits suffering from renal failure died or had to be euthanized.
Keywords: Encephalitozoonosis; Encephalitozoon cuniculi; Microsporidia; Rabbits; Serology; Polymerase chain reaction (PCR); Neurological symptoms; Phacoclastic uveitis; Renal failure; Toxoplasma gondii

Monica C. Wusteman, Joanne Simmonds, David Vaughan, David E. Pegg, Vitrification of rabbit tissues with propylene glycol and trehalose, Cryobiology, Volume 56, Issue 1, February 2008, Pages 62-71, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2007.10.177.
(http://www.sciencedirect.com/science/article/B6WD5-4R53WF1-5/2/fa79122b5fc34f2313bdb4458af7ec9d)
Abstract:
A previous study had suggested the use of a mixture of propanediol and trehalose for the preservation of tissues by vitrification. In this paper, we describe experiments in which stepwise procedures were developed for adding these cryoprotectants to high final concentrations in two rabbit tissues--carotid artery and cornea. The tissue concentration of the additives was measured at the end of each step so that the temperature of the next step could be chosen to reduce toxicity but avoid freezing. This process was arrested when a concentration had been reached that should permit vitrification if the tissues were cooled rapidly to -175 [degree sign]C. They were stored at that temperature; warmed rapidly by conduction; the cryoprotectants removed by stepwise dilution; and appropriate active functions measured. These were contraction and relaxation for arteries and endothelial integrity and ability to control stromal swelling for the corneas. In control experiments the exposure and functional assays were carried out without vitrification. It was shown that the tissue concentration of propanediol was 33%w/w in artery and 30% in cornea. These permitted cooling to -175 [degree sign]C without freezing but devitrification occurred during the warming of the arteries, though not of the corneas, despite the lower tissue concentration reached in the cornea. The function of the vitrified arteries was severely reduced but the endothelium of the corneas was substantially intact although we were unable to demonstrate any ability to control stromal swelling during normothermic perfusion. It appears that concentrations of cryoprotectants sufficient to prevent freezing in these tissues during cooling were well tolerated so long as appropriate stepwise means of addition and removal were used. Devitrification during warming remained a major problem with arteries, but not with corneas. We suggest that the composition of the aqueous phase in the tissue with respect to components other than the vitrifying agents may be crucial here and that the search for agents that will suppress devitrification is an important avenue for further study.
Keywords: Vitrification; Devitrification; Propylene glycol; Trehalose; Tissue preservation; Carotid artery; Cornea

E. Fernandez-varon, C.M. Carceles, P. Marin, D. Vancraeynest, A. Montes, J. Sotillo, J.D. Garcia-Martinez, Disposition kinetics and pharmacokinetics-pharmacodynamic integration of difloxacin against Staphylococcus aureus isolates from rabbits, Research in Veterinary Science, Volume 84, Issue 1, February 2008, Pages 90-94, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2007.04.002.
(http://www.sciencedirect.com/science/article/B6WWR-4P00S6J-1/2/d7398d1d284a6cdbf55520078764c6c2)
Abstract:
The pharmacokinetics of difloxacin were studied following intravenous (IV), subcutaneous (SC) and oral administration of 5 mg/kg to healthy white New Zealand rabbits (n = 6). Difloxacin concentrations were determined by HPLC assay with fluorescence detection. Minimal inhibitory concentrations (MICs) assay of difloxacin against different strains of S. aureus from different european countries was performed in order to compute the main pharmacodynamic surrogate markers. The plasma difloxacin clearance (Cl) for the IV route was (mean +/- SD) 0.41 +/- 0.05 L/h kg. The steady-state volume of distribution (Vss) was 1.95 +/- 0.17 L/kg. The terminal half-life (t1/2[lambda]z) was (mean +/- SD) 4.19 +/- 0.34 h, 7.53 +/- 1.32 h and 8.00 +/- 0.45 h after IV, IM and oral, respectively. From this data, it seems that a 5 mg/kg dose difloxacin would be effective by SC and oral routes in rabbits against bacterial isolates with MIC [less-than-or-equals, slant] 0.1 [mu]g/mL.
Keywords: Difloxacin; Pharmacokinetics; Pharmacodynamics; S. aureus; MIC; Rabbits

M.D. Vega, A.I. Pena, J. Gullon, C. Prieto, M. Barrio, J.J. Becerra, P.G. Herradon, L.A. Quintela, Sex ratio in rabbits following modified artificial insemination, Animal Reproduction Science, Volume 103, Issues 3-4, 30 January 2008, Pages 385-391, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2007.05.007.
(http://www.sciencedirect.com/science/article/B6T43-4NS0KRW-2/2/905477e2e541ea5c264523360cc91514)
Abstract:
The possibility of modifying the sex ratio of rabbit litters was examined in two experiments involving artificial insemination (AI) with fresh semen. Three time periods of AI, relative to ovulation, were used in Experiment 1: (a) control, GnRH was administered immediately after AI with ovulation estimated to occur 10-12 h after AI; (b) early AI, GnRH was given 6 h after AI so that ovulation was delayed until 16-18 h after AI; (c) late AI, GnRH was administered 6 h before AI, which was performed 4-6 h before ovulation. There were 13 does per treatment, and each doe was used in the same treatment for three AIs at 42-day intervals. The second experiment involved two treatments in which the does were inseminated as for the control in Experiment 1 and AI was performed using semen prepared in the normal manner (Treatment 1) or after centrifugation through 11 discontinuous Percoll gradients (Treatment 2). There were 20 does per treatment, and each doe was used in the same treatment for three AIs at 42-day intervals. The proportion of female kits produced in Experiment 1 was: control 41.7 +/- 19.1%, early AI 49.8 +/- 17.8%, and late AI 41.4 +/- 16.4%. These proportions did not differ significantly between treatments or from the expected 50:50 sex ratio. Fertility was reduced by the early (60.0%) and late (73.7%) AI treatments relative to control AI (80.0%), and the difference between early and control AI almost achieved statistical significance (P < 0.07). In Experiment 2, the proportion of female kits was not affected by treatment (control, 51.1%; Percoll, 54.8%), and there was a similar level of fertility for both treatments (control, 76.0%; Percoll, 74.1%). Prolificacy and perinatal mortality were not affected by treatment in either experiment. It was concluded that neither the timing of insemination nor Percoll centrifugation of semen affected the sex ratio at birth of rabbit litters.
Keywords: Rabbit (Oryctolagus cuniculus); Sex ratio; Artificial insemination; Percoll gradient centrifugation

Eva Skrivanova, Zuzana Molatova, Milan Marounek, Effects of caprylic acid and triacylglycerols of both caprylic and capric acid in rabbits experimentally infected with enteropathogenic Escherichia coli O103, Veterinary Microbiology, Volume 126, Issue 4, 25 January 2008, Pages 372-376, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2007.07.010.
(http://www.sciencedirect.com/science/article/B6TD6-4P6M621-2/2/bd35a52802c77f12808217c2d1ecc292)
Abstract:
Eighty-eight rabbits weaned at the age of 35 days were divided into four groups. Rabbits of the first two groups were fed a granulated feed, free of antimicrobials. Rabbits of the 3rd and the 4th groups were fed the same diet, supplemented with caprylic acid at 5 g/kg, and with triacylglycerols (TAG) of caprylic and capric acid at 10 g/kg, respectively. Rabbits of the 2nd, 3rd and 4th groups were challenged orally with 109 cells of Escherichia coli of the O103 serogroup. Numbers of coliform bacteria in faeces of non-infected rabbits averaged 4.66 log10 cfu/g. Six days after inoculation, caprylic acid and TAG of caprylic and capric acid decreased faecal output of coliforms from 10.18 +/- 0.62 to 7.79 +/- 0.48 log10 cfu/g and 8.04 +/- 0.50 log10 cfu/g, respectively. In the 2nd, 3rd and 4th groups 15, 11 and 9 infected rabbits died, respectively. However, the differences in mortality rate were not statistically significant. Surviving rabbits were slaughtered at 53 days of age. In caecal contents of infected rabbits, numbers of coliform bacteria were significantly reduced from 8.71 log10 cfu/g to 5.55-5.83 log10 cfu/g in treated groups. It can be concluded that both antimicrobial lipids are active against coliform bacteria, and may improve the resistance of weaned rabbits to enterocolitis.
Keywords: Rabbits; Escherichia coli; EPEC; Diarrhoea; Caprylic acid; Capric acid

Shirley C. Seaman, Natalie K. Waran, Georgia Mason, Richard B. D'Eath, Animal economics: assessing the motivation of female laboratory rabbits to reach a platform, social contact and food, Animal Behaviour, Volume 75, Issue 1, January 2008, Pages 31-42, ISSN 0003-3472, DOI: 10.1016/j.anbehav.2006.09.031.
(http://www.sciencedirect.com/science/article/B6W9W-4RCW7X0-1/2/ee62e6a3dbcd5a75b384a2019e8e268e)
Abstract:
We used novel techniques for assessing resource value to investigate what additions to a barren cage female laboratory rabbits, Oryctolagus cuniculus, value. We tested motivation to reach two resources that are potentially practical enrichments: a platform (providing a partly enclosed space and a raised area) and limited social contact with another rabbit through wire mesh and compared these to food and an empty space. To reach these resources, rabbits had to pay entry costs (pushing through weighted doors) which increased every 2 days. With rising costs, rabbits generally rescheduled their behaviour, often reducing visit number and increasing visit length. Measures from economics and behavioural ecology ranked the relative importance of resources similarly (food >= social contact >= platform > empty cage). `Travel cost consumer surplus' (the area under a demand curve of price versus number of visits) ranked food and social contact similarly, but higher than the platform; `aggregate consumer surplus' (the area under a plot of weight against the number of rabbits paying each price level for the resource) placed food higher than both social contact and the platform; `reservation price' (maximum weight pushed) did not discriminate between the three resources; and `expenditure rate' (weight x visits/days) again ranked food and social contact similarly, but higher than the platform. Overall, rabbits' motivation for access to limited social contact thus came close to that for food, suggesting that they value this highly. Rabbits were almost as strongly motivated to be near a platform, but rarely used it, suggesting it might serve a `bolt hole' function.
Keywords: access costs; animal economics; consumer demand; laboratory rabbit; motivation; Oryctolagus cuniculus; resource value

Gregory O. Hughes, Wilfried Thuiller, Guy F. Midgley, Kai Collins, Environmental change hastens the demise of the critically endangered riverine rabbit (Bunolagus monticularis), Biological Conservation, Volume 141, Issue 1, January 2008, Pages 23-34, ISSN 0006-3207, DOI: 10.1016/j.biocon.2007.08.004.
(http://www.sciencedirect.com/science/article/B6V5X-4R2XCX1-1/2/ffc7036091c3ee38225162dd1f11b994)
Abstract:
Declining population numbers coupled with the growing evidence of global change have focussed attention on the critically endangered riverine rabbit (Bunolagus monticularis) endemic to South Africa. The aim of this study is to develop a habitat model to aid in the identification of isolated populations, offer opportunities for re-introduction or introduction, and guide future conservation efforts by assessing the possible impacts of global change. We attempt a novel approach where plant species which afford the riverine rabbit cover from predation and its primary food sources are modelled utilising the same technique and are included as a predictor variable in the habitat model for both current and future projections of potential habitat. Inclusion of this proximal variable as well as riparian areas yields a more parsimonious habitat model than using climatic variables alone. Results suggest that unsurveyed suitable habitat east of Victoria West might harbour previously overlooked isolated populations or offer new opportunities for re-introductions. Future climatic conditions under the most severe general circulation model for the region (HADCM3) suggest that, on average, in excess of 96% of the current habitat could become unsuitable, mitigated only slightly by a possible 7% increase in range in adjacent upper catchment areas. Consideration of existing land transformation increases this range reduction by a further 1%. Given that ex situ captive breeding programmes have met with no success and that the bulk of future potential range lies well outside of the currently known and surveyed areas the current adaptation options of conservancy establishment and captive breeding need to be re-evaluated. Without positive human intervention the future of the critically endangered riverine rabbit under conditions of global change seems certain.
Keywords: Riverine rabbit; Habitat model; Global change; land transformation; Conservation

S.A. Rafat, H. de Rochambeau, R.G. Thebault, I. David, S. Deretz, M. Bonnet, B. Pena-Arnaud, D. Allain, Divergent selection for total fleece weight in Angora rabbits: Correlated responses in wool characteristics, Livestock Science, Volume 113, Issue 1, January 2008, Pages 8-13, ISSN 1871-1413, DOI: 10.1016/j.livsci.2007.02.012.
(http://www.sciencedirect.com/science/article/B7XNX-4NCKK7R-1/2/d218c7d46047a56ff16cc7119474053a)
Abstract:
An experiment was carried out to study direct and indirect responses to selection in the Angora rabbit. There were two selection lines, one selected for high fleece weight and the other for low fleece weight. Data from 669 female rabbits born in 1994-2001 and having produced a total of 2923 harvest of wool were analysed to quantify the correlated responses to selection. By 2001, there had been eight cohorts of selection. The correlated responses analysed included compression, resilience, fleece quality traits (bristle and down length, average fibre diameter, comfort factor, bristle diameter) and secondary to primary follicle ratio (S/P). Genetic correlations were obtained by restricted maximum likelihood techniques. In response to selection, a positive difference of 0.92, 0.21 and 0.55 genetic standard deviation were observed for bristle length, comfort factor and S/P, respectively. No correlated response was observed on down length while negative differences of 1.00, 1.31, 0.38 and 0.50 genetic standard deviations were observed for compression, resilience, bristle diameter and average fibre diameter, respectively. Selection for increasing total fleece weight results in an increase of qualitative component traits of wool production in the French Angora rabbit. The quantitative traits were examined in the first (published) part of the paper.

Keywords: Angora rabbit; Bristle; Divergent selection; Down; Fibre diameter; Follicle; Wool

Zoran Jaglic, Edita Jeklova, Lenka Leva, Vladimir Kummer, Zdenka Kucerova, Martin Faldyna, Jarmila Maskova, Katerina Nedbalcova, Pavel Alexa, Experimental study of pathogenicity of Pasteurella multocida serogroup F in rabbits, Veterinary Microbiology, Volume 126, Issues 1-3, 1 January 2008, Pages 168-177, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2007.06.008.
(http://www.sciencedirect.com/science/article/B6TD6-4P0DJS2-3/2/d3509fa2a0ea0f98f81e8f0540a1a9e9)
Abstract:
The role of Pasteurella multocida serogroup F in inducing disease in rabbits was investigated in this study. Three groups of 12 Pasteurella-free rabbits each were intranasally (i.n.), subcutaneously (s.c.), and perorally (p.o.) challenged, respectively. Six rabbits of each group were immunosuppressed using dexamethasone.
Eight rabbits (four of them immunosuppressed) inoculated i.n. showed symptoms of respiratory distress resulting in respiratory failure and died or were euthanized in the terminal stage of the disease 3-6 days post-infection (p.i.). The main pathological findings were fibrinopurulent pleuropneumonia (immunocompetent rabbits) or diffuse haemorrhagic pneumonia (immunosuppressed rabbits). Septicemic syndrome ending with shock occurred in 11 rabbits (6 of them immunosuppressed) inoculated s.c., which died or were euthanized in the terminal stage of the disease 2-3 days p.i. The most significant pathological findings were extensive cutaneous and subcutaneous lesions. All of the p.o. inoculated rabbits survived the challenge showing no clinical signs of the disease and no macroscopic lesions.
The observations in this study indicate that in addition to serogroups A and D of P. multocida, serogroup F also can be highly pathogenic for rabbits and therefore might be a cause of considerable economic loss in commercial rabbit production.
Keywords: Pasteurella multocida; Serogroup F; Rabbit; Pasteurellosis

Chengru Zhu, Shuzhang Feng, Venessa Sperandio, Zhuolu Yang, Timothy E. Thate, James B. Kaper, Edgar C. Boedeker, The possible influence of LuxS in the in vivo virulence of rabbit enteropathogenic Escherichia coli, Veterinary Microbiology, Volume 125, Issues 3-4, 15 December 2007, Pages 313-322, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2007.05.030.
(http://www.sciencedirect.com/science/article/B6TD6-4P0082M-1/2/b525e97e4777e28b251b7d3f75aee043)
Abstract:
Attaching and effacing (A/E) organisms, such as rabbit enteropathogenic Escherichia coli (EPEC), human EPEC or enterohemorrhagic E. coli (EHEC) share attaching and effacing phenotype and LEE pathogenicity island responsible for A/E. The present study was undertaken to investigate the impact of the LuxS quorum sensing (QS) signaling system in vitro and in vivo pathogenicity of A/E organisms using rabbit EPEC (rEPEC) strain E22 (O103:H2). Analysis of the bioluminescence indicated abolished production of the QS signal AI-2 by luxS mutant (E22[Delta]luxS). Strain E22[Delta]lux also exhibited impaired expression of several normally secreted proteins and reduced adherence to cultured HeLa cells. Complementation of the intact luxS gene to E22[Delta]luxS restored secreted protein expression comparable to the WT type but not adherence to HeLa cells. In experimentally infected rabbits, the isogenic luxS mutant induced clinical illness and intimate adherence to the intestinal mucosa, albeit to a less extent, comparable to that seen with the parent virulent strain. It is worth noting that reduced fecal bacterial shedding, mucosal adherence and improved cumulative weight gain were seen for the mutant strain complemented with luxS when compared to the WT. It appears that the luxS gene is not essential for in vivo pathogenicity by rEPEC where exogenous QS signals are present in the gut. The impact of AI-2 provided by multicopy plasmid on bacterial virulence is discussed.
Keywords: Quorum sensing; Autoinducer; LEE; Regulation

L. Meulemans, K. Hermans, L. Duchateau, F. Haesebrouck, High and low virulence Staphylococcus aureus strains in a rabbit skin infection model, Veterinary Microbiology, Volume 125, Issues 3-4, 15 December 2007, Pages 333-340, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2007.05.024.
(http://www.sciencedirect.com/science/article/B6TD6-4NYJ0S3-5/2/9f50f87399e791bca95908919add03eb)
Abstract:
In the present study, an in vivo rabbit skin infection model was developed to reproduce the lesions caused by high and low virulence Staphylococcus aureus strains from rabbits. 'O'-shaped dermal skin lesions were induced on the shaved flanks of anaesthetised rabbits using a tattoo pin and pincers. The induced lesions on the flanks of four groups of 10 rabbits were then inoculated by topical application of 0.1 ml of 108 cfu S. aureus bacteria. One group was inoculated with a typical high virulence (HV) S. aureus strain from rabbits, one group received an atypical HV strain and two groups were inoculated with low virulence (LV) strains. Five animals were kept as negative controls. The development, appearance and size of abscesses were scored daily for a period of 2 weeks. The infection model showed reproducible results for the different S. aureus inoculation groups. Inoculation of the skin with the typical HV strain resulted in significantly larger abscesses than those caused by the LV strains. The atypical HV strain caused abscesses of a size intermediate to that obtained with the HV and LV strains. In rabbits infected with LV strains, most of the lesions had healed by day 14 post-inoculation. The devised infection model is able to reliably reproduce the virulence properties of HV and LV S. aureus strains.
Keywords: Staphylococcus aureus; Rabbit; Skin; Infection model

Vanessa Neto, Thierry Joly, Pascal Salvetti, 61. Ovarian tissue cryopreservation in the doe rabbit: from freezing to birth, Cryobiology, Volume 55, Issue 3, December 2007, Page 344, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2007.10.064.
(http://www.sciencedirect.com/science/article/B6WD5-4R69YNR-26/2/c7845d2b41b984760b97861042b7c8fd)

Pascal Salvetti, Thierry Joly, Jean-Paul renard, 119. Viability of rabbit embryos after 14 years storage in liquid nitrogen, Cryobiology, Volume 55, Issue 3, December 2007, Page 364, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2007.10.122.
(http://www.sciencedirect.com/science/article/B6WD5-4R69YNR-48/2/cb50f64739c05944942675319db150ae)

M. Pascual, M. Pla, Changes in carcass composition and meat quality when selecting rabbits for growth rate, Meat Science, Volume 77, Issue 4, December 2007, Pages 474-481, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2007.04.009.
(http://www.sciencedirect.com/science/article/B6T9G-4NKJ0MR-7/2/db483c522274627b316c4c48acf5e59f)
Abstract:
Sixty rabbits from the 23rd generation (group S) of a line selected for growth rate were compared to sixty rabbits from the 7th generation of the same line (group C) to study possible relevant changes in carcass composition and meat quality due to the selection and the consequent decrease in degree of maturity at slaughter weight (2000 g). The only relevant changes in carcass composition were an increase in kidneys, liver and dissectible fat percentages and a decrease in meat to bone ratio of the hind leg. In m. Longissimus, group S had lower yellowness of the carcass and higher redness and yellowness of the meat. ICDH activity increased and the aldolase:ICDH ratio decreased. In the hind leg, group S had higher values of PUFA, PUFA/SFA ratio and n - 3 fatty acids.

Keywords: Selection; Carcass composition; Meat quality; Rabbit; Bayesian analysis

D. Fabian, A.V. Makarevich, P. Chrenek, A. Bukovska, J. Koppel, Chronological appearance of spontaneous and induced apoptosis during preimplantation development of rabbit and mouse embryos, Theriogenology, Volume 68, Issue 9, December 2007, Pages 1271-1281, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2007.08.025.
(http://www.sciencedirect.com/science/article/B6TCM-4R0CVN0-3/2/a8247833a9be895b32b0ea74429026c8)
Abstract:
This study was undertaken to obtain specific information on the characteristics of spontaneous and induced apoptosis during preimplantation development of rabbit in vivo and in vitro developed embryos and mouse in vitro embryos. After reaching appropriate developmental stages, embryos were transferred into culture media with or without apoptotic inductor (actinomycin D 500 ng/mL) and cultured for 10 h. The identification of apoptotic cells was based on morphological assessment of nuclei and on detection of specific DNA degradation, phosphatidylserine redistribution and active caspase-3 under fluorescence microscope.
Our experiments proved that apoptosis is a frequent physiological event occurring during normal preimplantation development. A high number of untreated rabbit and mouse blastocysts contained at least one apoptotic cell. Rabbit embryos showed a lower incidence of spontaneous apoptosis. Treated blastocysts of both species responded to the presence of apoptotic inductor by significant decrease in the average number of blastomeres and significant increase in the incidence of apoptotic cell death. The occurrence of spontaneous apoptosis during earlier preimplantation development was sporadic and its presence was observed only at stages following embryonic genome activation (at 4-cell stage and later in mouse, at 16-cell and morula stage in rabbit). The susceptibility of embryos at early stages to the apoptotic inductor was much lower. The presence of actinomycin D did not increase the incidence of apoptotic embryos or apoptotic cells. Nevertheless, it slowed down embryo growth and triggered earlier appearance of some apoptotic features (at the 6-cell stage in rabbit). The results show that the occurrence of both spontaneous and induced apoptosis in preimplantation embryos is stage- and species-specific.
Keywords: Apoptosis; Preimplantation embryo; Rabbit; Mouse; Actinomycin D

M. Reglero, J. Vicente, C. Rouco, R. Villafuerte, C. Gortazar, Trypanosoma spp. infection in wild rabbits (Oryctolagus cuniculus) during a restocking program in Southern Spain, Veterinary Parasitology, Volume 149, Issues 3-4, 10 November 2007, Pages 178-184, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2007.08.001.
(http://www.sciencedirect.com/science/article/B6TD7-4PPNMN1-2/2/376e68ebfb90963e6ab494934f1e045e)
Abstract:
The effect of parasites on managed rabbit populations may prove crucial to develop sanitary strategies during restocking programs of such key prey species. We investigated natural infection of European wild rabbits (Oryctolagus cuniculus) with Trypanosoma spp. in Spain. By fencing part of the warrens during a rabbit restocking program, we induced host variation in rabbit density across these socio-spatial units. We aimed (i) to compare Trypanosoma spp. infection spread between fenced and open warrens and (ii) to assess the relationship between body condition and infection. Trypanosoma spp. parasitaemia peaked in juveniles and decreased onwards. Adult females showed statistically higher infection rates than males. Rabbits from fenced warrens presented statistically higher infection rates than those from open ones, but did not differ in body condition. Parasite abundance negatively correlated with body condition in adults. Sex differences could resemble increased susceptibility to infection in females as a cost of reproduction and/or a higher exposition inside the warrens. Future studies should clarify whether aggregation caused enhanced exposition to intermediate hosts (fleas) and subsequent transmission of the parasite,

and we stress that the study of non-lethal parasites during restocking programs provides valuable information on host contact rates and on factors affecting disease susceptibility.
Keywords: Body condition; Density dependence; Oryctolagus cuniculus; Parasites; Restocking; Trypanosoma spp

Katalin Csatadi, Bilko Agnes, Altbacker Vilmos, Specificity of early handling: Are rabbit pups able to distinguish between people?, Applied Animal Behaviour Science, Volume 107, Issues 3-4, November 2007, Pages 322-327, ISSN 0168-1591, DOI: 10.1016/j.applanim.2006.10.013.
(http://www.sciencedirect.com/science/article/B6T48-4MXSY4V-1/2/b6c8160c1acb73f990b482014ffcb168)
Abstract:
Rabbits' early life contains a short period when pups are extremely sensitive to novel stimuli and become accustomed to it. If they are handled by the hand during this period their avoidance toward humans decreases. The present study investigated whether pups could distinguish between humans by performing an experiment where different persons handled and tested the rabbits' behaviour toward humans while the control group was left untouched. Handling occurred during the first week of the pups' life and their behaviour in an approach test was measured when they were 4 weeks old. We found that the pups did not behave differently toward neither of the testers, but they interacted significantly more frequently with the familiar person than with the unfamiliar one. Rabbits in the handling treatment approached the experimenters significantly sooner than the non-handled ones, regardless of whether the familiar or the unfamiliar person conducted the test. We also found that non-handled pups compared to both of the handled groups moved significantly less during the test. We can conclude that rabbits might be able to distinguish between humans and this may have applied indications.
Keywords: Handling; Rabbit; Human; Distinguish

M.P. Viudes-de-Castro, R. Lavara, F. Marco-Jimenez, C. Cortell, J.S. Vicente, Ovulation induced by mucosa vaginal absorption of buserelin and triptorelin in rabbit, Theriogenology, Volume 68, Issue 7, 15 October 2007, Pages 1031-1036, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2007.08.004.
(http://www.sciencedirect.com/science/article/B6TCM-4PMYXC3-1/2/791f79e67c474befe0e083ff20c7e5d1)
Abstract:
The aim of this study was to evaluate the supplementation of semen extender with two synthetic GnRH analogues (buserelin and triptorelin) to induce ovulation in rabbit does submitted to artificial insemination. In a first experiment, 255 receptive multiparous does were inseminated with 0.5 mL of Tris-citrate-glucose extender supplemented or not with two GnRH synthetic analogues. Experimental groups were: NC (not supplemented extender), PC (not supplemented extender and does treated with 1 [mu]g of buserelin i.m.), B2 (2 [mu]g per female buserelin supplemented extender), B5 (5 [mu]g per female buserelin supplemented extender), T2 (2 [mu]g per female triptorelin supplemented extender) and T5 (5 [mu]g per female triptorelin supplemented extender). Thirteen does of NC females ovulated, reaching an ovulation rate similar to the other groups. Ovulation rate was similar in all groups (11.4-12.5). The efficiency of ovulation induction was very low (32.5%) in NC group and showed the higher results in PC females (97.8%). Only B5 females reached similar ovulation induction response than PC group. In a second experiment, 702 receptive does were inseminated to compare fertility and prolificacy parameters from the conventional insemination technique (control group, females treated with 1 [mu]g per female of buserelin intramuscularly) versus a supplementation with buserelin or triptorelin (5 [mu]g per female) in semen extender (B5 and T5 groups, respectively). Fertility and prolificacy parameters were similar among the groups (77.8% fertility rate, 73.9% kindling rate, 9.4 live born and 9.9 total born). This study demonstrate the possibility of ovulation induction in rabbits by adding two GnRH

synthetic analogues in the seminal doses and open up new prospects for changing rabbit insemination procedures.
Keywords: Rabbit; Ovulation induction; Buserelin; Triptorelin; Fertility

S.J. Eady, H. Garreau, A.R. Gilmour, Heritability of resistance to bacterial infection in meat rabbits, Livestock Science, Volume 112, Issues 1-2, Special section: Non-Ruminant Nutrition Symposium, October 2007, Pages 90-98, ISSN 1871-1413, DOI: 10.1016/j.livsci.2007.01.158.
(http://www.sciencedirect.com/science/article/B7XNX-4N6NHSJ-1/2/f603a5b7bd4583d56b58175e9abdca16)
Abstract:
Incidence of visual signs of bacterial infection and mortality, from causes related to bacterial infection, were recorded on a weekly basis in growing meat rabbits from 5 to 10 weeks of age. Heritability of Weekly Incidence of disease was highest in weeks 9 and 10 (0.05 +/- 0.02 and 0.06 +/- 0.02, respectively with linear model, and 0.10 +/- 0.06 and 0.12 +/- 0.05, respectively with a threshold model). Common litter effects accounted for 5-20% of the variance of disease incidence, while maternal genetic variance was small (0-3%). Individuals from small litters at weaning had higher disease incidence, and disease incidence reduced as litter parity of the doe increased ($P < 0.05$), when the disease trait was measured at week 9 and 10, but not for earlier weeks. Genetic correlations between disease incidence and mortality were imprecise and not different from zero. Phenotypic correlations were low to moderate, and positive. Although the mechanism at this stage is unknown, these findings suggest that there are common/shared immunological responses to bacterial challenge that are under genetic control. This study demonstrates that observed signs of bacterial infection in rabbits can be used as an indicator trait for resistance to bacterial infection, and the heritability of the trait is high enough to warrant further evaluation of the merit of including it in a breeding program. From one week to the next, rabbits exhibiting disease symptoms were more likely (10 to 50 times depending on week of measurement) to die than those that were healthy. The relative economic value of resistance to bacterial infection could be based on the relationship between disease incidence and survival, as well as the direct costs of effective disease control and treatment.
Keywords: Disease resistance; Breeding program; Pasteurella multocida; Staphylococcus aureus; Microbial antibiotic resistance

H. Moyaert, A. Decostere, M. Baele, K. Hermans, P. Tavernier, K. Chiers, F. Haesebrouck, An unusual Actinobacillus equuli strain isolated from a rabbit with Tyzzer's disease, Veterinary Microbiology, Volume 124, Issues 1-2, 20 September 2007, Pages 184-186, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2007.04.013.
(http://www.sciencedirect.com/science/article/B6TD6-4NFH0BB-H/2/8974c89f43284cfdea44ea27743571a6)
Abstract:
Actinobacillus equuli was isolated in pure culture from the liver and lungs of an adult rabbit with Tyzzer's disease (Clostridium piliforme). Based on the haemolytic features on blood agar plates, a positive reaction in the CAMP-test, hydrolysis of esculin, the inability to ferment l-arabinose, tDNA-PCR and sequencing of the 16S rRNA gene, the isolate was classified as A. equuli subsp. haemolyticus biovar 1. However, the aqxA gene, characteristic for haemolytic A. equuli strains, was not detected by PCR.
Keywords: Actinobacillus equuli; Rabbit

William C. Davis, Karel Drbal, Abdel-El-Aziz A.E. Mosaad, Abdel-Rahman M. Elbagory, Ahmed Tibary, George M. Barrington, Yong Ho Park, Mary Jo Hamilton, Use of flow cytometry to identify monoclonal antibodies that recognize conserved epitopes on orthologous leukocyte differentiation antigens in goats, lamas, and rabbits, Veterinary Immunology and Immunopathology, Volume 119,

Issues 1-2, HLDA8 Animal Homologues, 15 September 2007, Pages 123-130, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2007.06.024.
(http://www.sciencedirect.com/science/article/B6TD5-4P2S8X5-3/2/a2cd3627300037cf5b93ebb88ecbcbac)
Abstract:
Flow cytometry was used to screen a panel of 320 mAbs, submitted to the Animal Homologues Section of the HLDA8, for mAbs that recognize epitopes conserved on orthologous leukocyte differentiation antigens (LDA) in goats, lamas, and rabbits. Nineteen mAbs specific for CD11a (1), CD14 (3), CD18 (1), CD21 (1), CD29 (2), CD44 (2), CD47 (3), CD49d (1), CD172a (1), CD45RB (1), CD61 (1), RACT48A, and GBSP71A reacted with goat LDA. Twenty three mAbs specific for CD7 (1), CD9 (2), CD11a (1), CD14 (3), CD18 (4), CD29 (1), CD32 (1), CD44 (1), CD47 (4), CD49d (2), CD50 (1), CD80 (1), CD172a (1), and GBSP71A reacted with llama LDA. Eighteen mAbs specific for CD9 (2), CD11a (1), CD14 (2), CD18 (4), CD21 (1), CD44 (2), CD45RB (1), CD49d (1), CD209 (1), RACT48A, and GBSP71A reacted with rabbit LDA. The specificities of two cross reactive mAbs that recognize different conserved epitopes on all leukocytes in two species (RACT48A) and all three species (GBSP71A) have not been determined. The patterns of reactivity of most of the mAbs were consistent with patterns of reactivity noted on human leukocytes. The specificity of some cross reactive mAbs generated in non-human species were validated on human leukocytes. Further studies are needed to verify that CD7, CD32, CD45RB, CD50, and CD209 recognize orthologous molecules in the indicated species.
Keywords: Monoclonal antibody; Leukocyte differentiation antigens; Goat; Rabbit; Llama

J. Sinkora, P. Samankova, V. Kummer, L. Leva, J. Maskova, Z. Rehakova, M. Faldyna, Commercially available rabbit anti-human polyclonal antisera as a useful tool for immune system studies in veterinary species, Veterinary Immunology and Immunopathology, Volume 119, Issues 1-2, HLDA8 Animal Homologues, 15 September 2007, Pages 156-162, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2007.06.023.
(http://www.sciencedirect.com/science/article/B6TD5-4P29K6X-2/2/b439d209aa4fb2ccd562573b638598ff)
Abstract:
We have used selected rabbit anti-human polyclonal antibodies as an example of useful and easily available tools for studies on immune system structure and development in important veterinary species, many of which also represent animal models in biomedicine. The cocktail of anti-human Ig[kappa]-FITC/anti-Ig[lambda]-RPE F(ab')2 fragments was used for two-colour and, in combination with the cross-reactive anti-CD79[alpha] monoclonal antibody HM-57, for three-colour flow cytometry of canine, feline, bovine and porcine peripheral B-cells. A possible application of such immunoreagents in studies on primary B-cell differentiation has been suggested in pigs; the same approach can be used in other species of interest. Rabbit anti-human lactoferrin-FITC F(ab')2 fragment was used for visualizing neutrophils in dogs, pigs and cattle and an application for two-colour immunophenotyping of canine granulocyte subsets has been designed. Affinity isolated rabbit anti-human CD3 and anti-human TdT have been shown to represent a ready-to-use tool for in situ studies on primary T-lymphopoiesis in pigs with possible extensions both to the B-lineage development in pigs and other animal models. Altogether, our study show that carefully selected polyclonal antibodies available on the market may possess broad cross-reactivity with important applications in veterinary research.
Keywords: Canine; Porcine; Bovine; Feline; Lactoferrin; TdT; Immunoglobulin light chain; Flow cytometry; Immunohistochemistry

Ludgarda Lombardi, Nestor Fernandez, Sacramento Moreno, Habitat use and spatial behaviour in the European rabbit in three Mediterranean environments, Basic and Applied Ecology, Volume 8, Issue 5, 3 September 2007, Pages 453-463, ISSN 1439-1791, DOI: 10.1016/j.baae.2006.09.004.

(http://www.sciencedirect.com/science/article/B7GVS-4M877S1-1/2/f03b1a20bbc0a4f76e57991d4ef7cd9e)
Abstract: Summary
The abundance and behaviour of mammalian prey species such as the European rabbit (Oryctolagus cuniculus) are known to be regulated by the availability of both food for maintenance and reproduction and shelter for protection against predators and harsh weather. However, the effect of vegetation structure and temporal variations in food availability on habitat selection and spatial behaviour are still poorly understood. The present study investigated the relationship between rabbit spatial ecology and vegetation structure and food quality and quantity in three neighbouring areas in SW Spain that differed in the distribution and amount of refuge sites and food patches. In all, 35 rabbits were radiotracked in the three study areas and home range and core area sizes in different seasons and at different times of the day estimated. Spatial behaviour was then compared with parameters of vegetation cover and food quantity and quality. Lastly, rabbit habitat selection at two levels was studied: home range selection and selection within home ranges. Home range size varied from one study area and season to another, but was not dependent on either sex or the availability or quality of food. We suggest that differences in home range size between study areas respond to differences in vegetation cover, with smaller home ranges in areas with higher proportion of sheltering vegetation. It was found that habitat selection patterns varied between the three areas in terms of the need for rabbits to exploit to a maximum the scarcest resource in each situation, thereby optimising access to both feeding and refuge patches. This pattern was manifest at the home range level of habitat selection but not at the level of selection within home ranges. Findings were consistent with the high behavioural plasticity of the European rabbit in its native habitats and provide useful information for habitat management.
Keywords: Donana National Park; Food quality; Habitat selection; Home range size; Mediterranean ecosystems; Oryctolagus cuniculus; Predation risk; Prey behaviour; Resource availability

H.G. Rodel, Gudrun Wibbelt, Anett Starkloff, D. von Holst, Postnatal remains of the foetal membranes affect growth and survival of wild European rabbit pups, Mammalian Biology - Zeitschrift fur Saugetierkunde, Volume 72, Issue 5, 3 September 2007, Pages 313-319, ISSN 1616-5047, DOI: 10.1016/j.mambio.2006.10.009.
(http://www.sciencedirect.com/science/article/B7GX2-4N3H10G-1/2/b87716898e75fbf098d6463fd284e5bb)
Abstract:
During a long-term study on reproduction of the European rabbit (Oryctolagus cuniculus L.) that was carried out on a population living under semi-natural conditions, occasionally single pups per litter were discovered being stuck in remnants of the foetal membranes. Here we describe this so far unknown phenomenon, quantify the occurrence, and investigate the consequences for the individual growth rate and for survival. Furthermore, we tested if maternal social rank and age were correlated with the occurrence of this phenomenon. Pups comprising the described adherence of the foetal membranes had lower growth rates than their unaffected litter siblings, and usually died during the nestling period or short after emergence above ground. Our findings point out that there was an individual predisposition of the mother for having affected litters. However, an impact of maternal social rank or age on the occurrence of this feature in their offspring was not supported by our data. Nevertheless, a pathological background also has to be considered as a possible cause.
Keywords: Oryctolagus cuniculus; early ontogeny; nest mortality; parturition

Cs. Eiben, G. Tobias, K. Kustos, K. Godor-Surmann, Sz. Kotany, B. Gulyas, G. Szira, The change of nursing for oestrus induction (biostimulation): Effect of contact between rabbit doe and its

young, Livestock Science, Volume 111, Issue 3, September 2007, Pages 193-203, ISSN 1871-1413, DOI: 10.1016/j.livsci.2007.01.146.
(http://www.sciencedirect.com/science/article/B7XNX-4N3H17X-7/2/48791b24dac404e2bb13598a18def07d)
Abstract:
This study focused on the effects on subsequent reproductive traits of females and development of the current litter as a result of different contact between the rabbit doe and its progeny when a temporary doe-litter separation was used for biostimulation. Immediately after parturition and adjusting to eight young per litter, multiparous Pannon White rabbit does (n = 400) were divided into five groups based on parity, doe condition, and weight of litter and the kits. Rabbits in the control group (C) nursed freely up to weaning at 35 days of age. In the group following local farm practice (F) using a metal-plate for separation, females nursed once a day (8 am to 9 am) for the first 14 days of lactation and freely afterwards. In three biostimulation groups, there was a change from free to once a day nursing before insemination (i.e. controlled nursing at 8, 9 and 10 days) provided with a wire-mesh separation (BW: permits visual, olfactory, and acoustic contact); using a metal-plate for separation (BM: no visual but possible olfactory, acoustic and vibration contact); or with taking the litter with the nest-tray 5 m away from the doe's cage (BN: there is no contact at all) and returning to free nursing just after AI (at 11 days in the morning) up to weaning. The type of separation exerted a significant influence on oestrus and subsequent kindling of does. Comparing C, F, BW, BM and BN groups, sexual receptivity (30.4, 45.4, 24.0, 25.6, 43.0%, respectively; $P < 0.05$), fertility (74.4, 84.2, 80.8, 80.3, 89.5%; $P < 0.05$) and kindling rates (71.1, 85.5, 76.9, 77.3, 88.2%, respectively; $P < 0.05$) improved in F and BN groups. The total number of kits born (10.0, 10.3, 10.5, 10.4, 9.55, respectively; $P = 0.392$) and kits born alive per litter (9.25, 9.65, 9.59, 9.83, 9.03, respectively; $P = 0.607$) were not affected, but newborn kit weight was numerically less in the BW group (69.7, 67.5, 65.5, 67.6, 67.3 g, respectively; $P = 0.166$). Growth rates of current progeny up to weaning were higher and identical in C and BM but less in F and BN groups (27.5, 25.6, 27.1, 27.3, 26.7 g/day, respectively; $P = 0.001$). However, the total weight of 70-day-old rabbits per doe did not differ significantly (17.51, 17.53, 17.54, 16.81, 15.81 kg, respectively; $P = 0.271$). On the whole, the production of the F, BM and BN groups was superior to that of the control and BW groups since subsequent kindling results improved without a significant reduction in slaughter rabbits per doe from current litters.
Keywords: Rabbit; Reproduction; Behaviour; Welfare

Edita Jeklova, Lenka Leva, Hana Kudlackova, Martin Faldyna, Functional development of immune response in rabbits, Veterinary Immunology and Immunopathology, Volume 118, Issues 3-4, 15 August 2007, Pages 221-228, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2007.05.003.
(http://www.sciencedirect.com/science/article/B6TD5-4NWKCKT-2/2/04c69a48c4fa6619847c21826cb52a12)
Abstract:
The aim of our study was to extend knowledge concerning postnatal development of the immune system in rabbits from two aspects. Firstly, capability of lymphocytes from peripheral blood, spleen, mesenteric, and popliteal lymph nodes to respond to Concanavalin A stimulation was investigated. Secondly, changes in the ability to produce antibodies against tetanus toxoid by rabbits during maturation were studied. Proliferation of lymphocytes was reduced in mesenteric lymph nodes in newborns, in PB up to the age of two weeks, and in popliteal lymph nodes up to the age of four weeks when compared to adults. High spontaneous lymphocyte proliferation that lasted up to the age of two weeks was recorded in spleen. The study of antibody response showed that even one-day-old rabbits were able to form specific antibodies of isotype IgM and IgG. Nevertheless, significantly lower formation of both isotypes was noted in one-day and two-week-old rabbits, and commencement of IgG isotype formation was delayed in one-day, two-week, and four-week-old rabbits when compared to adults.

Keywords: Lagomorpha; Postnatal development; Lymphocyte proliferation; Antibody production; Tetanus toxoid

Alexander S. Lebedinsky, Daria V. Cherkashina, Alexander N. Sukach, Nataliya A. Volkova, Barry J. Fuller, Alexander Yu. Petrenko, Positive effects of cryopreserved adult or fetal liver cell transplants on hypercholesterolemia and hepatic antioxidant defenses in cholesterol-fed rabbits, Cryobiology, Volume 55, Issue 1, August 2007, Pages 72-79, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2007.05.005.
(http://www.sciencedirect.com/science/article/B6WD5-4NXHCDP-2/2/9a2e7e4a5b02f80f93e688d5654d1f13)
Abstract:
The liver plays a central role in lipid metabolism and the pathophysiology of many lipid disorders leads in turn to liver cell injury. Adult hepatocyte transplants provide well-recognized metabolic support, whilst hepatic stem cells may promote liver regeneration and repair, but in both cases, any clinical application would require low temperature banking of the cells. A model of dietary hypercholesterolemia was established in rabbits over 5 months, and transplants of cryopreserved adult hepatocytes (CH) and cryopreserved fetal liver cells (CFLC) were compared to Sham transplants. Cryopreservation was performed by a two-step freezing protocol using 1.5 mol/l dimethyl sulfoxide (Me2SO). Serum contents of cholesterol lipid classes were measured during the subsequent 4 weeks, in addition to markers of serum and liver oxidative stress. Both CH and CFLC transplantation resulted in a decrease of serum lipids during the 1st week after transplantation. The effect of CH was limited to the 1st week, but CFLC provided a sustained lipid-lowering effect over the 4 weeks. The ultimate outcome of CFLC transplantation by the end of 4 weeks was more pronounced and statistically significant for both serum total cholesterol (0.15 +/- 0.05 versus 3.65 +/- 1.4 mmol/l) and high-density lipoprotein--cholesterol (0.04 +/- 0.01 versus 0.56 +/- 0.06 mmol/l) compared to Sham transplants ($p < 0.05$ in both cases). CFLC transplantation also normalized hepatic tissue antioxidant defenses, namely an increase in reduced glutathione content, and enzyme activities for catalase and glutathione reductase (all significantly higher at $p < 0.05$ than in Sham transplants) by 4 weeks.
Keywords: Fetal liver cells; Hepatic progenitor cells; Hepatocytes; Rabbit; Cryopreservation; Allogenic transplantation; Experimental hypercholesterolemia; Lipoproteins; non-alcoholic fatty liver disease; Lipid peroxidation

G. Bolet, H. Garreau, T. Joly, M. Theau-Clement, J. Falieres, J. Hurtaud, L. Bodin, Genetic homogenisation of birth weight in rabbits: Indirect selection response for uterine horn characteristics, Livestock Science, Volume 111, Issues 1-2, August 2007, Pages 28-32, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.11.012.
(http://www.sciencedirect.com/science/article/B7XNX-4MNHYBF-3/2/07db5996116823ffeeeebab251f56d58)
Abstract:
A divergent selection experiment on within-litter homogeneity of birth weight in rabbits was carried out at the INRA experimental farm at Auzeville. The two lines were created by selecting breeding does and bucks from the female strain AGP22 bred at the Grimaud Freres Selection Company. This involved a new model incorporating a genotypic value for the mean of individual birth weight and a genotypic value for the environmental variance. This new 'trait' was modelled in the usual infinitesimal framework, giving estimated breeding values for environmental variability. There was a favourable selection response with a significant difference in within-litter standard deviation of birth weight between the lines selected for increasing (HOM) or decreasing (HET) homogeneity. At the end of the third generation, 31 females from the HOM line and 33 from the HET line were sacrificed to collect the uterine horns and measure their initial length (L1) and their length after elongation with a weight of 50 g (L2) and then 70 g (L3). The length in the homogeneous line was

significantly greater, whatever the weight (L1: + 1.3 cm, P = 0.02; L2: + 2.8 cm P < 0.001; L3: + 4.2 cm, P < 0.001). The absolute and the relative elongations were significantly higher in the HOM line. There was no significant effect of the line on the number of ova shed, the weight of the ovary, or the weight of the uterine horns. It is concluded that the divergence between lines for the within-litter homogeneity of birth weight is at least partly due to the characteristics of the genital tract, i.e. the length and capacity for elongation of the uterine horn.
Keywords: Rabbit; Homogenisation; Selection; Litter weight; Uterus

Fahimeh Kamali, Mohammad Bayat, Giti Torkaman, Esmaeel Ebrahimi, Mahyar Salavati, The therapeutic effect of low-level laser on repair of osteochondral defects in rabbit knee, Journal of Photochemistry and Photobiology B: Biology, Volume 88, Issue 1, 27 July 2007, Pages 11-15, ISSN 1011-1344, DOI: 10.1016/j.jphotobiol.2007.04.010.
(http://www.sciencedirect.com/science/article/B6TH0-4NMC896-2/2/80eb8a28b86c7e68710d42c67cfb2d6c)
Abstract: Introduction
Low level laser therapy (LLLT) has been shown to enhance collagen production and wound healing but its effect on cartilage repair from biomechanical point of view is not known yet. The aim of present study was to evaluate the biomechanical behaviour of repairing osteochondral defect in rabbits which received a pulsed low-level gallium-arsenide (Ga-As) laser irradiation.Materials and methods
Osteochondral defects with 5 mm diameter and 4 mm in depth induced by drilling in right femoral patellar grooves of 41 adolescent male rabbits. They were divided into experimental and control groups. Experimental group received pulsed Ga-As (890 nm) laser irradiation with energy density of 4.8 J/cm2. The rabbits in control group received placebo LLLT with shut-down equipment. The control defects were allowed to heal spontaneously. Each group were divided into three subgroups: A, B and C. Subgroups A, B and C were sacrificed on 4, 8, and 16 weeks after surgery. The knee joint were removed, and the defects were examined biomechanically by in situ-indentation method. The thickness, instantaneous and equilibrium indentation stiffness was measured during the test. Data were analysed using ANOVA and independent sample t-test.Result
While no difference was observed in the repaired cartilage biomechanical properties among 4th, 8th, 16th weeks in study groups. The equilibrium indentation stiffness of experimental group was significantly higher in 8th week in comparison with control group.Conclusion
LLLT significantly enhances the stiffness of repairing tissue in the 8th week post injury in osteochondral defects in rabbits.
Keywords: Low level laser therapy; Osteochondral defects; Indentation method; Rabbit

Carlos M. Carceles, Emilio Fernandez-Varon, Pedro Mari'n, Elisa Escudero, Tissue disposition of azithromycin after intravenous and intramuscular administration to rabbits, The Veterinary Journal, Volume 174, Issue 1, July 2007, Pages 154-159, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2006.05.022.
(http://www.sciencedirect.com/science/article/B6WXN-4KM471W-3/2/f421f9dd9df0f333ab69e7fc6cec1f87)
Abstract:
Tissue disposition of azithromycin after intravenous (IV) or intramuscular (IM) injection at a single dose rate of 10 mg/kg bodyweight were investigated in rabbits using a modified agar diffusion bioassay for determining tissue concentrations. The pharmacokinetic behaviour of azithromycin was characterized by low and sustained plasma concentrations but high and persistent tissue concentrations. Kinetic parameters indicated a high retention of the drug in peripheral compartments. The plasma half-lives after IV and IM administrations were similar being 21.8 h and 23.1 h, respectively, while the half-lives obtained in tissues after IV and IM administration were at

least 1.4 and 1.9 times longer than in plasma, respectively. The highest tissue concentrations were found in bile, liver and spleen whereas the lowest ones were found in skeletal muscle (although they were higher than those in plasma). From the results of the single administration in this study an IM dosage regimen can be proposed that achieves minimum concentrations over 2 mg/L in rabbits: three doses of 4-5 mg/kg/day would provide suitable therapeutic concentrations in pulmonary tissues over seven days.
Keywords: Azithromycin; Tissue; Disposition; Rabbits; Half-life

Miguel Delibes-Mateos, Steve M. Redpath, Elena Angulo, Pablo Ferreras, Rafael Villafuerte, Rabbits as a keystone species in southern Europe, Biological Conservation, Volume 137, Issue 1, June 2007, Pages 149-156, ISSN 0006-3207, DOI: 10.1016/j.biocon.2007.01.024.
(http://www.sciencedirect.com/science/article/B6V5X-4NBXVMF-1/2/d631bb944d8e034494cd7ec15fb3aad2)
Abstract:
A keystone species is one that is crucial in maintaining the organization and diversity of their ecological communities. We tested the idea that rabbits act as a keystone species in southern Europe by exploring relationships between rabbit abundance and the abundance and diversity of raptor species. At 20 sites in southern Spain we assessed rabbit abundance through counts of animals along transects and assessed the number of raptor individuals and species through watches from vantage points. In a further 120 locations we also derived an index of rabbit abundance, from pellets and compared this to the presence or absence of the critically endangered Spanish imperial eagle. Rabbit abundance was positively associated with the number of observations of raptors, the number of raptor species and the number of species of conservation concern. Sites with the most rabbits had higher conservation value. Moreover, the presence of Spanish imperial eagle was strongly associated with sites where rabbits were at high density. We conclude that rabbits do act as a keystone species and we suggest that conservation efforts should focus on improving the status of this small-game species in southern Europe.
Keywords: Aquila adalberti; Hunting; Oryctolagus cuniculus; Raptor conservation; Spain; Spanish imperial eagle

Jiangli Dou, Chengyu Tan, Yuguang Du, Xuefang Bai, Keyi Wang, Xiaojun Ma, Effects of chitooligosaccharides on rabbit neutrophils in vitro, Carbohydrate Polymers, Volume 69, Issue 2, 1 June 2007, Pages 209-213, ISSN 0144-8617, DOI: 10.1016/j.carbpol.2006.09.029.
(http://www.sciencedirect.com/science/article/B6TFD-4MH8BFK-1/2/38ee579a4404adbfb2f2a159ecbe0aea)
Abstract:
The effects of chitooligosaccharides(COS) on resting and PMA-activated neutrophils were estimated. MTT assays, NO estimation and superoxide detection revealed that chitooligosaccharides at concentrations of 25, 50, 75, and 100 [mu]g/ml increased the viability, ability to produce reactive oxygen intermediates and nitrogen intermediates of resting neutrophils. Superoxide detection, degranulation assay and adhesion assay suggested that chitooligosaccharides at concentrations from 50 to 150 [mu]g/ml reduced PMA-induced activation of neutrophils.
Keywords: Neurophil; Chitooligosaccharide; PMA-activated

Nazmi Cetin, Ebru Cetin, Gokhan Eraslan, Ali Bilgili, Chlorpyrifos induces cardiac dysfunction in rabbits, Research in Veterinary Science, Volume 82, Issue 3, June 2007, Pages 405-408, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2006.08.002.
(http://www.sciencedirect.com/science/article/B6WWR-4M645BT-3/2/14c7f54b34e7a49c6e0ec98841c6701d)
Abstract:

This study was carried out to evaluate the effects of organophosphate (OP) insecticide chlorpyrifos on cardiac morphology and function in rabbits using echocardiography.
Twenty New Zealand male rabbits were divided equally into four groups. Rabbits were exposed to chlorpyrifos in drinking water at concentrations of 0, 125, 250 or 375 ppm for 90 days.
The comparison among the groups indicated that 375 ppm chlorpyrifos resulted in significant decrease ($p < 0.05$) in heart rate (HR), cardiac output (CO), left ventricular fractional shortening (FS), left ventricular ejection fraction (EF), percentage thickening of left ventricle posterior wall (PWT), and significant increase ($p < 0.05$) in left atrial diameter (LA), left ventricular internal diameter in end diastole (LVIDD), left ventricular end diastolic (EDV) and end systolic volumes (ESV) compared to those of the control group.
These results showed that chlorpyrifos induces cardiac dysfunction in rabbits.
Keywords: Organophosphates; Rabbit; Echocardiography; Cardiotoxicity

Mohammad Bayat, Enayatallah Ansari, Narges Gholami, Aghdas Bayat, Effect of low-level helium-neon laser therapy on histological and ultrastructural features of immobilized rabbit articular cartilage, Journal of Photochemistry and Photobiology B: Biology, Volume 87, Issue 2, 25 May 2007, Pages 81-87, ISSN 1011-1344, DOI: 10.1016/j.jphotobiol.2007.02.002.
(http://www.sciencedirect.com/science/article/B6TH0-4N49VMM-1/2/1319965a2b55bbc8406b2d7696846b66)
Abstract:
The present study investigates whether low-level helium-neon laser therapy can increase histological parameters of immobilized articular cartilage in rabbits or not.
Twenty five rabbits were divided into three groups: the experiment group, which received low-level helium-neon laser therapy with 13 J/cm2 three times a week after immobilization of their right knees; the control group which did not receive laser therapy after immobilization of their knees; and the normal group which received neither immobilization nor laser therapy. Histological and electron microscopic examinations were performed at 4 and 7 weeks after immobilization.
Depth of the chondrocyte filopodia in four-week immobilized experiment group, and depth of articular cartilage in seven-week immobilized experiment group were significantly higher than those of relevant control groups (exact Fisher test, $p = 0.001$; student's t-test, $p = 0.031$, respectively). The surfaces of articular cartilages of the experiment group were relatively smooth, while those of the control group were unsmooth.
It is therefore concluded that low-level helium-neon laser therapy had significantly increased the depth of the chondrocyte filopodia in four-week immobilized femoral articular cartilage and the depth of articular cartilage in seven-week immobilized knee in comparison with control immobilized articular cartilage.
Keywords: Low-level laser therapy; Immobilization; Articular cartilage; Histology; Ultra structure; Rabbit

Peter Chrenek, Jozef Trandzik, Peter Massanyi, Alexander Makarevich, Norbert Lukac, Dana Peskovicova, Rekha Paleyanda, Effect of transgenesis on reproductive traits of rabbit males, Animal Reproduction Science, Volume 99, Issues 1-2, May 2007, Pages 127-134, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2006.04.052.
(http://www.sciencedirect.com/science/article/B6T43-4JTXCS5-1/2/006b009cde0f2b9b01d29d20213f27bc)
Abstract:
The influence of foreign transgene integration on the reproductive capabilities of rabbit males is not known. Therefore, we analyzed their ejaculate characteristics, reproductive capabilities, occurrence of pathological spermatozoa and histological structure of the testis. We have generated transgenic rabbits by microinjection of WAP-hFVIII gene into pronucleus of fertilized egg.

We observed that the libido, volume and pH value of the ejaculate did not differ significantly between transgenic and non-transgenic male lines. The motility, concentration, osmolarity, thermoresistant test of spermatozoa (at 1 or 6 h) and the percentage of alive spermatozoa were significantly different ($p < 0.001$) among transgenic and non-transgenic males. No significant differences were found between transgenic and non-transgenic male lines in the occurrence of pathological spermatozoa and histology of the testis. The ability of spermatozoa from transgenic and non-transgenic males to fertilize eggs was ranged within 96 and 100%; while the yield of transgenic embryos ranged from 43 to 57%.
Our results show that mammary gland specific over-expression mWAP-hFVIII gene construct does not affect reproductive traits of transgenic rabbit males.
Keywords: Transgenic rabbit; Reproductive traits; Sperm; Testis; Histology

R. Rodriguez-De Lara, C.A. Herrera-Corredor, M. Fallas-Lopez, R. Rangel-Santos, V. Mariscal-Aguayo, P.A. Martinez-Hernandez, J.G. Garcia-Muniz, Influence of supplemental dietary sprouted wheat on reproduction in artificially inseminated doe rabbits, Animal Reproduction Science, Volume 99, Issues 1-2, May 2007, Pages 145-155, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2006.04.055.
(http://www.sciencedirect.com/science/article/B6T43-4K18Y02-1/2/e4a3d181d3af05690099190542fd63d0)
Abstract:
The sprouted wheat contains great amounts of 6-methoxybenzoxazolinone (6-MBOA) a phenol compound that stimulates reproduction in certain small wild herbivorous mammals. The objective of the present study was to evaluate the effect of dietary sprouted wheat as supplement on reproduction in artificially inseminated doe rabbits. Two-month-old New Zealand White doe rabbits (n = 48) were randomly allocated to one of two treatments: (1) pelleted diet plus sprouted wheat for 6 consecutive days prior to service, (2) pelleted diet only (control). First insemination occurred when does reach 3200 g body weight and bred 6 days after parturition across 6 months period during summer and autumn. Records from 41 does completing the experiment accounted for 192 inseminations and 142 kindlings equivalent to 4.6 +/- 0.15 and 3.5 +/- 0.15 litters per doe, respectively. Mean daily intake of sprouted wheat on wet and dry matter bases were 196.1 +/- 7.5 and 75.4 +/- 2.9 g, respectively. The number of young born produced per doe during the trail was significantly ($P = 0.02$) greater in does fed sprouted wheat (28.1 +/- 1.2 versus 23.6 +/- 1.3 control). Does fed sprouted wheat had 0.65 +/- 0.06 receptivity rate at AI over 28% greater ($P = 0.001$) than does in the control treatment. Sexual receptivity was not influenced by physiological status of does and season ($P > 0.05$). Diet and season had no effect ($P > 0.05$) on kindling rate. However, physiological status had an effect ($P = 0.002$) on this variable. Kindling rates for nulliparous, lactating and non-lactating does were 0.95 +/- 0.08, 0.63 +/- 0.04 and 0.78 +/- 0.11, respectively. Sexually receptive does had a greater ($P = 0.0001$) kindling rate (0.95 +/- 0.05) than non-receptive females (0.63 +/- 0.05). Does fed sprouted wheat produced larger ($P = 0.02$) litters than those in the control group: 7.7 +/- 0.30 and 6.8 +/- 0.32, respectively. There was an effect of season ($P = 0.04$) on the size of the litter at birth. Largest litters were born during autumn (7.9 +/- 0.37) than during summer (6.6 +/- 0.41). Receptive does had more ($P = 0.002$) young in the litter (7.9 +/- 0.28) than non-receptive (6.6 +/- 0.35). Feeding sprouted wheat as a source of biological 6-MBOA enhanced sexual receptivity and prolificacy in artificially inseminated doe rabbits bred in summer and autumn.
Keywords: Rabbits--dietary 6-methoxybenzoxazolinone; Season; Oestrus synchronization; AI

C. Corino, D.P. Lo Fiego, P. Macchioni, G. Pastorelli, A. Di Giancamillo, C. Domeneghini, R. Rossi, Influence of dietary conjugated linoleic acids and vitamin E on meat quality, and adipose tissue in rabbits, Meat Science, Volume 76, Issue 1, May 2007, Pages 19-28, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2006.10.007.

(http://www.sciencedirect.com/science/article/B6T9G-4MH2C7N-1/2/b5bb463228ec977d02bb08a6e0083f26)
Abstract:
Eighty New Zealand White rabbits, age 55 days, half male and half female, were randomly assigned to one of four diets in a 2 x 2 x 2 factorial arrangement. The diets contained 0% or 0.5% CLA, and 60 or 240 mg/kg [alpha]-Tocopheryl acetate. Forty-eight rabbits were slaughtered at age 92 days. Growth performances and carcass weight were higher ($P < 0.05$) in 240 mg/kg of [alpha]-tocopheryl acetate-fed rabbits. Fat and CLA isomers content of Longissimus Lumborum (LL) muscle was higher ($P < 0.05$) in CLA-fed rabbits than control. Fatty acid composition of LL muscle was modified ($P < 0.05$) and oxidative stability was increased ($P < 0.001$) by both dietary treatments. CLA increased ($P < 0.05$) triglyceride, total cholesterol and glucose levels in plasma. Adipocytes in interscapular and perirenal fat in the 240 mg/kg [alpha]-tocopheryl acetate and 0.5% CLA groups were larger in size but lesser in number than in 60 mg/kg [alpha]-tocopheryl acetate and no CLA rabbit ($P < 0.01$).
Keywords: Rabbit; Nutrition; Conjugated linoleic acids; Vitamin E; Meat quality; Adipocyte histometry

A.M. King, J. Hall, F. Cranfield, M. Sullivan, Anatomy and ultrasonographic appearance of the tympanic bulla and associated structures in the rabbit, The Veterinary Journal, Volume 173, Issue 3, May 2007, Pages 512-521, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2006.09.002.
(http://www.sciencedirect.com/science/article/B6WXN-4M7KB3K-1/2/ddd1b3614535d79380113e1db113472b)
Abstract:
Otitis media is a relatively common condition in the rabbit although it can be difficult to evaluate clinically. Diagnostic imaging of the rabbit has traditionally involved radiography and there are few reports regarding the use of ultrasound. The aim of this study was to determine if the tympanic bulla (TB) and associated structures could be evaluated in the rabbit using currently available ultrasound equipment. The normal anatomy of the region was established using gross dissection and emascerated specimens and compared with the dog and cat. Ten New Zealand white rabbit cadavers were examined using two ultrasound machines and four transducers from a variety of locations. A 12 MHz linear transducer was found to be most appropriate. From a lateral approach the external ear canal could be visualized to the level of the external acoustic meatus while the TB itself could only be visualized from a ventral approach. The jugular and mastoid processes in the rabbit are very prominent and interfered with imaging of the TB from all approaches. Water-soluble lubricant introduced into the TB could be identified through the ventral bone wall of the TB and allowed the lumen and far wall to be visualised. Further work is required to determine whether ultrasound examination of the TB can be performed in live rabbits and to evaluate its benefits in the evaluation of clinical cases of otitis media.
Keywords: Rabbit; Anatomy; Tympanic bulla; Ultrasound; Otitis media

I.M. Szalo, C. Lassence, D. Licois, P. Coudert, A. Poulipoulis, H. Vindevogel, D. Marlier, Fractionation of the reference inoculum of epizootic rabbit enteropathy in discontinuous sucrose gradient identifies aetiological agents in high density fractions, The Veterinary Journal, Volume 173, Issue 3, May 2007, Pages 652-657, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2005.12.013.
(http://www.sciencedirect.com/science/article/B6WXN-4J9WRCT-3/2/8514658942de7c81d7afc2b1eb78ef80)
Abstract:
Epizootic rabbit enteropathy (ERE) is a major cause of economic loss in intensive rabbit production. Since its first recognition in 1997, much work has been done to determine the pathogenic mechanisms of the disease and to identify the aetiological agent(s). Unfortunately, the quest for aetiology has only met with limited success despite the ability to reproduce the syndrome

by inoculation of intestinal contents from field cases. These intestinal inocula contain a huge number of microorganisms which could all be involved in the aetiology of ERE. To decrease the number of putative agents, the French reference inoculum TEC3 was fractionated on a discontinuous sucrose gradient so that seven fractions (supernatant, 10%, 20%, 30%, 40%, 50% and pellet) were obtained. Specific-pathogen-free rabbits were inoculated with three out of these seven fractions (supernatant, 30%, and pellet). The objectives were: (1) to characterise the seven fractions by bacteriological examination; (2) to verify whether the aetiological agent was present in the fractions by inoculation of rabbits; (3) to assign the aetiological agent of ERE to a morphological group of pathogens; (4) to identify a fraction which could replace the reference inoculum TEC3 in applications such as cell cultures or egg inoculation. The results strongly suggest that ERE is a bacterial disease and does not have a viral or parasitic aetiology.
Keywords: Rabbit; Epizootic rabbit enteropathy; Bacteria; Aetiology

D. Viana, L. Selva, P. Segura, J.R. Penades, J.M. Corpa, Genotypic characterization of Staphylococcus aureus strains isolated from rabbit lesions, Veterinary Microbiology, Volume 121, Issues 3-4, 15 April 2007, Pages 288-298, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2006.12.003.
(http://www.sciencedirect.com/science/article/B6TD6-4MM1P38-1/2/4b2bac9a3a66dea13cc0b57e4335eb02)
Abstract:
Since staphylococcal infections are the main pathological problem in rabbit does, the objective of this study was to characterize epidemiologically Staphylococcus aureus isolates from different lesion types in rabbits. Using 3 genetic markers (coagulase, staphylococcal protein A and clumping factor B genes), 22 different genotypes were identified among 301 isolates recovered from 259 rabbit does with 10 different kinds of chronic purulent lesions. These infected rabbits were obtained from 30 herds located in the Valencia province on the Spanish Mediterranean coast. The most frequent genotype was designated A1/II1/[delta] (coa/spa/clfB combination genotype) and represented 70.76% of the isolates. Although most genotypes were previously identified in other countries, novel types were also documented. No specificity between genotypes and nature of the pathologic process could be identified. After genetic comparison between strains from different origins, the results may suggest that rabbit, bovine and human S. aureus isolates are not clonally related, suggesting that specific host-dependent pathogenic factors may have evolved independently in these species. These differences indicate that a rational and effective strategy to control infections caused by rabbit-specific isolates may be advantageous.
Keywords: Staphylococcus aureus; Rabbit; Typing; Pathology

Dieter Vancraeynest, Freddy Haesebrouck, Katleen Hermans, Multiplex PCR assay for the detection of high virulence rabbit Staphylococcus aureus strains, Veterinary Microbiology, Volume 121, Issues 3-4, 15 April 2007, Pages 368-372, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2006.12.011.
(http://www.sciencedirect.com/science/article/B6TD6-4MMPNJC-2/2/627aae04b1383d1bf10c520ee94ab0a0)
Abstract:
High virulence rabbit Staphylococcus aureus strains, which are clonal in origin, are responsible for the spread of chronic staphylococcosis at the rabbit flock level. The aim of the present study was to develop a multiplex PCR assay that can be used for the identification of these high virulence strains. Two targets of the assay were the bbp and the selm genes, which have recently been shown to occur specifically in high virulence isolates. A third target was a sequence designated 'flank', which was derived from a previously generated high virulence specific RAPD pattern. Furthermore, the femA gene, which is specific for S. aureus, was incorporated in order to avoid false negative results due to insufficient DNA preparation. The multiplex PCR was successful at differentiating the 26 typical high virulence and 50 low virulence rabbit S. aureus strains

incorporated in the present study. Therefore it is useful for the initial screening of newly acquired breeding stock, in order to prevent the intake of high virulence strains in rabbitries.
Keywords: Staphylococcus aureus; Rabbit; Virulence; Diagnosis; PCR

Ji-Kang Fang, Subbuswamy K. Prabu, Naresh B. Sepuri, Haider Raza, Hindupur K. Anandatheerthavarada, Domenico Galati, Joseph Spear, Narayan G. Avadhani, Site specific phosphorylation of cytochrome c oxidase subunits I, IVi1 and Vb in rabbit hearts subjected to ischemia/reperfusion, FEBS Letters, Volume 581, Issue 7, 3 April 2007, Pages 1302-1310, ISSN 0014-5793, DOI: 10.1016/j.febslet.2007.02.042.
(http://www.sciencedirect.com/science/article/B6T36-4N56NRT-3/2/fc446193143a460c48df183aa41ef2fe)
Abstract:
We have mapped the sites of ischemia/reperfusion-induced phosphorylation of cytochrome c oxidase (CcO) subunits in rabbit hearts by using a combination of Blue Native gel/Tricine gel electrophoresis and nano-LC-MS/MS approaches. We used precursor ion scanning combined with neutral loss scanning and found that mature CcO subunit I was phosphorylated at tandem Ser115/Ser116 positions, subunit IVi1 at Thr52 and subunit Vb at Ser40. These sites are highly conserved in mammalian species. Molecular modeling suggests that phosphorylation sites of subunit I face the inter membrane space while those of subunits IVi1 and Vb face the matrix side.
Keywords: Cytochrome c oxidase; Subunit phosphorylation; Myocardial ischemia/reperfusion; Protein kinase A; Nano-LC-MS/MS analysis

P.G. Peiretti, P.P. Mussa, L. Prola, G. Meineri, Use of different levels of false flax (Camelina sativa L.) seed in diets for fattening rabbits, Livestock Science, Volume 107, Issues 2-3, April 2007, Pages 192-198, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.09.015.
(http://www.sciencedirect.com/science/article/B7XNX-4M57HJC-2/2/f0c9a01eef88ab75cd074eb96ea5ba49)
Abstract:
An experiment has been conducted to study the effects of various levels of false flax (Camelina sativa L.) seed (FFS) in the diet on the growth performance, some carcass characteristics and fatty acid profile of rabbits meat and fat. In the experiment, a total of 30 weaned crossbred rabbits aged 70 days and weighing, on average, 2316 g were equally divided into three groups of 10 (five male and five female rabbits each). Three levels (0%, 10%, or 15%) of FFS were included in isonitrogenous and isocaloric diets. The experimental period lasted 50 days. At the end of the experiment, there were no significant differences among the groups in live weight, live weight gain, feed consumption, feed efficiency, carcass yield and the percentages of edible organs. The percentage values of head, skin and limbs, fore legs, hind legs, breast and ribs, loin and abdominal wall were not affected by the inclusion level of FFS. Although the chemical composition of the meat was not significantly affected by the dietary treatment, the polyunsaturated fatty acid (PUFA) concentration in the longissimus dorsi muscle and perirenal fat was significantly increased with the increasing of FFS inclusion, while saturated fatty acid (SFA) decreased. The n-6/n-3 PUFA ratio of the meat decreased from 3.86 in the control group, to 1.19 in the 15% of FFS group. These results showed that the use of a diet supplemented with FFS was effective in reducing the saturation, atherogenic and thrombogenic indexes, with consequent benefits on the nutritional quality of rabbit meat for consumers, without significant adverse effects on growth performance and carcass characteristics.
Keywords: Rabbit; Meat quality; Camelina sativa; Fatty acid

Muammer Elmas, Kamil Uney, Enver Yazar, Ayse Karabacak, Bunyamin Tras, Pharmacokinetics of enrofloxacin following intravenous and intramuscular administration in Angora rabbits, Research

in Veterinary Science, Volume 82, Issue 2, April 2007, Pages 242-245, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2006.06.008.
(http://www.sciencedirect.com/science/article/B6WWR-4KPP4FH-2/2/b61b83ad8c9bb5f06c0c067e37a60ffc)
Abstract:
The pharmacokinetic behaviour and bioavailability of enrofloxacin (ENR) were determined after single intravenous (iv) and intramuscular (im) administrations of 5 mg/kg bw to six healthy adult Angora rabbits. Plasma ENR concentrations were measured by high performance liquid chromatography. The pharmacokinetic data were best described by a two-compartment open model. ENR pharmacokinetic parameters were similar ($p > 0.05$) for iv and im administrations in terms of AUC0-[infinity], t1/2[beta] and MRT. ENR was rapidly (t1/2a, 0.05 h) and almost completely (F, 87%) absorbed after im injection. In conclusion, the pharmacokinetic properties of ENR following iv and im administration in Angora rabbits are similar to other rabbit breeds, and once or twice daily iv and im administrations of ENR at the dose of 5 mg/kg bw, depending upon the causative pathogen and/or severity of disorders, may be useful in treatment of infectious diseases caused by sensitive pathogens in Angora rabbits.
Keywords: Pharmacokinetics; Enrofloxacin; Angora rabbits

Pascal Salvetti, Michele Theau-Clement, Jean-Francois Beckers, Jacques Hurtaud, Pierre Guerin, Vanessa Neto, Jacky Falieres, Thierry Joly, Effect of the luteinizing hormone on embryo production in superovulated rabbit does, Theriogenology, Volume 67, Issue 6, 1 April 2007, Pages 1185-1193, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2007.01.013.
(http://www.sciencedirect.com/science/article/B6TCM-4N4S0DH-2/2/d8529a30bd316706cb72994224342188)
Abstract:
For most domestic animals, the responses to superovulation treatments are not controlled as a consequence of the lack of knowledge on exogenous gonadotrophins effects on the ovarian function. The role of luteinizing hormone (LH) on the number and quality of embryos produced was evaluated on rabbit does superovulated with porcine FSH (pFSH). Parameters of embryos recovery, in vitro and in vivo embryo development rates after freezing/thawing were compared. We used three experimental groups: (1) control group without superovulation treatment, (2) 'pFSH + pLH' and (3) 'pFSH' groups where females were treated with pFSH, respectively, with (20%) or without (0%) porcine LH supplementation. The number of corpora lutea and the number of embryos produced were significantly higher ($p < 0.001$) in superovulated does than in control group (27.1, 26.7 versus 11.9 corpora lutea and 20.3, 21.2 versus 9.6 embryos produced for pFSH + pLH, pFSH and control group, respectively). However, both gonadotrophins administrations (groups 2 and 3) led to defaults of ovulation when compared with untreated does. No significant difference was observed between the number and quality of the embryos produced by does treated with pFSH + pLH or with pFSH alone. Moreover, we observed no significant difference between results of in vivo and in vitro viability assays after thawing. We concluded that pFSH alone seems to be sufficient to stimulate the follicles growth and that exogenous pLH administrated has no effect on the quantity and quality of embryos. Further studies are needed to evaluate the hormonal patterns before and after the gonadotrophins injections in the rabbit species.
Keywords: Rabbit; Superovulation; pFSH and pLH; Embryo production; Embryo freezing

C. Castellini, R. Cardinali, P.G. Rebollar, A. Dal Bosco, V. Jimeno, M.E. Cossu, Feeding fresh chicory (Chicoria intybus) to young rabbits: Performance, development of gastro-intestinal tract and immune functions of appendix and Peyer's patch, Animal Feed Science and Technology, Volume 134, Issues 1-2, 1 March 2007, Pages 56-65, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2006.05.007.

(http://www.sciencedirect.com/science/article/B6T42-4K71681-1/2/315b73d5c03fd79e5afe5d7ac9bb4fd6)

Abstract:
The aim of the study was to evaluate the effect of the administration of fresh chicory (Chicorium intybus L.) to young pups before and after weaning, investigating the morphological development of two main lymphoid tissues (appendix and Peyer's patch) and the productive performance. The trial was divided in two parts: the first, immediately after kindling, 20 New Zealand White (NZW) multiparous rabbit does were homogenised for litter size (n = 8) and were divided into two groups: control group, in which young rabbits (from 18 to 28 d) fed a standard diet; chicory group, in which young rabbits were fed control diet and fresh chicory, separately. In the second trial the young rabbits pursued the same diet until 77 d old. At weaning, 10 young rabbits/group were weighed and killed. The pH, dry matter, ammonia and volatile fatty acids (VFA) were evaluated on the caecal content. The histological sections were made of the appendix and Peyer's patch. The dietary administration of fresh chicory to young rabbits before weaning, improved biochemical traits of caecum content: the lowered NH3 (0.5 versus 0.6 [mu]mol/g; P<0.05) and pH values (5.9 versus 6.1; P<0.05) and the increased VFA content (52 versus 46 mmol/L; P<0.01) indicated a higher fermentation of gut microflora. With respect to the morpho-functional aspects of the appendix and Peyer's patch no final conclusion could be drawn; in fact the significant improvement of appendix size (weight: 0.31 versus 0.23% live weight; P<0.05; diameter: 7.81 versus 6.82 mm; P<0.05) and of its follicles (perimeter: 2.99 versus 2.71 mm; P<0.05; area: 0.32 versus 0.25 mm2; P<0.01) is associated with a reduced number of follicles (34.78 versus 45.86; P<0.01). Addition of chicory in the post-weaning phase slightly affected rearing performance; the rabbits fed chicory showed a higher feed intake (134.0 versus 124.5 g/d; P<0.05) and daily gain (35.3 versus 33.7; P<0.05).
Keywords: Rabbit; Chicory; Immune functions; Productive performance

L. Fortun-Lamothe, S. Boullier, A review on the interactions between gut microflora and digestive mucosal immunity. Possible ways to improve the health of rabbits, Livestock Science, Volume 107, Issue 1, March 2007, Pages 1-18, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.09.005.
(http://www.sciencedirect.com/science/article/B7XNX-4M6S07D-1/2/b90855f5a0d43551e85c5fc8021d607a)

Abstract:
Enteric diseases frequently occur in rabbits around weaning leading to extensive use of antibiotics in rabbit breeding. In this context, breeders as well as consumers ask for alternative strategies that improve the health of animals. But the maintenance of gut health is complex and relies on a delicate balance between the mucosa (including the absorptive epithelium and the digestive immune system), the gut microbiota and environmental factors including diet. Firstly, immune and non-immune mechanisms of protection against pathogens in the gut are presented, in relation with the installation and composition of the gut microbial ecosystem in the rabbit and its role on health. Finally, several strategies to stimulate digestive immune system or favour beneficial microbiota to exclude enteric pathogens were discussed. Several nutrients including fatty acids and fibres, were implicated in the development of immune response and could be used to improve immune ability of animals. Dietary fatty acids ([omega]3/[omega]6 ratio) could be of interest in the rabbit. The role of dietary fibre on digestive health has been demonstrated in weaned rabbits, and strong relations between fibre supply and caecal microbiota were evidenced. Some works also reported an influence of fibre level in the diet given to the young before weaning on health status of rabbits after weaning. Therefore, nutritional needs of suckling rabbits, more especially fibre requirements, to enhance subsequent gut health need to be thoroughly studied, in relation with needs of their mothers. Exogenous flora could also be added to the diet to stimulate the digestive immune system and prevent the development of enteric pathogens. Finally, vaccines permit protection of the host against specific pathogens.

Keywords: Gut; Immunity; Nutrition; Microbiota; Probiotics; Rabbit

B. Arino, P. Hernandez, M. Pla, A. Blasco, Comparison between rabbit lines for sensory meat quality, Meat Science, Volume 75, Issue 3, March 2007, Pages 494-498, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2006.08.013.
(http://www.sciencedirect.com/science/article/B6T9G-4M3BGV7-3/2/4b72ca680d4c4b489066dd52337da88f)
Abstract:
Rabbits from three synthetic lines were used in the experiment. Line R was selected for growth for 24 generations. Lines V and A were selected for litter size at weaning for 30 and 33 generations, respectively. Sensory analysis was carried out on the Longissimus muscle. The parameters evaluated were: juiciness (J), hardness (H), fibrousness (F), flouriness (Fl), intensity of rabbit flavour (IRF), aniseed odour (AO), aniseed flavour (AF), liver odour (LO) and liver flavour (LF). A Bayesian analysis was performed. Line V was only 82% as juicy as line R. Line V was 18% harder and 17% more fibrous than line R. Lines A and R had the same H and F. No differences in Fl were found. Small effects were found for flavour traits. We conclude that line origin has an influence on some sensory traits determining rabbit meat tenderness.
Keywords: Rabbits; Breeds; Sensory traits; Bayesian analysis

B. Sekalska, A. Ciechanowicz, B. Dolegowska, M. Naruszewicz, Effect of ibuprofen on the development of fat-induced atherosclerosis in New Zealand rabbits, Journal of Experimental Animal Science, Volume 43, Issue 4, 26 February 2007, Pages 283-299, ISSN 0939-8600, DOI: 10.1016/j.jeas.2006.10.001.
(http://www.sciencedirect.com/science/article/B7GW2-4MHPBP3-1/2/40089221b1a7aa4064be2a8729dcc4da)
Abstract:
Inflammatory mechanism plays important role in the pathogenesis of atherosclerosis. The migration of monocytes to activated arterial endothelium with involvement of chemokines and adhesion molecules is one of the earliest detectable events in it. The monocyte chemotactic protein type 1 (MCP-1) is known for its potent attractant action on monocytes, precursors of foam cells accounting for the bulk of atheromatous plaques. MCP-1 is synthesized in vivo by activated endothelial cells expressing the MCP-1 gene under control of transcription factor-[kappa]B (NF-[kappa]B). Inhibitors of NF-[kappa]B activation include ibuprofen (2-[4-isobutyl-phenyl]-propionic acid) belonging to non-steroid anti-inflammatory drugs (NSAIDs). The aim of this study was to determinate the effect of ibuprofen on the development of fat-induced atherosclerosis in New Zealand White rabbits.
Ibuprofen significantly reduced the expression of the MCP-1 gene both in rabbit groups fed the standard chow for 2 and 3 months as compared with control groups consumed the standard chow without ibuprofen for 2 ($p<0.005$) and 3 months ($p<0.01$), respectively, and with control groups consumed high-cholesterol chow for 2 ($p<0.005$) and 3 ($p<0.05$) months, respectively. Ibuprofen significantly reduced the expression of the MCP-1 gene in the study group fed the high-cholesterol chow for 2 months as compared with the group consumed the high-cholesterol chow without ibuprofen for 2 months ($p<0.01$). Nevertheless, ibuprofen failed to protect against outcomes of the high-fat diet such as atherosclerotic lesions of the aorta, elevated concentrations of cholesterol and triglycerides, and markedly higher liver/body mass and adrenals/body mass ratios. It was concluded that low doses of ibuprofen suppress the expression of the MCP-1 gene without any effect on the progress of fat-induced atherosclerosis.
Keywords: Rabbit; Atherosclerosis; Ibuprofen; Monocyte chemotactic protein type 1 (MCP-1); Reverse transcription polymerase chain reaction

A. Gall, B. Hoffmann, J.P. Teifke, B. Lange, H. Schirrmeier, Persistence of viral RNA in rabbits which overcome an experimental RHDV infection detected by a highly sensitive multiplex real-time RT-PCR, Veterinary Microbiology, Volume 120, Issues 1-2, 25 February 2007, Pages 17-32, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2006.10.006.
(http://www.sciencedirect.com/science/article/B6TD6-4M3H7HX-6/2/b3b47cfb64e8121515ae26fe00a89533)
Abstract:
An internally controlled multiplex real-time RT-PCR using TaqMan(R) probes and external standards for absolute RNA quantification was developed as a new diagnostic tool for the detection of rabbit haemorrhagic disease virus (RHDV). The test revealed a specificity of 100%, an analytical sensitivity of 10 copies/well and a linearity over a range from 101 to 1010 copies. The viral loads in organs, leukocytes, sera and excretions of seropositive, convalescent rabbits which were overcoming an experimental infection with RHDV were determined using the validated assay. As a result, viral RNA was demonstrated and quantified for at least 15 weeks. Thus, a persistence of viral RNA after experimental infection of rabbits could be shown for the first time. In contrast, neither antigen nor infectious virus could be detected by antigen-ELISA, immunohistochemistry or experimental transmission. Therefore, further experiments are necessary to prove that the persistence of RNA is linked with the persistence of infectious virus particles.
Keywords: RHDV; Rabbit; Real-time RT-PCR; Persistence

J.R. Cardoso, S.N. Bao, Effects of chronic exposure to soy meal containing diet or soy derived isoflavones supplement on semen production and reproductive system of male rabbits, Animal Reproduction Science, Volume 97, Issues 3-4, February 2007, Pages 237-245, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2006.01.014.
(http://www.sciencedirect.com/science/article/B6T43-4JG5FDY-2/2/4747aba859b86aa23b258ebea729a6ce)
Abstract:
Soy and derivative diets deliver large doses of isoflavones to human and animals throughout their lifespan, including gestation. Epidemiologic and experimental data suggest that the consumption of soybean containing foods may protect against cardiovascular disease and decrease breast, prostate and endometrial cancer risk. Based on animal and in vitro studies, however, concerns have been raised that consumption of isoflavones may cause potential adverse effects on the reproductive tract and behavior. The aim of this study was to investigate the effects of chronic consumption of a soy meal containing diet or soy isoflavones supplement on the morphology of reproductive organs, semen quality, age that males reached puberty, and sexual behavior of male rabbits. With this purpose, 16 female rabbits were randomly assigned to receive: (1) a soy- and alfafa-free diet; (2) a soy- and alfafa-free diet supplemented with 5 mg/kg body wt./day of soy isoflavones; (3) a soy- and alfafa-free diet supplemented with 20 mg/kg body wt./day of soy isoflavones; (4) a diet containing 18% of soy meal, throughout the gestation and lactation. After weaning, male offspring received the same diet, which was given to the respective mother. The age that males reached puberty, semen characteristics and sexual behavior were evaluated in these animals. At 33 weeks of age, the reproductive organs were submitted to histological evaluation. Rabbits, which received large amounts of isoflavones (20 mg/kg body wt./day) had a lesser food intake, body weight and semen volume. Spermatogenesis, morphology of male genital organs and sexual behavior did not differ significantly from the control group. We conclude that chronic dietary treatment with soy based diet or soy isoflavones have no adverse effects on the observed reproductive patterns of male rabbits.
Keywords: Phytoestrogens; Isoflavones; Soy; Reproduction; Rabbits

I.E. Anderson, D. Buxton, I. Campbell, G. Russell, W.C. Davis, M.J. Hamilton, D.M. Haig, Immunohistochemical Study of Experimental Malignant Catarrhal Fever in Rabbits, Journal of

Comparative Pathology, Volume 136, Issues 2-3, February-April 2007, Pages 156-166, ISSN 0021-9975, DOI: 10.1016/j.jcpa.2007.01.007.
(http://www.sciencedirect.com/science/article/B6WHW-4N977P1-2/2/37c68ca4088f9aec26c0614d21392ae5)
Abstract: Summary
Malignant catarrhal fever (MCF) is an often-fatal lymphoproliferative disease of a variety of ungulates that occurs worldwide. It is caused by either of the highly related but distinct gammaherpesviruses alcelaphine herpesvirus-1 (AlHV-1, wildebeest reservoir) or ovine herpesvirus-2 (OvHV-2, sheep reservoir). MCF in rabbits is an excellent model as it closely resembles the disease in susceptible ungulates that include cattle, deer and bison. In this study, newly available and previously characterized monoclonal antibodies specific for rabbit leucocyte differentiation molecules were used to perform a detailed immunohistochemical examination of both AlHV-1 MCF and OvHV-2 MCF in rabbits. Differences in the MCF caused by the two viruses included: less tissue necrosis and more lymphoid cell accumulations in AlHV-1 MCF compared with OvHV-2 MCF, and in particular marked tissue necrosis in the mesenteric lymph node, appendix and liver of OvHV-2-infected animals when compared with either other tissues in OvHV-2 MCF or AlHV-1 MCF lesions in any tissue. In both AlHV-1 MCF and OvHV-2 MCF, lymphoid cell accumulations in lymphoid and non-lymphoid tissues consisted mainly of T-cells with a corresponding absence of B-cells. CD8+ T-cells accounted for a proportion of these in the non-lymphoid tissues, but there was evidence for the accumulation of an unidentified T-cell subset/subsets as well. This study extends our understanding of the mechanisms of immuno-pathogenesis of MCF.
Keywords: gammaherpesvirus; malignant catarrhal fever; histopathology; immunohistochemistry

S.A. Rafat, D. Allain, R.G. Thebault, H. de Rochambeau, Divergent selection for fleece weight in French Angora rabbits: Non-genetic effects, genetic parameters and response to selection, Livestock Science, Volume 106, Issues 2-3, February 2007, Pages 169-175, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.08.001.
(http://www.sciencedirect.com/science/article/B7XNX-4KW60VF-1/2/b84b69c7434024389d7b8494153ca516)
Abstract:
In order to explore genetic variability of wool production and other quantitative traits, an 8-cohort divergent selection experiment for total fleece weight (TFW) was carried out in French Angora rabbits. Studies were made on the wool production of 669 female rabbits born between 1994 and 2001 and having produced wool from the third to 12th harvests. The aim of the selection experiment was to obtain two divergent lines (low and high) on total fleece weight. The studied traits included total fleece weight, weight of the two qualities of wool (WAJ1 and WAW1), homogeneity (HOM), live body weight at ages of 4 (LW4), 8 (LW8), 12 (LW12), 16 (LW16), and 20 (LW20) weeks and then 9 weeks before each harvest (9LW). A preliminary analysis of non-genetic factors was done with the GLM procedure. The genetic parameters and genetic trends were analysed using a BLUP animal model. Heritability estimates for TFW, WAJ1, WAW1, HOM, LW4, LW8, LW12, LW16, LW20 and 9LW were 0.38, 0.30, 0.10, 0.06, 0.30, 0.09, 0.14, 0.32, 0.39 and 0.45, respectively. Genetic and phenotypic correlations between TFW and WAJ1 were high (0.98 +/- 0.01 and 0.89 +/- 0.01, respectively). There was a low genetic correlation between TFW and 9LW (0.26 +/- 0.12). After eight cohorts of selection, the divergence between the lines was approximately three genetic standard deviations. Selection for total fleece weight had a generally beneficial effect on fleece quality.
Keywords: Angora rabbit; Bristle; Body weight; Divergent selection; Fleece weight; Genetic responses; Wool quality

J. Orengo, T. Gidenne, Feeding behaviour and caecotrophy in the young rabbit before weaning: An approach by analysing the digestive contents, Applied Animal Behaviour Science, Volume 102, Issues 1-2, January 2007, Pages 106-118, ISSN 0168-1591, DOI: 10.1016/j.applanim.2006.03.010.
(http://www.sciencedirect.com/science/article/B6T48-4JYKKJN-1/2/d38dff7ebf65ce9645a21a7c006e7d71)
Abstract:
Young rabbits consume milk, feed and soft faeces during the pre-weaning period, but the biological rhythm of intake were scarcely described. This work aimed to analyse the behaviour of ingestion and caecotrophy by analysing the stomach and rectal contents of young rabbits. Chronological samplings were performed according to a 4 x 3 factorial experimental design (17, 22, 28 and 35 days at 3, 8 and 23 h after suckling, respectively). Both digestive contents were examined and scored according to a discrete 4-step scale. Milk intake peaked around 22 days (26.6 g/rabbit) and decreased by 50% at 28 days. Stomach score for milk content showed a negative relationship with age. Dry feed intake reached 7.2 g/rabbit at 22 days, but was relatively variable among litters (CV = 44%). After 22 days, nutrient intake from the solid feed exceeded that of the milk. A higher pellet intake was observed during the night period (18:00-09:00 h) whatever the age. Dry feed in the stomach content was affected by age (17 versus 22, 28 and 35 days). From 22 days, milk and feed components were particularly distributed in the stomach: the coagulated milk was close to the wall of the fundus, whereas the feed was homogeneously spread. Soft faeces were not found until 28 days of age, and were located in the fundic region (25-30% of stomach profile). Stomach weight increased almost threefold from 17 to 35 days of age, but showed a slower development than the rest of the body from 22 to 35 days (relative stomach weight from 1.65 to 1.38%). High pH values (5.5-3.0) were found in the fundus at 3 and 8 hours after suckling. The pH in the antrum decreased from 4.19 to 1.90 at 17 and 22 days, respectively. The excretion of hard and soft faeces was indirectly recorded by checking the content of distal colon and rectum. From 22 days onwards, the amount of hard faeces in distal colon and rectum reached a peak at 8 h after suckling (2.3 +/- 0.2). On the contrary, soft faeces were only observed at 3 and 23 h after suckling from 28 days of age.
Keywords: Caecotrophy; Feeding behaviour; Stomach contents; Young rabbit

M. Pla, P. Hernandez, B. Arino, J.A. Ramirez, Isabel Diaz, Prediction of fatty acid content in rabbit meat and discrimination between conventional and organic production systems by NIRS methodology, Food Chemistry, Volume 100, Issue 1, 2007, Pages 165-170, ISSN 0308-8146, DOI: 10.1016/j.foodchem.2005.09.029.
(http://www.sciencedirect.com/science/article/B6T6R-4HH81ST-4/2/5915afbfe78a6bcf3b22f42f6ce3dc7a)
Abstract:
To investigate the feasibility of using the NIRS methodology to analyse the fatty acid content of rabbit meat and to discriminate between conventional and organic production, the meat of a hind leg of 119 rabbits was scanned between 1100 and 2498 nm and 104 samples were sent to the laboratory for reference analysis of fatty acids by gas chromatography. A commercial spectral analysis program (WINISI-2, v. 1.04) was used to process the data and to develop chemometric models. The better calibration equation for each fatty acid, leading to a higher determination coefficient of cross-validation (r2) and low standard error of cross-validation (SECV) was retained. Prediction of linoleic, palmitic, palmitoleic and oleic acid content was excellent or good (r2 between 0.90 and 0.70); prediction of arachidonic, stearic, [alpha]-linolenic and eicosatrienoic FA has r2 between 0.69 and 0.50. However, miristic, vaccenic, icosaenoic and eicosadienoic FA are problematic to predict. When fatty acids were grouped, the r2 of the calibration equations were: 0.85 for saturated FA, 0.83 for MUFA, 0.92 for PUFA and 0.91 for n - 6 FA, indicating excellent or good prediction. Prediction of [alpha]-linolenic FA (r2 = 0.59) needs more precision. The obtained

equations have been applied for predicting meat fatty acid composition of both groups of production systems, conventional and organic, for an other 52 rabbit meat samples (2 x 26). Meat of the organic source had lower ($p = 0.000$) monounsaturated FA (30.54% vs. 34.64%) and higher ($p = 0.019$) polyunsaturated FA (27.28% vs. 23.66%) than rabbit meat from the conventional system, while the saturated FA content was similar (42%) in both groups. The discriminant model correctly classified (98%) between conventional or organic produced rabbit meat.
Keywords: Near-infrared spectroscopy; Prediction; Fatty acids; Organic rabbit meat

Emel Arinc, Sevki Arslan, Azra Bozcaarmutlu, Orhan Adali, Effects of diabetes on rabbit kidney and lung CYP2E1 and CYP2B4 expression and drug metabolism and potentiation of carcinogenic activity of N-nitrosodimethylamine in kidney and lung, Food and Chemical Toxicology, Volume 45, Issue 1, January 2007, Pages 107-118, ISSN 0278-6915, DOI: 10.1016/j.fct.2006.07.026.
(http://www.sciencedirect.com/science/article/B6T6P-4PNJ1NF-H/2/3ffd822b148f051719295d798737b5b6)
Abstract:
There are limited number of studies regarding the influence of diabetes on the regulation of cytochrome P450s and associated drug metabolizing enzyme activities especially in extrahepatic tissues such as kidney. However, there is almost no such study in lung. Alloxan-induced diabetes did not change CYP2B4 expression as measured with immunoblot analysis and associated enzyme, benzphetamine N-demethylase, activity in rabbit kidney and lung. Induction of cytochrome P4502E1 by diabetes was identified by immunochemical detection on Western blots in the lung and kidney microsomes of rabbits. In parallel to CYP2E1 induction, aniline 4-hydroxylase and p-nitrophenol hydroxylase activities were markedly increased in diabetic rabbit lung and kidney. CYP2B4 and CYP2E1 dependent drug metabolism did not show any tissue variation in diabetic rabbit. These findings are in contrast to those of rats, mice and hamster. The results of the present work, in combination with those of the previous work [Arinc, E., Arslan, S., Adali, O., 2005. Differential effects of diabetes on CYP2E1 and CYP2B4 proteins and associated drug metabolizing enzyme activities in rabbit liver. Arch. Toxicol. 79, 427-433], indicate the existence of species-dependent response of CYP-dependent drug metabolizing enzymes to diabetes. A procarcinogen and food contaminant, N-nitrosodimethylamine (NDMA), is converted to its carcinogenic form after it is activated with NDMA N-demethylase. In the current study, a statistically significant increase of liver, kidney and lung NDMA N-demethylase activity associated with CYP2E1 was shown in diabetic rabbit. Thus, it is expected that, the risk of nitrosamine induced carcinogenesis will be greater in liver, kidney and lung of the diabetic subjects.
Keywords: Diabetes; Rabbit liver; Lung; Kidney; CYP2E1; CYP2B4; NDMA; P-Nitrophenol; NDMA N-demethylase; p-Nitrophenol hydroxylase; Aniline 4-hydroxylase; Cytochrome P450 reductase; Benzphetamine N-demethylase

Vanessa Blanc, Raul Mesa, Montserrat Saco, Susana Lavilla, Guillem Prats, Elisenda Miro, Ferran Navarro, Pilar Cortes, Montserrat Llagostera, ESBL- and plasmidic class C [beta]-lactamase-producing E. coli strains isolated from poultry, pig and rabbit farms, Veterinary Microbiology, Volume 118, Issues 3-4, 20 December 2006, Pages 299-304, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2006.08.002.
(http://www.sciencedirect.com/science/article/B6TD6-4KKNDW5-2/2/7e52b2f2db5ce3b4a792a255c86166d7)
Abstract:
This study aims to determine the presence of extended-spectrum (ESBL) and plasmidic class C [beta]-lactamase-producing Enterobacteriaceae in poultry, pig and rabbit farms of Catalonia (Spain). PFGE typing showed a low clonal relationship among strains carrying these mechanisms of resistance. Ninety-three percent of them were resistant to two or more of the non-[beta]-lactam antimicrobials tested and harboured ESBL and plasmidic class C [beta]-lactamases. Greater

diversity of these enzymes was found in strains from poultry farms, the CTX-M-9 family, especially CTX-M-14, with CMY-2 being the most frequent. The isolation of TEM-52 and SHV-2-producing Escherichia coli strains from these animal farms is noteworthy. In contrast, 73% of the strains from pig farms had CTX-M-1, and neither the CMY-type nor CTX-M-9 family enzyme was found. Likewise, it is the first time that CTX-M-1 and SHV-5 encoding strains have been isolated in pigs. On the other hand, in rabbit farms CTX-M-9 family was also the most frequent, being detected in three of a total of four strains. The last one showed a CMY-2, for the first time detected in these animals, too. In conclusion, commensal E. coli strains of food-producing animal farms are a reservoir of ESBL and plasmidic class C [beta]-lactamases.
Keywords: ESBL; Plasmidic class C; Enterobacteriaceae; Escherichia coli; Poultry; Pig and rabbit farms

M.M. Oloumi, A. Derakhshanfar, M.M. Molaei, M. Tayyebi, The angiogenic potential of autogenous free omental graft in experimental tibial defects in rabbit: Short-term preliminary histopathological study, Journal of Experimental Animal Science, Volume 43, Issue 3, 12 December 2006, Pages 179-187, ISSN 0939-8600, DOI: 10.1016/j.jeas.2006.02.002.
(http://www.sciencedirect.com/science/article/B7GW2-4K9C6HC-1/2/c4eded5a656154027a6df4e0ebf83de8)
Abstract:
This study was designed to evaluate the role of free autogenous greater omentum in vasculogenesis during the process of bone healing. The study was carried out on 15 male adult white New Zealand rabbits in the same condition. Both tibiae of the animals were exposed medially and a 2 mm hole was drilled at proximal diaphysis. A small piece of greater omentum, obtained from a 1 cm mid-abdominal incision was secured on left tibial hole. The animals were euthanized 14 days after operation and the bones removed for histopathological and immunohistochemical (anti-CD31 application for endothelial cell labeling) studies. In histopathological sections, the soft callus area in treatment legs was significantly more than the control legs. Also, the hole diameter in treatment group was significantly less than the control group. The number of capillary buds in treatment legs was significantly more than the control group. This study showed that an autogenous free greater omentum graft can influence bone healing through augmentation of vasculogenesis, as an essential element for proper bone healing.
Keywords: Rabbit; Tibia; Vasculogenesis; Omental graft

P. Ypsilantis, V. Didilis, I. Bougioukas, C. Tsigalou, T. Lialiaris, C. Simopoulos, G. Bougioukas, Post-operative course in a surgical model of acute myocardial infarction in the rabbit, Journal of Experimental Animal Science, Volume 43, Issue 3, 12 December 2006, Pages 197-209, ISSN 0939-8600, DOI: 10.1016/j.jeas.2006.08.001.
(http://www.sciencedirect.com/science/article/B7GW2-4M64555-2/2/2806eeab60534bb434592e1b1177a9ac)
Abstract:
This study was undertaken to evaluate the post-operative (post-OP) course of rabbits in a surgical model of myocardial infarction (MI). Ten New Zealand White rabbits were subjected to coronary artery ligation after lateral thoracotomy. Anesthesia was delivered using a xylazine-ketamine-isoflurane protocol after endotracheal intubation. Among other cardiorespiratory parameters, arterial pressure was monitored via central ear artery catheterization. Post-OP care included oxygen, antibiotic and analgesic treatment as well as nutritional and fluid support. A series of cardiorespiratory, hematological, blood biochemical and clinical parameters were assessed during the first 21 days. The mortality rate was 10%. Hypotension and hypothermia, noted during the operation, reverted within the first few post-MI hours. Electrocardiographic alterations, which included ST segment elevation and Q wave, appeared after MI and remained throughout the study period. Tachycardia was observed during the first 5 days. Hematological examination revealed

mild and transient anemia during the post-OP period and leucocytosis up to the 5th day. Urea was increased up to the 12th post-MI hour while increased AST, ALT, LDH and CK levels normalized by the first 4-5 days. Although the post-OP anorexia period lasted around 5 days, the animals did not manage to regain their body weight by the end of the study period. In conclusion, the present model offers a low mortality rate and could be useful in mid- or long-term MI studies. The animals go through a critical post-OP period of around 5 days during which special care should be given. After that time, their clinical and blood laboratory parameters tend to normalize.
Keywords: Rabbit; Myocardial infarction; Surgical model; Post-operative course

Pascal Salvetti, Thierry Joly, Anne Baudot, 110. Effect of antibiotics on thermodynamic properties of freezing media in rabbit species: A first calorimetric approach, Cryobiology, Volume 53, Issue 3, December 2006, Pages 414-415, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2006.10.111.
(http://www.sciencedirect.com/science/article/B6WD5-4MJC233-3X/2/07bfe7d66ca52454c14da3a9f30ff7d0)

Raffaella Tudisco, Federico Infascelli, Monica Isabella Cutrignelli, Fulvia Bovera, Caterina Morcia, Primetta Faccioli, Valeria Terzi, Fate of feed plant DNA monitored in water buffalo (Bubalus bubalis) and rabbit (Oryctolagus cuniculus), Livestock Science, Volume 105, Issues 1-3, December 2006, Pages 12-18, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.04.036.
(http://www.sciencedirect.com/science/article/B7XNX-4KF78HN-1/2/d7d2d5a605dbf2dafe74268d7f5c2940)
Abstract:
The effect of the digestion process in the gastro-intestinal tract (GIT) of animal models on the fate and integrity of plant DNA has been widely evaluated since DNA availability and integrity is a key factor for hypothetical horizontal gene transfer of recombinant DNA from GM crop-derived feeds to animal and human gut microflora. In this study, plant DNA sequences from high and low copy number genes were monitored in GIT and tissues of buffaloes and rabbits. Using a real-time PCR approach to track plant DNA in animal samples, we demonstrated the persistence of fragmented plant DNA blood and tissues of buffaloes and rabbits raised with conventional feeding.
Keywords: Buffalo; Rabbit; Plant DNA survival; Real-time qPCR

P.G. Ferreira, A. Costa-e-Silva, A.P. Aguas, Liver disease in young rabbits infected by calicivirus through nasal and oral routes, Research in Veterinary Science, Volume 81, Issue 3, December 2006, Pages 362-365, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2006.02.001.
(http://www.sciencedirect.com/science/article/B6WWR-4JRVD5R-4/2/57d562a7502180013c5eb74530a6abf6)
Abstract:
Calicivirus infection causes rabbit haemorrhagic disease (RHD) that kills more than 90% of adult animals, whereas young rabbits are naturally resistant to this viral disease. It has been proposed that the different response of adult and young rabbits to calicivirus infection is due to absence of viral receptors in respiratory and digestive systems of young animals. We have searched for liver disease in 4-week-old rabbits inoculated with a calicivirus suspension by intranasal and oral routes. These young rabbits showed cell damage and mononuclear infiltration of the liver. The hepatic lesions were associated with mild to moderate increase in circulating transaminases. We conclude that the previously reported reduction of viral receptors in the epithelium of respiratory and digestive systems of young rabbits does not inhibit calicivirus from inducing liver disease in these hosts.
Keywords: RHD resistance; RHDV; Liver pathology; Mononuclear inflammation; Hepatic transaminases

E. Escudero, E. Fernandez-Varon, P. Marin, A. Espuny, M.D. Najera, C.M. Carceles, Pharmacokinetics and tissue tolerance of azithromycin after intramuscular administration to rabbits, Research in Veterinary Science, Volume 81, Issue 3, December 2006, Pages 366-372, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2006.01.006.
(http://www.sciencedirect.com/science/article/B6WWR-4JFHF8F-2/2/25e916b66639fe0432633235ed30fcd0)
Abstract:
The pharmacokinetics of azithromycin after intravenous and intramuscular injection at a single dose rate of 10 mg/kg bodyweight were investigated in rabbits by using a modified agar diffusion bioassay for determining plasma concentrations. The plasma creatine kinase activity was determined after i.m. administration for the evaluation of the tissue tolerance.
The elimination half-lives of azithromycin after intravenous and intramuscular administration were 24.1 and 25.1 h, respectively. After intramuscular administration mean peak plasma concentration was 0.26 +/- 0.01 mg/L and bioavailability was 97.7%. Plasma CK activity rose sharply within 8 h after i.m. injection of azithromycin; activity returned to pre-treatment level by 48-72 h post-treatment. The transient rise in serum CK activity indicates some degree of muscle tissue damage at the injection site.
Keywords: Azithromycin; Pharmacokinetics; Intramuscular; Tissue tolerance; Rabbits; Bioavailability; Creatine kinase

Jean-Michel Brun, Michele Theau-Clement, Jean Esparbie, Jacky Falieres, Georges Saleil, Catherine Larzul, Semen production in two rabbit lines divergently selected for 63-d body weight, Theriogenology, Volume 66, Issue 9, December 2006, Pages 2165-2172, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2006.07.004.
(http://www.sciencedirect.com/science/article/B6TCM-4KXVCSR-1/2/254250d58667c2362cb81c611d236974)
Abstract:
Thirty-one bucks from two lines divergently selected for 63-d body weight (low, L and high, H) were solicited every week (twice at a 15 min interval) during 18 weeks resulting in 482 ejaculates. While differing markedly on adult body weight (L: 4650 g versus H: 5925 g), both lines had the same testis weight. Libido did not differ between the lines. The proportion of ejaculates suitable for insemination was markedly higher in the L line (66.5% versus 44.2%). Mass motility and the volume of the ejaculates were higher in the L line while the sperm concentration was higher in the H line. Overall, the total number of spermatozoa per ejaculate was similar in both lines but the efficient number of spermatozoa per ejaculate, a synthetic criterion taking into account the ability of the ejaculate for insemination was higher in the L line (229 versus 170 x 106). The L line had higher values of average path velocity, linearity and curvilinear velocity but a lower value of beat cross frequency. In the L line, both ejaculates had the same concentration, while in the H line, the first ejaculate was more concentrated than the second one. Some male reproductive traits are therefore genetically related to body weight.
Keywords: Rabbit; Semen traits; Growth; Divergent selection; Correlated response

Cesare Castellini, Flavia Pizzi, Michele Theau-Clement, Paolo Lattaioli, Effect of different number of frozen spermatozoa inseminated on the reproductive performance of rabbit does, Theriogenology, Volume 66, Issue 9, December 2006, Pages 2182-2187, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2006.06.010.
(http://www.sciencedirect.com/science/article/B6TCM-4KPN9PX-1/2/bbd322d49178d78c2bf6bf89a65b37a0)
Abstract:
The relationship between the number of frozen spermatozoa inseminated and fertility rate and litter size at birth in rabbit does was investigated. Six hundred artificial inseminations (AI) were

performed on multiparous lactating does with three spermatozoa concentrations: 10, 25, 50 x 106 spermatozoa/AI. All the does were synchronized with 20 UI of eCG 2 days before AI. The estimated sexual receptivity was 87%. The freezing-thawing procedure strongly reduced kinetic and functional traits (acrosome integrity, capacitation) of the spermatozoa. The number of spermatozoa inseminated did not affect the reproductive performance: the mean fertility rate and litter size values were 51.5% and 7.6%, respectively. Sexually receptive does (n = 522) inseminated with frozen spermatozoa showed a 58.0% fertility rate whereas, non-receptive does (n = 78), had a very poor fertility rate (7.8%).
Keywords: Rabbit; Artificial insemination; Fertility rate; Frozen semen

M. Garcia-Tomas, J. Sanchez, O. Rafel, J. Ramon, M. Piles, Reproductive performance of crossbred and purebred male rabbits, Livestock Science, Volume 104, Issue 3, November 2006, Pages 233-243, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.04.006.
(http://www.sciencedirect.com/science/article/B7XNX-4K7NHYG-1/2/e23a8a3fa49bc2a6a6099e81b193b688)
Abstract:
The effect of buck genetic type and crossbreeding parameters on fertility and prolificacy were estimated using two rabbit sire lines and their reciprocal crosses. The relationship between the reproductive performance of inseminated multiparous does and several semen quality traits was also investigated. The semen characteristics evaluated were: pH (pH), mass and individual motility (MM, IM), percentage of viable spermatozoa (Vi), spermatozoa with normal apical ridge (NAR), normal spermatozoa (NSP), spermatozoa with morphological abnormalities of head (HAP), neck-midpiece (NAP), and tail (TAP), spermatozoa with the presence of proximal (PD) and distal (DD) cytoplasmic droplets.
Fertility was analysed as a continuous trait (kindling rate) or as a binary trait (success or failure of kindling). In the first case, the analysis was performed using GLM procedures of SAS v.8 according to a model that included the fixed factors of buck genetic type, number of ejaculates per pool and week of insemination. In the second case, fertility was analysed using GENMOD procedures of SAS v.8 according to a mixed model including the same fixed factors as before plus the physiological status of the does and the permanent random effect of female. Number of kits born alive and number of stillborn were analysed with MIXED procedures of SAS v.8 with the same model used for the analysis of fertility as a binary trait. Estimates of the estimable functions of crossbreeding genetic parameters of the lines were obtained from the solutions of the corresponding models by generalized least squares using GLM, GENMOD and MIXED procedures. Crossbreeding parameters were estimated according to the model of Dickerson. A linear regression was used to determine the relationship between fertility and litter size and the semen characteristics evaluated.
Significant differences in fertility were observed among buck genetic types, which were favourable to type R. Differences between lines in maternal genetic effects were relevant and favourable to type R for fertility. Individual heterosis was important but unfavourable for fertility.
A slight correlation was obtained between all semen quality traits and fertility and prolificacy. Two multiple models were found for fertility, including NAP, IM, NSP, buck genetic type and Vi in one model or NAR in other model. Individual motility had an important positive effect, while NAP had a small negative effect. When MM, TAP and buck genetic type were included in a multiple model for the number of kits born alive, both MM and TAP had significant small effects. Individual motility and DD appeared to be related to number of kits stillborn, but only DD had a significant although negligible effect.
Keywords: Crossbreeding parameters; Rabbit; Fertility; Prolificacy; Semen

D. Marlier, R. Dewree, C. Lassence, D. Licois, J. Mainil, P. Coudert, L. Meulemans, R. Ducatelle, H. Vindevogel, Infectious agents associated with epizootic rabbit enteropathy: Isolation and

attempts to reproduce the syndrome, The Veterinary Journal, Volume 172, Issue 3, November 2006, Pages 493-500, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2005.07.011.
(http://www.sciencedirect.com/science/article/B6WXN-4H2PJWM-4/2/0effa3e7db6f178855529a15c0cc2ba0)
Abstract:
Epizootic rabbit enteropathy (ERE), a highly lethal (30-80% mortality) disease of broiler rabbits aged 6-14 weeks, first appeared in 1997 in French intensive enclosed rabbitries and is of unknown aetiology. Bacteriological, virological and parasitical examination of the intestinal contents of rabbits that had died either in spontaneous field cases or after experimental reproduction of ERE, were undertaken in an attempt to identify infectious agents that may play a role in the disease. Two bacterial strains, Clostridium perfringens and non-enteropathogenic Escherichia coli were repeatedly isolated at high faecal counts from naturally infected animals. In field cases, a correlation between typical gross lesions of epizootic enteropathy and the presence of the alpha toxin of Cl. perfringens was observed ($P < 0.0001$; Chi-squared test). Although attempts to reproduce the disease by inoculation with different pools of cultivable bacterial strains failed, the disease was successfully reproduced by inoculation with one French and two Belgian samples of caecal contents.
Keywords: Epizootic rabbit enteropathy; Oryctolagus cuniculus; Aetiology; Clostridium perfringens; Inoculation

Dieter Vancraeynest, Katleen Hermans, Freddy Haesebrouck, Prevalence of genes encoding exfoliative toxins, leucotoxins and superantigens among high and low virulence rabbit Staphylococcus aureus strains, Veterinary Microbiology, Volume 117, Issues 2-4, 31 October 2006, Pages 211-218, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2006.05.009.
(http://www.sciencedirect.com/science/article/B6TD6-4KF6BP4-1/2/09f6ae3115559a5997e02260617d7824)
Abstract:
Staphylococcus aureus is an important cause of pododermatitis, subcutaneous abscesses and mastitis in rabbits. On rabbitry level, two types of S. aureus infections can be distinguished. In the first type, caused by low virulence strains, the infection affects only a small number of animals. The second type of infection is caused by high virulence strains and spreads throughout the rabbit flock. The pathogenic capacity of a particular S. aureus strain is attributed to a combination of invasive properties and extracellular factors such as toxin production. Therefore, 22 high virulence and 37 low virulence S. aureus isolates were compared regarding the prevalence of genes encoding exfoliative toxins, leucotoxins and superantigens. This study revealed a clearly significant difference between HV and LV rabbit S. aureus strains. All typical HV isolates were positive for the egc cluster, containing the enterotoxin(like) genes seg, sei, selm, seln, selo and selu, whereas these genes were not detected in any of the LV isolates. Further research is necessary to clarify the importance of the egc cluster in the pathogenesis of infections with high virulence S. aureus strains in rabbits.
Keywords: Staphylococcus aureus; Rabbit; Exfoliative toxin; Leucotoxin; Superantigen

Brandon T. Leader, Wesley C. VanVoorhis, Sheila A. Lukehart, Expression of rabbit interleukin-4 and characterization of its biologic activity on T and B-cells, Veterinary Immunology and Immunopathology, Volume 113, Issues 3-4, 15 October 2006, Pages 421-427, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2006.06.001.
(http://www.sciencedirect.com/science/article/B6TD5-4KJ5T3G-2/2/06835874bd7321833e00b4e23ad7c2ff)
Abstract:
The purpose of the current study was to express recombinant rabbit IL-4 (rRbIL-4) and to characterize its biological activity. The cDNA of RbIL-4 was cloned into an insect cell expression

vector that allowed for constitutive expression in Sf9 cells and incorporated a 6-histidine tag on the recombinant protein for purification. The purified protein corresponded to the predicted size of rRbIL-4 and was recognized by an anti-human IL-4 antibody in immunoblotting. As shown for IL-4 from other species, a dose-dependent proliferative response was observed in T-lymphoblasts cultured with rRbIL-4. rRbIL-4 also induced increased expression of MHC class II molecules on the surface of rabbit B-cells in a dose-dependent manner. These results indicate that we have produced recombinant rabbit IL-4 that exhibits expected biological activity on rabbit B and T-cells.
Keywords: Rabbit; Interleukin-4; IL-4; MHC class II; B-cell

Betty Bisdorff, Richard Wall, Blowfly strike prevalence in domestic rabbits in southwest England and Wales, Veterinary Parasitology, Volume 141, Issues 1-2, 10 October 2006, Pages 150-155, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2006.05.018.
(http://www.sciencedirect.com/science/article/B6TD7-4KBDWRH-2/2/90b45d5f9669b268e02be3ac6e8d5550)
Abstract:
The prevalence of blowfly strike in rabbits in southwest England and Wales was investigated using a retrospective postal survey of small animal and mixed veterinary practices. Questionnaires were sent to 474 practices; 219 were returned completed, giving a response rate of 46.2%. The prevalence of blowfly strike was estimated as the percentage of veterinary practices that reporting having treated at least one rabbit for strike between May and September 2005. Overall, 94.5% (+/-2.21) of practices treated at least one case of rabbit strike. Almost half, 49.3% (+/-11.3) of practices reported treating only 1-5 rabbits for blowfly strike in the study period; 32.8% (+/-4.56), 13% (+/-3.27) and 4.8% (+/-2.08) treated 6-10, 11-15 and more than 15 struck rabbits, respectively. In 46.3% (+/-4.84) of the practices most infested rabbits survived. For 40.4% (+/-4.77) of practices, about half the struck rabbits survived. However, for 13.3% (+/-3.30) of practices most struck rabbits were reported to have died. The practices reporting that most animals died were those that saw significantly fewer rabbits and fewer struck rabbits than practices where more animals survived. This suggests that training and experience in the appropriate care of infested rabbits may be critical in ensuring a favorable outcome.
Keywords: Blowfly; Lucilia sericata; Myiasis; Rabbit; Strike; Southwest England; Wales

Pascal Salvetti, Thierry Joly, Anne Baudot, Effect of antibiotics on thermodynamic properties of freezing media in rabbit species: A first calorimetric approach, Cryobiology, Volume 53, Issue 2, October 2006, Pages 268-275, ISSN 0011-2240, DOI: 10.1016/j.cryobiol.2006.07.002.
(http://www.sciencedirect.com/science/article/B6WD5-4KPP4GJ-2/2/8fc0338e5f2d6b6c0a380dc62d013f12)
Abstract:
Semen freezing is an effective and safe solution for the cryopreservation of animal genetic resources and for the diffusion of the genetic progress. Actually, these techniques are not yet under control for the rabbit species partly because methods are not clearly defined. Thus, the aim of this work is to study the effect of antibiotics (Penicillin G, Streptomycin) routinely used in freezing semen on the thermodynamic properties of freezing media mainly used in rabbit species. Measurements realized by differential scanning calorimetry show that these antibiotics may change the temperature of crystallization and the quantity of ice formed in the freezing media considered. Our calorimetric approach underlined that the composition and the properties of the cryoprotective solutions should be studied more precisely.
Keywords: Rabbit; Semen; Freezing; Antibiotics; Differential scanning calorimetry; Ice crystallization

I. Nagy, N. Ibanez, R. Romvari, W. Mekkawy, Sz. Metzger, P. Horn, Zs. Szendro, Genetic parameters of growth and in vivo computerized tomography based carcass traits in Pannon White

rabbits, Livestock Science, Volume 104, Issues 1-2, October 2006, Pages 46-52, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.03.009.
(http://www.sciencedirect.com/science/article/B7XNX-4JTRTPF-3/2/348dda9bf3ac03f19b6b0aaeede3a048)
Abstract:
Genetic parameters for average daily gain between the age of 5 and 10 weeks (ADG), the average cross-sectional area of the m. Longissimus dorsi (L) (between the 2nd-3rd and 4th-5th lumbar vertebrae-based on in vivo computerized tomography (CT)) and dressing out percentage (DoP) were estimated in a group of 28,686 Pannon White rabbits reared in 5044 litters and born between 2000 and 2003. Using multivariate animal models with Bayesian procedures, estimated heritabilities were moderate and moderately high for ADG, L and DoP (0.21 to 0.29, 0.25 to 0.42 and 0.19 to 0.71, respectively). Litter effects were moderate for ADG, L and DoP estimates (0.20 to 0.22, 0.10 to 0.18 and 0.09 to 0.30, respectively). Genetic correlation coefficient estimates between ADG and L and ADG and DoP were moderate and negative (- 0.41 to - 0.01, - 0.70 to + 0.10). A moderately high positive genetic correlation was found between L and DoP (0.13 to 0.83).
Keywords: Rabbits; Computer tomography; Genetic parameters

I.F.M. Marai, A.A. Askar, L.B. Bahgat, Tolerance of New Zealand White and Californian doe rabbits at first parity to the sub-tropical environment of Egypt, Livestock Science, Volume 104, Issues 1-2, October 2006, Pages 165-172, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.04.013.
(http://www.sciencedirect.com/science/article/B7XNX-4K2T5DD-1/2/a8022d640fbb8b5cb5f248248d06325c)
Abstract:
Tolerance of New Zealand White (NZW) and Californian (Cal) doe rabbits at the first parity to the sub-tropical environmental conditions of Egypt was evaluated. The study included 1090 parturitions: 601 NZW and 489 Cal. The does used were 5 months of age and 3.1 +/- 0.10 kg mean body weight. The study was carried out during the different seasons of the year. The results showed that the effects of breed on the traits studied were not significant except on the doe kindling weight. However, the traits studied were, in general, higher in NZW than in Cal. The estimated temperature-humidity index (THI) average values were 19.8, 18.0, 23.7 and 25.7 during autumn, winter, spring and summer, respectively, indicating absence of heat stress during autumn and winter (less than 22.2) and exposure to severe (more than 23.3) and very severe heat stress (more than 25.6), during spring and summer, respectively. The effects of season of kindling were highly significant ($P < 0.001$ or 0.01) on conception rate, gestation period, kindling weight, litter weight at birth (live and total), 21 days of age and at weaning and kit weight at birth. The values were, in general, the lowest ($P < 0.05$) during the very severe heat stress in summer, while the kindling interval and pre-weaning mortality were the highest in summer. Adaptability was estimated (during the four seasons of the year) to be 93.3% and 95.1% for NZW and Cal, respectively. No interactions were observed in the analysis.
Keywords: NZW and Cal doe rabbits; Season of birth; Productive; Reproductive traits

Jon Slate, Josephine Pemberton, Does reduced heterozygosity depress sperm quality in wild rabbits (Oryctolagus cuniculus)?, Current Biology, Volume 16, Issue 18, 19 September 2006, Pages R790-R791, ISSN 0960-9822, DOI: 10.1016/j.cub.2006.08.047.
(http://www.sciencedirect.com/science/article/B6VRT-4KXDWXW-9/2/978d064dba0ce0c22ca4a433664c2ab7)

D. Fouchet, S. Marchandeau, M. Langlais, D. Pontier, Waning of maternal immunity and the impact of diseases: The example of myxomatosis in natural rabbit populations, Journal of Theoretical Biology, Volume 242, Issue 1, 7 September 2006, Pages 81-89, ISSN 0022-5193, DOI: 10.1016/j.jtbi.2006.02.003.

(http://www.sciencedirect.com/science/article/B6WMD-4JM0TR9-1/2/fb49f01d402dc3a66eacbac74a6abab9)
Abstract:
Myxomatosis is a leporipoxvirus that infects the european rabbit, inducing a high mortality rate. Observations lead us to hypothesize that a rabbit carrying maternal antibodies (or having recovered) can be infected (or re-infected) upon being exposed (or re-exposed) to the virus. Infection will lead to mild disease, boosting host immune protection. Using a modelling approach we show that this phenomenon may lead to a difference of impact of myxomatosis according to its transmission rate. Young are exposed when they still carry maternal antibodies and develop a mild disease in high transmission populations. Our results show that the impact of myxomatosis is generally higher in epidemic situations compared to populations where the virus circulates all the year. As a consequence, waning of acquired immunity and the continuous supply of newborn along the year may reduce the impact of the disease.
Keywords: Rabbit; Myxomatosis; Waning immunity; Mathematical model; Transmission rate

Ivis T. Forrester-Anderson, James McNitt, Robin Way, Mark Way, Fatty acid content of pasture-reared fryer rabbit meat, Journal of Food Composition and Analysis, Volume 19, Issues 6-7, Biodiversity and nutrition: a common path, September-November 2006, Pages 715-719, ISSN 0889-1575, DOI: 10.1016/j.jfca.2006.02.011.
(http://www.sciencedirect.com/science/article/B6WJH-4K3D1F2-2/2/bbdc332f3044798f9bf6de99d48f36ff)
Abstract:
This study evaluated the fatty acid content of rabbit meat from New Zealand WhitexCalifornian cross fryers born and reared outdoors on pasture (O/O), born and reared indoors in cages (I/I), or born indoors in cages and reared outdoors on pasture (I/O). The rabbits were sacrificed at 104 days of age and the left loin muscle (m. Longissimus dorsi) harvested for fat analysis. The standard AOAC methods were used to determine total fat and fatty acid contents. Compared to animals reared in cages, rabbits reared outdoors on pasture had significantly less total fat, higher proportions of eicosatrienoic and docosaenoic fatty acids and higher amounts of the n-3 fatty acids docosahexaenoic, docosapentaenoic and eicosapentaenoic. These data suggest that a grass-based diet may alter the fatty acid profile of rabbit meat, thus enhancing the n-3 fatty acid content and the nutritional value of the meat.
Keywords: Pastured rabbit; Fatty acids

Jimin Zhang, Meng Fan, Yang Kuang, Rabbits killing birds revisited, Mathematical Biosciences, Volume 203, Issue 1, September 2006, Pages 100-123, ISSN 0025-5564, DOI: 10.1016/j.mbs.2006.01.004.
(http://www.sciencedirect.com/science/article/B6VHX-4JFGH1N-2/2/8d93055b3d42b64b79e29195ca1e2a2c)
Abstract:
We formulate and study a three-species population model consisting of an endemic prey (bird), an alien prey (rabbit) and an alien predator (cat). Our model overcomes several model construction problems in existing models. Moreover, our model generates richer, more reasonable and realistic dynamics. We explore the possible control strategies to save or restore the bird by controlling or eliminating the rabbit or the cat when the bird is endangered. We confirm the existence of the hyperpredation phenomenon, which is a big potential threat to most endemic prey. Specifically, we show that, in an endemic prey-alien prey-alien predator system, eradication of introduced predators such as the cat alone is not always the best solution to protect endemic insular prey since predator control may fail to protect the indigenous prey when the control of the introduced prey is not carried out simultaneously.

Keywords: Bird conservation; Control strategies; Hyperpredation process; Apparent competition; Mathematical models

N.L. Forrester, R.C. Trout, S.L. Turner, D. Kelly, B. Boag, S. Moss, E.A. Gould, Unravelling the paradox of rabbit haemorrhagic disease virus emergence, using phylogenetic analysis; possible implications for rabbit conservation strategies, Biological Conservation, Volume 131, Issue 2, Infectious Disease and Mammalian Conservation, August 2006, Pages 296-306, ISSN 0006-3207, DOI: 10.1016/j.biocon.2006.05.005.
(http://www.sciencedirect.com/science/article/B6V5X-4K4PST6-5/2/d083ffe0e315162e387e673ef538d130)
Abstract:
During the past 50 years two readily distinguishable rabbit-specific diseases caused by Myxoma virus (MYXV) and Rabbit haemorrhagic disease virus (RHDV) respectively, have decimated wild rabbit populations worldwide. Combined with the use of these viruses as biocontrol agents, the consequences for farming, commercial rabbit breeding and rare habitat conservation dependent on rabbit grazing, have been both positive and negative. Moreover, rare predators that rely on rabbits as a food resource, and even hunters, have suffered the consequences of rabbit populations being affected by one or other of these viruses.
Rabbit haemorrhagic disease virus was first identified after thousands of domestic rabbits died suddenly in China in 1984. Similar epidemics subsequently occurred in other regions of Asia, the Middle East, Europe and North America, suggesting that the virus had dispersed widely following its emergence in China. However, the discovery that RHDV had circulated apparently harmlessly for many years before the first recognised epidemic in China prompted us to investigate the evolution, emergence and dispersal of this virus in relation to its impact on conservation of wildlife species. Accordingly, we have sequenced new isolates of RHDV and combined these data with a global selection of available RHDV sequences. Using phylogenetic analysis we demonstrate that the Chinese epidemic virus diverged from European viruses that circulated many years prior to 1984. We also demonstrate that the lineages of the pathogenic viruses that emerged in the UK in the early 1990s, are distinct from and pre-date those of the 1984 Chinese virus. In other words, European strains of RHDV emerged from apparently harmless strains to cause epidemic outbreaks, independently of the Chinese 1984 epidemic virus. These studies demonstrate how understanding viral epidemiology can improve the development of strategies to conserve rabbits, rare predator species and the habitat.

Gabriele Brecchia, Adriana Bonanno, Giovanna Galeati, Claudia Federici, Margherita Maranesi, Anna Gobbetti, Massimo Zerani, Cristiano Boiti, Hormonal and metabolic adaptation to fasting: Effects on the hypothalamic-pituitary-ovarian axis and reproductive performance of rabbit does, Domestic Animal Endocrinology, Volume 31, Issue 2, August 2006, Pages 105-122, ISSN 0739-7240, DOI: 10.1016/j.domaniend.2005.09.006.
(http://www.sciencedirect.com/science/article/B6T62-4H6XNCK-2/2/f5e6cfa54307aeabcc3ed9ef8397c2b6)
Abstract:
To assess the impact of acute caloric shortage on reproduction, rabbit does were either fed ad libitum (control, AL), or fasted for 24 (STF) or 48 h (LTF) before induction of ovulation with GnRH injection. Blood samples were collected during the last 3 h of fasting, and the following 4 h after GnRH injection, when feed was provided again, to measure plasma concentrations of LH, estradiol-17[beta], leptin, insulin, T3, corticosterone, glucose, and NEFA.
Before re-feeding, plasma leptin, insulin, and T3 concentrations were lower ($P <= 0.01$) in both fasted groups than in controls, but then gradually increased following realimentation to match those of controls. During fasting, corticosterone levels were higher ($P <= 0.01$) in LTF than in STF and AL does, but decreased to control values soon after realimentation. During fasting, plasma

glucose concentrations did not differ among groups, but upon re-feeding they markedly increased (P <= 0.01) both in STF and LTF does. NEFA levels were also more elevated (P <= 0.01) in fasted rabbits than in controls, and rapidly decreased (P <= 0.01) after re-feeding. Following GnRH injection, LH peak was lower (P <= 0.01) in LTF than in AL and STF does. Estradiol-17[beta] showed higher pulse frequency and amplitude in AL than in STF and LTF does. Compared to controls, receptivity rate of STF and LTF artificially inseminated does declined respectively by -20.5% (P <= 0.05) and -22.7%, and fertility rate by -23.9% (P <= 0.05) and 21.4%, but no difference was found in ovulation rate. In summary, nutritional status of does, as modified by fasting, greatly influenced fertility, metabolic and reproductive hormones.
Keywords: Fasting; LH; Estradiol-17[beta]; Leptin; Insulin; T3; Corticosterone; Rabbit

P.G. Rebollar, N. Pereda, M. Villarroel, P. Millan, P.L. Lorenzo, Oestrus synchronization of rabbit does at early post-partum by dam-litter separation or eCG injection: Effect on kit mortality and growth, Livestock Science, Volume 103, Issues 1-2, August 2006, Pages 13-22, ISSN 1871-1413, DOI: 10.1016/j.livsci.2005.12.008.
(http://www.sciencedirect.com/science/article/B7XNX-4JKHN9B-1/2/c612102ac0525aca2b6478e871455413)
Abstract:
Insemination of rabbit does at early post-partum combined with dam-litter separation (DLS) can increase prolificacy and decrease parturition intervals, but little is known about longer-term effects on kit survival and growth. In this study, does (n = 138) were artificially inseminated on day 4 post-partum (nine times over a period of 10 months, 35-day reproductive rhythm, kits weaned at 25 days), after DLS (for 48 or 24 h) or 48 h after 25 UI eCG injection. The litters from each group were adjusted to seven to nine kits per doe and then weighed at 2, 4, 16 and 25 days of age. Mortality was calculated in the pre-weaning period and development of the digestive system was quantified (length of intestinal villi). After DLS24 or DLS48, 4-day-old kits were lighter than eCG or controls of the same age. By 16 and 25 days of age, 48-h weaned kits had regained the same weight as the eCG and control groups (higher daily weight gain). The 24-h weaned kits weighed less, probably because their litter size was larger and daily weight gain was lower. Total kit mortality (day 2 to day 25) was highest in the DLS48 group but percentage mortality varied among treatments depending on the period considered (days 2-4, days 5-16 and days 17-25). In the first period, mortality was higher for DLS48; in the second, mortality was similar for all groups except eCG (which was lower). After 16 days of age, mortality was quite low and similar in all groups. There was a significant effect of the number of parturitions on the parameters considered. Intestinal villi were measured in 12 kits slaughtered at 4, 16 and 25 days of age (DLS for 24 or 48 h on days 3 and 2, respectively) and compared with controls (2, 4, 16 and 25 days old). At 4 days (immediately after separation), the stomach and whole digestive system were lighter in DLS48 than controls, due to the absence of the milk, but there were no significant differences among groups by days 16 and 25. Intestinal villi were shorter in 4-day-old DLS kits (24 and 48 h) compared to controls of the same age, longer at 16 days (possibly due to an intense cellular proliferation) and similar among all groups by day 25. In summary, both 24-h DLS and 48-h DLS can substitute hormonal treatments to synchronize oestrus in intensive rhythms, but kit mortality was higher after 48-h DLS in primiparous does, suggesting that results would improve if those females had a better body condition.
Keywords: Rabbits; Lactating; Oestrus synchronization; Litter growth; Mortality

Zs. Szendro, M. Gyovai, L. Maertens, E. Biro-Nemeth, I. Radnai, Zs. Matics, Z. Princz, Zs. Gerencser, P. Horn, Influence of birth weight and nutrient supply before and after weaning on the performance of rabbit does to age of the first mating, Livestock Science, Volume 103, Issues 1-2, August 2006, Pages 54-64, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.01.006.

(http://www.sciencedirect.com/science/article/B7XNX-4JKRWN5-1/2/355d7a9aa5de146a1a5a76e0da03b039)

Abstract:
The objective of the study was to determine the effect of birth weight and the influence of nutrient supply during nursing and after weaning on the performance of suckling and growing rabbits (n = 182). The experiment was set-up using a 3 x 2 x 2 factorial arrangement. Newborn female rabbits were divided on the basis of their birth weight in 3 classes: low /L/ = 35-45 g, medium /M/ = 53-58 g and high /H/ = 65-70 g. Half of the litters were nursed by one (O) doe and the other half by two does (T). Kits were weaned at 3 weeks of age. From the age of 4 weeks half of the rabbits were fed ad libitum (AL), while the other half were reared on a restricted feeding regime (R) corresponding to 80-85% of the ad libitum feed intake level.
Birth weight had a significant effect on the body weight up to the end of the experiment (18 weeks of age). H kits attained higher body weight at all ages (3772 g at 18 weeks of age compared to 3565 g and 3373 g for L and M rabbits, respectively). Significant differences were found in feed intake between 3 and 15 weeks of age, in feed conversion between 9 and 12 weeks of age and in weight gain between 3 and 4 and 12 and 15 weeks of age, in the majority of cases in favour of the H rabbits.
Nursing by one or two does exerted the most pronounced effect on the body weight. T kits had significantly higher body weight than O kits up to 15 weeks of age (3306 vs. 3108 g). Differences in feed intake, feed conversion and body weight were only periodically demonstrable between the groups O and T.
The feeding regime exerted a significant influence on the feed intake, weight gain and body weight of kits. Significant differences in the feed conversion were found, however, only between 15 and 18 weeks of age. Although AL rabbits achieved better feed conversion at all ages except the period between 9 and 12 weeks of age.
It seems that the three factors (birth weight, number of nursing does and feeding regime), especially the feed restriction, could influence the production of does.
Keywords: Rabbits; Birth weight; Milk supply; Restricted feeding; Weight

P. Theilgaard, J.P. Sanchez, J.J. Pascual, N.C. Friggens, M. Baselga, Effect of body fatness and selection for prolificacy on survival of rabbit does assessed using a cryopreserved control population, Livestock Science, Volume 103, Issues 1-2, August 2006, Pages 65-73, ISSN 1871-1413, DOI: 10.1016/j.livsci.2006.01.007.
(http://www.sciencedirect.com/science/article/B7XNX-4JN2KS4-1/2/a4cff84c95a4eade01d84d3a52abd22b)

Abstract:
The aim of this experiment was to investigate the effect of body condition and selection for prolificacy on the reproductive life span of female rabbits. The body condition was obtained by ultrasound measurement of the perirenal thickness of 166 crossbred does at day 10 after parturition in 6 consecutive parities. Two genetic groups were included: the current generation of does crossbred between two lines, both selected within line for number of pups at weaning, and a control group consisting of animals from the same cross but from 12 generations earlier. This control population was obtained by use of cryopreservation techniques, and made a simultaneous comparison between animals of different generations possible. A proportional Cox model was used to obtain estimates of survival characteristics. Twelve generations of selection for litter size at weaning did not significantly affect reproductive life span. Animals in poor body condition were found to have a significantly ($P < 0.05$) higher risk of dying than animals in better condition. Also, animals with high body fat mobilisation had a higher risk of culling ($P < 0.05$) than animals with intermediate mobilisation. Animals with zero pups born alive were also found to have a high risk of culling ($P < 0.001$).
Keywords: Survival analysis; Body fatness; Genetic selection; Rabbits; Prolificacy

M. Hermida, M. Gonzalez, M. Miranda, J.L. Rodriguez-Otero, Mineral analysis in rabbit meat from Galicia (NW Spain), Meat Science, Volume 73, Issue 4, August 2006, Pages 635-639, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2006.03.004.
(http://www.sciencedirect.com/science/article/B6T9G-4JH6C7N-1/2/4e2c76d13508401a1eb13da0407128d7)
Abstract:
A total of 54 rabbits 50, 70 and 90 days old, were taken from farms in Galicia (NW Spain); 18 rabbits of each age were sampled. The minerals in the muscle meat from the back legs of the rabbits were analysed, and the following average concentrations were found: ash 1.21/100 g, potassium 388 mg/100 g; phosphorus 237 mg/100 g; sodium 60 mg/100 g; magnesium 27 mg/100 g; calcium 8.7 mg/100 g; zinc 10.9 mg/kg; iron 5.56 mg/kg; copper 0.78 mg/kg; and manganese 0.33 mg/kg.
The high potassium and low sodium concentration may make rabbit meat particularly recommended for hypertension diets. Rabbit meat is rich in phosphorus, and 100 g provides approximately 30% of the recommended daily intake. However, rabbit meat provides less zinc and iron than meats of other species. The Galician rabbit meat analysed in this study, shows higher copper and manganese, and lower calcium contents than those found in the literature for rabbit meat of other origins.
Keywords: Rabbit meat; Macrominerals; Trace elements

P. Hernandez, B. Arino, A. Grimal, A. Blasco, Comparison of carcass and meat characteristics of three rabbit lines selected for litter size or growth rate, Meat Science, Volume 73, Issue 4, August 2006, Pages 645-650, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2006.03.007.
(http://www.sciencedirect.com/science/article/B6T9G-4JWMXPP-2/2/f7fe307a8a75142ad3dd3aef02007138)
Abstract:
Rabbits from three synthetic lines were compared. Line V and A were selected for litter size at weaning and line R was selected for growth rate between weaning and slaughter time. Forty animals of each line were slaughtered at 9 week of age. Comparisons between lines were made using Bayesian statistical techniques. Line R had a higher meat/bone ratio, higher loin percentage and higher ultimate pH of M. Longissimus lumborum (LL) than A and V, but lower dressing out and lower hind part percentages. Some differences between lines in carcass and meat colour were found. No differences were found for percentage of released water of LL and for the activity of energy metabolic enzymes. At present, rabbit carcasses are not costed according to their retail cuts or meat/bone ratio, but dressing out percentage is taken into account, thus breeding companies should be concerned about lower carcass yield of lines selected by growth rate.
Keywords: Rabbit; Line comparison; Bayesian statistics; Meat quality

Beatriz Arino, Pilar Hernandez, Agustin Blasco, Comparison of texture and biochemical characteristics of three rabbit lines selected for litter size or growth rate, Meat Science, Volume 73, Issue 4, August 2006, Pages 687-692, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2006.03.014.
(http://www.sciencedirect.com/science/article/B6T9G-4JWMXPP-1/2/faf3e4e2b56db44a5f8c8f3297b4276b)
Abstract:
Meat texture and some biochemical characteristics that could influence meat tenderness were studied in rabbit loins. Rabbits from three synthetic lines were compared, lines V and A selected for litter size at weaning and line R selected for growth rate between weaning and slaughter time. The activities of cathepsins, collagen content and textural properties measured by Warner-Bratzler (WB) shear device and by the texture profile analyses (TPA) test were measured. Line R was more tender than line V and line A had an intermediate tenderness, Rabbit meat from line R had

higher activity of cathepsins B and B + L, lower total collagen content and lower cohesiveness, springiness and chewiness, shear force and total work (area under the curve obtained with WB device) than line V. Line A had an intermediate texture between lines R and V. Our results show evidence of genetic variation between lines in rabbit meat tenderness.
Keywords: Bayesian statistics; Cathepsins; Collagen; Texture; Rabbit lines

Marcia Brower, Practitioner's guide to pocket pet and rabbit theriogenology, Theriogenology, Volume 66, Issue 3, Proceedings of the Annual Conference of the Society for Theriogenology 2006, August 2006, Pages 618-623, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2006.04.015.
(http://www.sciencedirect.com/science/article/B6TCM-4K719R4-1/2/cb1406189685ba8a18e1dd7e124b4e5b)
Abstract:
This paper provides a review of reproductive characteristics of hamsters, guinea pigs, gerbils, hamsters, rats, and mice, as well as rabbits and chinchillas. It is not intended to be a source of the facts of reproduction (which can be readily found in many references) but rather to highlight some of the unique characteristics of the various species and common problems that clients may present to theriogenologists. This paper includes information regarding sexing, mating, gestation, parturition, lactation, and comments regarding spays and neuters.
Keywords: Rodent reproduction; Comparative medicine; Rabbit; Chinchilla; Guinea pig

H.W. Gu, C.P. Lu, Selection of immunodominant mimics of IROMP-99 of rabbit Pasteurella multocida from a random 12-peptide library, Veterinary Microbiology, Volume 115, Issue 4, 20 July 2006, Pages 339-348, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2006.02.020.
(http://www.sciencedirect.com/science/article/B6TD6-4JP9FVW-3/2/06884846ba2568d80e86724f08ff6f7f)
Abstract:
A random 12-peptide library was used to screen immunodominant mimics of 99 kDa iron-regulated outer membrane protein (IROMP-99) of rabbit Pasteurella multocida. In the present study, expression of IROMPs of rabbit P. multocida strain C51-12 were analyzed by SDS-PAGE, and Western blot to determine the specificity of rat antiserum antibodies against IROMP-99. Only IROMP-99 whose expression was induced under iron-restricted conditions was detected on nitrocellulose paper. The phage display library was screened with rat normal and IROMP-99-specific antiserum. The positive phage clones were identified using enzyme-linked immunoadsorbent assay (ELISA) and inhibition assays for their reactivity to the antiserum. Out of the 18 randomly selected positive clones that showed higher reactivity to rat antiserum, only ten clones efficaciously inhibited binding of rat antisera to IROMPs and their displayed peptides were determined. Alignment using DNAStar-MegAlign software, results showed that motif WHxTxP was highly conserved among nine clones, only clone A7 had no obvious linear homology with either. Our findings suggest that the motif WHxTxP could be an immunodominant mimic epitope of IROMP-99 of rabbit P. multocida strain C51-12.
Keywords: Phage display library; IROMP; Rabbit; Pasteurella multocida

J.C. Scanlan, D.M. Berman, W.E. Grant, Population dynamics of the European rabbit (Oryctolagus cuniculus) in north eastern Australia: Simulated responses to control, Ecological Modelling, Volume 196, Issues 1-2, 10 July 2006, Pages 221-236, ISSN 0304-3800, DOI: 10.1016/j.ecolmodel.2006.02.008.
(http://www.sciencedirect.com/science/article/B6VBS-4JKHMB9-1/2/ac5dccce09830c507b22b17a1f9fda0d)
Abstract:

Wild European rabbits are a serious problem to agriculture in Australia, with an estimated annual cost of A$ 113 million. Biological control agents (myxomatosis and rabbit haemorrhagic disease virus) have caused large and sustained declines in rabbit populations throughout Australia. A simulation model incorporates these diseases as well as warren destruction as methods of controlling rabbit populations in Queensland, north eastern Australia. These diseases reduced populations by 90-99% and the combination of these and warren destruction led to 100% control in simulations at six sites across southern Queensland. Increasing monthly pasture growth by 15% had little effect on simulated populations whereas a 15% decrease reduced populations by 0-50%. An increase in temperature of 2.5 [degree sign]C would lead to a 15-60% decrease in populations. These effects suggest that climate change will lead to a decrease in the population of rabbits in Queensland and a retraction in the northern limit of their distribution in Australia.
Keywords: Biological control; Climate change; Myxomatosis; Rabbit haemorrhagic disease; Warren destruction

P.G. Rebollar, A. Milanes, N. Pereda, P. Millan, P. Cano, A.I. Esquifino, M. Villarroel, G. Silvan, P.L. Lorenzo, Oestrus synchronisation of rabbit does at early post-partum by doe-litter separation or ECG injection: Reproductive parameters and endocrine profiles, Animal Reproduction Science, Volume 93, Issues 3-4, July 2006, Pages 218-230, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2005.06.032.
(http://www.sciencedirect.com/science/article/B6T43-4H3JJCD-1/2/250f8dbce84db65e8f615e7ca8ef9ce2)
Abstract:
Inseminating rabbit does at early post-partum, in combination with early weaning, can increase prolificacy (total kits born and still born per parturition) and decrease parturition intervals. Oestrus synchronisation increases fertility and prolificacy, while decreasing the number of inseminations required for gestation. However, little is known about the effectiveness of different oestrus synchronisation methods at early post-partum. In this study, does (n = 138) were artificially inseminated nine times (over a period of 1 year, kits weaned at 25 days), on day 4 post-partum after separation from the litter (for 48 or 24 h) or 48 h after 25 UI eCG injection. Plasma levels of prolactin and estradiol were also evaluated in a subsample of 12 multiparous lactating does per treatment, on days 2, 3 and 4 post-partum. The three treatments increased overall fertility of multiparous females compared to controls (which were not synchronised), but there were no differences among treatments in total kits born or stillborn. Does treated with eCG had a higher culling rate. The interval between parturitions and the number of inseminations required for gestation tended to decrease with increasing number of inseminations. In lactating does, there was an interaction between treatment and insemination order. Fertility decreased with increasing inseminations in eCG does but tended to increase above control values in the separated does until the fourth insemination. Control lactating does had significantly less kits per parturition compared to treatments, but eCG lactating does had more stillborn kits. Oestradiol levels increased on day 4 post-partum in all synchronised lactating does (and immediately before artificial insemination in 48 h doe-litter separation), so ovarian activity could be stimulated at early post-partum using all treatments. However, the increase could not be explained by prolactin levels, since there were no effects of suckling absence on plasma prolactin in separated does. In conclusion, separating does from the litter before insemination can be just as effective as eCG treatment, especially during for the first four inseminations.
Keywords: Rabbits; Reproduction; Fertility; Prolificacy; Synchronization methods; Oestradiol; Prolactin

Brent J. Martin, Mark A. Suckow, William R. Wolter, Thomas Berger, John W. Turner Jr., Use of mucosal immunization with porcine zona pellucida (PZP) in mice and rabbits, Animal Reproduction

Science, Volume 93, Issues 3-4, July 2006, Pages 372-378, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2005.09.007.
(http://www.sciencedirect.com/science/article/B6T43-4HD8DK3-1/2/199571d1ec0783164ac5775cdda7b48e)
Abstract:
Rabbits (Oryctolagus cuniculus) and two strains of mice (Mus musculus, one inbred and one outbred) were immunized against porcine zona pellucida (PZP) antigen. Alginate microspheres or cholera toxin B were used alone or in combination when mucosal immunization routes were used. Serum antibody responses and fertility were assessed. Neither rabbit or mouse groups immunized by mucosal routes generated significant antibody responses to PZP as compared to parenteral immunization (ANOVA, P > 0.05). The study shows that porcine zona pellucida is not an effective mucosal antigen in small mammals.
Keywords: Porcine zona pellucida; PZP; Mucosal immunity; Rabbit; Mouse; Alginate microsphere

S. Rougier, D. Galland, S. Boucher, D. Boussarie, M. Valle, Epidemiology and susceptibility of pathogenic bacteria responsible for upper respiratory tract infections in pet rabbits, Veterinary Microbiology, Volume 115, Issues 1-3, 15 June 2006, Pages 192-198, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2006.02.003.
(http://www.sciencedirect.com/science/article/B6TD6-4JFHF3R-1/2/28b40185a89562eccd1dbfbe1fb8122d)
Abstract:
For 8 months, 121 pet rabbits of more than 2 months old were included in an epidemiological study aimed at determining the nature, prevalence and bacteriological susceptibility of pathogenic bacteria responsible for upper respiratory tract disease ('snuffles'). All rabbits presented with nasal discharge and sneezing at inclusion and had not received any antibiotics in the 30 days prior to the study. Nasal samples were taken from all the rabbits before they received any treatment. Isolation of bacterial strains, susceptibility testing by disk diffusion for marbofloxacin, enrofloxacin, danofloxacin, gentamicin, oxytetracycline, doxycycline, cefalexin, trimethoprim-sulfamethoxazole, and marbofloxacin MIC determination for each pathogenic bacterium were also performed. The main bacterial strains isolated were Pasteurella multocida (54.8%), Bordetella bronchiseptica (52.2%), Pseudomonas spp. (27.9%) and Staphylococcus spp. (17.4%). Snuffles was mainly due to a polybacterial infection, and the most frequently found combination was P. multocida and B. bronchiseptica (28.9% of rabbits). Marbofloxacin was shown to be the most effective agent against all bacterial strains (between 87.8% and 100% susceptibility according to strain) except B. bronchiseptica, for which gentamicin was slightly more effective (96% versus 88.9%). Compared to other fluoroquinolones tested, marbofloxacin exhibited the highest level of activity. Marbofloxacin MIC90 was equivalent to 1.320, 0.079, 1.741 and 0.490 [mu]g/ml for B. bronchiseptica, P. multocida, Pseudomonas spp. and Staphylococcus spp. strains, respectively. In this study, marbofloxacin was shown to be a potentially good treatment option for upper respiratory tract disease in pet rabbits.
Keywords: Pasteurella multocida; Bordetella bronchiseptica; Snuffles; Pet rabbits; Fluoroquinolones; Marbofloxacin

L. Fortun-Lamothe, Energy balance and reproductive performance in rabbit does, Animal Reproduction Science, Volume 93, Issues 1-2, June 2006, Pages 1-15, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2005.06.009.
(http://www.sciencedirect.com/science/article/B6T43-4GRH728-3/2/d54e4a0b79578707f42c70422a56c0fd)
Abstract:
The mortality and the culling rates of females are very high in rabbit breeding. In many cases, the dead or culled females show low reproductive performances and poor body conditions. Energy

deficit leads to body mobilization and reduced reproductive performance. Consequently, energy balance and lifespan are closely linked. Two in vivo methods to estimate body composition were recently validated for rabbit does. Ultrasounds and TOBEC methods permitted the evaluation of the changes in energy balance and their relationship to reproductive performance of females. Influence of intrinsic (parity, litter size, genetic line, ...) and extrinsic (reproduction rhythm, temperature, ...) factors on the energetic balance of females are discussed. Energy deficit and depletion of body stores occurring during lactation lead to a decrease in reproductive performance and the physiological mechanisms implicated in these effects were presented. Interest and limitations of several strategies to reduce the body energy deficit in reproducing does and to improve their fertility and thus lifespan are discussed: rearing, feeding, management, genetic selection. A multi-facetted approach, combining these various strategies seems to be required to meet these objectives.
Keywords: Rabbit; Energy balance; Fertility; Lifespan; Feeding strategy; Management

Fukashi Inoue, Junichi Matsuda, Katsuhiro Ohkoshi, Tadashi Furusawa, Seiya Takahashi, Hiroshi Sasada, Eimei Sato, Tomoyuki Tokunaga, Differences in gene expression patterns between somatic cell nuclear transfer embryos constructed with either rabbit granulosa cells or their derivatives, Animal Reproduction Science, Volume 93, Issues 1-2, June 2006, Pages 76-87, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2005.06.008.
(http://www.sciencedirect.com/science/article/B6T43-4GTW8TD-1/2/0717d29ccc2985333b0ed0b6b6c0478f)
Abstract:
Successful production of offspring by somatic cell nuclear transfer (SCNT) is affected by the nature of the donor cells used. The purpose of this study was to determine whether characteristic changes induced in donor cells by culture conditions influenced gene expression patterns in the resultant SCNT embryos. Rabbit granulosa cells (rGC) were cultured under different conditions, either with or without hCG, and the two derivative cell types obtained (named respectively cGC+ and cGC-) were used as donor cells for SCNT. There were characteristic differences between fresh rGC and the two derivative cell types: p450scc expression and progesterone secretion were both higher in cGC+ than in cGC-; expression of bmp4 and fgfr2 was decreased in cGC+ and cGC- compared with rGC; and cGC+ and cGC- cell types gained collagenIV expression. Use of fresh rGC, or cGC+ and cGC- derivative cells, did not alter either the developmental potencies of SCNT oocytes or cell numbers at the blastocyst stage. The expression patterns of four genes (bmp4, fgfr2, gata4, oct3/4) in SCNT embryos and in fertilized embryos were analyzed by quantitative RT-PCR. We found that oct3/4 was expressed in all embryos. The expression patterns of the other three genes showed considerable variation between the different types of embryo: bmp4 was found in most fertilized embryos but only some of rGC and none of cGC+ and cGC- derived SCNT embryos; fgfr2 was present in fertilized embryos but was present in some rGC and cGC- NT embryos and in all cGC+ NT embryos; gata4 was not expressed in fertilized embryos but was present in a few rGC and cGC+ NT embryos and in most cGC- NT embryos. Our results suggest that the gene expression patterns in SCNT embryos derived from granulosa donor cells are affected by characteristic changes to the cells during in vitro culture.
Keywords: Rabbit; Granulosa cell; Somatic cell nuclear transfer; Early development; Gene expression

M. Garcia-Tomas, J. Sanchez, O. Rafel, J. Ramon, M. Piles, Variability, repeatability and phenotypic relationships of several characteristics of production and semen quality in rabbit, Animal Reproduction Science, Volume 93, Issues 1-2, June 2006, Pages 88-100, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2005.06.011.
(http://www.sciencedirect.com/science/article/B6T43-4GSTS37-1/2/d44ca7527d9ec76f79e8eab537fc323e)

Abstract:
A total of 2140 ejaculates from 156 adult males pertaining to four groups of bucks were analysed and the following traits were recorded: pH, ejaculate volume (V), mass motility (Mm), individual motility (Mi), concentration (Cn), total number of spermatozoa per ejaculate (TSE), percentage of sperm viability (Vi), percentage of sperm with acrosome integrity (NAR), percentage of sperm normalcy (Nr), percentage of sperm morphological abnormalities of head (H), neck-midpiece (Nm) and tail (T) and presence of proximal and distal cytoplasmic droplet (Dp, Dd). Principal component (PC) analysis and phenotypic correlations were performed in order to examine the relationships between qualitative and quantitative traits of rabbit semen. The repeatability of the traits measured was also estimated.
Phenotypic correlations between sperm traits were estimated as the residual correlation from an analysis of variance, including the effects of: genetic type of the male, order of the ejaculate, day of collection and the permanent non-additive random effect of the male to which the observation corresponds. The repeatability of these traits was analysed separately, in a set of univariate analyses, using VCE software. The previously defined mixed model was used for this analysis. The principal component analysis was performed using the Princomp procedure of the SAS v.8 package.
The first four PC explained 62% of total variation: 23%, 18%, 12% and 8%, respectively. Percentage of sperm viability, NAR, Nr, T and Nm were the predominant variables in the first PC. Mass motility, Mi, pH, Cn and TSE were located in the second. Percentage of sperm with the presence of proximal and distal cytoplasmic droplet, NAR, Vi and Nr were the predominant traits in the third and V defined the fourth.
Repeatability of semen quality traits was moderate for most of the traits. The highest values (about 0.45) corresponded to V, Cn, Nr and Dp and the lowest (about 0.10) to H and Nm. Repeatability of the first ejaculate was greater than that of the second for pH, Mm, Mi, H, Dp and Dd.
Keywords: Semen; Rabbit; Correlation; Principal component

Carlos Calvete, The use of immunization programs in wild populations: Modelling effectiveness of vaccination campaigns against rabbit hemorrhagic disease, Biological Conservation, Volume 130, Issue 2, June 2006, Pages 290-300, ISSN 0006-3207, DOI: 10.1016/j.biocon.2005.12.025.
(http://www.sciencedirect.com/science/article/B6V5X-4J91RB9-2/2/c37e9da4813694117984348a3569679d)
Abstract:
Vaccination programs are occasionally used on wild mammal populations with conservation goals. In the case of the European wild rabbit Oryctolagus cuniculus, vaccination campaigns against rabbit hemorrhagic disease (RHD) have been widely applied to enhance rabbit populations, but their overall effects have not been compared. I used a modelling approach to compare the effects of several vaccination strategies on the growth rate of wild rabbit populations. For all simulated vaccination strategies, vaccination campaigns yielded positive or negative population growth rates, depending on rabbit population dynamics and subsequent RHD dynamics. Growth rate was negative when the proportion of RHD-seropositive adult rabbits was low or medium before vaccination, which occurred in populations at low rabbit density. Given that these low density populations are mainly targeted by vaccination campaigns, the model suggested that current immunization programs may be causing harmful effects on many rabbit populations. The best annual period to carry out vaccination campaigns was determined by the age-class targeted for immunization. If the RHD dynamics were not known, vaccination of only juvenile rabbits seemed to be the most conservative option, since it minimized the probability of yielding negative growth rates, whereas vaccination of only adult rabbits was the worst option. These findings suggest that prior knowledge of RHD dynamics in populations subject to immunization is essential to minimize the risk of harmful effects.
Keywords: Oryctolagus cuniculus; Vaccination; Rabbit hemorrhagic disease; Wild rabbit

M.J. Argente, M.A. Santacreu, A. Climent, A. Blasco, Influence of available uterine space per fetus on fetal development and prenatal survival in rabbits selected for uterine capacity, Livestock Science, Volume 102, Issues 1-2, June 2006, Pages 83-91, ISSN 1871-1413, DOI: 10.1016/j.livprodsci.2005.11.022.
(http://www.sciencedirect.com/science/article/B7XNX-4K5SD89-5/2/f23f02a09a3c5408e1a21ec901c91747)
Abstract:
The relation between the number of implanted embryos and available uterine space per fetus in intact does, and also the effect of available uterine space on the development of the fetus and the survival rate at 18 days of gestation were examined. Rabbits came from the sixth generation of a divergent selection experiment on uterine capacity. The high and low lines showed the same ovulation rates, but the high line had a higher rate of implantation and number of live fetuses ($P < 0.05$). As a consequence of the higher degree of uterine overcrowding in the high line, the length of full uterine horn was 10% higher ($P < 0.10$) and the available uterine space per live fetus was 20% lower ($P < 0.05$) than in the low line. The available uterine space per implantation site showed a negative quadratic regression coefficient with the number of implanted embryos ($P < 0.001$) and a negative linear regression coefficient with the number of dead fetuses (- 0.19 +/- 0.10). The available uterine space had a quadratic relation with the length of maternal placenta ($P < 0.001$), and it was linearly associated to development of fetal placenta and fetus ($P < 0.05$). The fetal position within the uterus did not affect the proportion of dead embryos. However, the fetuses with placentae receiving fewer than three blood vessels showed a higher probability of death ($P < 0.01$) and a smaller uterine space ($P < 0.05$) than those receiving more than three blood vessels. A poor vascular supply and reduced uterine space could affect the subsequent fetal development.
Keywords: Blood vessels; Fetal development; Fetus; Placenta; Rabbits; Uterine horn

Omar Farnos, Manuel Rodriguez, Maylin Chiong, Francisco Parra, Oscar Boue, Norailys Lorenzo, Manuel Colas, Ricardo Lleonart, The recombinant rabbit hemorrhagic disease virus VP60 protein obtained from Pichia pastoris induces a strong humoral and cell-mediated immune response following intranasal immunization in mice, Veterinary Microbiology, Volume 114, Issues 3-4, 31 May 2006, Pages 187-195, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2005.11.062.
(http://www.sciencedirect.com/science/article/B6TD6-4HWXP0T-8/2/1a6ccc4d304ec266297c6b9d2f2f8a20)
Abstract:
Rabbit hemorrhagic disease (RHD) is a contagious and highly lethal viral disease of rabbits that spreads rapidly and infects animals by nasal, conjunctival and oral routes. Therefore, this experiment was undertaken to study the immune response generated after intranasal (i.n.) vaccination with the recombinant VP60 capsid protein from rabbit hemorrhagic disease virus (RHDV) expressed at high levels in Pichia pastoris. Groups of BALB/c mice were immunized with three doses of purified VP60 protein (Group 1), VP60 formulated within the cell debris fraction of the transformed yeast (Group 2) and placebo (Group 3) by intranasal route. Mice were also intramuscularly injected with purified VP60 protein (Group 4). A rapid antibody response specific against rabbit hemorrhagic disease virus was observed in all the experimental groups, except in Group 3, as detected by ELISA. The highest titers were found 60 days after the first immunization. Mice from Group 1 showed the highest IgG response ($p < 0.05$) and the most balanced profile of IgG1, IgG2a and IgG2b subclasses. IgA titers specific to the virus were found only in animals from this group, which also developed the highest specific lymphocyte proliferative response. Interferon-[gamma] (IFN-[gamma]) and interleukin-12 (IL-12) gene expression was also detected after an ex vivo-specific stimulation of mice from Groups 1 and 4. These data demonstrated the capacity of VP60 protein expressed in P. pastoris to elicit a potent humoral and cell-mediated immune response following an intranasal immunization scheme.

Keywords: VP60; Pichia pastoris; RHDV; Intranasal immunization; Cellular immune response; Recombinant capsid protein

E. Tsalie, K. Kouzi, T. Poutahidis, Z. Abas, K. Sarris, N. Iliadis, E. Kaldrymidou, Effect of Vitamin E Nutritional Supplementation on the Pathological Changes Induced in the Ileum of Rabbits by Experimental Infection with Enteropathogenic Escherichia coli, Journal of Comparative Pathology, Volume 134, Issue 4, May 2006, Pages 308-319, ISSN 0021-9975, DOI: 10.1016/j.jcpa.2005.12.001.
(http://www.sciencedirect.com/science/article/B6WHW-4K12CKF-1/2/6a99fcc11bd2c8bf3aec7526a1457e83)
Abstract: Summary
A well-established rabbit model of enteropathogenic E. coli (EPEC) disease was used to examine whether vitamin E (VE) nutritional supplementation had an effect on the pathological changes induced in the bowel by EPEC. Quantitative methods were used to evaluate the influence of VE on bacterial colonization, intestinal mucosal architecture and inflammation, and intestinal epithelial proliferation and apoptosis. VE did not affect EPEC colonization and did not give significant protection against EPEC-induced changes and diarrhoea. Although VE had no effect on the EPEC-related increase of enterocyte apoptosis, it clearly contributed to an acceleration of epithelial cell proliferation in the ileal crypts. This finding may explain why ileal morphometry undertaken in this study showed that VE ameliorated somewhat the effects of EPEC on intestinal mucosal architecture. Quantitative studies on inflammatory cells in the intestinal mucosa revealed that VE nutritional supplementation resulted in an increased neutrophilic and mononuclear inflammatory cell response to EPEC infection, which did not contribute, however, to the clearance of infection.
Keywords: bacterial infection; enteropathogenic E. coli; EPEC; Escherichia coli; rabbit; vitamin E

H. de Rochambeau, D. Licois, T. Gidenne, S. Verdelhan, P. Coudert, J.M. Elsen, Genetic variability of the resistance for three types of enteropathy in the growing rabbit, Livestock Science, Volume 101, Issues 1-3, May 2006, Pages 110-115, ISSN 1871-1413, DOI: 10.1016/j.livprodsci.2005.10.019.
(http://www.sciencedirect.com/science/article/B7XNX-4JXS70Y-D/2/2612422481393e97739f100f941f59cb)
Abstract:
This paper describes the genetic variability for the resistance to three digestive stresses in the growing rabbit: after inoculation of coccidia (trial 'coccidia'), with a fibre deficient diet (trial 'FD'), and after experimental reproduction of epizootic rabbit enteropathy (trial 'ERE'). Genetic variability was analysed from a sample of 48 sires, which produced the experimental young rabbits. These animals were examined on D0, D4, D11, D18, D25 and D32 after weaning (at 30 days old). Three clinical symptoms were checked: bloated abdomen, diarrhoea and mucus. Mortality and clinical symptoms were used to assess an individual response to each digestive stress. Two binary indexes were defined to describe this rabbit individual response. The first one ('Alive') dealt with mortality. The second ('Tolerant') dealt with mortality and morbidity. 'Alive', and 'tolerant' percentages were low for the 'coccidia' trial (61% and 23% respectively), high for the 'FD' trial (75% and 36% respectively) and intermediate for the 'ERE' trial (66% and 37% respectively). The sire effect was significant for each index in the 'coccidia' and the 'FD' trials. The sire effect was significant for the 'tolerant' index in the 'ERE' trial. Correlations between sire rankings for the two indexes of one trial were often significant. Correlations between sire rankings for indexes of 'coccidia' and 'FD' trials were weakly significant. Our results demonstrate that there is a genetic variability for the resistance to three different enteropathies.
Keywords: Genetic resistance; Epizootic rabbit enterocolitis; Coccidiosis; Dietary fibre

Noelia Ibanez, Maria Antonia Santacreu, Maria Martinez, Agueda Climent, Agustin Blasco, Selection for ovulation rate in rabbits, Livestock Science, Volume 101, Issues 1-3, May 2006, Pages 126-133, ISSN 1871-1413, DOI: 10.1016/j.livprodsci.2005.10.024.
(http://www.sciencedirect.com/science/article/B7XNX-4JXS70Y-G/2/d025b15aaddcd02148595f3d0f7f6ae7)
Abstract:
An experiment of selection for ovulation rate was carried out. Animals were derived from a synthetic line first selected 12 generations for litter size, then 10 generations for uterine capacity. Selection was relaxed for 6 generations. Selection was based on the phenotypic value of ovulation rate with a selection pressure on does of 30%. Males were selected from litters of does with the highest ovulation rate. Males were selected within sire families in order to reduce inbreeding. Ovulation rate was measured in the second gestation by a laparoscopy, 12 days after mating. Each generation had about 80 females and 20 males. Results of three generations of selection were analyzed using Bayesian methods. Marginal posterior distributions of all unknowns were estimated by Gibbs sampling. Heritabilities of ovulation rate (OR), number of implanted embryos (IE), litter size (LS), embryo survival (ES), fetal survival (FS), and prenatal survival (PS) were 0.44, 0.32, 0.11, 0.26, 0.35, and 0.14, respectively. Genetic correlation between OR and LS was 0.56, indicating that selection for ovulation rate can augment litter size. Response to selection for OR was 1.80 ova. Correlated responses in IE and LS were 1.44 and 0.49, respectively. Selection for ovulation rate may be an alternative to improve litter size.
Keywords: Selection; Ovulation rate; Bayesian analysis; Litter size

Michal Pakandl, Alena Jelinkova, The rabbit coccidium Eimeria piriformis: Selection of a precocious line and life-cycle study, Veterinary Parasitology, Volume 137, Issues 3-4, 30 April 2006, Pages 351-354, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2006.01.012.
(http://www.sciencedirect.com/science/article/B6TD7-4J84T0S-3/2/374c917669cadf87daf3b4ecf252b3ae)
Abstract:
Specific pathogen-free (SPF) rabbits were inoculated with oocysts of an original strain (OS) of Eimeria piriformis and the first newly developed oocysts recovered from the intestine were used for infection of other rabbits. The prepatent period (PP) was shortened after 12 passages from 194 to 170 hours and remained stable after 5 passages without any selection pressure. Oocysts of the precocious line (PL) exhibited peculiar morphology. Besides refractile bodies (RB) within sporozoites, one huge RB joined with a residual body was present inside each sporocyst. The parasite developed in the proximal colon and, to a lesser extent, in other parts of the large intestine. All stages were seen in the epithelium of crypts. In OS, four asexual generations preceded gamogony and, like in other rabbit coccidia, two types of meronts were observed: meronts of type A that develop into polynucleate merozoite, in which endomerogony takes place, and meronts of the type B that form uninucleate merozoites. The endogenous development of PL was identical with that of OS except for the last merogony which was absent. This resulted in earlier appearance of gamogony and shortening of PP. These observations of the life cycle of E. piriformis substantially improve on its description made 50-60 years ago.
Keywords: Rabbits; Eimeria piriformis; Precocious line; Endogenous development

Baoliang Pan, Ming Wang, Farong Xu, Yuwan Wang, Yuntang Dong, Zhende Pan, Efficacy of an injectable formulation of eprinomectin against Psoroptes cuniculi, the ear mange mite in rabbits, Veterinary Parasitology, Volume 137, Issues 3-4, 30 April 2006, Pages 386-390, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2006.01.013.
(http://www.sciencedirect.com/science/article/B6TD7-4J84T0S-2/2/bf832c74549bd630679dd1169846e18e)
Abstract:

Thirty rabbits naturally infected with ear mange mite, Psoroptes cuniculi, were subcutaneously administrated with a single dose of eprinomectin at 100, 200 and 300 [mu]g/kg body weight or vehicle on day 0. The extent of lesions was scored on day -6 (prior to treatment), day 0 (treated), days 7, 14, 21, 28 and 35, the ear scabs were collected simultaneously; mites in scabs were examined and counted. The results showed that a single dose of eprinomectin at 200 or 300 [mu]g/kg body weight following subcutaneous administration was able to eliminate P. cuniculi infection in rabbits, and a dose of eprinomectin at 100 [mu]g/kg could significantly reduce mites but was unable to eliminate P. cuniculi.
Keywords: Rabbit; Efficacy; Eprinomectin; Ear mange mite; Psoroptes cuniculi; Injectable formulation

E. Borrmann, F. Schulze, K. Cussler, I. Hanel, R. Diller, Development of a cell culture assay for the quantitative determination of vaccination-induced antibodies in rabbit sera against Clostridium perfringens epsilon toxin and Clostridium novyi alpha toxin, Veterinary Microbiology, Volume 114, Issues 1-2, 16 April 2006, Pages 41-50, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2005.10.043.
(http://www.sciencedirect.com/science/article/B6TD6-4HV74J6-1/2/2752581c6f2defd3c57b3a91240ab080)
Abstract:
Cell culture assays are possible alternatives to replace in vivo neutralization tests currently required for potency testing of clostridial vaccines. Cell culture assays based on the MDCK cell line and the Vero cell line which are sensitive to the Clostridium (C.) perfringens type D epsilon toxin and Clostridium novyi type B alpha toxin, respectively, were developed, and the test conditions were standardized. The antibody titres of vaccinated rabbits measured in vitro were compared with the results of current test procedures recommended by European Pharmacopoeia. The correlation coefficients calculated were significant for all sera tested. The cell culture assays proved to be sensitive, specific, reproducible and reliable. Therefore, these cell culture assays could be suitable in vitro alternatives to the in vivo mouse neutralization experiments required for potency tests of clostridial vaccines, but further validation studies are necessary.
Keywords: C. perfringens type D; Epsilon toxin; C. novyi type B; Alpha toxin; Clostridial vaccines; Potency test; Cell culture assay

Gamal Mohamed Kamel Mehaisen, Maria Pilar Viudes-de-Castro, Jose Salvador Vicente, Raquel Lavara, In vitro and in vivo viability of vitrified and non-vitrified embryos derived from eCG and FSH treatment in rabbit does, Theriogenology, Volume 65, Issue 7, 15 April 2006, Pages 1279-1291, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2005.08.007.
(http://www.sciencedirect.com/science/article/B6TCM-4H4T2YF-1/2/2f3f4434ecff96cce6f4681cc247c5cf)
Abstract:
This study aimed to evaluate the in vitro and in vivo viability of vitrified and non-vitrified embryos derived from eCG and FSH treatments in rabbit does. Ninety-six nulliparous does were randomly subjected to consecutive superovulation treatments with eCG (20 IU/kg body weight intramuscularly (i.m.), eCG group), FSH (3 x 0.6 mg/doe at 24 h intervals i.m., FSH group), or without superovulation treatment (control group). Does were artificially inseminated 3 days later and ovulation was induced immediately by hCG (75 IU/doe intravenous). Seven experimental groups were differentiated: first FSH and eCG treatment, second FSH and eCG treatment, eCG-interchanged group (does with previous FSH treatment), FSH-interchanged group (does with previous eCG treatments) and control group. Embryos were collected in vivo by laparoscopy 76-80 h post-insemination in the first and second recovery cycles and post mortem in the third recovery cycles. The ovulation rate was significantly higher in does treated with the first-FSH than in those treated with eCG or in control does (25.2 +/- 2.0 versus 19.2 +/- 1.4 to 11.0 +/- 1.5, and 12.2 +/- 1.2, first-FSH, first-eCG to second-eCG and control groups, respectively, $P < 0.05$). Significant

differences were observed in the total recovery influenced by ovulation rate in each group (20.3 +/- 2.2 to 9.4 +/- 1.2, first-FSH to control groups). Embryo donor rate (donor with at least one normal embryo) was similar among groups with an overall of 75.1%. The number of normal embryos recovered per doe with at least one normal embryo increased significantly in relation to ovulation rate (17.7 +/- 2.2 to 8.41 +/- 3, first-FSH and control groups). The vitrification of embryos negatively affected their in vitro development to hatched blastocyst in all groups (88.1% versus 48%, $P > 0.05$). However, after embryo transfer, this negative effect was only observed in superovulated vitrified embryos (16.8 and 12.8% versus 39.4% total born rate from eCG, FSH and control vitrified groups, $P < 0.05$). Results indicated that the primary treatments with eCG or FSH increased the number of normal embryos recovered per donor doe, but these embryos are more sensitive to vitrification protocols.
Keywords: Superovulation; Vitrification; Embryo recovery; Embryo transfer; Rabbit

M. Garcia-Tomas, J. Sanchez, O. Rafel, J. Ramon, M. Piles, Heterosis, direct and maternal genetic effects on semen quality traits of rabbits, Livestock Science, Volume 100, Issues 2-3, April 2006, Pages 111-120, ISSN 1871-1413, DOI: 10.1016/j.livprodsci.2005.08.004.
(http://www.sciencedirect.com/science/article/B7XNX-4JMKVM1-6/2/eb9fa5960cc45521e6f264df7f983cf4)
Abstract:
A complete diallel cross involving two rabbit sire lines (C and R) was carried out to estimate the crossbreeding genetic parameters of seminal traits. 2140 ejaculates from 153 males were analyzed. The traits studied were: presence of gel plugs (G), urine (U), and calcium carbonate deposits (CC), number of useful ejaculates (UE), pH, volume (V), mass and individual motility (Mm, Mi), useful Mi (UM), concentration (Cn), number of spermatozoa per ejaculate (TSE), percentage of viable spermatozoa (Vi), spermatozoa with normal apical ridge (NAR), normal spermatozoa (Nr), spermatozoa with morphological abnormalities of head (H), neck-midpiece (Nm), and tail (T), presence of proximal and distal cytoplasmic droplet (Dp, Dd).
Estimates of heterosis, direct and maternal genetic effects were obtained from the solutions of the mixed model. There were major differences in direct genetic effects between lines, which were favourable to line C for Cn and TSE, and unfavourable for CC, Nm and Dp. Smaller differences were also observed in Vi and NAR favourable to line R. Differences between lines with respect to the maternal genetic effects were relevant and favourable to line C for V and to line R for U, UM, Cn, TSE, Nm, Mi, and Mm. Individual heterosis was high for Dp and Dd.
Keywords: Semen quality; Heterosis; Direct genetic effects; Maternal genetic effects; Rabbit

N. Nicodemus, J. Garcia, R. Carabano, J.C. De Blas, Effect of a reduction of dietary particle size by substituting a mixture of fibrous by-products for lucerne hay on performance and digestion of growing rabbits and lactating does, Livestock Science, Volume 100, Issues 2-3, April 2006, Pages 242-250, ISSN 1871-1413, DOI: 10.1016/j.livprodsci.2005.09.004.
(http://www.sciencedirect.com/science/article/B7XNX-4JMKVM1-N/2/637dae3e87ff0ec3a4b57307a317c351)
Abstract:
The effect of a reduction of dietary particle size by the substitution of a mixture of paprika meal, sugar-beet pulp and soya bean hulls for lucerne hay was evaluated in rabbits. Four isonutritive diets were formulated containing a decreasing proportion of large particles (> 0.315 mm) 24.1%, 22.0%, 20.6% and 18.9%. Nutrient digestibility, caecotrophy and caecal traits were determined using 9 growing rabbits per diet. Growth and lactation performance was determined in 45 weanling rabbits and 13 rabbit does per diet, respectively. The diet with the shortest particle size increased by 20% the weight of caecal contents and reduced feed intake of fattening rabbits, lactating does and suckling rabbits (21-30 d of age) by 7%, 10% and 30%, respectively, with respect to the average of the other three diets. It also decreased growth in fattening rabbits, milk production and

litter weight at weaning by 6%, 13% and 18%, respectively. Feed efficiency decreased by 7% in rabbit does and was not affected during fattening, as the decrease in performance was parallel to a higher (+ 3%) digestible energy concentration in this diet. Reduction of particle size also increased NDF digestibility and caecal volatile fatty acid concentration. It is concluded that a minimal proportion of large particles (> 0.315 mm) of 20.6% is required to maximise growth and lactation performance in rabbits.
Keywords: Particle size; Digestion; Growth; Lactation; Rabbits

Lamberto Lambertini, Giorgio Vignola, Anna Badiani, Giuliano Zaghini, Andrea Formigoni, The effect of journey time and stocking density during transport on carcass and meat quality in rabbits, Meat Science, Volume 72, Issue 4, April 2006, Pages 641-646, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2005.09.012.
(http://www.sciencedirect.com/science/article/B6T9G-4HHP5BJ-2/2/22a1a34023e1c3dbab5cfb2d3551daca)
Abstract:
Four hundred and fifty hybrid commercial rabbits (half males and half females) at the end of their productive cycle (82 days old) were transported in cages (98 x 52 x 24 cm, length x width x height) at high or low density (75.5 or 49.0 kg/m2 - 15 or 10 animals per cage) on an uncovered truck for 1, 2 or 4 h. Live weight before and after transport as well as slaughter data were recorded for each rabbit. A subset of 180 carcasses were evaluated for meat quality on the basis of meat pH, colour (CIELab system), cooking loss, drip loss and shear force. As a representative of the whole carcass muscle/bone ratio, the left hind leg was separated, dissected and its meat analysed in order to determine its water, protein, ash and lipid content. It was found that a longer journey significantly increases the live weight losses (3.3% vs. 2.0% vs. 1.6% for 4, 2 or 1 h, respectively; $P < 0.001$), as a result not only of urine and fecal losses, but also of a decrease in carcass weight ($P < 0.01$) during transport. Ultimate pH (pHu) was higher and pH drop lower in rabbits transported for 4 h compared to those transported for 2 h ($P < 0.05$). Moreover, the meat from animals that had undergone the longest journey was more purple-red ($P < 0.05$), darker ($P < 0.0001$), and firmer when raw and showed less cooking loss than meat from those that underwent shorter journeys. Transport density did not influence any of the considered parameters and there was no interaction between transport time and density.
Keywords: Rabbit; Slaughtering data; Meat quality; Transport time; Density

G.A. Mari'a, T. Buil, G. Liste, M. Villarroel, C. Sanudo, J.L. Olleta, Effects of transport time and season on aspects of rabbit meat quality, Meat Science, Volume 72, Issue 4, April 2006, Pages 773-777, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2005.10.012.
(http://www.sciencedirect.com/science/article/B6T9G-4HR76RS-1/2/d93b1d22b6c26170ff2ab4cf9be461e2)
Abstract:
The aim of this study was to determine whether transport times of up to 7 h can have a significant effect on instrumental meat quality traits in rabbits. Spain has very hot summers and cold winters; therefore, we performed replicates in two seasons. To evaluate the effect of transport time and season on rabbit meat quality, we assessed four meat quality parameters: pH, water holding capacity (WHC), texture (compression and Warner-Bratzler analyses), and colour (CIEL*a*b*). We also considered the effect of the position of the animals on the transport vehicle. After slaughter, we analysed steaks of Longissimus dorsi from all transported animals (n = 216). Average pH at 24 h and WHC did not differ significantly between transport time treatments. Position on the vehicle did not influence the measures of meat quality. Transport time had a significant effect on all the meat texture parameters measured by compression, but did not affect shear force or toughness. Transport time influenced a* but not L* or b*. Transport time had much less of an effect on meat quality than time of year; therefore the effect of season appeared to be independent of transport

time. Position on the vehicle had no effect on meat quality. Based on our results, we conclude that the transport process can affect instrumental meat quality.
Keywords: Rabbit; Meat quality; Transport time; pH; Colour; Texture

P.G. Ferreira, A. Costa-e-Silva, M.J.R. Oliveira, E. Monteiro, E.M Cunha, A.P. Aguas, Severe leukopenia and liver biochemistry changes in adult rabbits after calicivirus infection, Research in Veterinary Science, Volume 80, Issue 2, April 2006, Pages 218-225, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2005.05.007.
(http://www.sciencedirect.com/science/article/B6WWR-4GJM3TG-3/2/a87a58fcbfeb7efd39cf7c9eb70dbad5)
Abstract:
Calicivirus infection is the major cause of the severe decrease in the stocks of wild and farm rabbits that has occurred worldwide during the last two decades. Adult rabbits (10-weeks-old) were experimentally infected with a calicivirus inoculum that killed all animals by causing rabbit haemorrhagic disease (RHD) within 24-62 h of infection. The rabbits were used to evaluate blood cell numbers and serum biochemistry every 6 h, starting 12 h after the inoculation of the caliciviruses. No significant changes in blood parameters were observed in most of the rabbits up to 18 h of infection. Severe leukopenia was seen 6 h before death of the infected rabbits; both heterophils and lymphocytes contributed to the decrease in circulating white blood cells. Platelets were also severely decreased in number. Marked enhancement in liver enzymes was seen 6-12 h before death of the infected rabbits. There was also evidence both for cholestasis, as expressed by the elevated levels of direct (conjugated) bilirubin, and for hypoglycemia, an alteration that it is likely to contribute for the seizures that rabbits show during the late stages of RHD. Liver ultrastructure of rabbits that died from RHD revealed extensive hepatocyte vacuolization, severe changes in mitochondrial structure, and depletion of glycogen granules. We conclude that: (i) severe leukopenia characterizes the final hours of calicivirus-induced RHD; (ii) hypoglycemia and cholestasis precede death of rabbits from RHD; (iii) the kinetics of liver enzymes allows an accurate prediction of the time of death of rabbits from calicivirus-induced RHD.
Keywords: RHD; Hepatic transaminases; Hypoglycemia; Cholestasis; Ultrastructure

C. Bombardi, A. Grandis, R. Chiocchetti, R. Bortolami, H. Johansson, M.L. Lucchi, Immunohistochemical localization of alpha1a-adrenoreceptors in muscle spindles of rabbit masseter muscle, Tissue and Cell, Volume 38, Issue 2, April 2006, Pages 121-125, ISSN 0040-8166, DOI: 10.1016/j.tice.2005.12.003.
(http://www.sciencedirect.com/science/article/B6WXF-4JCCJJG-1/2/11f0457de66fe9b10a2940ce038d1ce7)
Abstract:
The expression of [alpha]1a-adrenoreceptors ([alpha]1a-ARs) within the muscle spindles of rabbit masseter muscle was investigated. The [alpha]1a-ARs were detected by immunohistochemical fluorescent method and examined along the entire length of 109 cross serially sectioned spindles. The sympathetic fibers were visualized by the immunofluorescent labeling of the noradrenaline synthesizing enzymes tyrosine hydroxylase (TH) and dopamine beta-hydroxylase (DBH). In order to recognize the intrafusal muscle fiber types, antibodies for different myosin heavy chain isoforms (MyHCI) were used. TH and DBH immunolabeled nerve fibers have been observed within the capsule lamellar layers, in the periaxial fluid space and close to intrafusal muscle fibers. The [alpha]1a-ARs were detected on the smooth muscle cells of the blood vessels coursing in the muscle and in the capsule lamellar layers or within the periaxial fluid space of the spindles. Moreover, at the polar regions of a high percentage (88.1%) of muscle spindles a strong [alpha]1a-ARs immunoreactivity was present on the intrafusal muscle fibers. In double immunostained sections for [alpha]1a-ARs and MyHCI it was evidenced that both bag, and nuclear chain fibers

express [alpha]1a-ARs. The receptors that we have detected by immunofluorescence may support a direct control by adrenergic fibers on muscle spindle.
Keywords: Masseter muscle; Muscle spindles; Intrafusal sympathetic fibers; [alpha]1a-Adrenoreceptors; Immunohistochemistry

V. Skrivanova, M. Marounek, A note on the effect of triacylglycerols of caprylic and capric fatty acid on performance, mortality, and digestibility of nutrients in young rabbits, Animal Feed Science and Technology, Volume 127, Issues 1-2, 30 March 2006, Pages 161-168, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2005.07.001.
(http://www.sciencedirect.com/science/article/B6T42-4H6XKYG-1/2/38c8374d625cabd2bbcd905b1012fc2f)
Abstract:
Two experiments, an apparent digestibility trial and a feeding experiment, were carried out to evaluate the effect of medium-chain fatty acids (MCFA) supplied as triacylglycerols (TAG) to a diet of growing rabbits. Hyplus rabbits weaned at the age of 35 days were used. In the digestibility trial 20 rabbits were housed individually, in the feeding experiment 216 rabbits were housed four per cage. Rabbits of experimental groups received a diet supplemented with 10 g kg-1 of Akomed R (TAG of caprylic and capric acid). Coefficient of total tract apparent digestibility (CTTAD) of dry matter, N-free extract and ash was higher by 3.4, 3.8 and 9.9%, respectively, in rabbits fed the diet with Akomed R than in control rabbits ($P<0.05$). Digestibility of other dietary components, the rate of growth, feed intake and carcass yield were not significantly affected. In the feeding experiment, mortality of treated rabbits (15.7%) was significantly lower than that of control rabbits (27.8%; $P=0.048$). No effect on growth rate and shedding of Eimeria sp. oocysts was observed. It can be concluded that MCFA supplied as TAG of caprylic and capric acid in a commercially available oil significantly decreased high mortality of growing rabbits under practical field conditions, without affecting the rate of growth, feed intake and carcass yield.
Keywords: Rabbit; Lipid supplement; Fatty acids; Mortality

Matthew J.G. Gage, Alison K. Surridge, Joseph L. Tomkins, Emma Green, Louise Wiskin, Diana J. Bell, Godfrey M. Hewitt, Reduced Heterozygosity Depresses Sperm Quality in Wild Rabbits, Oryctolagus cuniculus, Current Biology, Volume 16, Issue 6, 21 March 2006, Pages 612-617, ISSN 0960-9822, DOI: 10.1016/j.cub.2006.02.059.
(http://www.sciencedirect.com/science/article/B6VRT-4JHMFT0-11/2/201a0b6b4de2007e4a90adec5f4d311c)
Abstract: Summary
When close relatives are forced to reproduce, the resulting offspring inherit above average homozygosity and reduced fitness [1] and [2]. Biologists now recognize inbreeding depression in the wild [3], [4] and [5], a phenomenon that will probably increase as natural populations become depleted and fragmented. Inbreeding depression is most commonly expressed as compromised fertility and embryogenesis [4], but actual mechanisms remain poorly understood, especially for wild populations. Here, we examine how reduced heterozygosity influences spermatozoal and gonadal traits in wild rabbits (Oryctolagus cuniculus) sampled across the United Kingdom. By using a suite of 29 microsatellite markers (analyzed to confirm representation of individual heterozygosity across our sample), we found a significant negative relationship between heterozygosity and the production of normal sperm; the relationship was significant both between (n = 12) and within (n = 91 [total males], 42 [island], 49 [mainland]) populations. Reduced heterozygosity was also associated with decreased testis size across males (n = 112), but no relationship was seen at the population level, suggesting environmental confounds. Our results show, for a wild mammal, that inbreeding is associated with decreased sperm quality, confirming suggestions of links between inbreeding and elevated sperm abnormalities in rare felids [6], [7]

and [8]. These findings could explain why inbreeding depression so frequently arises via compromised fertility and embryogenesis [4].
Keywords: EVO_ECOL

Rajesh K. Sinha, Cornelius Alexander, Rose G. Mage, Regulated expression of peripheral node addressin-positive high endothelial venules controls seeding of B lymphocytes into developing neonatal rabbit appendix, Veterinary Immunology and Immunopathology, Volume 110, Issues 1-2, 15 March 2006, Pages 97-108, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2005.09.009.
(http://www.sciencedirect.com/science/article/B6TD5-4HD8DGK-1/2/1c890ef0eecc1cb6b790cea4a9bf8c84)
Abstract:
Young rabbit appendix is a homologue of chicken bursa of Fabricius; both are crucial sites for preimmune B-cell repertoire diversification. Here, we report that appendix regulates precursor lymphocyte recruitment for further development by modulating the sites of extravasation. The total area of peripheral node addressin-positive (PNAd+) high endothelial venules (HEVs) increased from 1 day to 1 week after birth, remained constant up to 2 weeks and declined to a low and persistent amount by 3 weeks. In normal 1-week and manipulated 5-week appendix where growth of follicles was retarded, PNAd+ HEVs were present in the basolateral sides of B-cell follicles whereas, in normal 5-wk-appendix these were restricted to T-cell areas. The PNAd was expressed on the lumenal surface of HEVs. The proportions of CD62L+ B cells in appendix declined from ~40% at 3 days to 2-3% at 4 weeks. In lymphocyte transfer experiments, CD62L+ B cells were preferentially recruited compared with CD62L- B cells, anti-PNAd antibody blocked migration of B cells by ~50%, and 100 times more B cells were recruited in 1-week compared to 6-week appendix. Thus, a unique spatiotemporal expression pattern of PNAd+ HEVs is associated with development of B-cell follicles. This regulates migration of blood-borne B-lymphocytes into developing appendix by interacting with CD62L.
Keywords: PNAd; l-Selectin; B lymphocyte recruitment; Appendix

Keisuke Okamoto, Masamithu Kanoe, Yukio Yaguchi, Takeshi Inoue, Tadao Watanabe, Effects of a collagenolytic cell wall component from Fusobacterium necrophorum subsp. necrophorum on rabbit tissue-culture cells, The Veterinary Journal, Volume 171, Issue 2, March 2006, Pages 380-382, ISSN 1090-0233, DOI: 10.1016/j.tvjl.2004.11.016.
(http://www.sciencedirect.com/science/article/B6WXN-4FBW5V9-1/2/aaabe43f0a3230b6432b5610ab43cf08)
Abstract:
The effects on rabbit tissue-cultured cells of collagenolytic cell wall component (CCWC) from Fusobacterium necrophorum subsp. necrophorum were investigated. Scanning electron microscopy demonstrated that CCWC damaged the cell surfaces of the rabbit granulocytes and hepatocytes but the effects of the cells differed from each other. Granulocytes appeared smooth and morphologically irregular whereas hepatocytes looked rough and had tiny holes in the cell membranes. Differences in cell viability were observed in MTS (3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulphophenyl)-2H-tetrazolium, inner salt) assay. The findings suggest that cytotoxic activity in vivo may well contribute to the establishment of an initial injury in visceral tissues, and the action of CCWC could increase the chances of survival for an invading F. necrophorum subsp. necrophorum at the first stages of infection.
Keywords: Fusobacterium necrophorum; Pathogenicity; Cytotoxicity; Collagenolytic activity; Rabbit cell

Cesare Castellini, Raffaella Cardinali, Alessandro Dal Bosco, Alba Minelli, Oliva Camici, Lipid composition of the main fractions of rabbit semen, Theriogenology, Volume 65, Issue 4, 1 March 2006, Pages 703-712, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2005.05.053.

(http://www.sciencedirect.com/science/article/B6TCM-4GNCXRG-1/2/f67404cac6cdd5db8e954b99b986b8a2)
Abstract:
Rabbit semen contains mature spermatozoa and several other fractions (seminal plasma, droplets and vesicles) which are separated by various procedures. These fractions have a variable lipid profile: spermatozoa contain the largest amount of phospholipids (PL), whereas seminal plasma, droplets and vesicles accounted for 49.8% of the total PLs. The cholesterol content in raw semen was 811 [mu]g/109 but was only 21-23% in spermatozoa. The main PL classes of rabbit spermatozoa were PC, LPC, PE, PS, SM and PI, which varied according to the separation procedures used. Percoll-separated spermatozoa (Spp) showed an increase of LPC, a higher LPC/PC ratio but a lower lipid content compared to the theoretical amount. This membrane modification did not affect the number of live cells but greatly influenced the functional properties of the rabbit spermatozoa, i.e. the HOS-test and induced acrosome reaction. PC, followed by PE and LPC were the most abundant PL classes of seminal plasma, droplets and vesicles. These fractions have higher PE and SM levels and lower PC/PE + PC ratios than in the germinal cells. Some physiological implications are discussed.
Keywords: Rabbit spermatozoa; Semen; Lipid profile

Wei Si, Thomas B. Hildebrandt, Catherine Reid, Ronald Krieg, Weizhi Ji, Mirja Fassbender, Robert Hermes, The successful double cryopreservation of rabbit (Oryctolagus cuniculus) semen in large volume using the directional freezing technique with reduced concentration of cryoprotectant, Theriogenology, Volume 65, Issue 4, 1 March 2006, Pages 788-798, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2005.06.010.
(http://www.sciencedirect.com/science/article/B6TCM-4GX64KT-1/2/d90d565ab60df09a089565297d5eb146)
Abstract:
Using directional freezing, our objective was to cryopreserve rabbit semen and achieve fertility that was equal or higher than that achieved with conventional freezing. The working hypothesis was that controlling the ice-front propagation would allow reduction of DMSO concentration to <1 M, in addition to the capability to freeze large volumes (2-10 mL). Moreover, single and double freezing of semen were used to demonstrate the abbreviated mechanical stress imparted by directional freezing. Single-cryopreserved semen from 15 males extended with 0% egg yolk/1.75 M DMSO, 15.3% egg yolk/0.88 M DMSO and 20% egg yolk/0 M DMSO resulted in lower ($P < 0.05$) mean +/- S.E.M. post-thaw motility (3.6 +/- 1.1, 28.5 +/- 2.8 and 36.3 +/- 1.8%, respectively) compared to fresh semen (73.3 +/- 1.2%). Semen from seven of these males, subject to double freezing using only egg yolk based extenders, resulted in post-thaw motilities of 18.1 +/- 2.2 and 16.4 +/- 3.3%. Despite the reduced functional parameters of cryopreserved semen, fertility and kindling rates of 73.9 and 56.5% for single frozen-thawed, and 28.6 and 35.7% for double frozen-thawed semen were achieved (with insemination of 98 females). There was no significant difference in fertility rate between fresh semen (87.5%) and semen that was single frozen-thawed with the 15.3% egg yolk/0.88 M DMSO extender (73.9%). In conclusion, cryopreservation of rabbit semen in large volumes using directional freezing achieved fertility rates similar to those achieved with fresh semen. Furthermore, acceptable fertility rates with double frozen-thawed semen could facilitate the future use of sex-sorted semen in rabbits.
Keywords: Rabbit; Reproduction; Semen cryopreservation; Directional freezing; Fertility

J.L. Mourao, V. Pinheiro, A. Alves, C.M. Guedes, L. Pinto, M.J. Saavedra, P. Spring, A. Kocher, Effect of mannan oligosaccharides on the performance, intestinal morphology and cecal fermentation of fattening rabbits, Animal Feed Science and Technology, Volume 126, Issues 1-2, 28 February 2006, Pages 107-120, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2005.06.009.

(http://www.sciencedirect.com/science/article/B6T42-4GPW3GK-1/2/7c1cc2ba262b6ed40c77612a0772e10b)

Abstract:
A common problem in rabbits is the occurrence of digestive disorders just after weaning. This problem is associated with instability of the cecal microflora and characterized by diarrhea, loss of appetite and increased mortality. In the current study the effects of mannan oligosaccharide (MOS, Bio-Mos(R), Alltech Inc., USA), a natural growth promoter, were compared to a commonly used antibiotic growth promoter (AGP, Zn-Bacitracin).
The five experimental treatments were as follow: Control (no additives); MOS 1 (Bio-Mos(R), 1 g kg-1); MOS 1.5 (Bio-Mos(R), 1.5 g kg-1); MOS 2 (Bio-Mos(R), 2 g kg-1) and AGP (Zn-Bacitracin; 0.1 g kg-1). Experimental diets were based on alfalfa, sunflower meal, wheat and beet pulp and were offered ad libitum through out the experiment. Trial 1 used 400 weaned mixed-sex rabbits divided into the five treatments with 10 replicates and 8 rabbits/replicate. Rabbits were weighed at weaning (day 32) and at the end of the experiment (day 67). Weight gain, feed intake, feed conversion ratio (FCR) and mortality were evaluated using a commercial grow-out facility. Trial 2 used 220 weaned rabbits divided into the same five experimental treatment groups and housed in groups of 4 in 11 flat deck cages located in an experimental rabbit house. In trial 2 performance, intestinal morphology and cecal fermentation were determined.
In both trials, rabbit daily weight gain and feed intake were not affected by treatments. However, in trial 1 MOS rabbits had better ($P<0.05$) FCR than control rabbits and similar to AGP rabbits. Also in this trial, the mortality with MOS and AGP treatments tended to be lower ($P=0.052$) than with control diet.
Results in trial 2 showed longer villi ($P<0.05$) in rabbits fed MOS or AGP compared to the control group, this resulted in increased absorption surface. Cecal volatile fatty acid (VFA) concentration differed ($P<0.05$) between treatments. Rabbits fed MOS at 1 g kg-1 had higher total VFA concentration compared to the Control as well as the AGP treatment. Furthermore, cecal pH was significantly lower in rabbits fed MOS at 1 and 2 g kg-1 compared to the control. A reduction on total bacterial count in ileum contents ($P<0.05$) and Coliforms and Enterococci in cecal contents with MOS supplementation of diet was observed.
Results for these studies showed that the addition of MOS resulted in similar performance compared to an antibiotic growth promoter. Furthermore, differences in mortality, intestinal morphology and cecal VFA concentration suggest that MOS can improve the health status of growing rabbits.
Keywords: Rabbits; Mannan oligosaccharide; Mortality; Performance; Intestinal morphology; Cecal VFA

K.E. Moseby, J.L. Read, The efficacy of feral cat, fox and rabbit exclusion fence designs for threatened species protection, Biological Conservation, Volume 127, Issue 4, February 2006, Pages 429-437, ISSN 0006-3207, DOI: 10.1016/j.biocon.2005.09.002.
(http://www.sciencedirect.com/science/article/B6V5X-4HC0R4D-1/2/d4f878eb497032141a2d32bbf9345238)

Abstract:
Pen and field trials were used to test the effectiveness and cost-efficiency of wire netting and electric fence designs as barriers to feral cats, foxes and rabbits in northern South Australia. A 180 cm high wire netting fence with foot apron and a curved `floppy' overhang effectively contained most rabbits, feral cats and foxes during pen trials and proved effective with intensively monitored paddock-scale exclosures. A reduced height fence of 115 cm did not reduce effectiveness of the fence during fence trials but paddock-scale trials are yet to be completed. Conventional 40 mm diameter hexagonal 'rabbit netting' was not an effective barrier against young independent rabbits and it is recommended that 30 mm hexagonal netting should be used. A 60 cm wide external netting overhang, curved in an arc and supported by lengths of heavy gauge wire, effectively

precluded more feral cats and foxes than a 30 cm wide overhang angled upwards. The 30 cm foot apron was augmented in erosion-prone dunes and watercourses by the addition of wider netting or rubber matting to prevent incursions. Posts, and particularly corners, were targeted by feral cats and foxes and the efficacy of the fence was improved by using steel, rather than timber posts. Electric wires offset from the netting at heights of 120 and 150 cm provided a shock to animals exploring the base of the overhang and further improved the fence efficacy. PVC conduit rollers on the top wire were not effective.
Material costs ranged from AUD $8814 per km for the 115 cm high fence to AUD $12,432 per km for the 180 cm high fence with two electric wires. The non-standard 30 mm hexagonal netting accounted for 57% of the material costs of the low netting fence. Increased demand for this netting may reduce the expense of rabbit exclusion. Expenses could also be reduced where existing stock fences are modified by the addition of netting.
Keywords: Cat; Exclusion fencing; Fox; Rabbit; Pen trials

M.P. Alvarez, D.P. Cardinali, V. Jimenez, M. Alvarino, A.I. Esquifino, Twenty-four hour rhythm of plasma prolactin in female rabbit pups: Correlation with hypothalamic and adenohypophysial dopamine, serotonin, gamma-aminobutyric acid and taurine content, Animal Reproduction Science, Volume 91, Issues 1-2, January 2006, Pages 143-153, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2005.03.007.
(http://www.sciencedirect.com/science/article/B6T43-4G2BG8J-1/2/688e57ce071426dd19c4b884345b0f6d)
Abstract:
Lactation in the rabbit is a nocturnal activity, extremely short and regular, that can be a strong synchronizer for the development of circadian rhythmicity in the pups. In the present study, 24-h rhythmicity of plasma prolactin and median eminence and anterior pituitary content of dopamine (DA), serotonin (5HT), gamma-aminobutyric acid (GABA) and taurine were examined in 11 days old female pups kept under 16 h light:8 h dark photoperiods (lights on at 08:00 h). Groups of six to seven female rabbit pups were killed by decapitation at six different time points throughout a 24-h cycle, starting at 09:00 h. Plasma prolactin levels changed significantly throughout the day, showing two peaks, one at first half of rest span (at 13:00 h) and another one at the beginning of the scotophase (at 01:00 h), just preceding doe visit. Median eminence DA content changed in a bimodal way as a function of time of day, displaying two maxima, at the beginning of the rest span and of the activity phase. Median eminence DA and plasma prolactin correlated significantly in an inverse way. Two maxima in median eminence 5HT levels were found, about 4 h in advance to the prolactin peaks. Circulating prolactin correlated inversely with median eminence 5HT content and directly with adenohypophysial 5HT content. Median eminence GABA content reached its maximum at the beginning of the scotophase and correlated significantly with plasma prolactin concentration. A positive correlation between plasma prolactin and adenohypophysial taurine content was observed. These results show that the circadian rhythmicity in prolactin secretory mechanisms in female rabbit pups develops during the early neonatal life.
Keywords: Female rabbit pups; Prolactin; Dopamine; Serotonin; Gamma-aminobutyric acid; Taurine; Median eminence; Adenohypophysis; Circadian rhythms

C. Casado, O. Piquer, C. Cervera, J.J. Pascual, Modelling the lactation curve of rabbit does: Towards a model including fit suitability and biological interpretation, Livestock Science, Volume 99, Issue 1, January 2006, Pages 39-49, ISSN 1871-1413, DOI: 10.1016/j.livprodsci.2005.05.019.
(http://www.sciencedirect.com/science/article/B7XNX-4J8C7C7-6/2/d5e64a9c6da42627abd7aad3127cd5bf)
Abstract:
This work proposes an adequate empirical model for the 28-day lactation curve of rabbit does, including fit suitability and biological interpretation. A total of 15,400 test-day milk records were

used, corresponding to 550 lactations collected from 134 hybrid New Zealand x Californian rabbit does during five consecutive lactations. To develop this model, five different functions were compared (quadratic, potential, beta-modified, gamma and Gauss models), evaluating their fitting ability to mean and individual lactation curves, and the suitability of their parameters to gather the sources of variation (genetic selection level, type of diet, parity order and gestation overlapping degree) on lactation curve shape. The possible relationship between model parameters and main performance traits was also evaluated. From the results of the present work, it may be concluded that beta-modified equation [Milk yield (g/day) = k x (day/30)a x (1 - (day/30))b] could be proposed as an alternative to quadratic models for daily milk yield prediction of reproductive rabbit does. When compared to quadratic models, beta-modified model give a slightly better fit to average (R2 = 0.986 vs. 0.985; RMSE = 5.648 vs. 5.813) and individual (Residuals = 21.31 vs. 21.37 g; Mean square prediction error = 883.0 vs. 897.2 g2) lactation curves, especially of those curves showing a lower lactation peak height and a greater persistence of milk yield. However, the most important advantage of the beta-modified model was the greater biological interpretation of its parameters (k regulates the curve height, while a and b regulate the milk yield of ascending and descending period, respectively) and the ability to gather curve changes. This latter aspect is revealed by the relationship of the parameters with main performance traits of lactating does (energy intake, live weight and body reserves mobilisation). Although further research on developing an optimal model is needed, the use of this type of models could provide additional information for a better understanding of the curve shape effect on the performance, body condition and health of reproductive rabbit does.
Keywords: Lactation curve; Model fitting; Performance traits; Body condition; Reproductive rabbit does

Marta Gil, Jorge A. Ramirez, Marcial Pla, Beatriz Arino, Pilar Hernandez, Mariam Pascual, Agustin Blasco, Luis Guerrero, Gyongyi Hajos, Emoke N. Szerdahelyi, Maria Angels Oliver, Effect of selection for growth rate on the ageing of myofibrils, meat texture properties and the muscle proteolytic potential of m. longissimus in rabbits, Meat Science, Volume 72, Issue 1, January 2006, Pages 121-129, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2005.06.014.
(http://www.sciencedirect.com/science/article/B6T9G-4GXVGHB-1/2/9276669b8d9b7dde75e555e66c05a861)
Abstract:
The effect of selection for growth rate on the degradation of the myofibrillar proteins and on meat texture properties of rabbit longissimus muscle at two ageing times (1 and 7 days) was studied as well as its effect on the proteolytic potential of the muscle. Two groups of contemporary animals (20 rabbits per group), one selected for growth rate (S) for 14 generations and the other unselected control group (C) were compared. The control group was formed from the offspring of the embryos belonging to the 7th generation and was compared with selected animals belonging to 21st generation. Myofibrillar protein degradation was studied by SDS-PAGE electrophoresis (12.5% and 4-15% polyacrylamide gels) followed by densitometric analysis of the pherograms. Texture properties were evaluated by Warner-Bratzler (WB) test and Texture profile analysis (TPA). The activities of proteolytic enzymes calpains and cathepsins and of their inhibitors were determined in the muscle at 24 h. Densitometric analysis of the pherograms of samples aged 7 days showed an extra 30 kDa band and the disappearance of a band with higher molecular weight than the myosin heavy chain with respect to samples aged 24 h in both groups of rabbits. TPA results showed that cohesiveness was significantly lower in meat at 7 days than at 24 h ($P < 0.0001$), whereas springiness and chewiness presented a clear tendency to be lower at 7 days than at 24 h ($P = 0.0646$ and $P = 0.0764$, respectively). Regarding the genetic type, S animals presented higher hardness and chewiness than C rabbits. Shear firmness (WB test) was significantly ($P < 0.0001$) higher for S group, whereas no significant differences in shear force and

area were found. No significant effect (P > 0.05) of ageing time was detected using WB test. Selection for growth rate did not affect the activities of proteolytic enzymes or their inhibitors.
Keywords: Myofibrillar protein degradation; Ageing; Texture; Rabbit; Cathepsins; Calpains

V.O. Fuentes, C. Villagran, J. Navarro, P.I. Fuentes, Effect of small doses of naloxone on sexual exhaustion in White New Zealand male rabbits, Animal Reproduction Science, Volume 90, Issues 3-4, December 2005, Pages 341-346, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2005.02.006.
(http://www.sciencedirect.com/science/article/B6T43-4G7NF7M-1/2/0758c1ad757a44e92e611047d2891f5c)
Abstract:
The objective of the present study was to determine the effect of small doses of naloxone on sexual exhaustion in White New Zealand male rabbits. Twelve young and 12 adult male rabbits 6-12 months old and 14-20 months of age, respectively, were selected from a commercial farm. Each male rabbit was housed individually in galvanized cages (90 cm x 60 cm x 40 cm). The rabbits were housed in an open shed exposed to natural photoperiod (12 L 12 D, 19[degree sign]N). Daily temperature fluctuated through the year from 28 to 16 [degree sign]C. Humidity was 45 +/- 5%. Water and food (rabbit chow PMI) was supplied ad libitum. After sexual behaviour for each studied group was established, the males were given a 6-day rest, and 3 days before next trial, six males of each group (treated) received a subcutaneous implant of 8 mg of naloxone in a crystalline nitrocellulose pellet formulated to be completely absorbed in 15 days. The remaining six males were sham-treated (control). At the end of the resting period as previously described, the sexual behavior of each group was studied and compared using a Mann-Whitney statistical U-test. The effect of naloxone on sexual behavior was analyzed with a Wilcoxon test for correlated samples. With regard to sexual activity between young and adult rabbits, it was observed that there was a significant difference between groups (P = 0.00275, Z = 2.8823, adjusted Z = 2.99.43) showing that younger rabbits mounted/ejaculated from 9 to 10 females compared with 6 to 8 mounted/ejaculated by older rabbits. When naloxone was administered to both groups, there was a significant difference when comparing sexual behavior before and after administration of naloxone (table first and second trial). Young rabbits treated with naloxone mounted/ejaculated 11-12 females while older rabbits mounted nine females before reaching sexual exhaustion. A significant difference was observed when comparing the number of estrous females that were mounted/ejaculated between groups. Environmental photoperiod and temperature changes were not considered. It was concluded that endogenous opioids are important modulators of behavioral and hormonal interactions related to sexual behavior.
Keywords: Rabbits; Sexual exhaustion; Naloxone

F.M. El-Demerdash, M.I. Yousef, Malak A. Zoheir, Stannous chloride induces alterations in enzyme activities, lipid peroxidation and histopathology in male rabbit: Antioxidant role of vitamin C, Food and Chemical Toxicology, Volume 43, Issue 12, December 2005, Pages 1743-1752, ISSN 0278-6915, DOI: 10.1016/j.fct.2005.05.017.
(http://www.sciencedirect.com/science/article/B6T6P-4GR341Y-1/2/4c4b826f8147b378e4b6b6903a39d250)
Abstract:
Stannous chloride (SnCl2) is widely used in daily human life to conserve soft drinks, in food manufacturing and biocidal preparations. It had genotoxicity, immunotoxicity, neurotoxicity and oxidative stress. Therefore, the present experiment was carried out to determine the effectiveness of l-ascorbic acid (AA) in alleviating the toxicity of SnCl2 on some enzyme activities and oxidative damage in male New Zealand white rabbits. Six rabbits per group were assigned to 1 of 4 treatment groups: 0 mg AA and 0 mg SnCl2/kg BW (control); 40 mg AA/kg BW; 20 mg SnCl2/kg BW (1/500 LD50); 20 mg SnCl2 plus 40 mg AA/kg BW. Rabbits were orally administered the respective doses every other day for 12 weeks. Liver and kidney specimens were processed for

histopathologic studies. Results obtained showed that SnCl2 significantly ($P < 0.05$) induced free radicals in rabbit liver, testes, kidney, lung, brain and heart. While, the activity of glutathione S-transferase (GST) and the level of sulfhydryl groups (SH-group) were decreased ($P < 0.05$) in all tested organs except brain and heart. Aspartate aminotransferase (AST) activity was increased ($P < 0.05$) in liver and decreased in testes, but alanine aminotransferase (ALT) did not change. The activities of alkaline phosphatase (AlP) and acid phosphatase (AcP) were decreased ($P < 0.05$) in liver, testes, kidney and lung. Also, the activity of acetylcholinesterase (AChE) was significantly decreased in brain and plasma of rabbits treated with SnCl2 compared to control group. Histopathologic studies showed marked changes in hepatocytes as well as proliferation of duct epithelium, dilatation and congestion of blood vessels as well as mononuclear inflammatory infiltrate. The kidney were also severely affected by SnCl2 the Bowman's space was increased, with infiltration of renal parenchyma by mononuclear inflammatory infiltrate and changes in cells lining convoluted tubule. Ascorbic acid alone significantly decreased the levels of free radicals, and increased the activity of GST and the levels of SH groups in tested organs except brain and heart. While, the rest of the tested parameters were not affected. Results showed that AA alleviated the harmful effects of SnCl2. This was proved histopathologically by the great improvement in liver and kidney histology where hepatocytes retained normal architecture with mild dilatation and congestion of blood vessels. Bowman's space of kidney was almost normal, with normal lining of proximal and distal convoluted tubules. In conclusion AA could be effective in the protection against stannous chloride toxicity.
Keywords: Stannous chloride; Ascorbic acid; Rabbits; Lipid peroxidation; Enzymes

William A. Foster, A rabbit with two million tails, Trends in Ecology & Evolution, Volume 20, Issue 12, December 2005, Pages 654-655, ISSN 0169-5347, DOI: 10.1016/j.tree.2005.06.007.
(http://www.sciencedirect.com/science/article/B6VJ1-4GGWG3M-2/2/10a6a0400e025e15f41a194f966d1db5)

Amando Bautista, Marisol Mendoza-Degante, Gerard Coureaud, Margarita Martinez-Gomez, Robyn Hudson, Scramble competition in newborn domestic rabbits for an unusually restricted milk supply, Animal Behaviour, Volume 70, Issue 5, November 2005, Pages 1011-1021, ISSN 0003-3472, DOI: 10.1016/j.anbehav.2005.01.015.
(http://www.sciencedirect.com/science/article/B6W9W-4H2FY68-1/2/de061833685b5b8b85865ff559ec59a5)
Abstract:
Rabbit pups, Oryctolagus cuniculus, are nursed only for about 3 min once every 24 h, and we have previously reported indirect evidence of strong competition among littermates for the mother's milk. In the present study, we examined the nature of this competition more closely. In experiment 1, we investigated the temporal pattern of milk intake during nursing and found that pups obtain almost all milk available to them each day during the second minute of a 3-min nursing event. In experiment 2, we investigated the availability of milk across the eight nipples and found a tendency for more milk to be available from the two middle pairs. In experiment 3, we observed the behaviour of pups beneath the mother during nursing and found no evidence of a fixed `teat order,' of overt aggression, or of pups displacing one another from nipples. However, the results confirmed previous findings of a positive correlation between milk intake and pups' birth weight. In experiment 4, the attempt to increase competition among pups by covering half of the mother's nipples did not lead to the expression of overtly aggressive behaviour or to recognizable displacements from nipples. We conclude that in the rabbit, littermates compete for milk by scramble rather than by contest competition, in which the heaviest pups have a clear advantage. It is a strategy presumably well suited to a situation in which milk is effectively available only for 1 min every 24 h, leaving little time for aggressive tussles.

G.M.K. Mehaisen, J.S. Vicente, R. Lavara, M.P. Viudes-de-Castro, Effect of eCG dose and ovulation induction treatments on embryo recovery and in vitro development post-vitrification in two selected lines of rabbit does, Animal Reproduction Science, Volume 90, Issues 1-2, November 2005, Pages 175-184, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2005.01.015.
(http://www.sciencedirect.com/science/article/B6T43-4FRB7WT-1/2/3b0c29fdb866b1fa51e0a6bb46416a81)
Abstract:
The aim of this work was to evaluate the effect of different doses of eCG administered subcutaneously (0, 50 and 200 IU) and the hormonal induction of ovulation (GnRH or hCG) on embryo recovery and in vitro development of embryos post-vitrification in two selected lines of rabbit does. The two selected lines were line V (selected for the litter size at weaning) and line R (selected for growth rate). Administration of 200 IU of eCG significantly increased ovulation rate (19.2 +/- 1.2 versus 15.5 +/- 1.1 and 12.2 +/- 1.3, and the number of haemorrhagic follicles (13.8 +/- 1.6 versus 3.8 +/- 1.4 and 3.8 +/- 1.7), but significantly decreased recovery rate (28.8 +/- 6.3 versus 47.7 +/- 5.7 and 48.7 +/- 6.7, 200 IU versus 50 IU and 0 IU eCG, respectively), the number of normal embryos recovered per doe with at least one embryo (5.8 +/- 0.9 versus 8.2 +/- 0.9, 200 IU versus 50 IU eCG doses) and the in vitro development of embryos post-vitrification (51.9% versus 66.1%, 200 IU versus 50 IU eCG doses, respectively). Inducing ovulation with hCG significantly increased ovulation rate when compared with GnRH (17.3 +/- 0.8 versus 13.8 +/- 1.4), but no significant differences in embryo recovery and embryo development post-vitrification were observed between the two treatments. No significant differences were observed between the two selected lines in ovulation and recovery rates, the number of haemorrhagic follicles and the number of recovered embryos per doe. However, the post-vitrification in vitro rate of development was 59.7% for line R and 51.9% for line V ($p < 0.05$). It was concluded that the use of 50 IU of eCG subcutaneous with hCG or GnRH prior to embryo cryopreservation programmes in rabbits achieves the best results for embryo recovery, with the best development of recovered embryos post-vitrification.
Keywords: eCG; Ovulation induction; Embryo recovery; In vitro development; Line; Rabbit

K. Csatadi, K. Kustos, Cs. Eiben, A. Bilko, V. Altbacker, Even minimal human contact linked to nursing reduces fear responses toward humans in rabbits, Applied Animal Behaviour Science, Volume 95, Issues 1-2, November 2005, Pages 123-128, ISSN 0168-1591, DOI: 10.1016/j.applanim.2005.05.002.
(http://www.sciencedirect.com/science/article/B6T48-4GHSGBD-1/2/e8a7efa3618bb66d9ba12696b113b379)
Abstract:
When handled around nursing time during the first week after birth, the fear response of rabbits toward humans is reduced later on. But although this might be crucial for practical application, the duration of daily treatment necessary to achieve this effect was not known so far. In the present experiment, we investigated whether even a minimal human contact, characteristic of animal caretaking in intensive rabbitries, can reduce avoidance. Newborn New Zealand rabbit pups were exposed to one of the following handling treatments in the first week of life: (1) full handling, within 0.5 h after nursing, which consisted of removing the pups of the nest and weighing them (about 5 min/litter), (2) full handling performed 2 h after nursing with a treatment similar to the previous, (3) routine check, within 0.5 h after nursing, which consisted of touching the pups by the stockperson to see whether all pups were alive (about 5 s/litter), (4) routine check, 2 h after nursing. At 28 days of age, the timidity of the pups was measured in a 5 min approach test. Pups that were handled within 0.5 h after nursing, irrespectively of the duration of handling, appeared to be tamer as they approached the experimenter's hand with a lower latency and more times then those handled later. We conclude that, in an apparent sensitive period, even minimal human contact is effective

in reducing avoidance of the caretaker. Thus, handling might be a useful tool to reduce stress and improve welfare even under intensive farming conditions.
Keywords: Welfare; Handling; Avoidance; Fear; Rabbitry

Raquel Monclus, Heiko G. Rodel, Dietrich Von Holst, Javier De Miguel, Behavioural and physiological responses of naive European rabbits to predator odour, Animal Behaviour, Volume 70, Issue 4, October 2005, Pages 753-761, ISSN 0003-3472, DOI: 10.1016/j.anbehav.2004.12.019.
(http://www.sciencedirect.com/science/article/B6W9W-4GX64Y9-2/2/e1e9f9406bd8ab011352157900296e81)
Abstract:
Animals show a variety of antipredator strategies in response to the presence of chemical cues from mammalian predators. Nevertheless, there is no general agreement as to whether recognition of predator odours is dependent upon experience. We conducted an experiment on European rabbits Oryctolagus cuniculus naive to any contact with predators and we investigated (1) whether they possessed a mechanism for the recognition of the odour of a predator, and (2) how they responded behaviourally and physiologically to that odour. We used fox Vulpes vulpes faeces as the source of the predator odour and sheep Ovis aries faeces as a nonpredator control odour. The experiments were conducted in small outdoor enclosures where the animals were kept singly. We recorded patterns of vigilance, activity and feeding, and changes in glucocorticoids and body mass. The rabbits showed a clear antipredator response to the presence of fox faeces, whereas they behaved neutrally in response to sheep odour. The response consisted of increased avoidance and vigilance while feeding and more investigation before feeding. Furthermore, the rabbits showed a physiological alarm response, that is, an increased responsiveness of their adrenocortical system and weight loss. However, the total activity budget, measured as time spent outside the burrow, the time spent feeding, and the amount of food ingested remained largely stable during the experiment. We conclude that rabbits recognised predator odours and that this recognition was independent of experience.

Z.-W. Yang, J.-A. Li, M.-H. Yang, Y.-S. Feng, Z. Tang, X.-S. Dai, H.-Y. Wang, Q.-Q. Yin, Y. Gao, J. Li, X.-L. He, Y. Zhang, Q. An, Comparison of blood counts in splenic, renal and mesenteric arterial and venous blood in post-pubertal rabbits, Research in Veterinary Science, Volume 79, Issue 2, October 2005, Pages 149-154, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2004.11.008.
(http://www.sciencedirect.com/science/article/B6WWR-4F9FR0X-2/2/24e22ad238a746c8c844ccb1386375fa)
Abstract:
Objectives: To compare blood counts between arterial and venous blood to and from visceral organs and indirectly look into the function of the organs.
Methods: Splenic, renal and superior mesenteric arterial and venous blood samples were obtained from the arteries and veins in 38 post-pubertal rabbits and blood profile, including complete and differential blood counts, haemoglobin concentration and haematocrit, were measured with an automatic haematology analyser.
Results and conclusions: The rabbit spleen released a large amount of leucocytes (both lymphocytes and granulocytes) into the splenic venous blood (a venous increase of 33% in total leucocyte count), and also received more leucocytes (36-58% more in terms of concentration) from the artery than the kidney or intestine. Significantly fewer red blood cells were present in the renal venous blood than in the arterial blood (a venous reduction of 5% in erythrocyte count), but it remains to be clarified why and how the reduction was induced. More than 3-4% of water might be taken into the mesenteric venous blood during microcirculation (a venous reduction of 3-4% in erythrocyte-related parameters) and a significant number of leucocytes (mainly large leucocytes)

in the mesenteric blood capillaries might migrate into the surrounding intestinal tissue (a venous reduction of 13% in leucocyte count).
Keywords: Arterial; Mesenteric; Renal; Splenic; Venous

Raquel Lavara, Eva Moce, Felipe Lavara, Maria Pilar Viudes de Castro, Jose Salvador Vicente, Do parameters of seminal quality correlate with the results of on-farm inseminations in rabbits?, Theriogenology, Volume 64, Issue 5, 15 September 2005, Pages 1130-1141, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2005.01.009.
(http://www.sciencedirect.com/science/article/B6TCM-4FNDRXB-1/2/4e629f3c228e2f3a7d45f0f83c0d49de)
Abstract:
This study was conducted to determine if different sperm characteristics correlate with the in vivo fertility of rabbit sperm. A total of 2765 heterospermic inseminations were performed in commercial rabbitries using 50-pooled samples of fresh semen. Sperm motility and morphological evaluations were performed on each of the heterospermic pooled samples to asses the seminal quality, and the percentage of kindling rate (76.2%) and number of kits born alive (9.3) were recorded. Sperm motility parameters, assessed using a computer-assisted sperm analysis (CASA) system (Sperm Class Analyzer, Microptic, Barcelona, Spain), were: average path velocity, curvilinear velocity, straight-line velocity, linearity, amplitude of lateral head displacement, beat cross-frequency, wobble and percentage of total motile spermatozoa. Morphological analyses included the percentage of sperm with a normal apical ridge, the percentage of sperm with cytoplasmatic droplets and the percentage of abnormal sperm. Significant correlations were observed between kindling rate and the percentage of total motile cells ($r = 0.31$; $P < 0.05$), linearity index ($r = -0.32$; $P < 0.05$) and the percentage of abnormal sperm in the sample ($r = -0.32$; $P < 0.05$). Regression models including motility and the morphological parameters explained 45% of the variation in kindling rate. These results indicate that motility parameters, determined by CASA systems, in combination with sperm morphology analyses can provide some information about the fertilizing potential of rabbit sperm.
Keywords: Semen quality; Fertility; CASA; Rabbit; Sperm

P. Baumann, H. Oester, M. Stauffacher, The influence of pup odour on the nest related behaviour of rabbit does (Oryctolagus cuniculus), Applied Animal Behaviour Science, Volume 93, Issues 1-2, September 2005, Pages 123-133, ISSN 0168-1591, DOI: 10.1016/j.applanim.2004.11.017.
(http://www.sciencedirect.com/science/article/B6T48-4FD13BW-1/2/841baf803d95b3a82e38208c50302606)
Abstract:
Under natural and near-to-nature conditions, rabbit does block the entrance to their nest after nursing by burrowing before they leave. This behavioural pattern serves to protect the pups from predators and is a highly evolutionary adaptive behaviours. Under commercial husbandry conditions, the entrance to the nest box stays permanently open, potentially counteracting a doe's behavioural goal of a closed nest. Due to the non-manipulable floor and the absence of roughage or other appropriate materials, a doe will fail to achieve the feedback of a successful removal of nest stimuli, in spite of conducting the appropriate behavioural patterns. This leads to repeated nest contacts, nest visits and nest closing attempts and can increase pup mortality due to the crushing of pups and the disturbance of their energy-saving strategy of resting deep inside the insulating nest material between nursing visits. Previous studies have shown that repeated nest related behaviour is even performed when the nest entrance is closed with a sliding door and opened once a day for nursing. This may be due to the ventilation openings in the nest box, potentially emitting olfactory and acoustic stimuli.
To investigate the effects of the olfactory stimulus alone, we provided the cages of 15 ZIKA does with nest boxes which contained no pups and emitted no pup odours (`N'), and compared the

does' nest related behaviour and general activity when nest boxes were attached which also contained no pups, but potentially emitted pup odour (`O'). Thus, each doe was both a test and control animal. In both treatments the nest entrance was closed with a sliding door and nursing allowed once a day.
The frequency and duration of nest contacts were significantly higher in `O' than in `N'. Furthermore, significantly more nesting activities were performed after and outside nursing in `O'. Accordingly, the number of hours without nest contacts and nesting activities was significantly lower when a nest box emitting pup odour was attached to the cage. Also, the does' general activity tended to be higher in `O'.
Keywords: Rabbit; Maternal behaviour; Nest access; Nest stimuli; Pup odour; Welfare

Tadeusz Jezierski, Nina Scheffler, Werner Bessei, Erich Schumacher, Demand functions for cage size in rabbits selectively bred for high and low activity in open-field, Applied Animal Behaviour Science, Volume 93, Issues 3-4, September 2005, Pages 323-339, ISSN 0168-1591, DOI: 10.1016/j.applanim.2005.01.009.
(http://www.sciencedirect.com/science/article/B6T48-4G4MM9H-1/2/386cecae5db988790ea26b604326cb06)
Abstract:
It was examined whether the divergent genetic selection for activity in open-field influences the motivation of rabbits to enlarge cage size, using operant conditioning technique. Twenty New Zealand White rabbits of both sexes, chosen randomly from two lines selected over nine generations for high (H, n = 10) and low (L, n = 10) locomotor activity in the open-field, were trained to press a lever to get access to more space by cage enlargement as a reinforcer. The demand functions were generated by plotting the achieved cage space (CS) as product of the number of enlargements x cage size at five increasing cage sizes, against the workload (fixed ratio (FR) = preselected number of lever pressing within 3 min, i.e. FR1, FR2, FR4 and FR8) using log-log-transformed CS and FR coordinates. To estimate the cage space demand, the total number of cage enlargements at given cage size was plotted against FR. All rabbits had learned to press the lever for food in the training phase. There was a non-significant tendency for more H than L rabbits and for more males than females to press the lever for cage enlargement when FR and cage size increased. The male H rabbits made on average more cage enlargements than the L rabbits of both sexes and the H females, resulting in more CS achieved and more area under the demand curve (differences non-significant). With increasing FR and increasing cage size classes, the rabbits did significantly less enlargements and thus achieved less CS ($P < 0.0001$).
The H males had the highest intercept and the L males had the lowest intercept and the shallowest slope, however, all the differences in characteristics of the demand functions between lines and sexes were non-significant. There were significant correlations between measures of motivation calculated from the demand function (baseline rate, total number of lever pressess, total cage size achieved, area under the curve, slope, intercept). The motivation for more cage space was negatively correlated with body weight. The percentage of animals that could be conditioned operantly have been suggested as the additional measure of differences in motivation between groups of animals. The results show that operant conditioning and demand function using the settings as in the present experiment could not demonstrate significant differences in motivation for more cage space in rabbits selected divergently for open-field locomotor activity.
Keywords: Operant conditioning; Demand function; Cage size; Open-field; Selection; Rabbits

H.G. Rodel, Winter feeding behaviour of European rabbits in a temperate zone habitat, Mammalian Biology - Zeitschrift fur Saugetierkunde, Volume 70, Issue 5, 1 September 2005, Pages 300-306, ISSN 1616-5047, DOI: 10.1016/j.mambio.2005.03.001.
(http://www.sciencedirect.com/science/article/B7GX2-4G9R23W-1/2/ef7142af3f31b0c547602ca81ce7b1cb)

Abstract:
Herbivores living in seasonal environments commonly have to deal with reduced food availability and quality during the winter season. The present study investigated how European rabbits Oryctolagus cuniculus living in a grassland habitat adapt their feeding behaviour to cope with this situation. Both adult and subadult animals markedly increased their feeding rates throughout the course of the winter, with the rates in subadults being generally higher. Nevertheless, both age classes showed a significant decline in body mass throughout the winter averaging 22.3% of the autumn mass in subadult and 9.7% in adult animals. In late winter, an increase in the faecal sand content was found, indicating that the animals were feeding on ground-level plant parts. Measurements of nitrogen content of (1) grass leaves and stems and (2) ground-level sprouts and roots demonstrated a decrease in the food quality of grass leaves and stems from early to late winter. In contrast, the nitrogen content of roots and ground-level sprouts remained stable. It can be speculated that the animals increasingly switched to ground-level plant parts as alternative food in the course of the winter in order to satisfy their needs for a sufficient source of nitrogen.
Keywords: Oryctolagus cuniculus; food quality; nitrogen content

Jing Qiu, QiuXia Wang, Ping Wang, GuiFang Jia, JunLing Li, ZhiQiang Zhou, Enantioselective degradation kinetics of metalaxyl in rabbits, Pesticide Biochemistry and Physiology, Volume 83, Issue 1, September 2005, Pages 1-8, ISSN 0048-3575, DOI: 10.1016/j.pestbp.2004.12.006.
(http://www.sciencedirect.com/science/article/B6WP8-4GSJXBM-1/2/03d53076589b85e2d0d77007fe9a0658)
Abstract:
Metalaxyl [methyl-N-(2'-methoxyacetyl)-N-(2,6-dimethylphenyl)-d,l- alaninate] is a potent phenylamide fungicide. The (-)-(R)-isomer accounts for most of the fungicidal activity. A possible stereo and/or enantioselective kinetics of metalaxyl in rabbits was investigated by intravenous injection. The concentrations of (-)-(R)- and (+)-(S)-metalaxyl in plasma, liver, and kidney tissue were determined by HPLC with a cellulose-Tris-(3,5-dimethylphenylcarbamate)-based chiral stationary phase and gas chromatography-mass spectroscopy. After intravenous administration of racemic metalaxyl (40 mg/kg), the (+)-(S)-enantiomer levels in plasma, liver, and kidney decreased more rapidly than the (-)-(R)-isomer. The area ratio of the (-)-(R)-/(+)-(S)-enantiomer under the concentration-time curve (AUC0 --> [infinity]) in plasma after drug application was 1.62. The total plasma clearance value of the (+)-(S)-enantiomer was 1.53 and higher than that of the (-)-(R)-enantiomer. The [R]/[S] ratio in plasma was >1 for standard rac-metalaxyl at each time point. The other pharmacokinetic parameters of the enantiomers were also different. The results indicate substantial stereoselectivity in the degradation of metalaxyl enantiomers in rabbits.
Keywords: Enantioselective degradation kinetics; Chiral HPLC analysis; Metalaxyl; Rabbit

Yusuke Izutani, Takuya Murai, Toshiaki Imoto, Masatake Ohnishi, Masayuki Oda, Sumio Ishijima, Gymnemic acids inhibit rabbit glyceraldehyde-3-phosphate dehydrogenase and induce a smearing of its electrophoretic band and dephosphorylation, FEBS Letters, Volume 579, Issue 20, 15 August 2005, Pages 4333-4336, ISSN 0014-5793, DOI: 10.1016/j.febslet.2005.06.070.
(http://www.sciencedirect.com/science/article/B6T36-4GNC906-7/2/ed951fdc806f39535aceb207080f7ec7)
Abstract:
Gymnemic acids (GA) inhibited rabbit muscle glyceraldehyde-3-phosphate dehydrogenase (GAPDH) activity. Binding of GA to GAPDH was observed by surface plasmon resonance measurement. Incubation of GAPDH with GA induced a smearing of the GAPDH band in SDS-PAGE. The GA-induced smearing was diminished by prior incubation of GA with [gamma]-cyclodextrin or by GA treatment with NAD. GA treatment did not affect the electrophoretic mobility of glucose-6-phosphate isomerase and dehydrogenase. GA treatment diminished the GAPDH band detected by an antibody to phosphoserine, but did not affect the phosphoserine bands of

glucose-6-phosphate isomerase and dehydrogenase. These results indicated that GA specifically induced dephosphorylation of GAPDH.
Keywords: Gymnemic acids; Glyceraldehyde-3-phosphate dehydrogenase; Dephosphorylation; [gamma]-Cyclodextrin; Rabbit

Changyun Xiong, Patricia M. Hixson, Leonardo H. Mendoza, C. Wayne Smith, Cloning and expression of rabbit interleukin-15, Veterinary Immunology and Immunopathology, Volume 107, Issues 1-2, 15 August 2005, Pages 131-141, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2005.04.013.
(http://www.sciencedirect.com/science/article/B6TD5-4GFV5DC-1/2/5ad0e277e7924ac25d17b7c1163693ab)
Abstract:
In order to understand the inflammatory mechanisms related to rabbit interleukin-15 (RIL-15), we cloned and expressed RIL-15 cDNA gene. A cDNA encoding RIL-15 was cloned from heart mRNA by reverse transcriptase polymerase chain reaction (RT-PCR) amplification using hIL-15 primers. The RIL-15 cDNA contains an open reading frame (ORF) of 162 amino acids (aa) with a 48 aa leader sequence. The predicted molecular weight of the encoded protein (12.5 kDa) matched the size of recombinant IL-15 on Western blotting in an Escherichia coli (pET32a) expression system. Amino acid and nucleotide sequence analyses of RIL-15 revealed 82.7% and 87% homology with human IL-15 (hIL-15), respectively. RIL-15 is similar to the hIL-15 (hIL-15) in that it contains seven cysteine residues. RT-PCR showed that IL-15 is expressed in many tissues in the rabbit, including heart, spleen, lung, liver, muscle and kidney. Expressed and purified recombinant RIL-15, in the absence of the 48 aa leader sequence, stimulated the proliferation of cells of the mouse T cell line, CTLL-2, and its activity is comparable to hIL-15. Western blotting demonstrated that recombinant RIL-15 can be recognized by anti-IL-15 neutralization antibody. Western blotting also confirmed that IL-15 is present in many tissues including heart, spleen, lung, liver, muscle and kidney.
Keywords: Cloning; Gene expression; Interleukin-15; Rabbit; RT-PCR (reverse transcriptase polymerase chain reaction); Western blotting

Chang-Che Chen, Li-Kaung Liu, Jeng-Dong Hsu, Hui-Pei Huang, Mon-Yuan Yang, Chau-Jong Wang, Mulberry extract inhibits the development of atherosclerosis in cholesterol-fed rabbits, Food Chemistry, Volume 91, Issue 4, August 2005, Pages 601-607, ISSN 0308-8146, DOI: 10.1016/j.foodchem.2004.06.039.
(http://www.sciencedirect.com/science/article/B6T6R-4D98J92-1/2/35e28ae5688b4b380afe777d80ea4354)
Abstract:
Mulberry (Morus alba L.) fruit is used effectively in Chinese medicines against fever, to protect the liver and to lower blood pressure. Here, we report a water extract, MWE (Mulberry water extract), which is designed to exhibit anti-hyperlipidemia and anti-atherosclerotic effects in rabbits with experimental atherosclerosis. New Zealand white rabbits were fed with a normal diet, high cholesterol (1.3%), lard oil (3%) diet (HCD) with or without 0.5 or 1% MWE for 10 weeks. The levels of triglyceride, cholesterol and low-density lipoprotein cholesterol (LDL-C) were lower in the serum of rabbits fed HCD plus MWE than in the serum of rabbits fed HCD. Feeding MWE (0.5 or 1% in the diet) to rabbits significantly reduced severe atherosclerosis in the aorta by 42-63%. Histopathological examination showed that MWE reduced aortic atherosclerotic lesion in the blood vessel of rabbits. From previous data and present results, we suspect that MWE not only inhibits LDL-oxidation but also has a direct effect on the anti-hyperlipidemia in animals.
Keywords: Mulberry water extract; Anti-hyperlipidemia; Atherosclerosis; Cholesterol-fed rabbit

Catherine Larzul, Hubert de Rochambeau, Selection for residual feed consumption in the rabbit, Livestock Production Science, Volume 95, Issues 1-2, 1 August 2005, Pages 67-72, ISSN 0301-6226, DOI: 10.1016/j.livprodsci.2004.12.007.
(http://www.sciencedirect.com/science/article/B6T9B-4FCRFJB-1/2/bcfba8dc3f51152b46f6c7b8d0d488ce)
Abstract:
We carried out a one-generation, divergent selection experiment on residual feed efficiency in order to estimate the genetic parameters of this trait. The selection criterion was the residual feed consumption. We measured the consequences of this selection on growth, feed efficiency, and carcass composition. One generation of selection was performed on young male rabbits from a heavy weight line. They were individually caged and measured for their weight gain and feed consumption between weaning (30 days) and 65 days of age. The fatness of all the males was estimated by ToBEC measurement (Total Body Electrical Conductivity) at 65 days of age. Their offspring were bred under the same conditions and 120 males were slaughtered at 65 days of age in order to estimate the correlated response on carcass traits: dressing yield, cutting parts, fatness, ultimate pH, and colour. Genetic parameters were estimated with restricted maximum likelihood applied to an animal model. The heritability value estimated for residual feed consumption was 0.45+/-0.11, which was of the same order as the heritability estimated for average daily gain (0.41+/-0.13) and higher than the heritability estimated for the feed conversion ratio (0.27). Residual feed consumption was negatively correlated with the hind part percentage (-0.71) and correlated positively with front part percentage (0.54). The genetic correlations with dressing percentage and carcass fatness were very low. Residual feed consumption may be introduced as a selection criterion for improving feed efficiency. Thus, no significant phenotypic differences were found between offspring of high and low residual feed consumption males, except for the hind part percentage, which was higher in the low residual feed consumption line.
Keywords: Rabbit; Residual feed consumption; Feed efficiency; Selection; Carcass composition

A. Dalle Zotte, H. Remignon, G.M. Chiericato, Influence of maternal feed rationing on metabolic and contractile properties of Longissimus lumborum muscle fibres in the rabbit offspring, Meat Science, Volume 70, Issue 4, August 2005, Pages 573-577, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2005.02.006.
(http://www.sciencedirect.com/science/article/B6T9G-4FTJ0DN-1/2/a37dd82505412ef725e526c03b74c4df)
Abstract:
Thirty hybrid female rabbits of 15 weeks of age were divided into three groups and fed for 8 weeks (until the first parturition) on one of the three following diets: 'C diet' (DE = 11.71 MJ/kg DM) fed ad libitum; 'R diet' was the C diet fed at 80% of ad libitum, 'F diet' rich in fibre (24.6% vs 18.7% for C diet; DE = 9.77 MJ/kg DM) fed ad libitum. Afterwards, all the does received the C diet ad libitum. One pup per litter was slaughtered at birth, one at 35 d (weaning) and one at 81 d of age. At the second parturition, another pup per litter was slaughtered at birth. Ten minutes post mortem the Longissimus lumborum (LL) muscle was sampled and the mean cross-sectional area, compactness index (CI) and sphericity of the fibres of the new-born rabbits were determined; on rabbits of 35 and 81 d of age the fibre type distribution ([beta]R, [alpha]R or [alpha]W) was also measured. The two maternal rationed-diets significantly increased the CI of LL fibres of new-born rabbits of the first kindling, compared to the C diet. On weaning rabbits the greatest effect of maternal feed rationing was observed on the percentage of [alpha]W fibres ($P < 0.01$), which was the highest for the F diet (85.2%), intermediate for the C diet (78.0%) and the lowest for the R diet (71.8%). At 81 d of age, no effect of maternal dietary treatment was found on offspring.
Keywords: Rabbit; Doe; Feed rationing; Muscle; Fibre type

F. Lopez-Gatius, G. Sances, M. Sancho, J. Yaniz, P. Santolaria, R. Gutierrez, M. Nunez, J. Nunez, C. Soler, Effect of solid storage at 15 [degree sign]C on the subsequent motility and fertility of rabbit semen, Theriogenology, Volume 64, Issue 2, 15 July 2005, Pages 252-260, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2004.11.015.
(http://www.sciencedirect.com/science/article/B6TCM-4F9F8JN-1/2/6c0ccb257224eac1fc2bc9d9df83c403)
Abstract:
We conducted two studies to improve preservation of rabbit semen. The objective of the first study was determine whether a glucose- and fructose-based extender with two different amounts of gelatin would solidify at 15 [degree sign]C, and to evaluate the influence of gelatin supplementation on sperm motility parameters after storing semen up to 10 days at 15 [degree sign]C. The fertility of rabbit semen diluted in the best gelatin-supplemented extender established in Study 1 and stored for up to 5 days was evaluated in the second study. In Study 1, semen was collected with an artificial vagina from 40 bucks. Each ejaculate was diluted to (80-100) x 106 spermatozoa/mL (1:3, semen/extender) at 37 [degree sign]C in one of the three following glucose- and fructose-based extenders: control (standard liquid extender), semi-gel or gel (0.7 or 1.4 g gelatin in 100 mL extender, respectively). Pools of semen were allocated among 0.6 mL plastic artificial insemination (AI) guns. Thirty (10 per extender group) AI doses were immediately analyzed (0 h) and the remainder stored in a refrigerator (15 [degree sign]C) for 12, 24, 36, 48, 72, 96, or 240 h. All doses with gelatin extenders solidified at 15 [degree sign]C. Semen samples, prewarmed to 37 [degree sign]C, were evaluated with a computer-assisted sperm analysis (CASA) system. The percentage of motile cells was significantly lower using the liquid compared to the gel extenders during semen storage from 0 to 96 h. Although significance was lost, these differences persisted after 240 h of storage. Motility of spermatozoa in the semi-gel extender was intermediate between that of liquid and gel extender throughout the study. Study 2 was performed on 1250 multiparous lactating does. Five homogeneous groups of 250 does previously synchronized were inseminated using semen previously stored for 120, 96, 72, 48 or 24 h, respectively. Rabbit does receiving 24 h-stored semen (diluted with the control extender used in Study 1) served as controls. The remaining females received seminal doses supplemented with 1.4 g/100 mL gelatin (gel extender used in Study 1). Kindling rates for rabbit does inseminated with gelatin-supplemented (solid) semen doses stored for 48 h (88%) or 72 h (83%) were similar to those recorded for liquid controls stored for 24 h (81%), whereas rates significantly decreased when the semen was solid and stored for 96 h (64%) or 120 h (60%) before AI. In conclusion, rabbit spermatozoa were effectively stored in the solid state at 15 [degree sign]C, with fertility preserved for up to 5 days. Solid storage of rabbit semen would facilitate commercial distribution.
Keywords: Semen solid storage; Gelatin; CASA; Fertility; Rabbit

Jordi Roca, Silvia Martinez, Juan Orengo, Inma Parrilla, Juan M. Vazquez, Emilio A. Martinez, Influence of constant long days on ejaculate parameters of rabbits reared under natural environment conditions of Mediterranean area, Livestock Production Science, Volume 94, Issue 3, July 2005, Pages 169-177, ISSN 0301-6226, DOI: 10.1016/j.livprodsci.2004.10.011.
(http://www.sciencedirect.com/science/article/B6T9B-4F1GRF8-7/2/33c2de750f04804788e7394b2cceef09)
Abstract:
Since rabbit bucks are usually housed under constant long daylight in artificial insemination (AI) centers, the main purpose of this study was to investigate whether constant long day influenced ejaculate parameters of rabbits housed in AI centers in the Spanish Mediterranean area. The study was carried out in Murcia, Spain (37[degree sign] N). Twenty commercial hybrid male rabbits, aged between 14 and 15 weeks, were randomly allotted to two groups and housed under either natural day length (n=10, ND) or a constant 16-h daylight exposure of 16 h (n=10, CLD). Other management conditions, such as air temperature or reproductive handling, were identical for

both groups. Two successive ejaculates were collected twice weekly from every male, and the first one was used to monitor ejaculate characteristics. Measurement of semen production, in terms of ejaculate and semen volume, sperm concentration and total sperm per ejaculate, and sperm quality, in terms of motility index, viability, morphology and acrosome integrity, was assessed in 783 ejaculates collected during 15 months (from October to December). No differences ($P>0.05$) in either semen production or sperm quality were shown among ejaculates collected from rabbits housed under ND and CLD conditions. A limited influence of season was observed ($P<0.01$); semen volume and motility index were highest and lowest, respectively, during summer. The increase of air temperature and humidity index (THI) had a significant detrimental effect ($P<0.01$) on both sperm production and quality parameters with a lag of 6 and 3 weeks, respectively. On the basis of these findings, annual variations of semen production and sperm quality in male rabbits seems more related to THI than to daylight length under conditions of AI management in the Mediterranean area of Spain.
Keywords: Rabbit; Semen; Long day; Air temperature; Mediterranean area

V.G.M. Mattaraia, E. Bianospino, S. Fernandes, J.L.M. Vasconcelos, A.S.A.M.T. Moura, Reproductive responses of rabbit does to a supplemental lighting program, Livestock Production Science, Volume 94, Issue 3, July 2005, Pages 179-187, ISSN 0301-6226, DOI: 10.1016/j.livprodsci.2004.10.012.
(http://www.sciencedirect.com/science/article/B6T9B-4F973CR-2/2/cb4595acb1771f720563b24a63eb2c84)
Abstract:
The objective was to investigate whether the productivity of rabbit does can be improved, when natural photoperiod is decreasing, by adopting a supplemental lighting program. Three experiments were conducted involving two groups: control, submitted to the natural decreasing photoperiod, and supplemented with a lighting program which provided 14 h light/24 h beginning at 10 weeks of age. In the first experiment, 20 nulliparous does, 10 from each group, were euthanized 8 h after being presented to a buck; the overall number of follicles, whose diameter exceeded 1 mm, was determined macroscopically. The right ovaries were collected, histologically analyzed, and electronically measured. In the second experiment, 30 nulliparous does, 15 from each group, were presented to a buck (day 1). Receptive does were euthanized on day 8 to evaluate embryonic survival (number of normal embryos/ovulation rate). In the third experiment, 48 nulliparous does, 24 from each group, were followed from the first presentation to the buck until the weaning of the first litter. The effect of treatment on reproductive and body weight traits of does, and litter performance traits, at birth and weaning, was evaluated. The average number of follicles whose diameter exceeded 1 mm was higher in the treatment group (12.05+/-1.07 vs. 8.63+/-1.00, $P=0.037$). Receptive does of the treatment group had heavier ovaries relative to those of the control group (790+/-59 vs. 470+/-64 mg, $P=0.004$), whereas no treatment difference regarding this trait was found for non-receptive ones. Treatment had a favorable effect on pregnancy rate of total exposed and of receptive does (80.0% vs. 33.3%, $P=0.01$, and 92.3% vs. 50.0%, $P=0.02$, respectively). The number of underdeveloped embryos was lower (0.067+/-0.380 vs. 2.500+/-0.455, $P=0.004$), embryonic survival up to day 8, and uterus weight was higher in the treatment group (0.839+/-0.075 vs. 0.534+/-0.087, $P=0.033$ and 13.83+/-0.72 vs. 10.99+/-0.84, $P=0.037$, respectively). Number of presentations tended to be lower (1.32+/-0.17 vs. 1.75+/-0.16, $P=0.077$) and adjusted litter size in the first reproductive cycle tended to be higher (7.09+/-0.89 vs. 5.22+/-0.68, $P=0.091$) in the treatment group relative to the control group. A supplemental lighting program providing 14 h light/24 h favors reproductive performance of primiparous does; its application may be recommended to increase productivity when natural photoperiod is decreasing.
Keywords: Embryonic survival; Litter performance; Ovarian follicle; Ovulation rate; Photoperiod; Reproduction

Spaska A. Stanilova, Lyuba D. Miteva, Svetlin G. Tanchev, Immunomodulatory effects of C3bgp on the antibody response to hemocyanin in outbred rabbits and the F1 generation of breeding with siblings, Veterinary Immunology and Immunopathology, Volume 106, Issues 1-2, 15 June 2005, Pages 15-21, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2004.12.018.
(http://www.sciencedirect.com/science/article/B6TD5-4FD0N38-2/2/7e5097ba986ac45452641debfb4ba74b)
Abstract:
Dynamics and quantitative analyses of monospecific antibody during the primary and secondary humoral responses were determined in outbred rabbits and in the F1 generation of breeding with siblings. The antibody response in rabbits immunized with Keyhole Limpet Hemocyanin (KLH) was studied during a 4-month immunization period. ELISA determination of anti-KLH Ig and anti-KLH IgG alone, in preimmune and immune rabbit sera, was performed. Antibody response in both groups of rabbits was similar when assessed by anti-rabbit Ig but displayed differences when assessed by anti-rabbit IgG. A statistically significant increase in anti-KLH IgG was observed in the F1 inbred rabbits compared to the control group after primary immunization from days 14 to 35. Immunomodulation also elicited differences in the antibody response in the two groups of animals. C3-binding glycoprotein isolated from Cuscuta europea (C3bgp), applied simultaneously with antigen (KLH), produced a much stronger secondary immune response than the antigen alone, in both experimental groups. The enhancement of anti-KLH Ig in C3bgp-treated inbred rabbits was statistically significant in comparison with nontreated inbred rabbits. A significant increase in anti-KLH IgG was observed only for the inbred group after treatment with C3bgp. The results demonstrate that the F1 generation of breeding with sibling leads to significant differences in antibody responses to immunization compared with outbred rabbits, as well as to immunomodulation with C3bgp.
Keywords: Inbreeding; Antibody response; Immunomodulation; C3bgp

A. Dalle Zotte, H. Remignon, J. Ouhayoun, Effect of feed rationing during post-weaning growth on meat quality, muscle energy metabolism and fibre properties of Biceps femoris muscle in the rabbit, Meat Science, Volume 70, Issue 2, June 2005, Pages 301-306, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2005.01.016.
(http://www.sciencedirect.com/science/article/B6T9G-4FNW4XR-1/2/22514478d107d6e2d91db028a8fa46d3)
Abstract:
During the weaning period (5 weeks of age), 50 hybrid rabbits were divided at random into five groups (or blocks). Animals from the block 1 were immediately slaughtered at this age and used as initial reference. The remaining rabbits were placed in individual cages and fed the same amount of food until slaughter, but differently rationed. From 5 to 8 weeks of age, the rabbits coming from blocks 2 and 4, and from blocks 3 and 5 received 70% and 90% of the ad libitum ration, respectively. Animals of blocks 2 and 3 were slaughtered at 8 weeks of age. Between 8 and 11 weeks of age, animals from blocks 4 and 5 were fed, respectively, 90% and 70% of the ad libitum ration, prior to sacrifice. At slaughter the Biceps femoris (BF) muscles were immediately removed from each rabbit and the ultimate pH (pHu) and meat colour L*a*b* parameters were measured. Thereafter, one BF was used for aldolase and isocitrate dehydrogenase (ICDH) activity determinations, while the other BF muscle was used for fibre distribution (% of [beta]R, [alpha]R and [alpha]W) and morphometric trait measurements. As expected, at 8 weeks of age, rabbits given for 3 weeks the strictest feed rationing (70% of the ad libitum ration) were lighter than rabbits fed the lowest feed rationing (90% of the ad libitum ration). At 11 weeks of age, rabbits given the 70% ration initially and then switched to 90% ration showed significantly higher body weights than rabbits fed the alternative diet (90% ration initially and then switched to 70% ration), and the best feed conversion ratio. Fibre type distribution, fibre cross-sectional area and compactness, colour

and metabolic characteristics varied according to slaughter age. The effects of feeding treatment were low.
Keywords: Rabbit; Feed rationing; Post-weaning growth; Muscle; Fibre type

Jose M. Rodriguez-Calleja, Maria-Luisa Garcia-Lopez, Jesus A. Santos, Andres Otero, Development of the aerobic spoilage flora of chilled rabbit meat, Meat Science, Volume 70, Issue 2, June 2005, Pages 389-394, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2005.01.009.
(http://www.sciencedirect.com/science/article/B6T9G-4FJXNH4-3/2/ae958940597f5105c5949f1efb485278)
Abstract:
Even though worldwide production of rabbit meat is over 1,000,000 ton, little information is available on rabbit meat microbiology. This paper reports on the microflora developing on chill-stored rabbit carcasses. Four different lots of 24 h post-mortem rabbit carcasses dressed and kept at 0 [degree sign]C in a medium-size abattoir were collected and evaluated for sensory, physicochemical and microbiological changes during aerobic storage at 3 +/- 1 [degree sign]C. Mean initial pH value (pH24), extract-release volume (ERV) and lactate content of Biceps femoris muscle, were 6.26 +/- 0.20, 13.50 +/- 3.50 ml and 0.70 +/- 0.07%, respectively. As with other muscle foods kept chilled in air, pH increased and ERV and lactate decreased as storage progressed. Initial levels (log cfu/g) of aerobes (APC), psychrotrophic flora, Pseudomonas spp., Brochothrix thermosphacta, lactic acid bacteria, Enterobacteriaceae and yeasts were 4.76 +/- 0.31, 4.81 +/- 0.81, 3.39 +/- 1.12, 2.01 +/- 0.92, 2.76 +/- 0.51, 0.49 +/- 0.45 and 3.46 +/- 0.32, respectively. Pseudomonads, most of them fluorescent, and to a lesser extent B. thermosphacta and yeasts grew faster than the remaining microorganisms and became predominant at the end of the shelf life. Carcasses spoiled when mean APC, psychrotrophic and pseudomonads numbers were ca. 8 log cfu/g, their mean shelf life being estimated at 6.8 days. A lot of DFD-like rabbit carcasses, with higher pH and lower ERV values but similar microbial loads to normal meat, developed a strong putrid odour after 4 days.
Keywords: Normal and DFD rabbit meat; Microbial spoilage; Physicochemical characteristics

P. Ypsilantis, V.N. Didilis, M. Politou, I. Bougioukas, G. Bougioukas, C. Simopoulos, A comparative study of invasive and oscillometric methods of arterial blood pressure measurement in the anesthetized rabbit, Research in Veterinary Science, Volume 78, Issue 3, June 2005, Pages 269-275, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2004.08.003.
(http://www.sciencedirect.com/science/article/B6WWR-4DFK7DS-2/2/eaea936fbfc1f6dea864cdf5293715ad)
Abstract: Introduction:
The aim of this project was to evaluate the reliability and accuracy of direct, using the central ear artery (CEA), and oscillometric, using limb-cuffs, methods of arterial blood pressure (AP) measurement in the anesthetized rabbit.Methods:
New Zealand rabbits were anesthetized using a xylazine-ketamine-isoflurane protocol. Using the abdominal aorta (ABA) as direct 'gold standard' for AP measurements, ABA pressure readings, via femoral artery catheterization, were compared with those made simultaneously from the ascending aorta after median sternotomy. Thereafter, direct CEA as well as forelimb-(FL) and hindlimb-(HL) cuff oscillometric readings were compared with those made simultaneously from ABA.Results:
The blood pressure in the ABA correlated with that from ascending aorta. Furthermore, CEA correlated with the ABA readings. Nevertheless, at high pressures, their divergence from 'true' pressure tended to increase. Oscillometric readings at the FL site correlated well with 'true' pressure while those at the HL site did not. Their divergence tended to increase at high pressures when using the FL site, while it varied when using the HL site. The accuracy of measurements was moderate for the FL site while poor for the HL site.Discussion:

Our results suggest that the CEA can be readily used with high reliability and accuracy for direct AP measurements in the anesthetized rabbit. On the other hand, the FL-cuff oscillometric method should only be used for the evaluation of AP at low and normal pressure ranges.
Keywords: Arterial blood pressure; Central ear artery; Limb-cuffs; Oscillometric; Methods; Rabbit

P. Baumann, H. Oester, M. Stauffacher, Effects of temporary nest box removal on maternal behaviour and pup survival in caged rabbits (Oryctolagus cuniculus), Applied Animal Behaviour Science, Volume 91, Issues 1-2, May 2005, Pages 167-178, ISSN 0168-1591, DOI: 10.1016/j.applanim.2004.08.026.
(http://www.sciencedirect.com/science/article/B6T48-4DN9Y93-2/2/0f4b34e2fbe62e7edc3cbf5503c427b1)
Abstract:
Free nest access is widely used in the management of commercial breeding units for fattening rabbits, but potentially counteracts the doe's behavioural goal of a closed nest entrance, leading to repeated nest visits without nursing and attempts to close the entrance due to an overtaxed adaptability. Due to injuries, crushing and hypothermia caused by such behavioural problems, pup mortality can be more than 20% under these circumstances. To study the effect of nest access on doe's nest related behaviour, pup mortality and pup weight, three groups of 10 does each had either free access (`F'), controlled access with the entrance closed with a sliding door (`S') or controlled access with the nest box removed outside nursing time (`R'). In groups with controlled access, nursing was admitted for 15 min each morning from day 1 to 15. Behavioural data were achieved from does rearing a second litter (7 does per group) and included the general activity and the frequency, intensity and temporal distribution of nest approaches, including investigations of the nest entrance (`entrance checks') or of the nest and pups (`nest checks') and nesting activities (nest opening and closing behaviour). Data on pup mortality, causes of death and pup weights were gained from 62 litters over three consecutive reproductive cycles. Over 24 h, group F showed significantly more short nest approaches than group R, whereas group S performed significantly more medium length approaches than group R and more long approaches than R and F. In the hour after nursing and outside nursing hours, group F showed significantly more nest checks than S and R. Group S performed significantly more entrance checks in the hour after nursing, more nesting activities before and outside nursing and the highest general activity. Outside nursing hours, group R showed the lowest frequency of nest approaches and nesting activities. Nesting activities were distributed over almost all 24 h a day in groups F and S, whereas they were more restricted to nursing time in group R. Pup mortality and weaning weights did not differ significantly between groups.
Keywords: Rabbit; Maternal behaviour; Nest access; Weaning weight; Pup mortality

Sonia Bas, Alicia Bas, Ignacio Lopez, Jose C. Estepa, Mariano Rodriguez, Escolastico Aguilera-Tejero, Nutritional secondary hyperparathyroidism in rabbits, Domestic Animal Endocrinology, Volume 28, Issue 4, May 2005, Pages 380-390, ISSN 0739-7240, DOI: 10.1016/j.domaniend.2005.01.002.
(http://www.sciencedirect.com/science/article/B6T62-4FCRC7B-1/2/cffab9e0dd313580b444bf2c8e2df93c)
Abstract:
The present study was designed to document the effect of a low (0.6%) calcium-high (1.2%) phosphorus (LCaHP) diet on the development of parathyroid gland hyperplasia in rabbits and to describe the dynamics of parathyroid function (PTH-Ca2+ curves) in rabbits with nutritional secondary hyperparathyroidism (N2HPT). Parathyroid gland weight, parathyroid cell proliferation (measured as percentage of cells in S-phase), and parathyroid calcium (CaRmRNA) and Vitamin D (VDRmRNA) receptor expression were measured in normal rabbits and in rabbits with N2HPT. The PTH-Ca2+ curve was studied in normal rabbits (Group I) and in rabbits with N2HPT at two

stages: 2-3 weeks (Group IIA) and 5-6 weeks (Group IIB) after being fed LCaHP diet. An increase in parathyroid gland weight and percentage of cells in S-phase was detected in the course of N2HPT. After receiving a LCaHP diet for 6 weeks rabbits had decreased levels of CaRmRNA but VDRmRNA remained unchanged. A progressive increase in the concentrations of plasma PTH (Group IIA = 167 +/- 14 pg/ml and Group IIB = 377 +/- 54 pg/ml, P < 0.05 versus Group I = 27 +/- 3 pg/ml) was detected in the rabbits fed a LCaHP diet. This was accompanied by an increase in maximal and minimal PTH, reductions in plasma Ca2+ and calcitriol and elevations in plasma phosphate and creatinine. In conclusion, feeding a LCaHPD results in a rapid induction of N2HPT in rabbits. After 6 weeks on the LCaHPD rabbits develop parathyroid hyperplasia characterized by increases in PTH secretion, glandular weight and proliferation and by a decrease in CaRmRNA.
Keywords: Calcium; Nutritional hyperparathyroidism; Phosphate; PTH; Rabbit

B.R. Naik, B.S. Rao, R. Vagdevi, M. Gnanprakash, D. Amarnath, V.H. Rao, Conventional slow freezing, vitrification and open pulled straw (OPS) vitrification of rabbit embryos, Animal Reproduction Science, Volume 86, Issues 3-4, April 2005, Pages 329-338, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2004.07.008.
(http://www.sciencedirect.com/science/article/B6T43-4DCMJBT-2/2/1d35f0dc10d589891601d96f4b6a275b)
Abstract:
Three different methods of cryopreservation viz., conventional slow freezing, vitrification and open pulled straw vitrification were compared for their ability to support post thaw in vitro and in vivo development of rabbit embryos. Morula stage rabbit embryos were collected from super-ovulated donor does. They were randomly allocated to different freezing methods and stored up to 3 months in liquid nitrogen. After thawing and removal of cryoprotectants, embryos exhibiting intact zona pellucida and uniform blastomeres were considered suitable for in vitro culture and/or transfer. Three to five cryopreserved embryos placed in ~1 ml of culture medium (TCM 199 supplemented with foetal calf serum and antibiotics) were incubated for up to 72 h under humidified atmosphere of 5% CO2 in air at 39 [degree sign]C. Development to hatched blastocyst stage was considered the initial indicator of success of cryopreservation of embryos. Of the embryos cryopreserved by programmed freezing, open pulled straw vitrification, vitrification-55 h pc and vitrification-72 h pc 55, 71, 17 and 48%, respectively, developed into hatched blastocysts. Similarly 19, 29, and 4% of embryos cryopreserved by programmed freezing, open pulled straw vitrification and vitrification -72 h pc developed into live offspring on transfer to recipient does. This is the first report on open pulled straw vitrification of rabbit embryos. Present results, suggest that (a) open pulled straw vitrification supports better in vitro survival of frozen thawed rabbit morulae; (b) both programmed freezing and OPS are similar but superior to vitirification in supporting in vivo survival of frozen thawed rabbit embryos.
Keywords: Cryopreservation; Embryos; OPS vitrification; Rabbit

P.B. Wangikar, P. Dwivedi, N. Sinha, A.K. Sharma, A.G. Telang, Effects of aflatoxin B1 on embryo fetal development in rabbits, Food and Chemical Toxicology, Volume 43, Issue 4, April 2005, Pages 607-615, ISSN 0278-6915, DOI: 10.1016/j.fct.2005.01.004.
(http://www.sciencedirect.com/science/article/B6T6P-4FFNBW9-8/2/1ef2c82108608c0142b0a287b2c8acd9)
Abstract:
Aflatoxin B1 (AFB1), is a food borne mycotoxin produced by fungal species of the genera Aspergillus. To elucidate the teratogenic effects, AFB1 was dissolved in corn oil and given orally to New Zealand White rabbits during 6-18 days of gestation with the dose levels of 0.025, 0.05 and 0.1 mg/kg body weight. To assess pathomorphological features of the anomalies induced by AFB1, the fetal serial sections were histologically examined. There was no maternal mortality in any group. There was non-significant decrease in percent of live fetuses and increase in the

percent resorptions and post-implantation losses at 0.1 mg/kg dose group as compared with those of controls. The mean crown to rump lengths of 0.05 and 0.1 mg/kg dose groups were significantly reduced than that of the control. The mean fetal weights were significantly reduced in 0.1 mg/kg dose group than that of other treated groups. The gross anomalies observed included wrist drop and enlarged eye socket whereas, skeletal anomalies were agenesis of caudal vertebrae, incomplete ossification of skull bones and bent metacarpals. The visceral anomalies of microphthalmia and cardiac defects were seen at 0.1 mg/kg dose group. The characteristic histological findings of fetal tissues were distortion of normal hepatic cord pattern and reduced megakaryocytes in liver, fusion of auriculo-ventricular valves, mild degenerative changes in myocardial fibers, microphthalmic eyes and lenticular degeneration. The results of this study indicated that AFB1 was found to be teratogenic in rabbits when given by oral route during gestation days 6-18 and the dose of 0.1 mg/kg could be considered as the minimum oral teratogenic dose. The histological examination of the fetal tissues indicated its importance in identifying the visceral anomalies which were otherwise not visible.
Keywords: Aflatoxin B1; Pathomorphology; Rabbit; Teratogenicity

Adela Mendoza, Valeria Guzman, Carolina Rojas, Robyn Hudson, Do whiskers contribute to nipple-search and suckling behavior in newborn rabbits (Oryctolagus cuniculus)?, Mammalian Biology - Zeitschrift fur Saugetierkunde, Volume 70, Issue 2, 31 March 2005, Pages 110-116, ISSN 1616-5047, DOI: 10.1016/j.mambio.2004.06.005.
(http://www.sciencedirect.com/science/article/B7GX2-4FH0D9Y-2/2/72a496630a91f1365abdcd0191e07264)
Abstract:
Rabbit pups are only nursed for about 3 min once a day. They depend on a pheromone on the mother's ventrum to locate nipples and on tactile stimulation of the muzzle to grasp them. In a continuing study of the sensory input guiding suckling behavior we investigated the whisker array in newborn pups and the possible contribution of the whiskers to suckling. Rabbits are born with approximately 76 whiskers arranged in seven to nine rows and increasing in length from rostral to caudal. No significant difference was found between pups with whiskers cut and intact controls in latency to perform the stereotyped nipple-search behavior, latency to attach to nipples, time spent on nipples, milk ingested, or in the strength of conditioning to a novel odor paired with suckling. Thus, the whiskers do not seem important for suckling in newborn rabbits.Zusammenfassung
Tragen die Schnurrhaare bei neugeborenen Kaninchen (Oryctolgus cuniculus) zum Zitzensuch- und Saugverhalten bei?
Jungkaninchen werden nur einmal am Tag fur etwa drei Minuten gesaugt. Fur das Auffinden der Zitzen sind sie auf ein Pheromon auf der Bauchhaut der Mutter angewiesen, und fur deren Ergreifen auf periorale taktile Reize. In Fortsetzung unserer Untersuchungen zur sensorischen Kontrolle dieses Verhaltens beschreiben wir die Anordnung der Schnurrhaare bei neugeborenen Kaninchen und untersuchen ihren moglichen Beitrag zum Saugeverhalten. Bei der Geburt besitzen Jungkaninchen etwa 76, in 7-9 Reihen angeordnete Schnurrhaare, deren Lange von rostral nach caudal zunimmt. Nach Abschneiden der Schnurrhaare wurden keine signifikanten Unterschiede zwischen Jungen mit und ohne Schnurrhaare beobachtet, sowohl in der Latenz des Zitzensuchens, des Zitzenfassens, wie in der Besaugungsdauer, der erhaltenen Milchmenge oder dem Grad der Konditionierung auf einen neuen Geruchsstoff. Demnach spielen bei neugeborenen Kaninchen die Schnurrhaare keine wesentliche Rolle fur das Auffinden und Besaugen von Zitzen.
Keywords: Oryctolagus cuniculus; suckling; vibrissae; altricial mammals

Jorge A. Ramirez, Isabel Diaz, Marcial Pla, Marta Gil, Agustin Blasco, Maria Angels Oliver, Fatty acid composition of leg meat and perirenal fat of rabbits selected by growth rate, Food Chemistry, Volume 90, Issues 1-2, March-April 2005, Pages 251-256, ISSN 0308-8146, DOI: 10.1016/j.foodchem.2004.04.001.

(http://www.sciencedirect.com/science/article/B6T6R-4CHRYPM-3/2/fa5f7ec67a4711285cf4454c4e8d15bb)
Abstract:
The effect of selection for growth rate on the fatty acid composition of edible rabbit fat and meat was studied. Two groups of contemporary animals, one selected for growth rate (S) during 14 generations and other unselected control group (C) were compared. Control group were the offspring of animals originated from embryos that were vitrified at the beginning of the experiment and thawed to produce a control group contemporary with the selected group. Forty four rabbits of both sexes of group C and forty of group S were used in the experiment. The composition of fatty acids of the meat of a hind leg and of the perirenal fat was determined by gas chromatography. Selection for growth rate modified the percentage of fatty acids both in meat and in perirenal fat, and increased the content of most fatty acids in meat, but the indices related to human health were only slightly modified by selection. The changes in percentage of fatty acids in meat affected myristic (2.24 and 2.48, for C and S, respectively) palmitic (25.38 and 26.50), cis n-7 palmitoleic (2.08 and 2.79), oleic (22.52 and 23.51), linoleic (31.41 and 29.06) and arachidonic (2.10 and 1.77) acids. The highest change in indices related to human health was a 10% of reduction of the ratio polynsaturated:saturated fatty acids, which represents less than a 1% of change per generation. The ratio n-6:n-3 fatty acids slightly improved. Selection for growth rate would not damage the quality of meat and edible fat from a human health point of view.
Keywords: Fatty acids; Inter and intramuscular fat content; Rabbit meat; Genetics; Growth rate

J.A. Vaughan, C. Lenghaus, D.J. Stewart, M.L. Tizard, W.P. Michalski, Development of a Johne's disease infection model in laboratory rabbits following oral administration of Mycobacterium avium subspecies paratuberculosis, Veterinary Microbiology, Volume 105, Issues 3-4, 25 February 2005, Pages 207-213, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2004.10.019.
(http://www.sciencedirect.com/science/article/B6TD6-4F320M1-3/2/2a97b94c26d335142b5b2e50313439d0)
Abstract:
To assess the rabbit as a model for the study of Johne's disease pathogenesis, a breeding group of adult and juvenile New Zealand white rabbits were orally challenged with three doses of the Mycobacterium avium subspecies paratuberculosis wildtype bovine strain, CLIJ623, on three occasions. Faecal culture, post-mortem tissue bacteriological culture and histopathology were used to monitor the disease progression in the rabbits for more than 2 years. Of 4 adult and 16 juvenile orally dosed rabbits M. paratuberculosis organisms were recovered bacteriologically from two and three animals, respectively, using the BACTEC(TM) radiometric culture system. Tissue sites from which the bacteria were recovered included the mesenteric lymph nodes, ileocaecal valve, vermiform appendix, caecum, proximal colon and jejunum. Body weight loss, reduced abdominal fat and mild lesions were observed at necropsy in four infected rabbits. Diarrhoea and persistent faecal shedding of bacteria were not observed. Faecal culture did not yield any cultivable mycobacterial organisms on solid media.
Keywords: Mycobacterium avium subspecies paratuberculosis; Johne's disease; Rabbit infection model; Bacteriology

Virginia Cody, Hong Shen, Mark Shlyankevich, Robert E. Tigelaar, Janet L. Brandsma, Douglas J. Hanlon, Generation of dendritic cells from rabbit bone marrow mononuclear cell cultures supplemented with hGM-CSF and hIL-4, Veterinary Immunology and Immunopathology, Volume 103, Issues 3-4, 10 February 2005, Pages 163-172, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2004.08.022.
(http://www.sciencedirect.com/science/article/B6TD5-4DPYMW2-1/2/5a6b6ad636d885b46c2daf3a65c748d1)
Abstract:

The in vitro generation of dendritic cells (DCs) from either blood or bone marrow has been accomplished for humans and a number of other species. This ability has facilitated the opportunity to test the efficacy of DC vaccines in various tumor models. The cottontail rabbit papillomavirus (CRPV) model is the most clinically relevant animal model for human papillomavirus (HPV)-associated carcinogenesis. The CRPV model has been used to test various preventative and therapeutic vaccination strategies, and the availability of rabbit DCs would further expand its utility. However, to date, rabbit DCs have not been phenotypically and/or functionally characterized. Here we show that DCs can be generated in vitro from rabbit bone marrow mononuclear cells (BMMCs) cultured in the presence of the human cytokines GM-CSF and IL-4 and matured with lipopolysaccharide (LPS). These cells show upregulation of MHC class II and CD86, as well as downregulation of CD14, do not have non-specific esterase activity, are able to perform receptor-mediated endocytosis, and are potent stimulators of allogeneic T cell proliferation in mixed lymphocyte reactions. The ability to generate rabbit DCs makes it possible to test the efficacy of DC vaccination in the prevention and treatment of CRPV-induced lesions, which may provide useful preclinical data regarding the use of DC vaccines for HPV-associated lesions, including cervical cancer.
Keywords: Dendritic cell; Rabbit; Bone marrow; GM-CSF; IL-4

P.G. Ferreira, A. Costa-E-Silva, M.J.R. Oliveira, E. Monteiro, A.P. Aguas, Leukocyte-hepatocyte interaction in calicivirus infection: differences between rabbits that are resistant or susceptible to rabbit haemorrhagic disease (RHD), Veterinary Immunology and Immunopathology, Volume 103, Issues 3-4, 10 February 2005, Pages 217-221, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2004.09.028.
(http://www.sciencedirect.com/science/article/B6TD5-4DV1K2J-1/2/b0be38f504e4b5f66fbc3f0c45fecd71)
Abstract:
Calicivirus infection is lethal for adult rabbits, whereas young rabbits (less than 8-weeks-old) are resistant to the same infectious agent. The virus replicates in the liver and causes a fulminant hepatitis in adult rabbits leading to rabbit haemorrhagic disease (RHD); this is in contrast with the mild and transient hepatitis observed in infected young rabbits. We have used electron microscopy to compare liver leukocyte infiltrates between young (resistant) and adult (susceptible) rabbits, 36-48 h after inoculation of the animals with caliciviruses. In adult rabbits, liver infiltrates were made up mostly of heterophils, and they were located near hepatocytes showing severe cellular damage. In contrast, liver leukocyte infiltrates of RHD-resistant young rabbits were dominated by lymphocytes that depicted membrane contacts with the cell surface of undamaged hepatocytes. We conclude that: (i) the cellular inflammatory response of the liver to calicivirus infection is different in rabbits that are susceptible (adult) or resistant (young) to RHD; (ii) leukocyte infiltration of the adult liver by heterophils is probably directed at the removal of dead hepatocytes, whereas the liver lymphocytic infiltration of young rabbits suggests the expression of viral antigens on the surface of liver cells of the RHD-resistant animals.
Keywords: Lymphocyte; Heterophil; Liver; Electron microscopy

Richard Pospisil, Harold Obiakor, Barbara A. Newman, Cornelius Alexander, Rose G. Mage, Stable expression of the extracellular domains of rabbit recombinant CD5: development and characterization of polyclonal and monoclonal antibodies, Veterinary Immunology and Immunopathology, Volume 103, Issues 3-4, 10 February 2005, Pages 257-267, ISSN 0165-2427, DOI: 10.1016/j.vetimm.2004.09.030.
(http://www.sciencedirect.com/science/article/B6TD5-4DTTFP5-1/2/5a76ac0a3b7fbabf220dd692142dd6ed)
Abstract:

Previous studies in our laboratory suggested that there was positive selection of B cells during early development in the appendix of normal and VH mutant (ali/ali) rabbits. Preferential expansion and survival of B lymphocytes was affected by the Ig VH frameworks 1 and 3 sequences expressed on the cell surface. We demonstrated a specific interaction between rabbit CD5 and the V region of rabbit heavy chains and suggested that CD5 is a potential selecting ligand for B-cell surface immunoglobulin framework region sequences. To further investigate the role of CD5 in rabbit B-cell selection and survival we prepared recombinant constructs and obtained stable expression of the three scavenger receptor cysteine-rich (SRCR) extracellular domains of rabbit CD5. Here we describe the production and purification of this expressed recombinant CD5 protein, polyclonal antibody obtained by immunization of a goat and initial production and characterization of specific mAbs against peptides selected from each sequenced SRCR domain.
Keywords: Rabbit; CD5; Monoclonal antibodies; Scavenger receptor cysteine-rich domains; B cells

Carlos Calvete, Elena Angulo, Rosa Estrada, Conservation of European wild rabbit populations when hunting is age and sex selective, Biological Conservation, Volume 121, Issue 4, February 2005, Pages 623-634, ISSN 0006-3207, DOI: 10.1016/j.biocon.2004.06.013.
(http://www.sciencedirect.com/science/article/B6V5X-4D2FKRH-4/2/e77f5f60418ff8ea9d24d009bc99541a)
Abstract:
Several predator species at risk of extinction in Southwestern Europe are dependent on the population density of European wild rabbits Oryctolagus cuniculus. Rabbit populations in the region, however, have recently undergone dramatic decreases in population density, which may be exacerbated by hunting. Current hunting policies set the autumn-winter season, just before the start of rabbit reproduction, as the main hunting season, and previous theoretical models have estimated that the current hunting season may have the greatest negative impact on rabbit abundance and should be changed. We utilised a model for rabbit population dynamics to determine the effects of the timing of hunting during two seasons, summer and autumn, on the tendency of rabbit populations to be over-harvested and on the number of rabbits hunted. This model included field estimates of age- and sex-selection biases of hunting by shotgun. Scenarios with different hunting rates and sex- and age-selection probabilities of hunting were simulated for populations with different turnover levels and with and without compensatory mortality mechanisms. Field estimations showed that hunting in summer was juvenile-biased whereas autumn hunting was juvenile- and male-biased. In contrast to previous findings, our modelling results suggested that hunting in autumn may be the most conservative option for harvesting of rabbit populations, since these populations were more prone to be over-harvested during the summer. The differences between the two seasons in number of rabbits hunted were dependent on population dynamics and hunting sex- and age-selection probabilities. Our findings suggest that altering of current hunting policies would not optimise the exploitation or conservation of wild rabbit populations, but that the latter may be improved by some changes in the timing of hunting.
Keywords: Hunting selection; Hunting timing; Oryctolagus cuniculus; Sex-age hunting biases; Sustainable harvesting

Mokhtar I. Yousef, Reproductive performance, blood testosterone, lipid peroxidation and seminal plasma biochemistry of rabbits as affected by feeding Acacia saligna under subtropical conditions, Food and Chemical Toxicology, Volume 43, Issue 2, February 2005, Pages 333-339, ISSN 0278-6915, DOI: 10.1016/j.fct.2004.10.006.
(http://www.sciencedirect.com/science/article/B6T6P-4F1GYSS-1/2/98f27c6fae8fa4fc9aaf71fc93c6622a)
Abstract:
Thirty-two New Zealand White growing rabbits (eight-week old) were used to determine the effect of feeding acacia-based diets on semen characteristics, plasma testosterone, free radicals,

seminal plasma enzymes and lipids. Rabbits were randomly assigned to four equal groups. The first group (control) was fed a basal diet only, and the other three groups were fed other three diets, as follows: 80% of basal diet + 20% of acacia leaves (low), 60% of basal diet + 40% of acacia leaves (medium) and 40% of basal diet + 60% of acacia leaves (high), respectively for 32 week. Semen samples were collected throughout the last 12 week of the experimental period. Rabbits fed on different levels of Acacia showed no significant changes in libido (reaction time), ejaculate volume, sperm concentration, packed sperm volume and initial hydrogen ion concentration compared to control. However, low and/or medium levels of Acacia caused significant ($P < 0.05$) increase in total sperm output (TSO), sperm motility (%), total motile sperm per ejaculate (TMS), normal sperm, total functional sperm fraction (TFSF), semen initial fructose, live sperm and plasma testosterone. On the other hand, high level of Acacia did not show any significant change in TSO, sperm motility (%), TMS, initial fructose, TFSF or testosterone, while live and normal sperm decreased. All levels of Acacia caused a significant decrease in the concentrations of thiobarbituric acid-reactive substances (TBARS) and an increase in the activity of glutathione S-transferease. The activities of lactate dehydrogenase (LDH), aminotransferases and phosphatases were significantly increased in seminal plasma of animals fed low or medium levels of Acacia. Seminal plasma total lipid, triglyceride, low density lipoprotein and free fatty acids were significantly ($P < 0.05$) decreased in low or medium levels of Acacia. On the other hand, total cholesterol, percentage cholesterol (out of total lipids) and high density lipoprotein were significantly ($P < 0.05$) increased in seminal plasma of rabbits fed on low or medium levels of Acacia. High level of Acacia did not cause any changes in the previous parameters. It can be concluded that up to 40% Acacia leaves could be used successfully and safely in the diet of rabbits without adversely affecting their reproductive performance under subtropical conditions.
Keywords: Rabbits; Acacia; Semen; Testosterone; Enzymes; Free radicals; Lipids

J. Henning, C. Heuer, P.R. Davies, Attitudes of New Zealand farmers to methods used to control wild rabbits, Preventive Veterinary Medicine, Volume 67, Issues 2-3, February 2005, Pages 171-194, ISSN 0167-5877, DOI: 10.1016/j.prevetmed.2004.10.008.
(http://www.sciencedirect.com/science/article/B6TBK-4F2B7F0-6/2/11b71406a4c87826aba2388bb9f93028)
Abstract:
Four years after the release of Rabbit haemorrhagic disease virus (RHDV) in New Zealand, we conducted a mail survey of farmers to ascertain their attitudes and practices about rabbit control. A multistage sampling frame (stratified by rabbit-proneness and farm type) was used to select 828 farms in eight geographical regions. The useable response proportion of the survey was 69.3%, and 21% of respondents considered rabbits to be a problem on their farms. Although practices for rabbit control had changed from 1995 to 2001, shooting (practised by 85% of respondents) remained the predominant method used (albeit less frequently than in 1995). Ten percent of farmers used RHDV baiting; of those, 90% released the virus relatively infrequently. Farmers perceived shooting to be the most-humane and environmentally safe method, while RHDV was perceived to be the most effective. Perception of the level of competition for grazing between rabbits and livestock was the factor most-strongly associated with the use of shooting and RHDV. Most (60%) respondents considered the introduction of RHDV to have been beneficial.
Keywords: Multistage sampling; Survey design; Attitudes; Rabbit haemorrhagic disease virus

Miriam Cantore, Salvatore Siano, Marcella Coronnello, Luca Mazzetti, Sergio Franchi-Micheli, Enrico Boldrini, Mario Ciuffi, Paola Failli, Pirenoxine prevents oxidative effects of argon fluoride excimer laser irradiation in rabbit corneas: biochemical, histological and cytofluorimetric evaluations, Journal of Photochemistry and Photobiology B: Biology, Volume 78, Issue 1, 14 January 2005, Pages 35-42, ISSN 1011-1344, DOI: 10.1016/j.jphotobiol.2004.09.005.

(http://www.sciencedirect.com/science/article/B6TH0-4DS6W4W-3/2/b725c4a8eeca49f5c99c6ac0c06ab804)
Abstract:
The production of reactive oxygen species (ROS) associated with excimer laser irradiation is recognized as a possible cause of corneal haze following photorefractive keratectomy (PRK). Our work was aimed at investigating in vitro the oxidative effects induced by subablative laser fluences and at demonstrating the protective effectiveness of pirenoxine. Comparative trials of subablative fluence on rabbit eyes with or without 10-5 M pirenoxine were carried out. Superoxide anion , conjugated diene (CD), and thiobarbituric acid reagent substance (TBARS) formation were analyzed. Cellular death was evaluated by flow cytometry. Histological examinations were also performed. No appraisable differences in formation were detected soon after irradiation, whereas they all increased following incubation. Pirenoxine inhibited such increases. Cytofluorimetric and histological observations gave coherent results. The experimental data indicate that oxidative and toxic effects are ascribable to ROS avalanches triggered by laser irradiation-induced photodissociation and are inhibited by pirenoxine.
Keywords: Reactive oxygen species; UV-C radiation; Pirenoxine

Anne-Sophie Moncomble, Gerard Coureaud, Brigitte Quennedey, Dominique Langlois, Guy Perrier, Benoist Schaal, The mammary pheromone of the rabbit: from where does it come?, Animal Behaviour, Volume 69, Issue 1, January 2005, Pages 29-38, ISSN 0003-3472, DOI: 10.1016/j.anbehav.2004.05.006.
(http://www.sciencedirect.com/science/article/B6W9W-4DMW2CG-1/2/69b0179f78eefac2af456d27f9711e39)
Abstract:
Newborn rabbits, Oryctolagus cuniculus, are directed to their mother's nipples by specialized odour cues. Previous investigations have suggested that these cues are released from the doe's abdominal surface from structures located around the nipple. We tested pups with samples of various cutaneous tissues or fluids collected from lactating females to determine the location of the source of the odour cues. After finding that the nipples from lactating does were more attractive than those of virgin females, we conducted three experiments using skin samples collected at increasing distance from the nipples, dermal and mammary tissues taken below the nipples, and milk collected at different levels of the mammary pathway. These different substrates were assessed for their ability to elicit searching/grasping responses in pups. Efficient odour cues were released only from the nipples, whereas the dermal or mammary tissues sampled beneath the nipples were behaviourally inefficient, and milk became behaviourally active only after it had flown through the nipple. These results suggest dual exocrine sources of active factors from the nipple of lactating rabbits: cues released within the nipple that render milk behaviourally active and cues distributed over the nipple epidermis.

P. Hernandez, L. Guerrero, J. Rami'rez, W. Mekkawy, M. Pla, B. Arino, N. Ibanez, A. Blasco, A Bayesian approach to the effect of selection for growth rate on sensory meat quality of rabbit, Meat Science, Volume 69, Issue 1, January 2005, Pages 123-127, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2004.06.013.
(http://www.sciencedirect.com/science/article/B6T9G-4D04T6K-6/2/10b0f5f368beaacc7970d092e28215ca)
Abstract:
The effect of selection for growth rate on the sensory characteristics of rabbit meat was assessed by comparing a selected and a control population of rabbits. Embryos belonging to generation 7th were frozen, thawed and implanted in does in order to produce the control group. The control group was formed from the offspring of the embryos belonging to the 7th generation. Selected animals belonging to 21st generation (S) were compared with animals of the control group (C),

both were contemporary. Forty animals per group were slaughtered at 9-weeks-old. The sensory analysis was carried out on samples of the Longissimus dorsi muscle. The parameters evaluated were: intensity of rabbit flavour (IRF), aniseed odour (AO), aniseed flavour (AF), liver flavour (LF), tenderness (T), juiciness (J), fibrousness (F). A Bayesian analysis was performed. The ratio of the selection and control effects was analysed. There was a difference between the selected and control groups for IRF, AO, AF and LF. Conversely, no differences were found in T, J and F between groups. Selected group had 3% and 23% higher values of IRF and LF, respectively, than the control group. A relevant effect of selection on AO and AF appeared (probability of relevance Pr = 1), with lower values for selected animals. There was a difference between male and female groups for IRF, but this was not relevant. No differences between sexes were found for the rest of the characteristics evaluated. Selection for growth rate did not affect the main sensory characteristics of meat, like T and J but, it had a negative effect on some flavour characteristics.
Keywords: Rabbit; Genetics; Growth rate; Sensory properties; Bayesian

Tao Chen, Yan-Ling Zhang, Yan Jiang, Shu-Zhen Liu, Heide Schatten, Da-Yuan Chen, Qing-Yuan Sun, The DNA methylation events in normal and cloned rabbit embryos, FEBS Letters, Volume 578, Issues 1-2, 3 December 2004, Pages 69-72, ISSN 0014-5793, DOI: 10.1016/j.febslet.2004.10.073.
(http://www.sciencedirect.com/science/article/B6T36-4DTM0BR-1/2/061a0cb6f656c156d8692a5acc8a39c0)
Abstract:
To study the DNA methylation events in normal and cloned rabbit embryos, we investigated the methylation status of a satellite sequence and the promoter region of a single-copy gene using bisulfite-sequencing technology. During normal rabbit embryo development, both sequences maintained hypermethylation status until the 8- to 16-cell stage when progressive demethylation took place. In cloned embryos, the single-copy gene promoter sequence was rapidly demethylated and precociously de novo methylated, while the satellite sequence maintained the donor-type methylation status in all examined stages. Our results indicate that unique sequences as well as satellite sequences may have aberrant methylation patterns in cloned embryos.
Keywords: DNA methylation; Embryo; Nuclear transfer; Rabbit

Carlos Calvete, Rosa Estrada, Short-term survival and dispersal of translocated European wild rabbits. Improving the release protocol, Biological Conservation, Volume 120, Issue 4, December 2004, Pages 507-516, ISSN 0006-3207, DOI: 10.1016/j.biocon.2004.03.023.
(http://www.sciencedirect.com/science/article/B6V5X-4CC7V6J-9/2/419099e6ddc713fb1b7fd8085980e4bb)
Abstract:
Translocation of European wild rabbit Oryctolagus cuniculus L. is one of the most frequent management tools to increase rabbit density in Spain, both as prey of several predators that are threatened with extinction and for sport hunting. Nevertheless the elevated short-term mortality by predation makes translocations unsuccessful and increases their biological cost. Information on the factors affecting the short-term survival and dispersal of translocated rabbits is required to improve release management and increase performance of translocated rabbits, and to avoid the use of non-selective lethal methods for predator control. In this study we tested electric fencing and night-shooting as alternative to traditional release protocols, and the effects of vegetation cover and warren fencing on short-term survival and dispersal of rabbits. Night shooting performed during the first nights after release increased significantly the survival of rabbits, by hindering the activity of carnivores in the release area. The use of an electric fence enclosure also increased the performance of rabbits, but was not efficient to constraint rabbit dispersal. Rabbits released in areas with low vegetation cover showed higher mortality and dispersal distances than rabbits released in high cover areas. Warren fencing decreased both the dispersal of rabbits and the

adverse impact of predation in low cover areas, but had no effect in high cover areas. Selection of high cover areas or warren fencing in low cover areas seem to be the most advantageous release conditions to decrease the short-term predation impact, reducing the biological cost of rabbit translocations and the risks for endangered predators derived from the use of traditional predator control practices during translocations.
Keywords: Oryctolagus cuniculus; Predation; Radio-tracking; Translocation; Vegetation cover

M.D. Rodriguez, J.E. Gonzalez, C. Aleman, I. Rodeiro, E. Arango, R. Gamez, S. Valdes, H. Garci'a, E. Goicochea, C.P. Acosta, Evaluation of the reproductive and developmental toxicity of the D-003, a mixture of long-chain fatty acids, in rats and rabbits, Food and Chemical Toxicology, Volume 42, Issue 12, December 2004, Pages 1977-1985, ISSN 0278-6915, DOI: 10.1016/j.fct.2004.07.014.
(http://www.sciencedirect.com/science/article/B6T6P-4D98FXP-1/2/6d75b174cc0b86f17ae763fae6b6f19d)
Abstract:
D-003 is a mixture of long-chain fatty acids isolated and purified from sugar cane wax with cholesterol-lowering properties. D-003 given orally (500 and 1000 mg/kg/day) to female rats for 15 days prior to mating, through mating and gestation to day 21 of lactation and male rats for 4 weeks prior and during mating did not induce toxic effects on reproduction. There were no significant reductions in the number of animals that conceived, in the numbers of pups born to those that did conceive, in the numbers of pups that survived until weaning, and in their body weights at weaning. Drug-treated and control groups' offspring were comparable in growth, physical and behavioral development, spontaneous activity and reproductive performance.
Pregnant New Zealand rabbits were given D-003 as oral doses of 500 and 1000 mg/kg/day on days 6 through 18 of gestation without any evidence of embryotoxicity or teratogenicity. The no-observed-effect dose in these two experimental studies was 1000 mg/kg/day. After assessment of the potential of high doses of D-003 to act on developing embryo and reproduction process, no evidence supports the conclusion that D-003 is a reproductive and developmental toxicant/teratogen.

Emmanuel J.P. Douzery, Dorothee Huchon, Rabbits, if anything, are likely Glires, Molecular Phylogenetics and Evolution, Volume 33, Issue 3, December 2004, Pages 922-935, ISSN 1055-7903, DOI: 10.1016/j.ympev.2004.07.014.
(http://www.sciencedirect.com/science/article/B6WNH-4DBCCF7-4/2/ef837fa5a3e54413295b165af7b0ca8f)
Abstract:
Rodentia (e.g., mice, rats, dormice, squirrels, and guinea pigs) and Lagomorpha (e.g., rabbits, hares, and pikas) are usually grouped into the Glires. Status of this controversial superorder has been evaluated using morphology, paleontology, and mitochondrial plus nuclear DNA sequences. This growing corpus of data has been favoring the monophyly of Glires. Recently, Misawa and Janke [Mol. Phylogenet. Evol. 28 (2003) 320] analyzed the 6441 amino acids of 20 nuclear proteins for six placental mammals (rat, mouse, rabbit, human, cattle, and dog) and two outgroups (chicken and xenopus), and observed a basal position of the two murine rodents among the former. They concluded that 'the Glires hypothesis was rejected.' We here reanalyzed [loc. cit.] data set under maximum likelihood and Bayesian tree-building approaches, using phylogenetic models that take into account among-site variation in evolutionary rates and branch-length variation among proteins. Our observations support both the association of rodents and lagomorphs and the monophyly of Euarchontoglires (= Supraprimates) as the most likely explanation of the protein alignments. We conducted simulation studies to evaluate the appropriateness of lissamphibian and avian outgroups to root the placental tree. When the outgroup-to-ingroup evolutionary distance increases, maximum parsimony roots the topology

along the long Mus-Rattus branch. Maximum likelihood, in contrast, roots the topology along different branches as a function of their length. Maximum likelihood appears less sensitive to the 'long-branch attraction artifact' than is parsimony. Our phylogenetic conclusions were confirmed by the analysis of a different protein data set using a similar sample of species but different outgroups. We also tested the effect of the addition of afrotherian and xenarthran taxa. Using the linearized tree method, [loc. cit.] estimated that mice and rats diverged about 35 million years ago. Molecular dating based on the Bayesian relaxed molecular clock method suggests that the 95% credibility interval for the split between mice and rats is 7-17 Mya. We here emphasize the need for appropriate models of sequence evolution (matrices of amino acid replacement, taking into account among-site rate variation, and independent parameters across independent protein partitions) and for a taxonomically broad sample, and conclude on the likelihood that rodents and lagomorphs together constitute a monophyletic group (Glires).
Keywords: Rodentia; Lagomorpha; Glires; Maximum likeliood; Bayesian inference

Dieter Vancraeynest, Katleen Hermans, Freddy Haesebrouck, Genotypic and phenotypic screening of high and low virulence Staphylococcus aureus isolates from rabbits for biofilm formation and MSCRAMMs, Veterinary Microbiology, Volume 103, Issues 3-4, 15 November 2004, Pages 241-247, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2004.09.002.
(http://www.sciencedirect.com/science/article/B6TD6-4DHXH1H-1/2/5d233a462c617fc005cf1e51188b129f)
Abstract:
At rabbit flock level, two types of Staphylococcus aureus infections can be distinguished. In the first type, caused by low virulence strains, the infection remains limited to a small number of animals. The second type of infection is caused by the high virulence strains, which spread throughout the rabbitry. The pathogenetic capacity of a particular S. aureus strain is attributed to a combination of extracellular factors and invasive properties such as adherence and biofilm formation. Twenty eight high virulence and 34 low virulence S. aureus isolates recovered from rabbits between 1998 and 2003 were used to study slime production on Congo red Agar (CRA) and prevalence of bap, icaA and icaD associated with biofilm formation. Furthermore these strains were screened for the presence of bbp, clfA, clfB, cna, ebpS, eno, fnbA, fnbB and fib encoding microbial surface components recognizing adhesive matrix molecules (MSCRAMMs). The presence of icaA and icaD was not correlated with slime production on CRA. Bap was absent in all strains. All rabbit S. aureus strains harboured clfA and clfB. The prevalences of ebpS, eno, fnbA and fib did not reveal striking differences between high and low virulence strains. FnbB prevalence in high virulence isolates was lower than in low virulence isolates and cna was absent in high virulence strains. It was remarkable that only high virulence strains were positive for bbp. Further research is necessary to elucidate the significance of bbp in the pathogenesis of high virulence strains.
Keywords: Staphylococcus aureus; Rabbit; Biofilm; Adhesion

Luisa Falcao-e-Cunha, Helena Peres, Joao P. B. Freire, Luis Castro-Solla, Effects of alfalfa, wheat bran or beet pulp, with or without sunflower oil, on caecal fermentation and on digestibility in the rabbit, Animal Feed Science and Technology, Volume 117, Issues 1-2, 10 November 2004, Pages 131-149, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2004.07.014.
(http://www.sciencedirect.com/science/article/B6T42-4D98JTY-1/2/068cca89c6e5edbb3367c180ec294913)
Abstract:
The study was designed to assess the influence of diets, differing in cell wall composition, on caecal fermentative activity and total tract apparent digestibility. The effect of adding fat to these diets was also tested. Six diets with 330 g NDF kg-1, were used. They were based either in dehydrated alfalfa (AL), wheat bran (WB), or beet pulp (BP); for each case 60 g of sunflower oil

was or was not substituted for starch. Diets were fed to 6 x 12 rabbits, from 28 to 70 days of age, in a 3 x 2 factorial arrangement. Growing performances, coefficient of total tract apparent digestibilities (CTTAD) (during the 5th and 9th weeks of age), caecotrophy and caecal fibrolytic activity (at 35 and 56 days of age), volatile fatty acids (VFA) concentration and full and empty digestive organs - stomach and caecum were all measured at slaughter at the end of experience.
The digestibility of all analytical fractions was affected ($P < 0.0001$) by the source of fibre. The digestibility of energy was 20% higher in BP diets (0.763) than in AL diets (0.635), intermediate in WB diets (0.719). The same pattern was seen in the digestibilities of cell wall fractions: at 9 weeks, CTTAD for NDF was 0.584, 0.393 and 0.267, and for ADF was 0.391, 0.230 and 0.174, in BP, WB and AL diets, respectively. Sunflower oil addition increased ($P < 0.001$) the digestibility of most analytical fractions by 3-5%. It had a greater effect on fat digestibility (from 0.7 to 0.9), and a more variable, albeit also positive, effect on the digestibilities of the cell wall fractions. Fibre source affected fibrolytic activities (mg sugar h-1 g-1 DM) in both the caecotrophs and the caecal contents. Pectinolytic and cellulolytic activities were higher in BP diets, xilanolytic activity higher in WB diets. Fat addition decreased ($P < 0.05$) cellulolytic activity in caecotrophs in the second collection, and the pectinolytic and cellulolytic activities in caecal contents. Fibre source also affected ($P < 0.001$) the VFA total level, individual levels, and relative proportions. Both the level and the molar proportion of C2 were higher in BP diets. Fat decreased ($P < 0.05$) total VFA level, from 43.7 to 39.9 mmol l-1. Source of fibre affected the composition of caecal contents, both in absolute ($P < 0.01$) and in relative ($P < 0.05$) terms. In absolute terms, WB diets gave less NDF, ADF and cellulose, and more hemicellulose in the contents. Fat reduced the amounts of NDF from 10 to 8.6 g ($P = 0.014$), ADF from 6.3 to 5.1 g ($P = 0.002$) and cellulose from 4.5 to 3.7 g ($P = 0.006$) in the contents. BP diets gave heavier ($P < 0.001$) stomachs and caecums. Fat gave heavier ($P < 0.001$) empty stomachs, lighter ($P = 0.019$) caecums. It may be concluded that caecal fermentative activity was affected by the composition of the fibrous feed, less so by the inclusion of fat in the diet.
Keywords: Rabbit; Fibrolytic activity; Fibre source; Fat inclusion; Digestibility.

J. P. Sanchez, M. Baselga, R. Peiro, M. A. Silvestre, Analysis of factors influencing longevity of rabbit does, Livestock Production Science, Volume 90, Issues 2-3, November 2004, Pages 227-234, ISSN 0301-6226, DOI: 10.1016/j.livprodsci.2004.06.002.
(http://www.sciencedirect.com/science/article/B6T9B-4D0NJC2-1/2/5748d94de86424edce7b936ebccb7821)
Abstract:
A survival analysis, using a Cox proportional hazard model, was carried out to show the factors influencing longevity of the does in a selection nucleus. It was shown that the year-season, the combination between number of live born and reproductive rhythm, the combination between kindling order and reproductive rhythm and the age of the doe at first mating significantly affected doe longevity. Once the significant factors were known, the model was extended, including the sire effect and the maternal grandsire effect, to estimate the additive variance of the trait. This estimate was 0.088. Finally, to evaluate the effects of factors influencing longevity, an animal model was used, with the additive variance estimated previously. Inclusion of longevity as a selection criterion in rabbits does not seem advisable due to its low heritability; the trait is only recorded in females; the live females have the trait censored and its consideration makes the generation interval longer. An alternative could be developing new strains of rabbits by applying very high selection intensities in commercial populations, similar to the schemes successfully applied in pigs and rabbits.
Keywords: Cox models; Rabbits; Longevity; Proportional hazard models

Nicole J. Siegel Thines, Lisa A. Shipley, Rodney D. Sayler, Effects of cattle grazing on ecology and habitat of Columbia Basin pygmy rabbits (Brachylagus idahoensis), Biological Conservation,

Volume 119, Issue 4, October 2004, Pages 525-534, ISSN 0006-3207, DOI: 10.1016/j.biocon.2004.01.014.
(http://www.sciencedirect.com/science/article/B6V5X-4BV4W29-1/2/e8c5aa75719dd6d8f8bab08843aec776)
Abstract:
Dramatic declines in the endangered Columbia Basin pygmy rabbit, a genetically unique population of small, burrowing rabbits in Northwestern United States, are likely the combined results of habitat degradation and fragmentation, disease, and predation. A critical component of pygmy rabbit habitat includes big sagebrush (Artemisia tridentata), which constitutes 82-99% of their winter diet and 10-50% of their summer diet. Sagebrush also forms the bulk of hiding cover around burrow sites. Across the range of pygmy rabbits, sagebrush habitat is grazed extensively by cattle. However, grazing has unknown effects on pygmy rabbits inhabiting the remaining, fragmented shrub-steppe habitat. We evaluated the effects of four grazing treatments on the distribution of pygmy rabbit burrows, diets of pygmy rabbits, and quality and quantity of vegetation at Sagebrush Flat in central Washington. Ungrazed areas contained significantly more burrows per unit area than did grazed areas. Vegetation composition and structure differed little among treatments in early summer before annual grazing by cattle. However, cattle grazing in late summer through winter removed about 50% of the grass cover, and reduced the nutritional quality (e.g., increased fiber and decreased protein) of the remaining grass. Although pygmy rabbits ate <2% grasses in winter, grasses and forbs comprised 53% of late summer diets. Because these endangered rabbits avoided grazed areas, removing cattle grazing from key habitat locations may benefit efforts to restore this rabbit in Washington.
Keywords: Cattle grazing; Columbia Basin; Habitat selection; Pygmy rabbits; Sagebrush

E. Siegfried, H. Ochs, P. Deplazes, Clinical development and serological antibody responses in sheep and rabbits experimentally infested with Psoroptes ovis and Psoroptes cuniculi, Veterinary Parasitology, Volume 124, Issues 1-2, 20 September 2004, Pages 109-124, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2004.06.014.
(http://www.sciencedirect.com/science/article/B6TD7-4D4D3C3-2/2/bfe2c5b43b4e21c84483b304841a3947)
Abstract:
Psoroptes ovis of sheep origin, and Psoroptes cuniculi of rabbit origin were used in experimental infestations. In experiment I, groups of four rabbits and four sheep were infested with 50-100 mites of each isolate on the skin of the back (skin infestation, SI) or in the external auditory canal (aural infestation, AI). In rabbits, SI and AI with P. cuniculi and AI with P. ovis induced in all animals typical ear lesions and pronounced antibody reactions to P. cuniculi antigens in ELISA. After SI of rabbits with P. ovis no clinical signs were detected, no mites could be reisolated and no specific antibodies were detected. In sheep, P. ovis SI induced mange whereas AI did not induce typical clinical signs and mites could not be reisolated. In both these animal groups, ELISA revealed pronounced and comparable specific antibody reactions. After SI and AI with P. cuniculi no clinical symptoms were observed and no mites could be reisolated. Nevertheless, low levels of specific antibody were detected. In experiment II, clinical progression and antibody reactions to P. ovis SI in naive sheep were compared with sheep previously exposed to P. ovis or P. cuniculi. In both pre-exposed groups of animals, clinical signs appeared within 2 days after challenge infestation and three days earlier than in primarily infested sheep. Subsequently, no obvious difference in the clinical progression was observed between the three groups of animals. The results of this study document antigenetic crossreactivity of the two morphologically and genetically distinguishable Psoroptes species but differences in their biological behaviour and virulence which both are of epidemiological and taxonomic relevance.
Keywords: Mange; Sheep; Arthopoda; Rabbit; Isolates; Virulence; ELISA; Psoroptes spp.

S. Almeria, C. Calvete, A. Pages, C. Gauss, J. P. Dubey, Factors affecting the seroprevalence of Toxoplasma gondii infection in wild rabbits (Oryctolagus cuniculus) from Spain, Veterinary Parasitology, Volume 123, Issues 3-4, 2 September 2004, Pages 265-270, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2004.06.010.
(http://www.sciencedirect.com/science/article/B6TD7-4CVR6RW-3/2/05587ef8d983b4e7488ed619b9dc1638)
Abstract:
Sera from 456 wild rabbits (Oryctolagus cuniculus) collected between 1992 and 2003 from five geographical regions of Spain were examined for antibodies to Toxoplasma gondii by the modified agglutination test. Antibodies to T. gondii were found in 65 (14.2%) wild rabbits. Prevalence of infection was significantly higher in samples collected from wild rabbits from Catalonia, northeast Spain (53.8%), where rabbits lived in forest, compared to other areas (Huelva and Cadiz, Andalucia, south Spain; Toledo, Castilla-La Mancha, central Spain; and Zaragoza, Aragon, northeast Spain) with more dry conditions, where prevalence ranged from 6.1 to 14.6%. No differences were observed on prevalence and age (young animals <7 months of age compared to older animals), sex, date of samples collection or season of samples collection. The results indicate that prevalence of T. gondii in some areas of Spain is high, and this finding could have environmental and/or public health implications if wild rabbits are to be used as a source of food.
Keywords: Toxoplasma gondii; Wild rabbits; Oryctolagus cuniculus; Spain; Modified agglutination test

Mokhtar I. Yousef, Kamel I. Kamel, Alshaimaa M. Esmail, Hoda H. Baghdadi, Antioxidant activities and lipid lowering effects of isoflavone in male rabbits, Food and Chemical Toxicology, Volume 42, Issue 9, September 2004, Pages 1497-1503, ISSN 0278-6915, DOI: 10.1016/j.fct.2004.04.012.
(http://www.sciencedirect.com/science/article/B6T6P-4CHRWBJ-9/2/92c514600a8368d8795891ccc3257b7d)
Abstract:
Dietary flavonoids appear to play a role in the prevention of a number of chronic diseases such as cancer and cardiovascular disease and the soy isoflavones have been the focus of particular. Consumption of soy isoflavones may reduce the risk of cardiovascular disease both through reduction in serum lipids and by the antioxidant properties. We have therefore investigate the effects of either 2.5 or 5 mg/kg B.W. doses of isoflavones on the levels of free radicals, lipids and lipoproteins in male New Zealand White rabbits. Animals were orally given 2.5 or 5 mg/kg B.W. doses of isoflavones. The tested doses were given to rabbits every other day for 13 weeks. Treatment with isoflavones caused significant ($P<0.05$) decrease in the concentrations of free radicals in plasma by 33% and 35%, liver by 18% and 27%, brain by 12% and 33%, testes by 40% and 21%, and kidney by 38% and 20% for 2.5 or 5 mg/kg B.W. doses, respectively, as compared to the control. On the other hand, the activity of glutathione S-transferase (GST) did not change in treated animals as compared to control. Also, results showed that isoflavones caused a significant decrease ($P<0.05$) in the levels of plasma total lipids (TL) by 16% and 19%, total cholesterol by 20% and 20%, triglyceride (TG) by 18% and 23%, low density lipoprotein (LDL) by 19%, 22%, very low density lipoprotein (VLDL) by 18% and 23%, and LDL:HDL ratio by 36% and 39% for 2.5 or 5 mg/kg B.W. doses, respectively, as compared to the control. While the level of high density lipoprotein (HDL) increased by 29% and 32%. The present results showed that the 5 mg/kg dose of isoflavone seemed to be related to a better plasma lipid and lipoprotein profiles and antioxidant activity.
Keywords: Isoflavones; Rabbits; Free radicals; Glutathion S-transferase; Lipids; Lipoprotein

A. Bonanno, F. Mazza, A. Di Grigoli, M. Alabiso, Effects of a split 48-h doe-litter separation on productivity of free-nursing rabbit does and their litters, Livestock Production Science, Volume 89,

Issues 2-3, September 2004, Pages 287-295, ISSN 0301-6226, DOI: 10.1016/j.livprodsci.2003.12.009.
(http://www.sciencedirect.com/science/article/B6T9B-4BT7FS8-1/2/9dad9ceaadae33a5b1793e54269b1e85)
Abstract:
To prevent the weight loss of litters, and the distress of both rabbit does and their litters due to doe-litter separation (DLS), without losing its beneficial effects on fertility, the DLS, lasting 48 h before artificial insemination (AI), was split into two periods of 24 h with a short controlled suckling. Initially, 105 does of different parity were divided into three groups. During the post partum, the free-nursing does were treated as follows: regular DLS (R-DLS), the nest-box was closed for 48 h, from days 9 to 11, before AI; split DLS (S-DLS), the nest-box was closed for 24 h and, after suckling, for other 24 h before AI; control, does had free access to the nest-box.
Fertility improved (P<=0.05) in both R-DLS (60.9%) and S-DLS (59.4%) does compared to control does (44.1%). R-DLS and S-DLS does showed lower rabbit losses from days 14 to 35 (P<=0.001) and higher litter sizes at weaning (P<=0.05) than control does. Whereas the S-DLS did not affect the growth-rate and the weight of nursed rabbits until the weaning, the R-DLS reduced growth from days 9 to 14 (9.3, 13.2 and 14.0 g/day for R-DLS, S-DLS and control, respectively; P<=0.001) and the weaning weight of rabbits (732, 777, 780 g for R-DLS, S-DLS and control, respectively; P<=0.01). Productivity improved by 35.4% and 44.2% with R-DLS and S-DLS, respectively.
Keywords: Rabbits; Reproduction; Split doe-litter separation; Fertility; Litter size; Litter growth

Delia Recalde, Nadine Baroukh, Celine Viglietta, Sonia Prince, Julian Verona, Laurent Vergnes, Josette Pidoux, M Nazeem Nanjee, Fernando Brites, Alberto Ochoa, Graciela Castro, Mario M Zakin, Norman E Miller, Louis Marie Houdebine, Human apoA-I/C-III/A-IV gene cluster transgenic rabbits: effects of a high-cholesterol diet, FEBS Letters, Volume 572, Issues 1-3, 13 August 2004, Pages 294-298, ISSN 0014-5793, DOI: 10.1016/j.febslet.2004.07.041.
(http://www.sciencedirect.com/science/article/B6T36-4CYCV3N-1/2/7e832676327b23aeb7af255af08185a9)
Abstract:
We have generated transgenic rabbits that express the entire human apoA-I/C-III/A-IV gene cluster. As in humans, h-apoA-I and h-apoC-III were expressed in liver and intestine, whereas h-apoA-IV mRNA was detected in intestine only. Transgenic rabbits had significantly higher plasma total cholesterol, HDL-cholesterol and total phospholipid concentrations than non-transgenic littermates. In contrast to similar transgenic mice previously generated, which have gross hypertriglyceridemia, triglyceride concentrations were only moderately raised in transgenic rabbits. Plasma and HDL from transgenic rabbits were more effective than those from controls in promoting cholesterol efflux from cultured hepatoma cells. They had lower LCAT, lower CETP and higher PLTP activities than non-transgenic littermates. Cholesterol-feeding produced major increases in plasma lipids. The qualitative response to the diet was not modified by cluster expression. Human apoA-I concentration was halved by cholesterol-feeding, whereas h-apoC-III and h-apoA-IV concentrations were not significantly altered. Cholesterol efflux from hepatoma cells to plasma and HDL was not altered by the diet. Since lipoprotein metabolism of rabbits closely resembles that of humans, human apoA-I/C-III/A-IV transgenic rabbits may provide a reliable model for studies of the transcriptional regulation of the cluster, and for evaluating the effects of different agents on the expression of the three genes.
Keywords: Apolipoprotein; ApoA-I/C-III/A-IV; Transgenic rabbit; Cholesterol-rich diet

Dieter Vancraeynest, Katleen Hermans, An Martel, Mario Vaneechoutte, Luc A. Devriese, Freddy Haesebrouck, Antimicrobial resistance and resistance genes in Staphylococcus aureus strains from rabbits, Veterinary Microbiology, Volume 101, Issue 4, 6 August 2004, Pages 245-251, ISSN 0378-1135, DOI: 10.1016/j.vetmic.2004.03.021.

(http://www.sciencedirect.com/science/article/B6TD6-4CTCWV0-1/2/a912727d0cd3b967fd73a5a28ac32cfb)
Abstract:
Fifty-six Staphylococcus aureus isolates recovered between 1998 and 2003 from 31 rabbit farms with and without problems of chronic staphylococcosis, were screened for resistance to enrofloxacin, erythromycin, gentamicin, lincomycin, neomycin, penicillin and tetracyclines using the agar dilution test. For penicillin, a disk diffusion test was also performed. The detection of tetP(B), tet(K), tet(L), tet(M), tet(O), tet(T), tet(W), erm(A), erm(B), erm(C) and mec(A) genes was done via a PCR assay. Four isolates showed resistance to erythromycin and lincomycin. These isolates were positive for the erm(C) gene in the PCR. Eleven strains were resistant to tetracyclines and all harboured the tet(K) gene. In the agar dilution test, five isolates showed resistance to penicillin, whereas in the disk diffusion test 12 isolates showed resistance. None of these 12 resistant isolates carried the mec(A) gene. Only one strain showed resistance to gentamicin, and all strains were susceptible to enrofloxacin and neomycin. This study demonstrates that resistance to antimicrobial agents in S. aureus isolates originating from rabbits is relatively rare compared to resistance in S. aureus isolates originating from other animals and humans.
Keywords: Staphylococcus aureus; Rabbit; Bacteria; Antimicrobial susceptibility

D. Selzer, K. Lange, St. Hoy, Frequency of nursing in domestic rabbits under different housing conditions, Applied Animal Behaviour Science, Volume 87, Issues 3-4, August 2004, Pages 317-324, ISSN 0168-1591, DOI: 10.1016/j.applanim.2004.01.013.
(http://www.sciencedirect.com/science/article/B6T48-4C09K91-1/2/192dfdc6f3410cf53688f6d70b919b86)
Abstract:
Nursing was recorded in 95 litters of 30 multiparous rabbit does (23 New Zealand White and 7 ZIKA hybrids) by infrared video technique during a total of 469 for 24 h periods. The litters were nursed 1.26 times per day for 202.1+/-38.7 s (n=585 nursings). There was a diametrically opposed dynamic of nursing frequency per day and the mean duration of nursing event with the highest nursing activity in the second week of lactation (1.39 nursings per day). There was a moderate tendency to decrease the nursing activity with increasing cage size and the presence of an enrichment tunnel at the entrance to nestbox. The light-dark change in the photoperiod is a timer for nursing activity. Forty-three percent of all nightly nursing events occurred during the first 2 h after the onset of dusk.
Keywords: Rabbit; Nursing behaviour

Hesham M. Badr, Use of irradiation to control foodborne pathogens and extend the refrigerated market life of rabbit meat, Meat Science, Volume 67, Issue 4, August 2004, Pages 541-548, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2003.11.018.
(http://www.sciencedirect.com/science/article/B6T9G-4BS0FJR-1/2/18ee50b2de39b37f4f801bfa09de785b)
Abstract:
This study set out to evaluate the microbiological status of rabbit meat and the possibility of using irradiation to control foodborne pathogenic bacteria and extend the refrigerated storage life of meat. Rabbit meat samples were [gamma] irradiated at doses of 0, 1.5 and 3 kGy. The samples were stored at refrigeration temperature, then the effects of irradiation and storage on their microbiological, chemical and sensory properties were studied. Irradiation at 1.5 kGy significantly reduced the counts of Staphylococcus aureus, Listeria monocytogenes, Enterococcus faecalis and enterobacteriaceae but was not enough for complete elimination of Salmonella. However, 3 kGy dose reduced the counts of S. aureus, L. monocytogenes, E. faecalis and enterobacteriaceae by more than 3, 3, 1.4 and 4 log units, respectively, while Salmonella was not detected. On the other hand, irradiation at 1.5 and 3 kGy significantly reduced the counts of aerobic mesophilic bacteria,

psychrophilic bacteria and molds and yeasts and prolonged the refrigerated shelf-life of samples to 12 and 21 days, respectively, compared to 6 days for non-irradiated controls. Irradiation of samples significantly increased their amounts of thiobarbituric acid reactive substances (TBARS) but had no significant effects on their total volatile nitrogen (TVN) contents, while storage significantly increased the TBARS and TVN for irradiated and non-irradiated samples. [gamma] irradiation showed no significant effects on the sensory properties of raw meat. Moreover, fried burgers prepared from irradiated rabbit meat showed high sensory acceptability similar to those prepared from non-irradiated meat.
Keywords: Irradiation; Rabbit meat; Safety and shelf-life; TBARS; TVN; Sensory preference

Jorge A. Ramirez, M. Angels Oliver, Marcial Pla, Luis Guerrero, Beatriz Arino, Agustin Blasco, Mariam Pascual, Marta Gil, Effect of selection for growth rate on biochemical, quality and texture characteristics of meat from rabbits, Meat Science, Volume 67, Issue 4, August 2004, Pages 617-624, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2003.12.012.
(http://www.sciencedirect.com/science/article/B6T9G-4BT8GNF-4/2/e111df925debaa08d329d7700eb2cabc)
Abstract:
Biochemical characteristics, including myosin heavy chain I (MHC-I) percentage, isocitrate dehydrogenase and aldolase activities, meat quality traits and instrumental texture properties of rabbits selected for different growth rates were studied. The animals of the control (C) group (7th generation; n=60) were raised in parallel with those of selection (S) group (21st generation; n=60). Carcass weights (1230.1 +/- 19.8 and 1348.3 +/- 20.1 g, for C and S, respectively) and perirenal and scapular fat content differed significantly (P<0.01) between the two groups. Water holding capacity was expressed as the percentage of pressure released water and was significantly different (P<0.05) between groups C and S (33.29% and 35.57%). MHC-I percentage and aldolase activity also differed significantly (P<0.05) between groups, group C showing higher oxidative traits than group S (MHC-I: 12.5% and 9.8%; aldolase: 597.11 and 636.83 UI/g muscle). Texture properties from the Warner-Bratzler test showed higher (P<0.001) shear firmness for loin in the S group (1.69 kg/s cm2) than in the C group (1.34 kg/s cm2). In addition, the texture profile analysis indicated that chewiness, gumminess and hardness were also higher in the S group (P<0.01). In conclusion, the results confirmed a positive effect of the selection on productive traits and a negative effect on instrumental texture properties and on the water holding capacity of the meat.
Keywords: Genetic selection; Meat quality; Muscle biochemical traits; Texture

Marcelo Emilio Beletti, Maria Luiza Silveira Mello, Comparison between the toluidine blue stain and the Feulgen reaction for evaluation of rabbit sperm chromatin condensation and their relationship with sperm morphology, Theriogenology, Volume 62, Issues 3-4, August 2004, Pages 398-402, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2003.10.016.
(http://www.sciencedirect.com/science/article/B6TCM-4BFVS9D-3/2/fc62e27801cb504b4a555f7612914fd2)
Abstract:
Sperm chromatin alteration is an important feature that can affect fertility of the male rabbit. This study compared toluidine blue staining with Feulgen reaction (as methods for evaluating chromatin alteration) and investigated the relationship between sperm morphology and chromatin alteration. Seven hundred rabbit ejaculates of animals with unknown fertility were used. Primary and secondary morphological sperm abnormalities were evaluated in semen smears with phase-contrast microscopy. Chromatin alterations were evaluated in semen smears stained with toluidine blue (pH 4.0 and 5.0) and with the Feulgen reaction. While the three methods were equally efficacious for identification of chromatin alterations, toluidine blue staining was more appropriate to characterize the intensity of chromatin alterations. The correlation between primary sperm

defects and chromatin alteration was high and positive, suggesting that sperm chromatin structure affected sperm head morphology. The correlation between secondary sperm defects and chromatin alteration was also positive, but lower. The final chromatin compaction occurs in the epididymus, where secondary sperm defects originate. Therefore, the causes of secondary sperm defects could also intervene with final chromatin compaction. In summary, the toluidine blue stain was an effective means of evaluating the sperm chromatin alteration in rabbit spermatozoa.
Keywords: Spermatozoa; Chromatin; Toluidine blue; Morphological abnormalities; Rabbit

Pablo Segura Gil, Bernat Peris Palau, Jorge Martinez Martinez, Joaquin Ortega Porcel, Juan Manuel Corpa Arenas, Abdominal pregnancies in farm rabbits, Theriogenology, Volume 62, Issues 3-4, August 2004, Pages 642-651, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2003.11.005.
(http://www.sciencedirect.com/science/article/B6TCM-4BF0GN0-1/2/c0b2eab59f5182634858095e7ab340dc)
Abstract:
Abdominal pregnancy is defined as the implantation and development of a fertilized ovum or a embryo in the peritoneal cavity. Although this has been reported in several species, it is considered as a low incidence process. It is classified as a primary abdominal pregnancy, if there is no evidence of uterine rupture, with presumed regurgitation of early embryos from the uterine tube and as a secondary abdominal pregnancy, when there is evidence of uterine rupture.
During a necropsy study of 550 adult fertile female New Zealand white rabbits (Oryctolagus cuniculus) from two rabbit farms in Valencia (Spain), the main causes of elimination were studied. Twenty-eight abdominal pregnancies were diagnosed. Seven animals showed no lesions in their reproductive tract. The remaining twenty one animals showed acute or chronic lesions in the reproductive tract. The classification as a primary or secondary condition is discussed.
It may be concluded therefore that extrauterine pregnancies would not be such an unusual finding in rabbits, and that this premise should be considered in the diagnostic approach when assessing rabbit doe pathology. New husbandry systems in rabbits such as artificial insemination are factors to be considered.
Keywords: Abdominal pregnancy; Ectopic pregnancy; Rabbit doe; Rabbitrie; Artificial insemination

Sacramento Moreno, Rafael Villafuerte, Sonia Cabezas, Ludgarda Lombardi, Wild rabbit restocking for predator conservation in Spain, Biological Conservation, Volume 118, Issue 2, July 2004, Pages 183-193, ISSN 0006-3207, DOI: 10.1016/j.biocon.2003.07.020.
(http://www.sciencedirect.com/science/article/B6V5X-4B0WKCP-4/2/8fc0b19f5729a476c7a3b8052ce973eb)
Abstract:
The decline of rabbit (Oryctolagus cuniculus) populations in Mediterranean Spain has been shown to be one of the main threats to rabbit-specialist predators such as the Iberian lynx (Lynx pardina) and the Spanish imperial eagle (Aquila adalberti), two species which are in serious danger of extinction. Consequently, corrective measures such as increasing rabbit populations by restocking have been carried out to help the recovery of predator populations. In order to determine the general applicability of rabbit restocking for predator conservation, we performed three experimental restockings and evaluated their success in relation to season, habitat quality and the number of animals introduced. Rabbits were released either in large or small numbers in all four seasons of the year, and in habitat types defined as `poor' or `rich' according to the food availability for rabbits. For each restocking we evaluated rabbit survival, degree of residency and expected population increase. As a rule, the highest restocking success occurred whenever smaller number of rabbits were released in the richest quality habitat. Restocking during the breeding season was less successful than in other seasons. Problems concerning intraspecific competition, reproductive failure and diseases are discussed.
Keywords: Threatened predator; Rabbits restockings; Oryctolagus cuniculus; Wildlife conservation

Nora Szijarto, Zsofia Faigl, Kati Reczey, Miklos Mezes, Andras Bersenyi, Cellulase fermentation on a novel substrate (waste cardboard) and subsequent utilization of home-produced cellulase and commercial amylase in a rabbit feeding trial, Industrial Crops and Products, Volume 20, Issue 1, 5th European Symposium on Industrial Crops and Products and the 3rd International Congress and Trade Show GreenTech 2002, July 2004, Pages 49-57, ISSN 0926-6690, DOI: 10.1016/j.indcrop.2003.12.012.
(http://www.sciencedirect.com/science/article/B6T77-4BRPBY8-1/2/db726716e3c0d50a8d900687b04b6401)
Abstract:
Cellulase and amylase enzymes are increasingly being used as feed additives in animal nutrition. Those are mainly applied in order to improve the nutritional value of feed by partially degrading its fiber content, which has major importance during the early post-weaning period of young animals possessing inadequate digestive enzyme activities. Due to their commercial availability at low cost, the utilization of amylases as animal feed additive can be highly recommended, while the high price of cellulases actually makes their use as a feed additive unreasonable. A promising way to gain cheap cellulases is to conduct the enzyme fermentation process on novel substrates, which are readily available at no cost. In this study, the utilization of old corrugated cardboard (OCC) as a novel fermentation substrate has been investigated for cellulase enzyme fermentation by Trichoderma reesei Rut C-30. Batch fermentation experiments were carried out in shake-flasks and in a 30 l laboratory fermenter. The OCC feedstock proved to be a suitable fermentation substrate, a filter paper activity (FPA) of as high as 2.27 FPU ml-1 was achieved in the fermenter, which corresponds to a yield of 227 FPU g-1 cellulose. The maximum productivity achieved was 35.7 FPU l-1 h-1. The subsequent utilization of this cellulase enzyme preparation was investigated as additive of commercial rabbit compound feed in order to improve its digestibility during the early post-weaning period. In parallel, commercial amylase preparations were also tested for the same purposes. The results of animal feeding experiments showed, that enzyme supplementation of the complete feed improved production traits, as it increased the digestibility of nutrients and thus reduced the mortality caused by digestive disorders.
Keywords: Enzyme production; Trichoderma reesei; Cellulase; Amylase; Rabbit diet

A. Szabo, M. Mezes, A. Dalle Zotte, Zs. Szendro, R. Romvari, Changes of the fatty acid composition and malondialdehyde concentration in rabbit Longissimus dorsi muscle after regular electrical stimulation, Meat Science, Volume 67, Issue 3, July 2004, Pages 427-432, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2003.11.013.
(http://www.sciencedirect.com/science/article/B6T9G-4BMC9GB-3/2/e92accc462803db34e866594d3b8296d)
Abstract:
The experiment was carried out to investigate, whether in vivo transcutaneous electrical nerve stimulation (TENS) affects the fatty acid composition and antioxidant status of rabbit Longissimus dorsi muscle. Altogether 20 Pannon White meat type rabbits were divided into two groups, from which one was routinely exposed to TENS treatment with the following settings: 2 events (each 20 min) a day/50 days, 1 channel (2 electrodes)/animal, 30 Hz, 20 [mu]s impulse length and 10 mA. The control group was not treated. After slaughtering gas chromatography analysis of the muscle showed significantly decreased stearic, arachidonic and docosahexaenoic acid proportions, while the estimated activity of the elongase enzyme decreased. The malondialdehyde concentration decreased insignificantly in the treated group, however, it followed the changes of the total highly unsaturated fatty acid amount (three or more double bonds), which decreased from 9.16% to 7.81%. The adaptation to the in vivo electrical treatment may significantly influence the meat fatty acid profile, especially PUFA proportion.

C. Larzul, R. G. Thebault, D. Allain, Effect of feed restriction on rabbit meat quality of the Rex du Poitou(R), Meat Science, Volume 67, Issue 3, July 2004, Pages 479-484, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2003.11.021.
(http://www.sciencedirect.com/science/article/B6T9G-4BHVFR2-5/2/47bba85c23e66a31139653a2dca38e6f)
Abstract:
Two orylag(R) rabbit genotypes, Castor and Chinchilla, feed restricted from 8 to 18 weeks of age at 130 g/d or fed ad libitum, were compared for growth, feed efficiency, carcass traits, and meat sensory characteristics. The total body electrical conductivity (ToBEC) value was also measured to predict meat quality. The feeding level was more restrictive for Castor than for Chinchilla rabbits (74% and 90%, respectively). As expected, growth, feed efficiency, carcass yield and adiposity were altered in both genotypes with feed restriction. For restricted animals, tenderness, juiciness, flavour, flouriness, stickiness and fatness were not affected by the genotype. Feed restriction only significantly decreased flouriness in the Castor genotype. Correlations between meat characteristics and sensory traits were low, and the ToBEC value was not correlated with organoleptic quality.
Keywords: Rabbit; Growth; Feed restriction; Meat sensory traits

D. P. Lo Fiego, P. Santoro, P. Macchioni, D. Mazzoni, F. Piattoni, F. Tassone, E. De Leonibus, The effect of dietary supplementation of vitamins C and E on the [alpha]-tocopherol content of muscles, liver and kidney, on the stability of lipids, and on certain meat quality parameters of the longissimus dorsi of rabbits, Meat Science, Volume 67, Issue 2, June 2004, Pages 319-327, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2003.11.004.
(http://www.sciencedirect.com/science/article/B6T9G-4B8KB81-2/2/35f6416d1cc90b6b8f3e0b51d589b6a6)
Abstract:
The trial was carried out to investigate the effects of adding to the diet of rabbits vitamin E (40; 300; 500 ppm) and C (0; 500 ppm), on vitamin E deposition in the muscles and organs, on the oxidative stability of muscular lipids, and on various meat quality characteristics. The [alpha]-tocopherol content in muscles and organs was roughly doubled by feeding the highest levels of vitamin E; it was also increased by giving 500 ppm of vitamin C, but only in those muscles of rabbits receiving 40 ppm of vitamin E. The [alpha]-tocopherol content in tissues was negatively correlated with TBARS values of the longissimus dorsi (LD) at days 6 and 8 post mortem (p.m.). Five hundred parts per million (ppm) of vitamin C increased lipid stability of the LD at both 6 and 8 days p.m., though its effect was significant only with 40 ppm of vitamin E. Moreover, 500 ppm of vitamin C resulted in the lowest L* and highest pH values at all p.m. times, when the dietary vitamin E was equal to 40 ppm, and in the highest L* and lowest pH values when the vitamin E was equal to 300 ppm. Conversely, weight losses of the LD were the lowest, at days 6 and 8 p.m., in the group fed the highest levels of both vitamins.
Keywords: Rabbit meat; Vitamin E; Vitamin C; Oxidative stability; Meat quality

Jean-Louis Chapuis, Yves Frenot, Marc Lebouvier, Recovery of native plant communities after eradication of rabbits from the subantarctic Kerguelen Islands, and influence of climate change, Biological Conservation, Volume 117, Issue 2, May 2004, Pages 167-179, ISSN 0006-3207, DOI: 10.1016/S0006-3207(03)00290-8.
(http://www.sciencedirect.com/science/article/B6V5X-49G5RP5-1/2/1ae4e2fe9c291f1a904260bdd634ece8)
Abstract:
The introduction of rabbits in 1874 into the Kerguelen archipelago had a significant impact on plant communities: the most sensitive species Pringlea antiscorbutica and Azorella selago disappeared and Acaena magellanica became dominant in most of the coastal areas. To study the recovery of

native plant communities, rabbits were eradicated by poisoning on two islands. This produced a significant increase in species richness on both islands with a decline in the cover of some native species (primarily A. magellanica) and an increase in the abundance of alien species (especially Taraxacum officinale). Other native species showed signs of increased abundance but overall responses were slow. These trends are obviously due to the removal of grazing, but recent changes in climatic conditions (warming and drought) may also be responsible for the decline or slow recovery of native species, and for the success of introduced species. Owing to the effects of present climate changes on plant communities, eradication of alien herbivores may not be always appropriate for the conservation of native biota in the subantarctic islands, and regulation of populations should be explored.
Keywords: Alien mammals; Invasive species; Plant communities; Climate change; Subantarctic islands

T. Astruc, G. Bielicki, J. P. Donnat, J. P. Renou, X. Fernandez, G. Monin, Lack of effects of hyperkalemia on the metabolism of normoxic or anoxic rabbit triceps brachii muscle, Meat Science, Volume 67, Issue 1, May 2004, Pages 15-18, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2003.09.001.
(http://www.sciencedirect.com/science/article/B6T9G-49P48NX-2/2/70df913532a23e01ed8750cc27669880)
Abstract:
Rabbit triceps brachii muscle was perfused with bovine red cells medium. Changes in phosphorus compounds and intracellular pH were followed using 31P NMR during 15 min in the perfused muscle and during 50 min in muscle made anoxic by perfusion stop. Potassium levels in perfusate was maintained at 4 mM (normal plasma concentration at rest) during all perfusion in one muscle and at 4 mM for 10 min then 10 mM during 5 min before perfusion stop in the contralateral muscle. The intracellular pH and phosphorylated compounds content remained stable in the perfused muscle whatever the potassium concentration of the perfusate. Five min after perfusion stop a decrease in phosphocreatine ($P<0.05$) and pH ($P<0.01$) and an increase in sugar-phosphates ($P<0.01$) were observed independently of potassium concentration. The lack of effect of increasing circulating potassium indicates that hyperkalemia does not affect, by itself the muscles energetic metabolism.
Keywords: Muscle metabolism; Perfused isolated muscle; Hyperkalemia; Potassium; NMR

Jose-Salvador Vicente, Maria-Pilar Viudes de Castro, Raquel Lavara, Eva Moce, Study of fertilising capacity of spermatozoa after heterospermic insemination in rabbit using DNA markers, Theriogenology, Volume 61, Issues 7-8, May 2004, Pages 1357-1365, ISSN 0093-691X, DOI: 10.1016/j.theriogenology.2003.08.009.
(http://www.sciencedirect.com/science/article/B6TCM-49WPS54-6/2/6aa1509adab35a18c2289005709e54f1)
Abstract:
The aim of this study was to evaluate the fertilising capacity of males belonging to a rabbit line selected for growth rate using heterospermic insemination and genetic markers. Semen from five males was used to make pools of three of them, and to perform homospermic insemination. Insemination was carried out in receptive multiparous lactating does with 6 million spermatozoa per insemination dose. DNA from 360 young rabbits born from heterospermic insemination, 5 sires and 42 does were amplified to nine microsatellite loci for determination of the offspring rate per male. Although each female was inseminated with the same number of spermatozoa from each male (2 million from a total dose of 6 million), sperm from one male was always dominant, notable differences being observed in the offspring among the males with similar semen quality (83-68% from dominant male versus 31-0% from non-dominant, $P<0.05$).
Keywords: Offspring rate; Heterospermic; Microsatellites; Rabbit

Th. Tsiligianni, A. Saratsi, U. Besenfelder, A. Anastasiadis, E. Vainas, Ph. Saratsis, G. Brem, The use of cytological examination of vaginal smears (CEVS) in the selection of rabbits for superovulation, Theriogenology, Volume 61, Issue 6, 15 April 2004, Pages 989-995, ISSN 0093-691X, DOI: 10.1016/S0093-691X(02)01293-1.
(http://www.sciencedirect.com/science/article/B6TCM-4BKPVJM-1/2/967a80ceff7be67ed8a74c4cc699d897)
Abstract:
In the present study, we examined two factors associated with the reproduction of rabbit does, cytology of vaginal smears and color of vulva, as potential predictors of the success of superovulation treatment. Vulval color and vaginal smear cytology were assessed in 55 young New Zealand does. Superovulation was then induced by a single administration of eCG (20 IU/kg BW i.m.). Does were artificially inseminated 3 days later, followed by intravenous administration of hCG (120 IU per animal). Does were classified with regard to vulval color (white, rose, red, purple), and the predominant cell type in the vaginal smear (i.e. parabasal, intermediate, superficial, or anuclear). Furthermore, we categorized cells into two groups because we usually observed parabasal and intermediate cells (Group A), and superficial and anuclear cell (Group B) in the same smear. Does were humanely killed 19 h after administration of hCG and the total numbers of corpora lutea (CLs), oocytes, and zygotes (i.e. 1-cell embryos) were determined. The zygotes were assessed by morphological appearance and classified as normal or abnormal. The color of the vulva at the time of eCG treatment did not predict the success of superovulation in terms of the number of CLs, oocytes or zygotes. Does with predominantly superficial cells in vaginal smears yielded significantly fewer CLs and oocytes-zygotes (OZ) compared to does with predominantly parabasal, intermediate, or anuclear cells ($P<0.05$). Does with predominantly superficial cells in vaginal smears tended to yield fewer normal zygotes (nZ), but this reached significance only when compared to does with predominantly parabasal cells ($P<0.05$). Does in Group A yielded significantly more ($P<0.05$) CLs, OZ and nZ compared to does in Group B. Does with predominantly parabasal and intermediate cells in vaginal smears and rose color vulva tended to yield more OZ and nZ ($P<0.05$). These results suggest that the cytology of vaginal smears may help identify does with a significantly higher likelihood of yielding low numbers of CLs, oocytes, or nZ.
Keywords: Cytology; Vaginal smears; Does; Superovulation; Rabbit

I Sotelo, I Perez-Munuera, A Quiles, I Hernando, V Larrea, M.A Lluch, Microstructural changes in rabbit meat wrapped with Pteridium aquilinum fern during postmortem storage, Meat Science, Volume 66, Issue 4, April 2004, Pages 823-829, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2003.08.014.
(http://www.sciencedirect.com/science/article/B6T9G-49PYNNC-F/2/4bd358dc5e2cbc3d837c58c7ede15686)
Abstract:
This work studied the microstructural degradation of rabbit semimembranosus muscle wrapped with Pteridium aquilinum fern fronds, stored at 4 [degree sign]C during the first 72 h postmortem. At the microstructural level, practically all the perimysial and endomysial connective tissue was destroyed and a small degradation of the myofibrils could be observed after the first 24 h postmortem; in addition, a degradation of the sarcolemma and the generation of numerous gaps were seen. After 32 h postmortem, tissue fibres were broken, cell membranes were more strongly degraded, and the connections between the sarcolemma and the myofibrils had disappeared. After 72 h postmortem, intercellular connections became degraded inside the muscle bundles and intercellular gaps became larger. The proteolytic activity is attributed to fern endogenous enzymatic activity in addition to the typical endogenous enzymatic activity of meat postmortem.
Keywords: Rabbit; Fern; Meat; Microstructure

J. M. Rommers, R. Meijerhof, J. P. T. M. Noordhuizen, B. Kemp, The effect of level of feeding in early gestation on reproductive success in young rabbit does, Animal Reproduction Science, Volume 81, Issues 1-2, March 2004, Pages 151-158, ISSN 0378-4320, DOI: 10.1016/j.anireprosci.2003.09.001.
(http://www.sciencedirect.com/science/article/B6T43-4BHH20N-2/2/55f6941e3edd5a1dd71b31263db8a638)
Abstract:
An experiment examined the effect of restricted feeding during early gestation on later feed intake and on kindling performance in young rabbit does. Nulliparous rabbit does (n=94) were inseminated at 14.5 weeks of age. During the first 10 days of gestation, does were fed individually either to appetite (AL) or 1.35 times maintenance requirement (R). After 10 days of gestation, all animals were fed to appetite. Does were weighed at insemination and after kindling. Feed intake was recorded during the first 10 days of gestation and weekly, thereafter. The number of does that kindled, number of live and stillborn kits and litter weight was recorded. The experiment ended after kindling. During feed restriction, AL does consumed 70 g/day more on an average than R does (209 and 139+/-4 g for AL and R, respectively; P<0.001). In the first and second week after feed restriction, compensatory feed intake occurred. Restrictive fed does ate more than AL does (+34+/-5 g/day from days 11 to 17 of gestation; P<0.001; +17+/-6 g/day from days 18 to 24 of gestation; P<0.05). In the last week of gestation, feed intake of AL and R was comparable (89 and 100+/-5 g, respectively). At kindling, AL does had consumed 8+/-3 g/day more feed over the total gestation period than R does (P<0.04). Feeding level during early gestation neither affected the kindling rate (83%), total litter size (7.9+/-0.4) nor the number of does with stillborn kits (10 versus 9 for AL and R, respectively). Regardless of treatment, in the last week of gestation (days 25-32) the number of does with stillbirth was lower and average birth weight was higher (P<0.01) in does eating more than the average daily feed intake compared to does eating below average. Based on the results of this study it was concluded that feed restriction for 10 days in early gestation does not affect kindling performance of young does, but feed intake in the last week of gestation affects kit survival and birth weight.
Keywords: Rabbit; Gestation; Feed intake; Mortality

S. Bas, A. Bas, J. C. Estepa, R. Mayer-Valor, M. Rodriguez, Escolastico Aguilera-Tejero, Parathyroid gland function in the uremic rabbit, Domestic Animal Endocrinology, Volume 26, Issue 2, March 2004, Pages 99-110, ISSN 0739-7240, DOI: 10.1016/j.domaniend.2003.08.006.
(http://www.sciencedirect.com/science/article/B6T62-4B6K8R9-1/2/1314b450bcf1d5be81c371dfc0f82bf9)
Abstract:
Rabbits with renal failure have been reported to be hypercalcemic and to have decreased parathyroid hormone (PTH) concentrations. Thus, it would seem that uremic rabbits are resistant to secondary hyperparathyroidism (HPT). The work reported here was designed to investigate parathyroid gland function in uremic rabbits and the effect of diets with different calcium (Ca) and phosphorus (P) content. The relationship between PTH and ionized calcium (Ca2+), parathyroid gland size and parathyroid cell cycle were studied in three groups of rabbits: Group I, rabbits with normal renal function on a standard diet (Ca=1.2%, P=0.6%); Group II, partially nephrectomized rabbits on a standard diet; and Group III, partially nephrectomized rabbits on a low Ca (0.6%)-high P (1.2%) diet. Group I rabbits had baseline Ca2+=1.71+/-0.05 mmol/l and PTH=26.9+/-3.2 pg/ml. During hypo- and hypercalcemic stimulation PTH reached maximal values (PTHmax) of 94.4+/-5.5 pg/ml and minimal concentrations (PTHmin) of 3.2+/-0.2 pg/ml. Rabbits from Group II were hypercalcemic (baseline Ca2+=2.03+/-0.06 mmol/l) and had very low PTH levels (1.7+/-0.5 pg/ml); however, they reached a PTHmax that was similar to Group I, 92+/-8.7 pg/ml. Group III rabbits were hypocalcemic (baseline Ca2+=1.22+/-0.08 mmol/l) and had very high basal PTH levels

(739+/-155 pg/ml). Their PTHmax and PTHmin were 801+/-169.4 pg/ml and 102.2+/-22.2 pg/ml, respectively. Both parathyroid gland size and parathyroid cell proliferation were increased in Group III. In conclusion, our results show that the Ca and P content of the diet markedly influence PTH secretion in the uremic rabbit and that when placed on a low Ca-high P diet uremic rabbits develop secondary HPT.
Keywords: Rabbit; PTH; Calcium; Hyperparathyroidism; Uremia

G. Xiccato, Angela Trocino, A. Sartori, P. I. Queaque, Effect of parity order and litter weaning age on the performance and body energy balance of rabbit does, Livestock Production Science, Volume 85, Issues 2-3, 16 February 2004, Pages 239-251, ISSN 0301-6226, DOI: 10.1016/S0301-6226(03)00125-8.
(http://www.sciencedirect.com/science/article/B6T9B-491J0HP-2/2/92f5e61d15102fdd1bd8ee431aea3f3d)
Abstract:
This study aimed to evaluate the effects of doe parity order and litter weaning age on reproductive performance and lactation and body energy balance of rabbit does from one kindling to the following. To this aim, 138 lactating does of three parity orders (first, second and third kindling: K1, K2 and K3) were remated 11 days after kindling. Their litters were weaned at 21, 26 and 32 days of age in a 3x3 factorial arrangement (three parity orders by three weaning ages). Thirty does at initial kindling and 69 pregnant does at final kindling were slaughtered to determine body tissue and energy balance. When increasing parity order, milk production, feed and digestible energy intake during lactation increased linearly while body energy deficit decreased (from -20.5% of the initial content in K1 does to -9.2% in K3 does). When weaning age was decreased from 32 to 21 days, body energy deficit decreased (-19.4% to -8.0%). Significant interactions between parity order and weaning age were recorded in energy balance and reproductive performance. According to these results, multiparous does showed a lower but still relevant energy deficit than primiparous does. Early weaning permitted us to reduce body energy deficit, especially at lower parity orders.
Keywords: Rabbit; Parity order; Weaning age; Reproductive performance; Energy balance

A. A. Adeniji, O. A. Omonijo, The replacement value of palmkernel cake for groundnut cake in the diets of weaner rabbits, Livestock Production Science, Volume 85, Issues 2-3, 16 February 2004, Pages 287-291, ISSN 0301-6226, DOI: 10.1016/S0301-6226(02)00196-3.
(http://www.sciencedirect.com/science/article/B6T9B-4B723SH-1/2/dd15253ea4f64268a8bba566c3b53443)
Abstract:
Forty five, 4-week-old weaner crossbred rabbits were used to investigate the effect of replacing palmkernel cake (PKC) for groundnut cake (GNC) in the diets of weaner rabbits. Dietary GNC was replaced with PKC at 0, 12.5, 25, 37.5 and 50%. Increasing the level of PKC in the diets of the rabbits had no significant effect (P>0.05) on feed intake, weight gain and feed to gain ratio. There was also no treatment effect on nitrogen intake (P>0.05). However, increasing the level of PKC in the diet had a significant effect on faecal nitrogen, urinary nitrogen, nitrogen balance and nitrogen digestibility. Feed cost decreased with increase in the level of PKC replacement. The results showed that PKC could replace up to 37.5% of dietary GNC level in the diets of weaner rabbits without adverse effects on performance.
Keywords: Groundnut cake; Palmkernel cake; Replacement; Weaner rabbits

Elena Angulo, Rafael Villafuerte, Modelling hunting strategies for the conservation of wild rabbit populations, Biological Conservation, Volume 115, Issue 2, February 2004, Pages 291-301, ISSN 0006-3207, DOI: 10.1016/S0006-3207(03)00148-4.

(http://www.sciencedirect.com/science/article/B6V5X-48JCDXV-5/2/ed8e748bd3e1f246acb268d43e66cef3)
Abstract:
Recently, European wild rabbit (Oryctolagus cuniculus) populations have undergone a sharp decline that may be exacerbated by hunting. We investigate the effects of the timing of hunting on the conservation of wild rabbit using a model for rabbit population dynamics. Scenarios with different hunting rates and age strategies were simulated for different population qualities. We interviewed hunters to ascertain the degree to which they would accept a change in the timing of hunting. We also investigated the hunting pressure applied by hunters and its relationship with rabbit abundance. Modelling results indicate that the current hunting season has the greatest impact on rabbit abundance. Hunting in late spring optimises hunting extraction while conserving rabbit populations. When the rabbit population quality is low the effects of age strategies and the timing of hunting are less important than the effect of the hunting rate applied. Almost half the hunters would agree to policy changes. More than 75% of hunters implemented self-imposed hunting restrictions to improve rabbit populations, that were more frequently applied in high rabbit abundance areas. Therefore, changing the timing of hunting and increasing the participation of hunters in low abundance areas could optimise both the exploitation and the conservation of wild rabbit populations in southwestern Europe.
Keywords: European wild rabbit; Hunting timing; Oryctolagus cuniculus; Pest management; Population dynamics

A. Dal Bosco, C. Castellini, L. Bianchi, C. Mugnai, Effect of dietary [alpha]-linolenic acid and vitamin E on the fatty acid composition, storage stability and sensory traits of rabbit meat, Meat Science, Volume 66, Issue 2, February 2004, Pages 407-413, ISSN 0309-1740, DOI: 10.1016/S0309-1740(03)00127-X.
(http://www.sciencedirect.com/science/article/B6T9G-49204GN-1/2/70959221f041a621e5a23a8bc86b1aba)
Abstract:
The synergistic effect of dietary linolenic acid and vitamin E on the oxidative stability and nutritional and eating characteristics of fresh and stored rabbit meat was studied. One-hundred hybrid male rabbits were divided into two homogenous groups and fed ad libitum two diets differing in the amount of sunflower and flaxseed and in the level of [alpha]-tocopherol, as follows: control diet: 0.08 kg kg-1 sunflower, 50 mg kg-1 [alpha]-tocopheryl-acetate and LNA-VE diet: 0.08 kg kg-1 flaxseed, 200 mg kg-1 [alpha]-tocopheryl-acetate. At 85 days, 20 rabbits per group were slaughtered and the thiobarbituric-acid reactive substances (TBA-RS), chemical composition, fatty acid profile and sensory quality were assessed on the longissimus dorsi muscles (fresh and stored for 8 days at 4 [degree sign]C). The proximate composition of the fresh muscle was not significantly affected by the dietary treatment. Rabbits fed the LNA-VE diet showed a good capability to elongate and desaturate linolenic acid and this diet enriched the n-3 PUFA content of the meat without affecting its peroxidative stability. The sensory quality of the fresh and stored muscle was slightly affected by the dietary treatment, even though final tenderness (fresh meat) and overall acceptability (stored meat) of the LNA-VE rabbits showed significantly higher scores.
Keywords: Rabbit meat; Linolenic acid; Vitamin E

P. G. Ferreira, A. Costa-e-Silva, E. Monteiro, M. J. R. Oliveira, A. P. Aguas, Transient decrease in blood heterophils and sustained liver damage caused by calicivirus infection of young rabbits that are naturally resistant to rabbit haemorrhagic disease, Research in Veterinary Science, Volume 76, Issue 1, February 2004, Pages 83-94, ISSN 0034-5288, DOI: 10.1016/j.rvsc.2003.08.003.
(http://www.sciencedirect.com/science/article/B6WWR-49JX8F0-1/2/b84c2aa347237af518a0526db0f9d066)
Abstract:

Young rabbits are naturally resistant to rabbit haemorrhagic disease (RHD) caused by the same calicivirus that kills, within 3 days, nearly all adult animals. We have investigated changes in blood leukocytes, and in the morphology and biochemistry of the liver (the organ where caliciviruses replicate) of young rabbits undergoing benign infection by the RHD virus. Four-week-old rabbits were infected with a calicivirus inoculum having a titre of 212 haemagglutination units either sacrificed 18, 24, 48 and 72 h later, or kept for follow-up studies up to 21 days after inoculation. The infection caused an acute and transient decrease in blood heterophils, and sustained enhancement in hepatic transaminases. Inflammatory infiltrates of the liver were seen in all animals after 24 h of infection; they had a predominant midlobular location. Hepatocytes could present different degrees of cell damage, including cell death; these lesions were limited to the liver cells located around the inflammatory infiltrates. Liver transaminases peaked 24-48 h after calicivirus infection; this was the same timing when liver infiltration and hepatocyte damage were more evident. No alterations of other parameters of liver biochemistry were observed. We conclude that calicivirus infection of young rabbits causes a subclinical disorder characterised by an acute and transient decrease in circulating heterophils, and focal liver damage that is expressed by intralobular infiltration by heterophils, initially, and, later on, by mononuclear cells. Our finding of persistence of increased values of liver transaminases suggests chronicity of the infection in young rabbits. We propose that, although resistant to RHD, young rabbits infected by calicivirus may be long-term carriers of the infectious agent and, thus, become a major source of transmission of the virus.
Keywords: Liver pathology; Transaminases; Electron Microscopy; Leukocytes

S. Hochi, T. Terao, M. Kamei, M. Kato, M. Hirabayashi, M. Hirao, Successful vitrification of pronuclear-stage rabbit zygotes by minimum volume cooling procedure, Theriogenology, Volume 61, Issues 2-3, 15 January 2004, Pages 267-275, ISSN 0093-691X, DOI: 10.1016/S0093-691X(03)00232-2.
(http://www.sciencedirect.com/science/article/B6TCM-49HXFY5-7/2/b715c3492ae2008e78d68d583baf3561)
Abstract:
Rabbit zygotes at the pronuclear-stage were cryopreserved by vitrification using a gel-loading tip (GL-tip), Cryoloop or Cryotop. In GL-tip and Cryoloop methods, zygotes were first exposed to 10% ethylene glycol (EG)+10% DMSO in TCM199+20% fetal bovine serum (FBS) for 2 min, and then equilibrated for 30 s in a vitrification solution composed of 20% EG+20% DMSO+0.6 M sucrose in TCM199+20% FBS. In Cryotop method, zygotes were first exposed to 7.5% EG+7.5% DMSO+20% FBS in TCM199 for 3 min, and then equilibrated for 1 min in a vitrification solution composed of 15% EG+15% DMSO+0.5 M sucrose+20% FBS in TCM199. In vitro culture of vitrified-warmed zygotes using GL-tip and Cryoloop resulted in low cleavage rates (2 and 5%, respectively) and no development into blastocysts. In contrast, zygotes vitrified-warmed using Cryotop exhibited higher proportions of cleavage (58%) and development into blastocysts (24%). When compacted morulae or early blastocysts were vitrified by these three procedures, 80-93% of them exhibited blastocoele expansion or zona hatching during the subsequent 48 h of culture. Use of Cryotop instead of GL-tip or Cryoloop for zygote vitrification, without changing conditions of solutions and periods for exposure, equilibration and post-warm dilution, resulted in cleavage and blastocyst development rates of 88 and 45%, respectively. A longer exposure time (10 min) of zygotes to 7.5% EG+7.5% DMSO+20% FBS in TCM199 resulted in higher proportions of zygotes cleaving (94%) and developing into blastocysts (51%) after Cryotop vitrification. Proportions of post-warm zygotes (10-min exposure group) and fresh control zygotes developing into newborn offspring were 36 and 53%, respectively. Pronuclear-stage rabbit zygotes were successfully cryopreserved by vitrification using the Cryotop method.
Keywords: Cryoloop; Cryotop; Gel-loading tip; Rabbit zygotes; Vitrification

Ling-ru Chu, Joseph P. Garner, Joy A. Mench, A behavioral comparison of New Zealand White rabbits (Oryctolagus cuniculus) housed individually or in pairs in conventional laboratory cages, Applied Animal Behaviour Science, Volume 85, Issues 1-2, 12 January 2004, Pages 121-139, ISSN 0168-1591, DOI: 10.1016/j.applanim.2003.09.011.
(http://www.sciencedirect.com/science/article/B6T48-4B4295B-6/2/621d0bdccd3610f2e921a2e6cf9326e4)
Abstract:
Despite their gregarious nature, rabbits used for research are often housed individually due to concerns about aggression and disease transmission. However, conventional laboratory cages restrict movement, and rabbits housed singly in these cages often perform abnormal behaviors, an indication of compromised welfare. Pairing rabbits in double-sized cages could potentially improve welfare by providing both increased space and social stimulation. We compared the behavior of female New Zealand White rabbits (Oryctolagus cuniculus) housed either individually (N=4) in cages measuring 61 cmx76 cmx41 cm or in non-littermate pairs (four pairs) in double-wide cages measuring 122 cmx76 cmx41 cm. The rabbits were kept under a reversed photoperiod (lights on 22:00-12:00 h). Each rabbit was observed five times per week for 5 months, using 15-min focal animal samples taken between 08:00-09:00, 12:00-13:00, and 16:00-17:00 h. Data were analyzed using a repeated measures General Linear Model (GLM). Over the 5 months, individually housed rabbits showed an increase in the proportion of the total behavioral time budget spent engaged in abnormal behaviors (digging, floor chewing, bar biting), from 0.25 to 1.77%, while pairs remained unchanged at 0.95% (treatmentxtime interaction, F1,24=4.60; P<=0.0422). Paired rabbits engaged in more locomotor behavior (F1,6=16.49; P<=0.0066) than individual rabbits (average proportions of time budget: 2.71 and 0.70% for paired and individual rabbits, respectively), which may be important because caged rabbits are susceptible to osteoporosis and other bone abnormalities due to the restricted ability to move. Time spent feeding and body weights of dominant and subordinate rabbits in a pair did not differ, indicating that food competition was not a problem, and paired rabbits were often observed in physical contact (26.7% of data records) although the size of the cages allowed physical separation. Aggression between pairmates did not increase significantly during the study. However, one pair did have to be separated at the end of the study due to bite wounds from persistent aggression. Thus, although methods for decreasing injurious aggression require further investigation, the beneficial effects of pair housing in decreasing abnormal behaviors and increasing locomotion suggest that pair housing should be considered as an alternative to individual housing for caged laboratory rabbits.
Keywords: Rabbits; Animal welfare; Pair housing; Social enrichment; Abnormal behaviour

V. O. Fuentes, C. Villagran, J. Navarro, Sexual behavior of male New Zealand white rabbits in an intensive production unit, Animal Reproduction Science, Volume 80, Issues 1-2, January 2004, Pages 157-162, ISSN 0378-4320, DOI: 10.1016/S0378-4320(03)00007-1.
(http://www.sciencedirect.com/science/article/B6T43-493HNT9-1/2/d40ac138ea21706c87798cd76311d5bb)
Abstract:
Sexual behavior in the male white New Zealand rabbit in intensive production units is not fully documented. Therefore, the objective of this work was to provide further information about the sexual behavior of this species in intensive production systems. Fourteen 6- to 12-month-old rabbits were studied for 6 months (July/December) when housed individually under natural photoperiod (19[degree sign] latitude north). They were mated once a week. When mated they were exposed at 6-min intervals to five oestrous females. The number of mounts, time between mounts, time and number of ejaculations, time between ejaculations, and also enuresis, grasping and kicking were recorded. Mounts (n=222) were observed and recorded. Males mated one to five times during each evaluative session. Enuresis was present only in one observation. Sexual agressivness such as grasping and kicking was present during 142 and 133 matings. Time for

mounting and ejaculation in accumulated means (minutes, seconds, tenths) from the first to the fifth mount were noted and an accumulative average of 4.20 min for the fifth mounting was noted. Minimum times for ejaculation and next mating was 00:17:00 min and maximum was 05:33:03 min. It was concluded that sexual behavior in white New Zealand male rabbits remained unchanged through the duration of the period of study.
Keywords: Rabbits; Sexual behavior; Mounting; Ejaculation

F.A. Cervantes, C. Lorenzo, F.X. Gonzalez-Cozatl, The Omiltemi rabbit (Sylvilagus insonus) is not extinct, Mammalian Biology - Zeitschrift fur Saugetierkunde, Volume 69, Issue 1, January 2004, Pages 61-64, ISSN 1616-5047, DOI: 10.1078/1616-5047-117.
(http://www.sciencedirect.com/science/article/B7GX2-4DTSNJ0-3N/2/f4ec023efee6974f23f01cd466b5cce6)
Keywords: Sylvilagus insonus; Guerrero; Mexico; rabbit; extinction

S. Combes, J. Lepetit, B. Darche, F. Lebas, Effect of cooking temperature and cooking time on Warner-Bratzler tenderness measurement and collagen content in rabbit meat, Meat Science, Volume 66, Issue 1, January 2004, Pages 91-96, ISSN 0309-1740, DOI: 10.1016/S0309-1740(03)00019-6.
(http://www.sciencedirect.com/science/article/B6T9G-4834HXG-C/2/6186bed530818f88a9731a308b442ff5)
Abstract:
The effects of cooking temperature (50-90 [degree sign]C) and time (10-120 min) on Warner-Bratzler (WB) tenderness measurement of longissimus lumborum (LL) muscle in 70-day-old rabbits were investigated. Cooking losses, total collagen content and collagen solubility of LL muscle were measured in parallel. Increasing cooking temperature caused a four-phase effect on WB measurement. Stress and total energy were significantly increased between raw meat and cooked meat at 50 [degree sign]C, then they dramatically decreased to a minimum observed at 60-65 [degree sign]C, and increased again to reach a maximum at 80-90 [degree sign]C. Cooking losses exhibited an 83% increase between 50 and 80 [degree sign]C. At 80 [degree sign]C, stress and total energy values remained constant after 20 and 40 min respectively. LL muscle collagen content was 16.4+/-2.3 mg/g of dried muscle. Collagen solubility at 77 [degree sign]C for 1 h was high: 75.3+/-8.1%.
Keywords: Rabbit; Meat; Cooking; Warner-Bratzler measurement; Mechanical properties

C. Corino, F. Filetti, M. Gambacorta, A. Manchisi, S. Magni, G. Pastorelli, R. Rossi, G. Maiorano, Influence of dietary conjugated linoleic acids (CLA) and age at slaughtering on meat quality and intramuscular collagen in rabbits, Meat Science, Volume 66, Issue 1, January 2004, Pages 97-103, ISSN 0309-1740, DOI: 10.1016/S0309-1740(03)00024-X.
(http://www.sciencedirect.com/science/article/B6T9G-4834HXG-B/2/d002650d012f70e5c280826f57ea6955)
Abstract:
To assess the effects of dietary conjugated linoleic acids (CLA) on meat composition and intramuscular collagen (IMC), 144 New Zealand White rabbits, half males half females, 55 days old (1.8 kg LW), were assigned to three weight- and sex- balanced groups and given the following dietary supplements: 0.5% sunflower oil, (C); 0.25% sunflower oil plus 0.25% CLA (T1); and 0.5% CLA (T2). The CLA was prepared from sunflower oil and contained 65% CLA isomers, half cis-9, trans-11 and half trans-10, cis-12. Six males and six females from each group (total 36) were slaughtered at 76, 90 and 104 days of age (corresponding to 2.5, 2.8, and 3.1 kg BW, respectively). The lean fraction was higher and the water content significantly higher in the meat of T2 compared to C and T1 for all ages combined. At the third slaughtering (104 days) the meat fat content was significantly lower in group T2. For all ages combined, IMC content, IMC

hydroxylysylpyridinoline (HLP) concentration (index of collagen cross-linking) and IMC maturity (HLP/IMC) were significantly lower in the intermediate supplementation group (T1) compared to C and T2, and were also lower in animals slaughtered at 90 days. CLA supplementation has limited effects on the chemical composition of rabbit meat, with positive effects on meat texture and tenderness after supplementation up to 35 days at 0.25%, and a significant decrease in fat content only at high slaughter weight and high supplementation level (0.5%).
Keywords: Rabbit; Nutrition; Conjugated linoleic acid; Meat; Collagen

C. Montesissa, F. Capolongo, A. Santi, G. Biancotto, M. Dacasto, Metabolism of tilmicosin by rabbit liver microsomes and hepatocytes, The Veterinary Journal, Volume 167, Issue 1, January 2004, Pages 87-94, ISSN 1090-0233, DOI: 10.1016/S1090-0233(03)00077-7.
(http://www.sciencedirect.com/science/article/B6WXN-497R9TG-1/2/4124bf021adfba11cb92aaec40c76063)
Abstract:
We investigated tilmicosin (TIM) metabolism, at 25, 50 or 100 [mu]M, in cultures of primary hepatocytes from rabbits bred commercially for food and in liver microsomes prepared from both untreated and rifampicin (RIF)-treated rabbits. RIF is a well-known cytochrome P4503A (CYP 3A) inducer in rabbits and most macrolides are known to be substrates of CYP 3A.
No peaks in addition to those of the cis and trans forms of TIM were observed by high performance liquid chromatography (HPLC) in extracts of microsomes from untreated rabbits. When TIM was incubated with induced microsomes, at least two peaks were found by HPLC and an additional peak, eluting at shorter retention time was isolated from hepatocytes incubated for 24 h with the macrolide.
The structures of the metabolites were then estimated by liquid chromatography-mass spectrometry (LC-MS) in concentrated extracts from induced microsomes. Five metabolites were separated and putatively identified: cis and trans demethylated tilmicosin, tilmicosin N-oxide and cis and trans tilmicosin epoxide. The overall amount of metabolites produced in vitro using livers of untreated and RIF treated rabbits was very low, has also been observed in vivo and in vitro in cattle, chickens and pigs.
Keywords: Microsomes; Hepatocytes; Tilmicosin; In vitro; Metabolism; Rabbits