SCIENCEDIRECT 2007-2009

TEA (CAMELLIA SINENSIS)

LAND ECONOMICS AND POLICIES (1 JDL)

Xianchun Liao, Yaoqi Zhang, Economic impacts of shifting sloping farm lands to alternative uses,
Agricultural Systems, Volume 97, Issues 1-2, April 2008, Pages 48-55, ISSN 0308-521X, DOI: 10.1016/j.agsy.2007.11.002.
(http://www.sciencedirect.com/science/article/pii/S0308521X07001229)

Abstract:
China has been engaging in one of the world's largest ecological conservation programs, the Slope Land Conversion Program (SLCP), which is also called the grain-for-green policy. This paper is intended to address the economic impacts of shifting from farm lands to four other land use options using land expectation value (LEV). Sensitivity analyses are conducted to examine the impacts by changing interest rates, prices, wage, and tax rates. Current subsidy program is examined as well. The results show that farmers would suffer more losses for planting pine and orchard trees (citrus and chestnut) and tea when interest rates increase. In addition, planting pine trees, orchard trees, and tea create more benefits than annual crops when wage rates increase by 25%. The provision of subsidies by the government could reduce loss from shifting farm lands to alternative uses, but under the current situation (interest rate, price, wage rate and subsidy program), farmers still would prefer orchard trees and tea to pines because orchard trees and tea could generate more land value than pine trees. For the benefit of the program, several policy measures are recommended.

Keywords: Economic impacts; Faustmann model; Land expectation value; Slope land conversion program; Land uses

PLANT PROPAGATION (1 JDL)

Ai-hua YE, Chang-jun JIANG, Lin ZHU, Mei YU, Zhao-xia WANG, Wei-wei DENG, Chao-lin WEI, Cloning and Sequencing of a Full-Length cDNA Encoding the RuBPCase Small Subunit (RbcS) in Tea (Camellia sinensis),
Agricultural Sciences in China, Volume 8, Issue 2, February 2009, Pages 161-166, ISSN 1671-2927, DOI: 10.1016/S1671-2927(09)60023-7.
(http://www.sciencedirect.com/science/article/pii/S1671292709600237)

Abstract:
This study was aimed to isolate ribulose-1,5-bisphosphate carboxylase/oxygenase small subunit (RbcS) from tea plant [Camellia sinensis (L.) O. Kuntze]. In the study of transcriptional profiling of gene expression from tea flower bud development stage by cDNA-AFLP (cDNA amplified fragment length polymorphism), we have isolated some

transcript-derived fragments (TDFs) occurring in both the young and mature flower bud. One of them showed a high degree of similarity to RbcS. Based on the fragment, the full length of RbcS with 769-bp (EF011075) cDNA was obtained via rapid amplification of cDNA ends (RACE). It contained an open reading frame of 176 amino acids consisting of a chloroplast transit peptide with 52 amino acids and a mature protein of 124 amino acids. The amino acids sequence presented a high identity to those of other plant RbcS genes. It also contains three conserved domains and a protein kinase C phosphorylation site, one tyrosine kinase phosphorylation site and two N-myristoylation sites. Analysis by RT-PCR showed that the expression of RbcS in tea from high to low was leaf, young stem, young flower bud and mature flower bud, respectively. The isolation of the tea Rubisco small subunit gene establishes a good foundation for further study on the photosynthesis of tea plant.
Keywords: RbcS; tea; full-length cDNA

PLANT GENETICS AND BREEDING (2 JDL)

D.M. Kamau, J.H.J. Spiertz, O. Oenema, P.O. Owuor, Productivity and nitrogen use of tea plantations in relation to age and genotype,
Field Crops Research, Volume 108, Issue 1, 11 July 2008, Pages 60-70, ISSN 0378-4290, DOI: 10.1016/j.fcr.2008.03.003.
(http://www.sciencedirect.com/science/article/pii/S0378429008000580)
Abstract:
Lack of science-based knowledge on responses of tea bushes to nitrogen (N) in ageing tea plantations hampers the development of ecologically sound and economically profitable N-management strategies. It is hypothesized that ageing of tea plantations lowers productivity and weakens the yield response to N application. To establish insight into the relationship between ageing, productivity and N-use efficiency, seasonal and annual responses to N were studied in field experiments superimposed on a chronosequence of tea plantations (14, 29, 43, and 76 years). The two youngest plantations comprised of a clonal cultivar planted at a density of 10,766 and 13,448 plants ha-1 and the two oldest plantations of seedlings at a density of 6730 and 7179 plants ha-1, respectively. N was applied as urea at 0, 50, 100, 200, and 400 kg N ha-1 year-1. Mean annual made tea (mt) yields were higher for the clonal tea compared to the seedling tea and increased with age within genotypes. The clonal bushes out-yielded the seedlings by about 800 kg mt ha-1 under favourable weather conditions in 2003/2004, while yield differences between the genotypes were minimal under stress conditions in 2002/2003. The yields of the clonal 29- and 14-year-old plantations responded positively to N fertilizer, whereas the 43- and 76-year-old plantations did not. Within the clonal cultivar made tea yield and N uptake were closely associated. Apparent shoot N-recovery (ASNR) based on N uptake by `two leaves and a bud' was higher in clonal than in seedling tea plantations. A simple N-balance sheet showed that N excess was strongly associated with the rate of N application and N uptake. The effect of plant genotype on productivity was greater than the effect of age. The genotypes (seedlings or a clonal cultivar) to a great extent determined the yield response to N. In a well-managed mature tea plantation of up to 80 years, ageing did

not lower the yielding ability within the same genotype. Thus, planting improved genotypes and implementing appropriate N-management strategies are key factors to avoid the risk on decline of productivity and profitability associated with ageing and bush degradation. N-management strategies should be based on the yielding potential of tea bushes in the target environment as defined by plant genotype and age of plantations.

Keywords: Camellia sinensis (L.); Clone; Seedlings; Made tea yield; N uptake; Ageing of tea bushes

Liang CHEN, Fu-lian YU, Ming-zhe YAO, Bo LU, Kun YANG, Yuan-yuan DU, Preparation of the UPOV Guidelines for the Conduct of Tests for Distinctness, Uniformity and Stability-Tea Plant [Camellia sinensis (L.) O. Kuntze],

Agricultural Sciences in China, Volume 7, Issue 2, February 2008, Pages 224-231, ISSN 1671-2927, DOI: 10.1016/S1671-2927(08)60043-7.
(http://www.sciencedirect.com/science/article/pii/S1671292708600437)

Abstract:
Distinctness, Uniformity and Stability (DUS) testing is the technical base of Plant Variety Protection (PVP) and the scientific basis for the approval of Plant Breeder's Rights (PBR). DUS Test Guidelines are not only the technical manuals for the DUS testing authorities to conduct the testing, but also the technical standards for the competent authorities to examine the DUS of new varieties of plants. Tea plant, originated from Yunnan Province, China, is a very important woody cash species in the world. The International Union for the Protection of New Varieties of Plants (UPOV) DUS Test Guidelines for tea plant is the first Test Guidelines prepared by China for the UPOV. In this article, the subject, selection, and determination of characteristics, states of expression of characteristics and the selection of example varieties, assessment of the UPOV DUS Test Guidelines for tea plant were elucidated in detail. Finally, the proposal of PVP for tea plant in China was also proposed. The preparation of UPOV DUS Test Guidelines for tea plant will have important significance both for promoting the development of PVP and increasing the status of international PVP fields for China.

Keywords: Distinctness; Uniformity and Stability; Plant Variety Protection; tea plant; Test Guidelines; International Union for the Protection of New Varieties of Plants (UPOV)

PLANT PHYSIOLOGY AND BIOCHEMISTRY (16 JDL)

Akio Morita, Osamu Yanagisawa, Satoshi Takatsu, Setsuko Maeda, Syuntaro Hiradate, Mechanism for the detoxification of aluminum in roots of tea plant (Camellia sinensis (L.) Kuntze),

Phytochemistry, Volume 69, Issue 1, January 2008, Pages 147-153, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2007.06.007.

(http://www.sciencedirect.com/science/article/pii/S0031942207003986)

Abstract:
To determine the mechanism of aluminum (Al) detoxification in the roots of tea plants (Camellia sinensis (L.) Kuntze), the amounts of Al and Al-chelating compounds (fluoride (F), organic acids and catechins) were measured and the chemical forms of Al in root cell extracts were identified by the application of 27Al-nuclear magnetic resonance (NMR) spectroscopy. Tea plants were cultivated in nutrient solutions containing 0, 4, 1.0 and 4.0 mM of Al at pH 4.2 for approximately 10 weeks. The levels of soluble Al, water-soluble oxalate and citrate, but not F, malate or catechins in young roots increased with an increase in the concentration of Al in the treatment solution. The 27Al NMR spectra of root tips and cell sap extracted from root tips that had been treated with Al were almost identical and had four signals, with two (11 and 16 ppm) apparently corresponding to the known chemical shifts of Al-oxalate complexes. In the spectra of cell sap, the resonances at 11 and 16 ppm increased with an increase in the Al contents. These results suggest that the levels of Al-oxalate complexes increased in response to an increase in the Al level, implying that oxalate is a key Al-chelating compound in the mechanism of Al detoxification in the tea root.

Keywords: Tea plant Camellia sinensis; Theaceae; Roots; Aluminum; Oxalate; 27Al-nuclear magnetic resonance

Shaoping Nie, Mingyong Xie, Zhihong Fu, Yiqun Wan, Aiping Yan, Study on the purification and chemical compositions of tea glycoprotein,
Carbohydrate Polymers, Volume 71, Issue 4, 7 March 2008, Pages 626-633, ISSN 0144-8617, DOI: 10.1016/j.carbpol.2007.07.005.
(http://www.sciencedirect.com/science/article/pii/S0144861707003529)

Abstract:
In this paper, improvement in the method for purifying glycoprotein from green tea (Camellia sinensis) was described; some properties and chemical compositions of tea glycoprotein (TGP) were determined by HPGPC, FT-IR, GC-MS technologies. Compared to existing methods, a more compatible method for purifying TGP was proposed. This method was faster, simpler, more effective and easier to be extended to the industrial production than the method that used in our previous work. The molecular weight of TGP was 126,513 Da using HPGPC. GC-MS analysis of TGP showed that TGP was composed of seven kinds of monosaccharides, namely ribose, rhamnose, arabinose, xylose, mannose, glucose, galactose in molar ratios of 1.71:5.88:13.70:1.99:1.00:1.84:33.75. Eighteen amino acids were identified in TGP by amino acid analysis. The FT-IR spectrum of the TGP revealed also typical characteristics of polysaccharides, protein and uronic acid.

Keywords: Green tea (Camellia sinensis); Tea glycoprotein; Molecular weight; Monosaccharide composition; Amino acid composition; FT-IR

Kristin C. Lewis, Tzvia Selzer, Chen Shahar, Yael Udi, Dmitry Tworowski, Irit Sagi, Inhibition of pectin methyl esterase activity by green tea catechins,
Phytochemistry, Volume 69, Issue 14, October 2008, Pages 2586-2592, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2008.08.012.
(http://www.sciencedirect.com/science/article/pii/S003194220800366X)
Abstract:
Pectin methyl esterases (PMEs) and their endogenous inhibitors are involved in the regulation of many processes in plant physiology, ranging from tissue growth and fruit ripening to parasitic plant haustorial formation and host invasion. Thus, control of PME activity is critical for enhancing our understanding of plant physiological processes and regulation. Here, we report on the identification of epigallocatechin gallate (EGCG), a green tea component, as a natural inhibitor for pectin methyl esterases. In a gel assay for PME activity, EGCG blocked esterase activity of pure PME as well as PME extracts from citrus and from parasitic plants. Fluorometric tests were used to determine the IC50 for a synthetic substrate. Molecular docking analysis of PME and EGCG suggests close interaction of EGCG with the catalytic cleft of PME. Inhibition of PME by the green tea compound, EGCG, provides the means to study the diverse roles of PMEs in cell wall metabolism and plant development. In addition, this study introduces the use of EGCG as natural product to be used in the food industry and agriculture.
Keywords: Camellia sinensis; Theaceae; Green tea; Cuscuta pentagona; Cuscutaceae; Dodder; Castilleja indivisa; Orobanchaceae; Entireleaf Indian paintbrush; Cell wall degrading enzymes; Inhibition; Parasitism; Pectin methyl esterase; Catechins; Epigallocatechin gallate

P.D. Eungwanichayapant, S. Popluechai, Accumulation of catechins in tea in relation to accumulation of mRNA from genes involved in catechin biosynthesis,
Plant Physiology and Biochemistry, Volume 47, Issue 2, February 2009, Pages 94-97, ISSN 0981-9428, DOI: 10.1016/j.plaphy.2008.11.002.
(http://www.sciencedirect.com/science/article/pii/S098194280800209X)
Abstract:
Catechins are a group of polyphenols found in tea (Camellia sinensis var. sinensis) at high levels. They are beneficial for health. From the study on accumulation of catechins in shoots and mature leaves of a tea cultivar, Oolong No. 17, using high-performance liquid chromatography (HPLC), it was found that the amounts of most catechins in the shoots were higher than those in the mature leaves, with an exception of catechins gallate (CG) that was found in trace amounts in both the shoots and mature leaves. mRNA accumulation of genes involved in catechin synthesis was studied using reverse transcriptase-polymerase chain reaction (RT-PCR). The results showed that the mRNA accumulation of the genes were higher in the shoots than in the mature leaves. These genes included genes of phenylalanine ammonia-lyase 1 (PAL1; EC 4.3.1.5), chalcone synthase (CHS; EC 2.3.1.74), dihydroflavonol 4-reductase (DFR; EC 1.1.1.219), leucoanthocyanidin reductase (LCR; EC 1.17.1.3), and flavanone 3-hydroxylase (F3H; EC 1.14.11.9).
Keywords: Tea; Camellia sinensis; Catechins; RT-PCR; HPLC

Lin Zhu, Wei-Wei Deng, Ai- Hua Ye, Mei Yu, Zhao-Xia Wang, Chang-Jun Jiang, Cloning of two cDNAs encoding a family of ATP sulfurylase from Camellia sinensis related to selenium or sulfur metabolism and functional expression in Escherichia coli, ***Plant Physiology and Biochemistry***, Volume 46, Issues 8-9, August-September 2008, Pages 731-738, ISSN 0981-9428, DOI: 10.1016/j.plaphy.2007.03.029.
(http://www.sciencedirect.com/science/article/pii/S0981942807000848)

Abstract:
ATP sulfurylase, the first enzyme in the sulfate assimilation pathway of plants, catalyzes the formation of adenosine phosphosulfate from ATP and sulfate. Here we report the cloning of two cDNAs encoding ATP sulfurylase (APS1 and APS2) from Camellia sinensis. They were isolated by RT-PCR and RACE-PCR reactions. The expression of APS1 and APS2 are correlated with the presence of ATP sulfurylase enzyme activity in cell extracts. APS1 is a 1415-bp cDNA with an open reading frame predicted to encode a 360-amino acid, 40.5 kD protein; APS2 is a 1706-bp cDNA with an open reading frame to encode a 465-amino acid, 51.8 kD protein. The predicted amino acid sequences of APS1 and APS2 have high similarity to ATP sulfurylases of Medicago truncatula and Solanum tuberosum, with 86% and 84% identity respectively. However, they share only 59.6% identity with each other. The enzyme extracts prepared from recombinant Escherichia coli containing Camellia sinensis APS genes had significant enzyme activity.

Keywords: Cloning; cDNA; ATP sulfurylase; Camellia sinensis; Expression

Jibu Thomas, R. Raj Kumar, A.K.A. Mandal, Metabolite profiling and characterization of somaclonal variants in tea (Camellia spp.) for identifying productive and quality accession,
Phytochemistry, Volume 67, Issue 11, June 2006, Pages 1136-1142, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2006.03.020.
(http://www.sciencedirect.com/science/article/pii/S0031942206002020)

Abstract:
A study has been undertaken to characterize 15 field grown somaclonal variants derived from cotyledonary tissues of UPASI-10 using morphological, physiological and biochemical characters. Although variants were derived from UPASI-10, a very few variants possessed unique 'Chinery' characters while others exhibited 'Assam' characters. However, no variant showed identical morphological characters aligning with the parent. Somaclonal variants showed distinct variation in terms of photosynthetic carbon assimilation, stomatal conductance and diffusion resistance. Proline accumulation and water use efficiency showed marginal variations among the variants. SE 8 and SE 10 recorded higher values of membrane stability index denoting their tolerant nature against stress. Class interval analysis based on physiological parameters grouped these plants into three clusters. Three variants grouped under good category representing higher values of productivity index followed by five variants under moderate category. Green leaf constituents and quality profile of made tea produced with crop shoots of variants exhibited wide variation. Center point radar graph analysis of quality constituents grouped these plants into three clusters. Variants SE 2 and SE 13 were segregated distinctly representing their black tea characters.

When considering both the quality and productivity indices, SE 3 and SE 7 fall under moderate category and in future these two variants may be subjected to further quality tests for commercial exploitation.

Keywords: Camellia; Somaclonal variants; Physiology; Volatile flavour constituents; Tea; Productivity and quality

Jia-Hua Li, Atsushi Nesumi, Keiichi Shimizu, Yusuke Sakata, Ming-Zhi Liang, Qing-Yuan He, Hong-Jie Zhou, Fumio Hashimoto, Chemosystematics of tea trees based on tea leaf polyphenols as phenetic markers,

Phytochemistry, Volume 71, Issues 11-12, August 2010, Pages 1342-1349, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2010.05.002.
(http://www.sciencedirect.com/science/article/pii/S0031942210001779)

Abstract:
This study examined the polyphenols of tea leaves as chemotaxonomic markers to investigate the phenetic relationship between 89 wild (the small-leaved C. sinensis var. sinensis and large-leaved C. sinensis var. assamica), hybrid, and cultivated tea trees from China and Japan. (-)-Epigallocatechin 3-O-gallate, EGCG (1); (-)-epigallocatechin, EGC (2); (-)-epicatechin 3-O-gallate, ECG (3); (-)-epicatechin, EC (4); (+)-catechin, CA (5); strictinin, STR (6); and gallic acid, GA (7) were used as polyphenolic markers. Of the 13 polyphenol patterns observed, Principal Component Analysis (PCA) indicated that the structure-types of the flavonoid B-rings, such as the pyrogallol-(EGCG (1) and EGC (2)) and catechol-(ECG (3) and EC (4)) types, greatly influenced the classification. Ward's minimum-variance cluster analysis was used to produce a dendrogram that consisted of three sub-clusters. One sub-cluster (A) was composed of old tea trees `Gushu' cha (C. sinensis var. assamica) and cv `Taidi' cha, suggesting that relatively primitive tea trees contain greater amounts of compounds 3 and 4 and lower amounts of compounds 1 and 2. The other two sub-clusters B and C, made up of Chinese hybrids (sub-cluster B) and Japanese and Taiwanese tea trees (sub-cluster C), had lower contents of 3 and 4 than sub-cluster A. Therefore, PCA and cluster analysis indicated that the greater the amounts of 1 and 2 (and the lower of 3 and 4), the more recent the origin of the tea line. Based on morphological characteristics, geographical information, and the historical information on tea trees, these results show good agreement with the current theory of tea tree origins, and this suggests that the Xishuangbanna district and Puer City are among the original sites of the tea tree species.

Keywords: Cha (tea); Camellia sinensis; Theaceae; Chemical taxonomy; Flavan-3-ol; Green tea; Polyphenol; Puer tea; Yunnan macrophyllus species

Dale G. Nagle, Daneel Ferreira, Yu-Dong Zhou, Epigallocatechin-3-gallate (EGCG): Chemical and biomedical perspectives,

Phytochemistry, Volume 67, Issue 17, September 2006, Pages 1849-1855, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2006.06.020.
(http://www.sciencedirect.com/science/article/pii/S0031942206003530)

Abstract:
The compound (-)-epigallocatechin-3-gallate (EGCG) is the major catechin found in green tea [Camellia sinensis L. Ktze. (Theaceae)]. This polyphenolic compound and several related catechins are believed to be responsible for the health benefits associated with the consumption of green tea. The potential health benefits ascribed to green tea and EGCG include antioxidant effects, cancer chemoprevention, improving cardiovascular health, enhancing weight loss, protecting the skin from the damage caused by ionizing radiation, and others. The compound EGCG has been shown to regulate dozens of disease-specific molecular targets. Many of these molecular targets are only affected by concentrations of EGCG that are far above the levels achieved by either drinking green tea or consuming moderate doses of green tea extract-based dietary supplements. In spite of this, well-designed double-blinded controlled clinical studies have recently demonstrated the efficacy of green tea extracts and purified EGCG products in patients. Therefore, this review highlights results from what the authors believe to be some of the most clinically significant recent studies and describes current developments in the stereoselective total synthesis of EGCG.
Keywords: Camellia sinensis; Green tea; Catechins; Flavonols; Epigallocatechin-3-gallate; EGCG; Clinical trials; Cancer chemoprevention

K. OH, T. KATO, H.L. XU, Transport of Nitrogen Assimilation in Xylem Vessels of Green Tea Plants Fed with NH4-N and NO3-N,
Pedosphere, Volume 18, Issue 2, April 2008, Pages 222-226, ISSN 1002-0160, DOI: 10.1016/S1002-0160(08)60010-7.
(http://www.sciencedirect.com/science/article/pii/S1002016008600107)
Abstract:
An experiment was carried out to study the transport process of nitrogen (N) assimilation from tea roots by monitoring the dynamic composition of N compounds in xylem sap after 15N-NO3 and 15N-NH4 were fed to the root of tea plants (Camellia sinensis L.). Results showed that the main amino acids were glutamine, theanine, arginine, asparic acid and glutamic acid, which accounted for 49%, 17%, 8%, 7%, and 4%, respectively, of the total amino acids in the xylem sap. After the tea plants were fed with 15N-NO3 and 15N-NH4 for 48 h, the amount of total amino acids in xylem sap significantly increased and those fed with 15N-NH4 had higher increment than those with 15N-NO3. Two hours after 15N- NO3 and 15N-NH4 were fed, 15N abundance in glutamine, asparagine, glutamic acid, alanine, and arginine were detected and increased quickly over time. This indicated that it took less than 2 h for NO3-N and NH4-N to be absorbed by tea roots, incorporated into the above amino acids and transported to the xylem sap. Rapid increase in 15N-NO3 in the xylem sap of tea plants fed with 15N-NO3 indicated that nitrate could be directly transported to the xylem sap. Glutamine, theanine, and alanine were the main amino acids transported in xylem sap of tea plants fed with both 15N-NO3 and 15N-NH4.
Keywords: amino acid; 15N; nitrogen assimilation; tea plant; xylem sap

Tsutomu Hatano, Mayumi Tsugawa, Miwako Kusuda, Shoko Taniguchi, Takashi Yoshida, Sumiko Shiota, Tomofusa Tsuchiya, Enhancement of antibacterial effects of epigallocatechin gallate, using ascorbic acid,

Phytochemistry, Volume 69, Issue 18, Tannin/Polyphenol Special Issue, December 2008, Pages 3111-3116, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2007.08.013.
(http://www.sciencedirect.com/science/article/pii/S0031942207005146)

Abstract:
Although plant polyphenols such as (-)-epigallocatechin gallate (EGCG) have antibacterial activity towards methicillin-resistant Staphylococcus aureus (MRSA), such polyphenols are unstable in solution. Because the instability of polyphenols is attributable to their oxidation, we examined the effects of antioxidants and inhibitors of polyphenol oxidation on the maintenance of polyphenol antibacterial activity. The antibacterial activity of EGCG was enhanced in the presence of ascorbic acid, and ascorbic acid was the most effective for retaining the concentration of stable EGCG. On the other hand, the antibacterial activity of EGCG was lowered in the presence of casein in spite of its suppressing effect on the EGCG decrease. The effect of EGCG on the antibiotic resistance of MRSA was also enhanced in the presence of ascorbic acid. The addition of an antioxidant may affect other pharmacological effects of polyphenols in analogous ways, although this does not mean the clinical usefulness of the addition directly.

Keywords: Camellia sinensis L. (Theaceae); Antibacterial; Antibiotic resistance; Ascorbic acid; Epigallocatechin gallate; Methicillin-resistant Staphylococcus aureus; Polyphenol; Tea

Iker Hernandez, Leonor Alegre, Sergi Munne-Bosch, Enhanced oxidation of flavan-3-ols and proanthocyanidin accumulation in water-stressed tea plants,

Phytochemistry, Volume 67, Issue 11, June 2006, Pages 1120-1126, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2006.04.002.
(http://www.sciencedirect.com/science/article/pii/S0031942206002081)

Abstract:
(-)-Epicatechin (EC) and (-)-epigallocatechin gallate (EGCG), two major tea flavan-3-ols, have received attention in food science and biomedicine because of their potent antioxidant properties. In plants, flavan-3-ols serve as proanthocyanidin (PA) building blocks, and although both monomeric flavan-3-ols and PAs show antioxidant activity in vitro, their antioxidant function in vivo remains unclear. In the present study, EC quinone (ECQ) and EGCG quinone (EGCGQ), the oxidation products of EC and EGCG, increased up to 100- and 30-fold, respectively, in tea plants exposed to 19 days of water deficit. Oxidation of EC and EGCG preceded PAs accumulation in leaves, which increased from 35 to 53 mg gDW-1 after 26 days of water deficit. Aside from the role monomeric flavan-3-ols may play in PAs biosynthesis, formation of ECQ and EGCGQ strongly negatively correlated with the extent of lipid peroxidation in leaves, thus supporting a protective role for these compounds in drought-stressed plants. Besides demonstrating flavonoid accumulation in drought-stressed tea plants, we show for the first time that EC and EGCG are oxidized to their respective quinones in plants in vivo.

Keywords: Camellia sinensis; Water deficit; Antioxidants; Flavonoids; Flavan-3-ols; Proanthocyanidins; Epicatechin; Epigallocatechin gallate; Quinones

Yan Li, Takashi Tanaka, Isao Kouno, Oxidative coupling of the pyrogallol B-ring with a galloyl group during enzymatic oxidation of epigallocatechin 3-O-gallate, ***Phytochemistry***, Volume 68, Issue 7, April 2007, Pages 1081-1088, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2007.01.005.
(http://www.sciencedirect.com/science/article/pii/S0031942207000453)

Abstract:
In order to clarify the mechanism for formation of catechin oligomers during the fermentation stage of black tea manufacture, epigallocatechin-3-O-gallate, the most abundant tea flavanol in fresh tea leaves, was enzymatically oxidized and the resulting unstable quinone metabolites were converted to phenazine derivatives by treatment with o-phenylenediamine. In addition to formation of monomeric and dimeric derivatives, four trimeric derivatives were isolated whose structures were determined by application of spectroscopic methods. The derivatives differed from each other in the location of the phenazine moieties and in the atropisomerism of the biphenyl bond. The results suggested that oxidative coupling of the galloyl group with the B-ring proceeds by a quinone dimerization mechanism similar to that for production of theasinensins.

Keywords: Camellia sinensis; Theaceae; Black tea; Polyphenol; Oxidation; Epigallocatechin-3-O-gallate

Wei-Wei Deng, Shinjiro Ogita, Hiroshi Ashihara, Distribution and biosynthesis of theanine in Theaceae plants,
Plant Physiology and Biochemistry, Volume 48, Issue 1, January 2010, Pages 70-72, ISSN 0981-9428, DOI: 10.1016/j.plaphy.2009.09.009.
(http://www.sciencedirect.com/science/article/pii/S0981942809002010)

Abstract:
The theanine content of the leaves of 27 species or varieties of Theaceae plants was investigated. Theanine was present in 21 species or varieties, but in much lower amounts (<0.2 [mu]mol/g fresh weight) than the quantity detected in Camellia sinensis var. sinensis. The major free amino acids in leaves of four species belonging to the genera Schima and Eurya, were glutamic acid, aspartic acid, glutamine, asparagine, alanine and proline and content of these amino acids is similar to or higher than theanine. Accumulation of free amino acids in these plants was generally lower than in C. sinensis var. sinensis. The biosynthetic activity of theanine, assessed by the incorporation of radioactivity from [14C]ethylamine, was detected in seedlings of two species of Schima. The theanine biosynthetic activity in roots was higher than that of leaves.

Keywords: Theaceae; Amino acid; Theanine; Distribution; Biosynthesis

Jixu Yu, Yaqiong Jia, Yansu Guo, Geng Chang, Weisong Duan, Mengmeng Sun, Bin Li, Chunyan Li, Epigallocatechin-3-gallate protects motor neurons and regulates glutamate level,

FEBS Letters, Volume 584, Issue 13, 2 July 2010, Pages 2921-2925, ISSN 0014-5793, DOI: 10.1016/j.febslet.2010.05.011.
(http://www.sciencedirect.com/science/article/pii/S0014579310004047)

Abstract:
Epigallocatechin-3-gallate (EGCG) is a major component of green tea polyphenols which displays potential properties of anticancer and neuroprotection. Here we show that protection of motor neuron by EGCG is associated with regulating glutamate level in organotypic culture of rat spinal cord. In this model, EGCG blocked glutamate excitotoxicity caused by threohydroxyaspartate, an inhibitor of glutamate transporter. This property of EGCG may be not due to its intrinsic antioxidative activity, because another antioxidant could not regulate glutamate level under the same condition. These results show that EGCG may be a potential therapeutic candidate for neurodegenerative diseases involving glutamate excitotoxicity such as ALS.

Keywords: Green tea polyphenol; Glutamate excitotoxicity; Motor neuron; Spinal cord organotypic culture; Amyotrophic lateral sclerosis

Kalyan Sundar Ghosh, Tushar Kanti Maiti, Abhishek Mandal, Swagata Dasgupta, Copper complexes of (-)-epicatechin gallate and (-)-epigallocatechin gallate act as inhibitors of Ribonuclease A,

FEBS Letters, Volume 580, Issue 19, 21 August 2006, Pages 4703-4708, ISSN 0014-5793, DOI: 10.1016/j.febslet.2006.07.054.
(http://www.sciencedirect.com/science/article/pii/S0014579306008957)

Abstract:
Green tea polyphenols, which have the ability to inhibit angiogenesis, form complexes with Cu(II), a known potent stimulator of blood vessel proliferation. Copper complexes of (-)-epicatechin gallate and (-)-epigallocatechin gallate were found to inhibit the enzymatic activity of Ribonuclease A (RNase A) as revealed by an agarose gel based assay and urea denatured gel electrophoresis. The copper complexes were found to be non-competitive inhibitors of RNase A with inhibition constants in the micromolar range. Changes in the secondary structure of the protein are found to occur due to the interaction as revealed from Fourier transform infrared and circular dichroism studies.

Keywords: Copper complexes; Green tea polyphenols; Ribonuclease A; Noncompetitive inhibition; Fourier transformed infrared; Circular dichroism

M. Le Roux, J.C. Cronje, E. Joubert, B.V. Burger, Chemical characterization of the constituents of the aroma of honeybush, Cyclopia genistoides,

South African Journal of Botany, Volume 74, Issue 1, January 2008, Pages 139-143, ISSN 0254-6299, DOI: 10.1016/j.sajb.2007.08.006.
(http://www.sciencedirect.com/science/article/pii/S0254629907003584)

Abstract:
A high-capacity headspace sample enrichment probe (SEP) was used in conjunction with gas chromatography-mass spectrometry (GC-MS) to analyse the volatile organic compounds present in the aroma of dry or infused, unfermented (green) and fermented C. genistoides, one of the South African Cyclopia species from which a herbal tea, known as honeybush tea, is made. Seventy-seven compounds were identified in the volatile fraction of the aroma of dry, green C. genistoides, comprising, inter alia, a large number of saturated and unsaturated alcohols, aldehydes and methyl ketones. In the aroma of dry, as well as infused, fermented C. genistoides, 79 compounds were identified, 46 of which were terpenoids that were mostly present in much lower relative concentrations in the unfermented material. The methodology developed and the results obtained in the analysis of the aroma of C. genistoides provide a basis for ongoing comparative studies on the chemical composition of a series of prominent Cyclopia species with the view to developing a rapid screening device and protocol for honeybush tea evaluation.
Keywords: Aroma profile; Cyclopia genistoides; Headspace-GC-MS; Honeybush tea; Terpenoids; Volatile organic compounds

PLANT PHYSIOLOGY-NUTRITION (6 JDL)

Hiroshi Ashihara, Hiroshi Sano, Alan Crozier, Caffeine and related purine alkaloids: Biosynthesis, catabolism, function and genetic engineering,
Phytochemistry, Volume 69, Issue 4, February 2008, Pages 841-856, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2007.10.029.
(http://www.sciencedirect.com/science/article/pii/S0031942207006346)
Abstract:
Details of the recently elucidated biosynthetic pathways of caffeine and related purine alkaloids are reviewed. The main caffeine biosynthetic pathway is a sequence consisting of xanthosine --> 7-methylxanthosine --> 7-methylxanthine --> theobromine --> caffeine. Genes encoding N-methyltransferases involved in three of these four reactions have been isolated and the molecular structure of N-methyltransferases investigated. Pathways for the catabolism of caffeine have also been studied, although there are currently no reports of enzymatic and genetic studies having been successfully carried out. Metabolism of purine alkaloids in species including Camellia, Coffea, Theobroma and Ilex plants is summarised, and evidence for the involvement of caffeine in chemical defense and allelopathy is discussed. Finally, information is presented on metabolic engineering that has produced coffee seedlings with reduced caffeine content, and transgenic caffeine-producing tobacco plants with enhanced disease resistance.
Keywords: Camellia sinensis; Theaceae; Coffea sp.; Rubiaceae; Theobroma cacao; Sterculiaceae; Review; Metabolism; Caffeine

Chun-Fang GUO, Yun SUN, Chang-Song CHEN, Rong-Bing CHEN, Mu-Qing ZHANG, Comparison and Cluster Analysis of Photosynthetic Characters and Water Use Efficiency in Tea (Camellia sinensis) Cultivars,
Acta Agronomica Sinica, Volume 34, Issue 10, October 2008, Pages 1797-1804, ISSN 1875-2780, DOI: 10.1016/S1875-2780(09)60010-9.
(http://www.sciencedirect.com/science/article/pii/S1875278009600109)
Abstract:
Photosynthetic parameters in leaves of 52 tea cultivars were determined under field conditions. Significant differences ($P < 0.01$) among cultivars were observed in net photosynthesis rate (Pn), transpiration rate (Tr), stomatal conductance (Gs), intercellular CO2 concentration (Ci), and water use efficiency (WUE). Based on these parameters, the first 3 principal components were chosen for further analyses. Their cumulative contribution of variance was more than 96.98%. Parameters Pn, Tr, and Gs were the main factors in the first principal component, and WUE and Ci were the main factors in the second and the third principal components, respectively. Fifty-two cultivars were classified into 5 clusters based on Pn, Tr, Gs, and WUE. Cluster I consisted of 15 cultivars characterized with high Pn, medium Tr, high Gs, and high WUE. Therefore, this group was favorable for improving tea cultivars. Five discrimination models with good distinguishability were set up based on Pn, Tr, Gs and WUE.
Keywords: tea (Camellia sinensis); photosynthetic parameter; pheneticclassification; cluster analysis

Hiroshi Ashihara, Wei-Wei Deng, William Mullen, Alan Crozier, Distribution and biosynthesis of flavan-3-ols in Camellia sinensis seedlings and expression of genes encoding biosynthetic enzymes,
Phytochemistry, Volume 71, Issues 5-6, April 2010, Pages 559-566, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2010.01.010.
(http://www.sciencedirect.com/science/article/pii/S0031942210000178)
Abstract:
The distribution of phenolic compounds in young and developing leaves, stems, main and lateral roots and cotyledons of 8-week-old tea (Camellia sinensis) seedlings was investigated using HPLC-MS2. Fourteen compounds, flavan-3-ols, chlorogenic acids, and kaempferol-O-glycosides, were identified on the basis of their retention time, absorbance spectrum, and MS fragmentation pattern. The major phenolics were (-)-epigallocatechin-3-O-gallate and (-)-epicatechin-3-O-gallate, located principally in the green parts of the seedlings. Considerable amounts of radioactivity from [ring-14C]phenylalanine were incorporated in (-)-epicatechin, (-)-epigallocatechin, (-)-epicatechin-3-O-gallate and (-)-epigallocatechin-3-O-gallate, by tissues of young and developing leaves and stems. Expression of genes encoding enzymes involved in flavan-3-ol biosynthesis, CHS, CHI, F3H, F3'5'H, DFR, ANS, ANR and LAR was investigated. Transcripts of all genes, except LAR, were more abundant in leaves and stems than in roots and cotyledons. No significant difference was found in the amount of transcript of LAR. These findings indicate that in tea seedlings flavan-3-ols are

produced by a naringenin-chalcone --> naringenin --> dihydrokaempferol pathway. Dihydrokaempferol is a branch point in the synthesis of (-)-epigallocatechin-3-O-gallate and other flavan-3-ols which can be formed by routes beginning with either a flavonoid 3'-hydroxylase mediated conversion of the flavonol to dihydroquercetin or a flavonoid 3',5'-hydroxylase-catalysed conversion to dihydromyricetin with subsequent steps involving sequential reactions catalysed by dihydroflavanol 4-reductase, anthocyanidin synthase, anthocyanidin reductase and flavan-3-ol gallate synthase.

Keywords: Camellia sinensis; Theaceae; Tea seedlings; Flavan-3-ols (aka catechins); (-)-Epigallocatechin gallate; Distribution; Biosynthesis; Gene expression

Keiko Kobayashi, Toshiaki Teruya, Kiyotake Suenaga, Yoko Matsui, Hideki Masuda, Hideo Kigoshi, Isotheasaponins B1-B3 from Camellia sinensis var. sinensis tea leaves, ***Phytochemistry,*** Volume 67, Issue 13, Reports on Structure Elucidation, July 2006, Pages 1385-1389, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2006.05.025.
(http://www.sciencedirect.com/science/article/pii/S0031942206002949)

Abstract:

Three saponins, isotheasaponins B1-B3, were isolated from the leaves of the tea plant Camellia sinensis var. sinensis, and their structures were determined to be theasapogenol B [[beta]-d-galactopyranosyl(1 --> 2)][[beta]-d-xylopyranosyl(1 --> 2)-[alpha]-l-arabinopyranosyl(1 --> 3)]-[beta]-d-gulcopyranosiduronic acid with two acyl groups by spectroscopic analysis.

Keywords: Tea leaves; Camellia sinensis var. sinensis; Theaceae; Isotheasaponin; Theasapogenol B

Yosuke Matsuo, Yuko Yamada, Takashi Tanaka, Isao Kouno, Enzymatic oxidation of gallocatechin and epigallocatechin: Effects of C-ring configuration on the reaction products,
Phytochemistry, Volume 69, Issue 18, Tannin/Polyphenol Special Issue, December 2008, Pages 3054-3061, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2007.08.007.
(http://www.sciencedirect.com/science/article/pii/S0031942207005158)

Abstract:

Tea leaf is rich in pyrogallol-type catechins, and their oxidation is important in the generation of black tea polyphenols. In the present study, the enzymatic oxidation of three pyrogallol-type catechins, (+)- and (-)-gallocatechins and (-)-epigallocatechin, was compared. The reactions yielded unstable quinone products, which were trapped as condensation products with o-phenylenediamine. The oxidation of (+)-gallocatechin proceeded very slowly compared to the reaction of (-)-epigallocatechin, and yielded a proepitheaflagallin-type dimer as the major product, though oxidation of (-)-epigallocatechin gave predominantly dehydrotheasinensin C. The cis-configuration of the C-3 hydroxyl group and the B-ring of (-)-epigallocatechin was apparently crucial for rapid and selective production of dehydrotheasinensin C. Oxidation of (-)-gallocatechin proceeded in a manner similar to that of (+)-gallocatechin, and produced an

enantiomer of the (+)-gallocatechin product. The results suggest that enzymes catalyze oxidation of the pyrogallol B-ring to the o-quinone, with subsequent non-enzymatic coupling reactions proceed under highly steric control.

Keywords: Black tea; Camellia sinensis; Theaceae; Epigallocatechin; Gallocatechin; Oxidation; Polyphenol

Frank Thielecke, Michael Boschmann, The potential role of green tea catechins in the prevention of the metabolic syndrome - A review,

Phytochemistry, Volume 70, Issue 1, January 2009, Pages 11-24, ISSN 0031-9422, DOI: 10.1016/j.phytochem.2008.11.011.
(http://www.sciencedirect.com/science/article/pii/S0031942208005888)

Abstract:
The metabolic syndrome (MetS) represents an emerging health burden for governments and health care providers. Particularly relevant for prevention and early management of MetS are lifestyle conditions including physical activity and the diet. It has been shown that green tea, when consumed on a daily basis, supports health. Many of the beneficial effects of green tea are related to its catechin, particularly (-)-epigallocatechin-3-gallate (EGCG), content. There is conclusive evidence from in vitro and animal studies which provide the concepts for underlying functional mechanisms of green tea catechins and their biological actions. An increasing number of human studies have explored the effects of green tea catechins on the major MetS conditions such as obesity, type-2 diabetes and cardiovascular risk factors. This article provides a comprehensive overview of the human studies addressing the potential benefits of green tea catechins on the MetS.The number of human studies in this field is still limited. However, the majority of human epidemiological and intervention studies demonstrate beneficial effects of green tea or green tea extracts, rich in EGCG on weight management, glucose control and cardiovascular risk factors. The optimal dose has not yet been established.The current body of evidence in humans warrants further attention. In particular, well-controlled long-term human studies would help to fully understand the protective effects of green tea catechins on parameters related to the MetS.

Keywords: Green tea catechins; EGCG; Metabolic syndrome; Obesity; Diabetes; Cardiovascular health

PLANT DISEASES (2 JDL)

D.Saravanakumar, Charles Vijayakumar, N. Kumar, R. Samiyappan, PGPR-induced defense responses in the tea plant against blister blight disease,

Crop Protection, Volume 26, Issue 4, April 2007, Pages 556-565, ISSN 0261-2194, DOI: 10.1016/j.cropro.2006.05.007.
(http://www.sciencedirect.com/science/article/pii/S0261219406001396)

Abstract:
Plant growth-promoting rhizobacteria (PGPR) bioformulations (Pseudomonas and Bacillus) were tested for their efficacy against blister blight (Exobasidium vexans) disease in tea (Camellia sinensis) under field conditions for two seasons. Among the bioformulations tested, foliar application of Pseudomonas fluorescens Pf1 at 7-d intervals consistently reduced the disease incidence of blister blight for two seasons, almost comparable with that of chemical fungicide. In addition to disease control, it also increased tea yield significantly compared to the untreated control. Induction of defense enzymes such as peroxidase, polyphenol oxidase, phenylalanine ammonia lyase, chitinase, [beta]-1,3-glucanase and phenolics were studied. The enzyme accumulation was greater in P. fluorescens Pf1-treated plants compared to control. The study revealed the probable influence of plant growth promotion and induced systemic resistance (ISR) in enhancing the disease resistance in tea plants against blister disease by PGPR bioformulations.
Keywords: PGPR; Bioformulations; Defense enzymes; Blister blight; Biotrophs; Exobasidium vexans

Abhaya Balasuriya, N.K.B. Adikaram, Some spatial, temporal and spatio-temporal considerations of wood decay of tea (Camellia sinensis), caused by Nemania diffusa (Syn. Hypoxylon vestitum),
Crop Protection, Volume 28, Issue 3, March 2009, Pages 273-279, ISSN 0261-2194, DOI: 10.1016/j.cropro.2008.11.008.
(http://www.sciencedirect.com/science/article/pii/S0261219408002159)
Abstract:
Tea stem wood decay caused by N. diffusa is confirmed here to be a soft rot. The activity of periodic pruning of tea bushes contributed to dissemination of disease through the contaminated pruning knife. Once contaminated, the infection can spread linearly in either direction at approximately 1.2 cm per annum. This compared well with the rates experienced under ex situ inoculation tests, which worked out to be 1.7 cm per annum. Field resistant tea cultivars recorded a relatively lower number of fibre cells than the field susceptible cultivars. The natural susceptibility (decay potential) of tea stem wood due to N. diffusa infection was around 69 g cm-3 yr-1, with the capacity to cause in vitro wood loss/decay in the range of 62-75%. Under natural field conditions, long-term infections accounted for an increase in disease score of about 0.3 for every 1 m rise in altitude starting from a base level of 1500 m, commensurate with a rate of increase of disease of approximately 0.01% m-1 rise per year.
Keywords: Nemania diffusa; Hypoxylon vestitum; Camellia sinensis; Chaetomium globosum; Soft rot; Spatio-temporal spread of disease

PEST OF PLANTS (1JDL)

Ananda Mukhopadhyay, Damayanti De, Pathogenecity of a baculovirus isolated from Arctornis submarginata (Walker) (Lepidoptera:Lymantriidae), a potential pest of tea growing in the Darjeeling foothills of India,
Journal of Invertebrate Pathology, Volume 100, Issue 1, January 2009, Pages 57-60, ISSN 0022-2011, DOI: 10.1016/j.jip.2008.08.006.
(http://www.sciencedirect.com/science/article/pii/S0022201108001948)
Abstract:
A granulosis virus (GV) was isolated from the diseased caterpillars of Arctornis submarginata (Walker) (Lymantriidae), a defoliating pest of tea from Darjeeling foothill region. The phase contrast and transmission electron microscopic studies identified the virus as granulosis virus. SDS-PAGE analysis of major protein of the occlusion bodies was found to be 31 kDa, characteristic for granulin. The total genomic DNA was isolated. The major band found was of molecular weight 16 kDa. Bioassay conducted with the occlusion bodies (OBs) of the virus showed LC50 value of 4.46 x 104 OBs/ml for the second instar caterpillars. Median lethal time (LT50) were 6.6 days for 1 x 104 OBs/ml, 5.09 days for 1 x 105 OBs/ml, 4.45 days for 1 x 106 OBs/ml and 3.87 days for 1 x 107OBs/ml concentrations. The results indicated the potential of the virus for its future application as microbial pesticide against A. submarginata in future.
Keywords: Pest; Arctornis submarginata; Camellia sinensis; Granulosis virus; Darjeeling

SOIL BIOLOGY (1JDL)

Wenyan Han, Sarah J. Kemmitt, Philip C. Brookes, Soil microbial biomass and activity in Chinese tea gardens of varying stand age and productivity,
Soil Biology and Biochemistry, Volume 39, Issue 7, July 2007, Pages 1468-1478, ISSN 0038-0717, DOI: 10.1016/j.soilbio.2006.12.029.
(http://www.sciencedirect.com/science/article/pii/S0038071707000120)
Abstract:
Tea (Camellia sinensis) is a globally important crop and is unusual because it both requires an acid soil and acidifies soil. Tea stands tend to be extremely heavily fertilized in order to improve yield and quality, resulting in a great potential for diffuse pollution. The microbial ecology of tea soils remains poorly understood; an improved understanding is necessary as processes affecting nutrient availability and loss pathways are microbially mediated. We therefore examined the relationships between soil characteristics (pH, organic C, total N, total P, available P, exchangeable Al), the soil microbial biomass (biomass C, biomass ninhydrin-N, ATP, phospholipid fatty acids--PLFAs) and its activities (respiration, net mineralization and nitrification). At the Tea Research Institute, Hangzhou (TRI), we compared fields of different productivity levels (low, medium and high) and at Hongjiashan village (HJS) we compared fields of different stand age (9, 50 and 90 years). At both sites tea soils were compared with adjacent forest soils. At both sites, soil pH was highest in the forest soil and decreased

with increasing productivity and age of the tea stand. Soil microbial biomass C and biomass ninhydrin-N were significantly affected by tea production. At TRI, microbial biomass C declined in the order forest>low>high>middle production and at HJS in the order stand age 50>age 9>forest>age 90. Soil pH had a strong influence on the microbial biomass, demonstrated by positive linear correlations with: microbial biomass C, microbial biomass ninhydrin-N, the microbial biomass C:organic C ratio, the microbial biomass ninhydrin-N:total N ratio, the respiration rate and specific respiration rate. Above pH(KCl) 3.5 there was net N mineralization and nitrification, and below this threshold some samples showed net immobilization of N. A principal component (PC) analysis of PLFA data showed a consistent shift in the community composition with productivity level and stand age. The ratio of fungal:bacterial PLFA biomarkers was negatively and linearly correlated with specific respiration in the soils from HJS (r2=0.93, p=0.03). Our results demonstrate that tea cultivation intensity and duration have a strong impact on the microbial community structure, biomass and its functioning, likely through soil acidification and fertilizer addition.

Keywords: Tea; Camellia sinensis; Soil microbial biomass; Phospholipid fatty acid (PLFA); ATP; Acid soil

F00D CONTAMINATION AND TOXICOLOGY(17 JDL)

Rossana M. Costa, Ana S. Magalhaes, Jose A. Pereira, Paula B. Andrade, Patricia Valentao, Marcia Carvalho, Branca M. Silva, Evaluation of free radical-scavenging and antihemolytic activities of quince (Cydonia oblonga) leaf: A comparative study with green tea (Camellia sinensis),

Food and Chemical Toxicology, Volume 47, Issue 4, April 2009, Pages 860-865, ISSN 0278-6915, DOI: 10.1016/j.fct.2009.01.019.
(http://www.sciencedirect.com/science/article/pii/S0278691509000325)

Abstract:
This study aimed to determine the phenolic profile and to investigate the antioxidant potential of quince (Cydonia oblonga) leaf, comparing it with green tea (Camellia sinensis). For these purposes, methanolic extracts were prepared and phenolics content of quince leaf was determined by HPLC/UV. The antioxidant properties were assessed by Folin-Ciocalteu reducing capacity assay and by the ability to quench the stable free radical 2,2'-diphenyl-1-picrylhydrazyl (DPPH) and to inhibit the 2,2'-azobis(2-amidinopropane) dihydrochloride (AAPH)-induced oxidative hemolysis of human erythrocytes. 5-O-Caffeoylquinic acid was found to be the major phenolic compound in quince leaf extract. Quince leaf exhibited a significantly higher reducing power than green tea (mean value of 227.8 +/- 34.9 and 112.5 +/- 1.5 g/kg dry leaf, respectively). Quince leaf extracts showed similar DPPH radical-scavenging activities (EC50 mean value of 21.6 +/- 3.5 [mu]g/ml) but significantly lower than that presented by green tea extract (EC50 mean value of 12.7 +/- 0.1 [mu]g/ml). Under the oxidative action of AAPH, quince leaf methanolic extract significantly protected the erythrocyte membrane from hemolysis in a similar manner to that found for green tea (IC50 mean

value of 30.7 +/- 6.7 and 24.3 +/- 9.6 [mu]g/ml, respectively, P > 0.05). These results point that quince leaf may have application as preventive or therapeutic agent in diseases in which free radicals are involved.

Keywords: Antioxidant activity; Cydonia oblonga; Quince leaf; Hemolysis; Phenolic compounds; Camellia sinensis

Chungang Yuan, Erle Gao, Bin He, Guibin Jiang, Arsenic species and leaching characters in tea (Camellia sinensis),

Food and Chemical Toxicology, Volume 45, Issue 12, December 2007, Pages 2381-2389, ISSN 0278-6915, DOI: 10.1016/j.fct.2007.06.015.
(http://www.sciencedirect.com/science/article/pii/S0278691507002025)

Abstract:
Tea is one of the most popular non-alcoholic beverages consumed in the world. Arsenic including species totalling to 47 Chinese tea samples from 18 tea-producing provinces in China were analyzed. By simulating the infusion process, leaching characters, effects of extraction time and temperature on arsenic extraction were investigated. Total amount of arsenic in tea leaf samples was in the range below the detection limit to 4.81 [mu]g/g. Leaching of arsenic was strongly affected by extraction time and temperature. Because arsenic leaching ability by hot water was low and most of the arsenic was left in tea leaf residues after infusion, the concentration of arsenic in tea infusion was low even when some original tea leaf samples contained high level of arsenic. The major species in tea infusion were inorganic arsenic form (arsenite AsIII and arsenate AsV). Compared with the amount of arsenic in infusion, more organic arsenic species were found in the original tea leaf samples. The contents of extractable inorganic arsenic in tea leaf samples were in the range below the detection limit to 226 ng/g. Considering ingestion dose and assuming one person (60 kg body weight) consumes 10 g of Chinese tea per day, the maximum inorganic arsenic contribution from tea infusion is 2.26 [mu]g, which is equal to 0.038 [mu]g/kg/d excluding water contribution. This value only accounts for 1.8% of provisional tolerable weekly intake (PTWI) (2.1 [mu]g/kg/d) recommended by the Food and Agriculture Organization/World Health Organization [FAO/WHO, 1989. Evaluation of certain food additives and contaminants. Thirty-third Report of the Joint FAO/WHO Expert Committee on Food Additives. WHO Technical Report Series No. 776, Geneva, World Health Organization].

Keywords: Tea; Arsenic species; Leaching characters

Ana B. Martin-Diana, Daniel Rico, Catherine Barry-Ryan, Green tea extract as a natural antioxidant to extend the shelf-life of fresh-cut lettuce, Innovative

Food Science & Emerging Technologies, Volume 9, Issue 4, October 2008, Pages 593-603, ISSN 1466-8564, DOI: 10.1016/j.ifset.2008.04.001.
(http://www.sciencedirect.com/science/article/pii/S1466856408000350)

Abstract:
Green tea extract (GT) was evaluated as a preservative treatment for fresh-cut lettuce. Different quality markers, e.g. respiration, browning, ascorbic acid and carotenoid

content were evaluated. GT concentration (0.25, 0.5 and 1 g 100 mL- 1) and temperature (20 [degree sign]C and 50 [degree sign]C) were tested. Optimal GT treatment (0.25 g 100 mL- 1 at 20 [degree sign]C) was compared with chlorine (120 ppm at 20 [degree sign]C). High GT concentrations (0.5 g 100 mL- 1 and 1.0 g 100 mL- 1) maintained better prevent ascorbic acid and carotenoid loss than 0.25 g 100 mL- 1 GT and chlorine. GT increased browning of samples, probably due to the content of polyphenols of the treatment; the use of heat-shock reduced this negative effect. GT and heat-shock combined also showed negative effects, reducing the antioxidant content (ascorbic acid and carotenoids). No significant differences were observed between chlorine and optimal GT (0.25 g 100 mL- 1 at 20 [degree sign]C) in browning appearance and sensory properties. GT better kept the antioxidant activity of the samples than chlorine.Industrial relevance
An alternative treatment for minimally processed Iceberg lettuce is tested, based on its antioxidant capacity. Minimally processed industry is constantly looking for new treatments to avoid the use of chlorine which is a standard at the moment.
Keywords: Green tea; Camellia sinensis L.; Fresh-cut lettuce; Polyphenols; Browning

I.C. Kuo, M. Falco, A. Olmedo, L. Misani, T.P. O'Brien, V.E. Reviglio, Corneal tattoo with tea infusion,
Food and Chemical Toxicology, Volume 46, Issue 6, June 2008, Pages 2303-2305, ISSN 0278-6915, DOI: 10.1016/j.fct.2008.01.052.
(http://www.sciencedirect.com/science/article/pii/S0278691508000690)
Abstract:
Except in animal models of cataractogenesis, the literature on the effects of tea infusion on ocular tissue is scant. In our patient, prolonged exposure to tea infusion may have led to a hypesthetic cornea with secondary limbal stem cell loss. In turn, the eye developed keratinization and corneal neovascularization.
Keywords: Corneal tattooing; Camellia sinensis infusion; Corneal neovascularization

Osamu Morita, Jeannie B. Kirkpatrick, Yasushi Tamaki, Christopher P. Chengelis, Melissa J. Beck, Richard H. Bruner, Safety assessment of heat-sterilized green tea catechin preparation: A 6-month repeat-dose study in rats,
Food and Chemical Toxicology, Volume 47, Issue 8, August 2009, Pages 1760-1770, ISSN 0278-6915, DOI: 10.1016/j.fct.2009.04.033.
(http://www.sciencedirect.com/science/article/pii/S027869150900194X)
Abstract:
Evidence suggests that the purported health benefits associated with green tea consumption are related to tea catechins. In the present study, potential adverse effects of a standardized heat-sterilized green tea catechin (GTC-H) preparation was investigated following gavage administration to rats at doses of 0, 120, 400, 1200 mg/kg/day for 6 months. A decaffeinated high-dose group (1200 mg/kg/day) (GTC-HDC), was included for comparison. A possibly test article-related clinical finding of

intermittent increased activity was noted in the 400 and 1200 mg/kg/day GTC-H groups, but was not considered to be adverse. Lower body weight gains without any decrease in food consumption were noted in the high-dose (1200 mg/kg/day)-treated GTC-H and GTC-HDC females. In the high-dose male GTC-H group, a lower total motor activity count for the 60-min session was noted prior to dosing at the study week 25 evaluations compared to the control group. Similar changes were not observed in the GTC-HDC group. Based on the results of this study, the no-observed-adverse-effect level (NOAEL) for GTC-H was 1200 mg/kg/day for males, the highest dose tested, and 400 mg/kg/day for females based on reduced body weight gains. The NOAEL for GTC-HDC was 1200 mg/kg/day for males and could not be determined in females.

Keywords: Green tea extract; Green tea catechins; Rat; Toxicity; Functional observational battery; Long-term effects

H. Raza, A. John, In vitro protection of reactive oxygen species-induced degradation of lipids, proteins and 2-deoxyribose by tea catechins,

Food and Chemical Toxicology, Volume 45, Issue 10, October 2007, Pages 1814-1820, ISSN 0278-6915, DOI: 10.1016/j.fct.2007.03.017.
(http://www.sciencedirect.com/science/article/pii/S0278691507001263)

Abstract:
Both the anti- and pro-oxidant effects of tea catechins, have been implicated in the alterations of cellular functions which determine their chemoprotective and therapeutic potentials in toxicity and diseases. Here, we have studied the protective mechanism (s) of three main green tea catechins namely, epicatechin (EC), epicatechin gallate (ECG) and epigallocatechin gallate (EGCG) on free radical induced oxidative degradation of membrane lipids and proteins under in vitro conditions using isolated cell free fractions from rat liver. In addition, we have also studied the effects of the tea catechins on 2-deoxyribose degradation in the presence of Fenton and Haber-Weiss oxidants. Glutathione S-transferase and cytochrome P450 2E1 activities and lipid peroxidation were found to be markedly inhibited by tea catechins. These catechins also inhibited the reactive oxygen species formation and oxidative carbonylation of subcellular proteins induced by a physiological oxidant, 4-hydroxynonenal. EGCG and the other catechins showed a time and concentration-dependent effects on the degradation of 2-deoxyribose in the presence of Fenton oxidants. Our results indicate that tea catechins prevent molecular degradation in oxidative stress conditions by directly altering the subcellular ROS production, glutathione metabolism and cytochrome P450 2E1 activity. These results may have implications in determining the chemotherapeutic use of tea catechins in oxidative stress related diseases.

Keywords: Tea catechins; Lipid peroxidation; GSH metabolism; ROS; Protein carbonylation

Ubonrat Siripatrawan, Bruce R. Harte, Physical properties and antioxidant activity of an active film from chitosan incorporated with green tea extract,

Food Hydrocolloids, Volume 24, Issue 8, November-December 2010, Pages 770-775, ISSN 0268-005X, DOI: 10.1016/j.foodhyd.2010.04.003.

(http://www.sciencedirect.com/science/article/pii/S0268005X10000652)

Abstract:
An active film from chitosan incorporated with aqueous green tea extract (GTE) was developed. The effects of GTE concentrations including 2, 5, 10 and 20% (w/v) of green tea in the film-forming solution on the film properties were determined by measuring physical properties, total polyphenolic content and antioxidant activity of the active films. Fourier Transform Infrared (FTIR) spectrometry was carried out to observe the potential modifications of the chitosan films when incorporated with GTE. The results suggested that incorporation of GTE into chitosan films improved mechanical and water vapor barrier properties and enhanced polyphenolic content and antioxidant activity of the films. Changes in the FTIR spectra of the chitosan films were observed when GTE was incorporated, suggesting some interactions occurred between chitosan and the polyphenols from GTE. This study showed the benefits of incorporation of GTE into chitosan films and the potential for using the developed film as an active packaging.

Keywords: Active packaging; Chitosan film; Green tea polyphenols; Film properties; Antioxidant activity

Subbiah Seenivasan, Narayanan Nair Muraleedharan, Residues of lambda-cyhalothrin in tea,
Food and Chemical Toxicology, Volume 47, Issue 2, February 2009, Pages 502-505, ISSN 0278-6915, DOI: 10.1016/j.fct.2008.12.010.
(http://www.sciencedirect.com/science/article/pii/S0278691508007060)

Abstract:
Field experiments were conducted at two places in Tamil Nadu (India) during dry season of 2006 to determine the residues of lambda-cyhalothrin in fresh green tea leaves and black tea. Residues were quantified at different harvest intervals of `0' (3 h), 1st, 3rd, 5th, 7th, 10th and 14th day after insecticide application. Persistence, dissipation pattern, half-life value and safe harvest interval of the insecticide in tea were calculated. Residues of lambda-cyhalothrin dissipated exponentially after application at both the locations and reached below the European Union maximum residue limit (MRL) of 1 mg/kg on the 5th day. Lambda-cyhalothrin showed that like other insecticides it followed the first order dissipation kinetics. Half-life values varied from 2.8 to 3.5 days for lambda-cyhalothrin and a safety harvest interval of 5 days is suggested for tea at the recommended dosage.

Keywords: Lambda-cyhalothrin; Residues; Tea; Persistence; Dissipation; MRL

Chong Wei Jin, Shao Ting Du, Kai Zhang, Xian Yong Lin, Factors determining copper concentration in tea leaves produced at Yuyao County, China,
Food and Chemical Toxicology, Volume 46, Issue 6, June 2008, Pages 2054-2061, ISSN 0278-6915, DOI: 10.1016/j.fct.2008.01.046.
(http://www.sciencedirect.com/science/article/pii/S0278691508000689)

Abstract:
Over consumption of copper (Cu) from food and beverages is detrimental to human health. In this study, we investigated Cu accumulation in tea leaves produced in Yuyao County in China. Copper concentrations in all tea leaves sampled from tea gardens were below 60 mg kg-1, the permissible level given by the Chinese Ministry of Health; however, 15% of the samples were over 15 mg kg-1, the allowable level of `green food' as defined by the Chinese Ministry of Agriculture. These observations indicate that Cu concentrations in tea leaves from the investigated producing areas are acceptable, but still a concern. To understand what factors affect the Cu accumulation in the tea leaves, we further analyzed soils from the tea gardens for Cu availability, pH and organic matter content. The Cu availability in soil was found to be closely correlated with the soil's H+ activity, followed by organic matter content. The soils in the tea gardens were also found to be severely acidic with the lowest pH of 3.58. The tea garden soils, if fertilized with animal manure, could also contribute to the risk of Cu contamination. Additionally, Cu concentrations in the final products of tea leaves were greatly increased by the machinery processing in factories that used copper boards at the twisting stage. In one factory, the Cu level was increased by 32.1 mg kg-1. This study suggests that both edaphic and non-edaphic factors can contribute to the final Cu accumulation in tea leaves used by consumers.
Keywords: Cu bioavailability; Organic matter; Processing stage; Soil pH; Tea garden

Joshua D. Lambert, Mary J. Kennett, Shengmin Sang, Kenneth R. Reuhl, Jihyeung Ju, Chung S. Yang, Hepatotoxicity of high oral dose (-)-epigallocatechin-3-gallate in mice, ***Food and Chemical Toxicology***, Volume 48, Issue 1, January 2010, Pages 409-416, ISSN 0278-6915, DOI: 10.1016/j.fct.2009.10.030.
(http://www.sciencedirect.com/science/article/pii/S0278691509004918)
Abstract:
The tea polyphenol (-)-epigallocatechin-3-gallate (EGCG) has been studied for chronic disease preventive effects, and is marketed as part of many dietary supplements. However, case-reports have associated the use of green tea-based supplements with liver toxicity. We studied the hepatotoxic effects of high dose EGCG in male CF-1 mice. A single dose of EGCG (1500 mg/kg, i.g.) increased plasma alanine aminotransferase (ALT) by 138-fold and reduced survival by 85%. Once-daily dosing with EGCG increased hepatotoxic response. Plasma ALT levels were increased 184-fold following two once-daily doses of 750 mg/kg, i.g. EGCG. Moderate to severe hepatic necrosis was observed following treatment with EGCG. EGCG hepatotoxicity was associated with oxidative stress including increased hepatic lipid peroxidation (5-fold increase), plasma 8-isoprostane (9.5-fold increase) and increased hepatic metallothionein and [gamma]-histone 2AX protein expression. EGCG also increased plasma interleukin-6 and monocyte chemoattractant protein-1. Our results indicate that higher bolus doses of EGCG are hepatotoxic to mice. Further studies on the dose-dependent hepatotoxic effects of EGCG and the underlying mechanisms are important given the increasing use of green tea dietary supplements, which may deliver much higher plasma and tissue concentrations of EGCG than tea beverages.

Keywords: Green tea; (-)-Epigallocatechin-3-gallate; Hepatotoxicity; Mouse; Oxidative stress

Huseyin Bozkurt, Utilization of natural antioxidants: Green tea extract and Thymbra spicata oil in Turkish dry-fermented sausage,
Meat Science, Volume 73, Issue 3, July 2006, Pages 442-450, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2006.01.005.
(http://www.sciencedirect.com/science/article/pii/S0309174006000271)

Abstract:
Effect of natural (green tea extract, Thymbra spicata oil) and synthetic antioxidants (buthylatedhydroxytoluene, BHT) on the safety (biogenic amine and TBARS values) and quality (pH, colour and sensory attributes) of sucuk (Turkish dry-fermented sausage) were investigated during the ripening periods. Addition of antioxidants decreased ($P < 0.05$) the TBARS values. It was found that natural antioxidants decreased TBARS formation more than BHT. Antioxidants reduced ($P < 0.05$) putrescine formation in the following order: green tea extract > green tea extract-T. spicata oil > T. spicata oil > BHT, and their mean values were 70.45, 76.05, 83.13, and 95.97 mg/kg, respectively. The highest tyramine concentration was observed in control sucuk prepared without any antioxidants, while the lowest was in the recipe with green tea extract as their mean values were about 99.42 and 64.31 mg/kg, respectively. The pH, L, b, and overall sensory quality were not significantly different ($P > 0.05$) with the addition of green tea extract, T. spicata oil, green tea extract-T. spicata oil. These results indicated that the most effective antioxidant was found to be green tea extract. This study pointed out that natural antioxidants were more effective than synthetic antioxidants, so they could be easily utilized in sucuk to enhance quality and provide safer products.

Keywords: Green tea extract; Thymbra spicata; Natural antioxidants; Sucuk; Biogenic amines

Osamu Morita, John F. Knapp, Yasushi Tamaki, Donald G. Stump, John S. Moore, Mark D. Nemec, Effects of green tea catechin on embryo/fetal development in rats,
Food and Chemical Toxicology, Volume 47, Issue 6, June 2009, Pages 1296-1303, ISSN 0278-6915, DOI: 10.1016/j.fct.2009.03.005.
(http://www.sciencedirect.com/science/article/pii/S0278691509001045)

Abstract:
Evidence suggests that the health benefits associated with green tea consumption are related to tea catechins. The objective of this study was to evaluate potential maternal and fetal effects of standardized heat-sterilized green tea catechins (GTC-H). GTC-H was gavage administered to mated female rats from gestation day 6 through 17, at doses of 0, 200, 600, and 2000 mg/kg/day. There were no GTC-H-related deaths or macroscopic findings. During the entire gestation period in the high-dose (2000 mg/kg/day)-treated group and during days 6-9 and 6-18 in the 600 mg/kg/day group, mean body weight gain was lower. Mean feed consumption was lower during gestation days 6-9 in the 600 mg/kg/day group and during gestation days 6-9 and 9-12 in the

2000 mg/kg/day group. Compared to the control group, mean body weights in the 600 and 2000 mg/kg/day groups were up to 5.1% and 7.7% lower during gestation days 9-20. GTC-H administration did not affect mean gravid uterine weights or intrauterine growth and survival. There were no GTC-H-related fetal malformations or developmental variations. Based on the results of this study, the no-observed-adverse-effect level (NOAEL) for GTC-H was 200 mg/kg/day for maternal toxicity, and 2000 mg/kg/day for embryo/fetal development.

Keywords: Green tea catechins; Teratology; Toxicity; Embryonic development

Hye-Kyung Na, Young-Joon Surh, Modulation of Nrf2-mediated antioxidant and detoxifying enzyme induction by the green tea polyphenol EGCG,

Food and Chemical Toxicology, Volume 46, Issue 4, Molecular and Physiological Effects of Bioactive Food Components, April 2008, Pages 1271-1278, ISSN 0278-6915, DOI: 10.1016/j.fct.2007.10.006.
(http://www.sciencedirect.com/science/article/pii/S0278691507004644)

Abstract:
Frequent consumption of green tea, one of the most popular and widely consumed beverages, has been known to protect against development of various cancers according to numerous experimental and several population-based studies. Molecular mechanisms underlying chemopreventive effects exerted by green tea and its components have been extensively investigated. (-)-Epigallocatechin-3-gallate (EGCG), a major green tea polyphenol, has been shown to induce expression of glutathione S-transferase, glutathione peroxidase, glutamate cysteine ligase, hemeoxygenase-1, etc. that are involved in the elimination or inactivation of reactive oxygen species and electrophiles implicated in multi-stage carcinogenesis. The redox-sensitive transcription factor, nuclear factor erythroid 2 p45 (NF-E2)-related factor (Nrf2) plays a key role in regulating induction of phase II detoxifying or antioxidant enzymes. Thus, activation of Nrf2 is considered to be an important molecular target of many chemopreventive and chemoprotective agents. This review summarizes the molecular basis of chemoprevention and cytoprotection afforded by EGCG with emphasis on its ability to modulate Nrf2-mediated cellular events.

Keywords: Nrf2; EGCG; Antioxidant enzymes; Chemoprevention; Cytoprotection; Green tea

Amar K. Chandra, Neela De, Goitrogenic/antithyroidal potential of green tea extract in relation to catechin in rats,

Food and Chemical Toxicology, Volume 48, Issues 8-9, August-September 2010, Pages 2304-2311, ISSN 0278-6915, DOI: 10.1016/j.fct.2010.05.064.
(http://www.sciencedirect.com/science/article/pii/S0278691510003431)

Abstract:
Catechins are flavonoids found in abundance in green tea, have elicited high interest due to their beneficial effects on health. Though flavonoids have been reported to have an antithyroid effect and also to be goitrogenic there have been no reports about the

effect of green tea on rat thyroid. The present study was designed to examine whether high doses of green tea has any harmful effect on thyroid physiology. For this purpose green tea extract was administered orally to male albino rats for 30 days at doses of 1.25 g%, 2.5 g% and 5.0 g%, respectively. Similarly, pure catechin was administered at doses of 25, 50 and 100 mg/kg body weight which is equivalent to above doses of green tea extract. Lower body weight gain associated with marked hypertrophy and/or hyperplasia of the follicles was noted in the high dose of green tea and catechin treated groups. Decreased activity of thyroid peroxidase and 5'-deiodinase I and substantially elevated thyroidal Na,K + ATPase activity have been observed. Moreover, serum T3 and T4 levels were found to reduce followed by significant elevation of serum TSH. Taken together, these results suggest that catechin present in green tea extract might behave as antithyroid agent and possibly the consumption of green tea at high dose could alter thyroid function adversely.

Keywords: Catechins; Green tea extracts; Thyroid; Thyroid peroxidase; Na,K + ATPase; 5'-Deiodinase I

R. Ogura, N. Ikeda, K. Yuki, O. Morita, K. Saigo, C. Blackstock, N. Nishiyama, T. Kasamatsu, Genotoxicity studies on green tea catechin,
Food and Chemical Toxicology, Volume 46, Issue 6, June 2008, Pages 2190-2200, ISSN 0278-6915, DOI: 10.1016/j.fct.2008.02.016.
(http://www.sciencedirect.com/science/article/pii/S0278691508000975)

Abstract:

The beneficial effects of tea catechins are well documented. We evaluated the genotoxic potential of a green tea catechin preparation using established genotoxicity assays, including a bacterial reverse mutation assay (Ames test), a chromosomal aberration assay in cultured Chinese hamster lung cells (CHL/IU), a mouse lymphoma L5178Y/tk assay, and a bone marrow micronucleus (MN) assay in ICR CD mice and SD rats. No significant increases in the number of revertant colonies were observed in the Ames test, but positive responses were observed in two in vitro assays: the chromosomal aberration assay and mouse lymphoma L5178/tk assay. However, the in vivo study demonstrated no significant increase in micronucleated polychromatic erythrocytes (MNPCE) in the bone marrow of both ICR CD mice and SD rats administered a high dose of the green tea catechin preparation up to 2000 mg/kg. Combined with favorable epidemiological information suggesting a chemopreventive effect of tea catechins on carcinogenesis, we conclude that green tea catechin presents no significant genotoxic concern under the anticipated conditions of use. These results are consistent with other genotoxicity studies of tea catechins, which show minimal, if any, genotoxic potential.

Keywords: Catechin; Genotoxicity; Green Tea; Beverage

Shin-Pei Yang, Kimberly Wilson, Abdul Kawa, Gregory M. Raner, Effects of green tea extracts on gene expression in HepG2 and Cal-27 cells,
Food and Chemical Toxicology, Volume 44, Issue 7, July 2006, Pages 1075-1081, ISSN 0278-6915, DOI: 10.1016/j.fct.2006.01.001.
(http://www.sciencedirect.com/science/article/pii/S027869150600007X)
Abstract:
Green tea extract is known to contain compounds that are able to produce antioxidant effects in many types of living cells. Treatment of cultured human hepatoma (HepG2) cells with green tea extract resulted in dramatically increased expression of at least 15 genes that are present on a commercial human drug metabolism gene array. RT-PCR was used to confirm the microarray results, and analysis of the 5'-flanking region of each of these genes revealed potential electrophile/antioxidant response elements. Members of the acetyl transferase, epoxide hydrolase, sulfotransferase and glutathione transferase gene families were strongly induced. In addition, the human tongue carcinoma cell line Cal-27 did not respond to green tea extract in the same way, as none of the induced genes in the HepG2 cells were induced in the Cal-27 cells. The lack of induction of detoxification enzymes in the Cal-27 cell line may help to explain the previously observed increased cytotoxicity of green tea catechins on this cell line.
Keywords: Microarray; Green tea extract; Antioxidant response element; Nrf2; RT-PCR; Gene expression

Sancho Banon, Pedro Diaz, Mariano Rodriguez, Maria Dolores Garrido, Alejandra Price, Ascorbate, green tea and grape seed extracts increase the shelf life of low sulphite beef patties,
Meat Science, Volume 77, Issue 4, December 2007, Pages 626-633, ISSN 0309-1740, DOI: 10.1016/j.meatsci.2007.05.015.
(http://www.sciencedirect.com/science/article/pii/S0309174007001738)
Abstract:
Green tea (GTE) and grape seed (GSE) extracts are proposed as preservatives for increasing the shelf life of low sulphite raw beef patties. The antioxidant and antimicrobial activities of both extracts were compared with ascorbate. Five groups were established for the patties: Control (with no additives), S (100 SO2), SA (100 SO2 + 400 sodium ascorbate), ST (100 SO2 + 300 GTE) and SG (100 SO2 + 300 GSE) (mg per kg of meat). Patties were stored at 4 [degree sign]C in aerobic packaging for 0, 3, 6 or 9 days under retail display conditions. Meat spoilage (total viable and coliform counts, pH, lightness, chroma, hue angle, metmyoglobin and TBARS) was determined. The sensory contribution of the extracts to cooked patties was evaluated (colour, odour, flavour and texture). The results pointed to the possibility of using low SO2-vegetable extract combinations to preserve raw meat products. ST, SG and SA delayed microbial spoilage, redness loss and lipid oxidation, thus increasing the shelf life of the raw sulphite beef patties by 3 days. ST, SG and SA also delayed the onset of rancid flavours in cooked patties. No anomalous sensory traits were caused by either extract. Ascorbate, GTE and GSE improved the preservative

effects of SO2 on beef patties, especially against meat oxidation. This suggested that the quantity of SO2 added can be reduced to obtain healthier raw meat products.

Keywords: Green tea; Grape seed; Vitamin C; Sulphite; Raw beef patties; Shelf life

POSTHARVEST TECHNOLOGY (2 JDL)

Weining Hao, Guohua Zhong, Meiying Hu, Jianjun Luo, Qunfang Weng, Muhammad Rizwan-ul-Haq, Control of citrus postharvest green and blue mold and sour rot by tea saponin combined with imazalil and prochloraz,

Postharvest Biology and Technology, Volume 56, Issue 1, April 2010, Pages 39-43, ISSN 0925-5214, DOI: 10.1016/j.postharvbio.2009.10.003.
(http://www.sciencedirect.com/science/article/pii/S0925521409002191)

Abstract:
Tea saponin (TS), generally regarded as a safe compound, was evaluated to control postharvest decay of citrus fruit. TS inhibited mycelial growth and spore germination of Penicillium italicum, P. digitatum and Geotrichum candidum. The influence of TS on the growth of hyphae and germination of spores of P. italicum, P. digitatum and G. candidum was determined individually and in combination with imazalil and prochloraz. The results indicated the best ratio of TS (8:2) with a low rate of prochloraz or imazalil to control P. italicum, P. digitatum and G. candidum. TS was compatible with these fungicides at this ratio and consistently improved their performance to control blue mold, green mold or sour rot on inoculated `Shatang' mandarin fruit and the combination also could prolong the persistence of TS residues in the fruit. The level of disease control provided by the synergistic combinations tested was higher than that of the individual treatments of these fungicides. TS alone or in combination with a low rate of prochloraz or imazalil significantly reduced postharvest decay in `Shatang' mandarin fruit without impairing any of the other fruit quality parameters.

Keywords: Tea saponin; Citrus postharvest diseases; Synergistic effect; Geotrichum candidum

Vipin Kumar, Dhananjay Kumar Tewary, Srigiripuram Desikachar Ravindranath, Adarsh Shanker, Investigation in tea on fate of fenazaquin residue and its transfer in brew,

Food and Chemical Toxicology, Volume 44, Issue 4, April 2006, Pages 596-600, ISSN 0278-6915, DOI: 10.1016/j.fct.2005.10.010.
(http://www.sciencedirect.com/science/article/pii/S0278691505003261)

Abstract:
Fenazaquin is a non-systemic acaricide/insecticide used widely in controlling mites and other related pests in fruits, vegetables and tea. The objective of this research was to investigate the disappearance trend in tea of fenazaquin residue level and its transfer in brew. Fenazaquin was applied on a tea crop at two rates, 125 and 250 g AI/ha in wet and dry seasons under field conditions. Samples (green shoots, made tea and its

brew) were analyzed for fenazaquin and quantification was by high performance liquid chromatography using a UV detector. The residue dissipated faster in the wet season than in the dry season. Seven days after the treatment (normal round of plucking) the residues observed in the green shoots at the two rates were 2.17, 3.07 mg/kg and 2.04, 2.84 mg/kg in the wet and dry seasons, respectively. However, the degradation rale in both seasons followed first-order kinetics. Half-lives in green shoots were in range 1.43-1.70 and 2.10-2.21 days and in made tea 1.59-1.73 and 1.87-1.94 days for wet and dry seasons, respectively. During processing of green shoots to made tea considerable loss (42-70%) of residue was observed. The transfer of residue from made tea brew was in the range 3-22%. In brew residue were below 0.02 mg/l after 5 days of application at both the rates in either of the seasons. The estimated intake with brew (normal consumption of 10 cup/day/adult) thus would be below the acceptable daily intake for fenazaquin (0.005 mg/kg-body weight). To avoid health hazards due to the toxic effect of residues in brew, a waiting period for plucking the tea shoots after fenazaquin application of more than 5 days for both the seasons at recommended rate (125 g AI/ha) may be suggested and considered quite safe.

Keywords: Fenazaquin; Residue; Tea; Brew; Transfer

FOOD COMPOSITION (1 JDL)

Avi Shpigelman, Gal Israeli, Yoav D. Livney, Thermally-induced protein-polyphenol co-assemblies: beta lactoglobulin-based nanocomplexes as protective nanovehicles for EGCG,

Food Hydrocolloids, Volume 24, Issue 8, November-December 2010, Pages 735-743, ISSN 0268-005X, DOI: 10.1016/j.foodhyd.2010.03.015.
(http://www.sciencedirect.com/science/article/pii/S0268005X10000615)

Abstract:
Delivery of sensitive water-soluble compounds in foods is an important challenge. (-)-Epigallocatechin-3-gallate (EGCG), the major catechin in green tea, is a potent antioxidant with numerous attributed health benefits. However, its sensitivity to oxidation limits its enrichment in the diet for preventive medicine. We have studied the possibility of using thermally modified [beta]-lactoglobulin ([beta]-Lg) to form co-assembled nanovehicles for delivery of EGCG, as a model system for delivery of polyphenols by heat-modified proteins. Using fluorescence spectroscopy, DLS and spectrophotometry we found that optimal nano-entrapment is obtained when EGCG is added to preheated (75-85 [degree sign]C, 20 min) [beta]-Lg solution during cooling and vortexing. The measured association constant with the heated protein was 3.7 x 105 M-1, about 3.5-fold higher than that with the native protein: 1.05 x 105 M-1. Thermally-induced protein-EGCG co-assemblies were smaller than 50 nm, thus excellent transparency was maintained, enabling their application in clear beverages. These complexes conferred considerable protection to EGCG against oxidative degradation: A 33-fold lower initial degradation rate, and a 3.2-fold slower degradation over 8 days were observed for nano-entrapped compared to unprotected EGCG.

Keywords: Protein-polyphenol interactions; [beta]-Lactoglobulin ([beta]-Lg); (-)-Epigallocatechin-3-gallate (EGCG); Nutraceutical delivery; Green tea

HUMAN NUTRITION-GENERAL ASPECTS (6 JDL)

Concetta Tedeschi, Veronique Clement, Martine Rouvet, Baltasar Valles-Pamies, Dissolution tests as a tool for predicting bioaccessibility of nutrients during digestion, Food Hydrocolloids, Volume 23, Issue 4, Food Colloids:
Creating Structure, Delivering Functionality, June 2009, Pages 1228-1235, ISSN 0268-005X, DOI: 10.1016/j.foodhyd.2008.09.012.
(http://www.sciencedirect.com/science/article/pii/S0268005X08002415)
Abstract:
Bioaccessibility and bioavailability of active ingredients (like vitamins, antioxidants, etc.) into food systems is often compromised by factors like low permeability and/or solubility within the gut, lack of stability during food processing (temperature and oxygen) as well as in the gastrointestinal tract (pH, enzymes, presence of other nutrients). Moreover, little is known on the influence of food structure and breakdown in the gut on nutrient release. The possibility of predicting the release of nutrients from food matrices under simulated gastrointestinal conditions is of great relevance in order to define which food matrix is best for which nutrient, as well as for looking at the interaction of ingredients with the enzymes involved in the digestive process. This study explores the potential relevance of dissolution tests as a tool for predicting bioaccessibility of nutrients during in vitro digestion. Whey protein hydrogels containing green tea extract (GTE) were chosen for this study. Different simulated in vitro gastrointestinal conditions (GI) were applied throughout the dissolution experiments and the GTE was analysed by UV-vis absorption spectroscopy. It was possible to distinguish between two different release kinetics when experiments were performed in simulated gastric or intestinal media. In the gastric step, the kinetic of GTE release was lower than in an intestinal environment, suggesting that more GTE is released and available for absorption into the intestine than in the stomach. The present study shows that it is possible to use the dissolution tester as a screening method to mimic nutrient release from a food matrix in the gastrointestinal tract.
Keywords: Dissolution test; Bioaccessibility of nutrients; [beta]-Lactoglobulin; Whey protein hydrogels; Green tea extract; In vitro digestion; UV-vis absorption spectroscopy

Gregory M. Raner, Sean Cornelious, Kamalika Moulick, Yingqing Wang, Ashley Mortenson, Nadja B. Cech, Effects of herbal products and their constituents on human cytochrome P4502E1 activity,
Food and Chemical Toxicology, Volume 45, Issue 12, December 2007, Pages 2359-2365, ISSN 0278-6915, DOI: 10.1016/j.fct.2007.06.012.
(http://www.sciencedirect.com/science/article/pii/S0278691507001998)
Abstract:
Ethanolic extracts from fresh Echinacea purpurea and Spilanthes acmella and dried Hydrastis canadensis were examined with regard to their ability to inhibit cytochrome P4502E1 mediated oxidation of p-nitrophenol in vitro. In addition, individual constituents of these extracts, including alkylamides from E. purpurea and S. acmella,

caffeic acid derivatives from E. purpurea, and several of the major alkaloids from H. canadensis, were tested for inhibition using the same assay. H. canadensis (goldenseal) was a strong inhibitor of the P4502E1, and the inhibition appeared to be related to the presence of the alkaloids berberine, hydrastine and canadine in the extract. These compounds inhibited 2E1 with KI values ranging from 2.8 [mu]M for hydrastine to 18 [mu]M for berberine. The alkylamides present in E. purpurea and S. acmella also showed significant inhibition at concentrations as low as 25 [mu]M, whereas the caffeic acid derivatives had no effect. Commercial green tea preparations, along with four of the individual tea catechins, were also examined and were found to have no effect on the activity of P4502E1.

Keywords: Echinacea; Cytochrome P4502E1; Hydrastis; Goldenseal; Spilanthes; Green tea

E. Malinowska, I. Inkielewicz, W. Czarnowski, P. Szefer, Assessment of fluoride concentration and daily intake by human from tea and herbal infusions,
***Food and Chemical Toxicology**,* Volume 46, Issue 3, March 2008, Pages 1055-1061, ISSN 0278-6915, DOI: 10.1016/j.fct.2007.10.039.
(http://www.sciencedirect.com/science/article/pii/S027869150700511X)

Abstract:
The fluoride content in infusions of commercially available black, green, oolong, pu-erh and white teas was determined by ion-selective electrode. Herbal infusions as well as instant tea and ready-to-drink tea beverages were also examined. It is found that brewing time (5, 10 and 30 min) does increase the fluoride content, which in infusions of black tea (5 min brewing) was higher than that in the other types of tea, with contents ranging between 0.32 and 4.54 mg/l for black tea to 0.37-0.54 mg/l for white tea and with even lower values for herbal tea infusions of 0.02-0.09 mg/l. On the basis of the results obtained, the daily intake of fluoride provided from tea and herbal beverages was estimated for an adult person and for children in comparison with the Polish SAI (Safe and Adequate Daily Intake) of fluoride which is strictly attributable to ADI (Acceptable Daily Intake). The fluoride intake resulted from the regular consumption of black tea infusions was raised as compared to the other types of teas as well as herbal teas. For adult and children tea drinkers consuming five cups of black tea per day the intake of fluoride will be in the range of 8.0-303% and 12-303% of the SAI, respectively. People are often exposed to multiple sources of fluoride, such as in food, water, air and excessive use of toothpaste. The control of tea quality is important to protect human against too high uptake of this element from black tea, which is the most popular beverage. Excessive intake of fluoride with black tea, especially in the regions with its high level in the drinking water, increases the risk of dental fluorosis in children during the years of tooth development. The long-term exposure to large amounts of fluoride can lead to potentially skeletal fluorosis (WHO, 1984).

Keywords: Tea and herbal infusions; Fluoride; SAI; ADI

Demirhan Citak, Mustafa Tuzen, A novel preconcentration procedure using cloud point extraction for determination of lead, cobalt and copper in water and food samples using flame atomic absorption spectrometry,
Food and Chemical Toxicology, Volume 48, Issue 5, May 2010, Pages 1399-1404, ISSN 0278-6915, DOI: 10.1016/j.fct.2010.03.008.
(http://www.sciencedirect.com/science/article/pii/S0278691510001572)
Abstract:
In this work, a new cloud point extraction (CPE) procedure was developed for the separation and preconcentration of lead(II), cobalt(II), and copper(II) in various water and food samples. Complexes of metal ions with 1-Phenylthiosemicarbazide (1-PTSC) were extracted into the surfactant-rich phase of octylphenoxypolyethoxyethanol (Triton X-114) from samples. After phase separation, the enriched analytes were determined by flame atomic absorption spectrometry (FAAS). Factors affecting cloud point extraction, such as pH, reagent and surfactant concentrations, temperature, and incubation time were evaluated and optimized. The interference effect of some cations and anions was also studied. After optimization of the CPE conditions, the preconcentration factor of 25 and the limits of detection (L.O.D.) obtained for lead(II), cobalt(II), and copper(II) based on three sigma (n = 20) were 3.42, 1.00, and 0.67 [mu]g L-1, respectively. The method presented precision (R.S.D.) between 1.7% and 4.8% (n = 7). The presented preconcentration procedure was applied to the determination of metal ions in reference standard materials (SRM 1515 Apple leaves and GBW 07605 Tea) and some real samples including tap water, spring water, sea water, canned fish, black tea, green tea, tomato sauce and honey.
Keywords: Separation; Preconcentration; Cloud point extraction; Triton X-114; 1-Phenylthiosemicarbazide; Atomic absorption spectrometry

Han-Seok Seo, Thomas Hummel, Effects of olfactory dysfunction on sensory evaluation and preparation of foods,
Appetite, Volume 53, Issue 3, December 2009, Pages 314-321, ISSN 0195-6663, DOI: 10.1016/j.appet.2009.07.010.
(http://www.sciencedirect.com/science/article/pii/S0195666309005765)
Abstract:
Aim of this study was to investigate the impact of olfactory dysfunction on behavior during sensory evaluation and self-preparation, as well as on sensory perception and pleasantness of green tea and coffee. We compared the intensities of overall odor, flavor, and bitter taste, respectively, and the pleasantness ratings for three different concentrations of green teas and coffees between three groups: young (n = 30) and elderly (n = 30) with normal olfactory function and elderly (n = 30) with olfactory dysfunction. In addition, we compared the subject groups' behavior during sensory testing and preparation of green tea or coffee. As expected, elderly subjects with olfactory dysfunction rated the overall odor intensity less intense than subjects with normal olfactory function. Also, elderly subjects with olfactory dysfunction rated the intensities of overall flavor and bitter taste significantly lower rather than subjects with normal olfactory function in green tea, whereas this result was not obtained in coffee.

Compared to young subjects with normal olfactory function, elderly with olfactory dysfunction used more green tea powder to optimize their own green tea. Moreover, olfactory function scores assessed by the 'Sniffin' Sticks' test were positively related with sniffing frequency for green tea and with sniffing time for coffee during sensory evaluation. During preparation of the green tea, compared to elderly subjects, young healthy subjects tried to adjust the green tea more frequently by adding green tea powder or water. Such behavioral differences were not present during coffee preparation. In conclusion, our findings demonstrate that olfactory dysfunction affects odor perception and sniffing behavior. However, under the current conditions, it appeared to have no effect on hedonic ratings and self-preparation behaviors.

Keywords: Behavior; Food preparation; Olfactory dysfunction; Sensory evaluation; Sniffin' Sticks test; The elderly

Jia-Sheng Wang, Haitao Luo, Piwen Wang, Lili Tang, Jiahua Yu, Tianren Huang, Stephen Cox, Weimin Gao, Validation of green tea polyphenol biomarkers in a phase II human intervention trial,
Food and Chemical Toxicology, Volume 46, Issue 1, January 2008, Pages 232-240, ISSN 0278-6915, DOI: 10.1016/j.fct.2007.08.007.
(http://www.sciencedirect.com/science/article/pii/S0278691507002906)

Abstract:
Health benefits of green tea polyphenols (GTPs) have been reported in many animal models, but human studies are inconclusive. This is partly due to a lack of biomarkers representing green tea consumption. In this study, GTP components and metabolites were analyzed in plasma and urine samples collected from a phase II intervention trial carried out in 124 healthy adults who received 500- or 1000-mg GTPs or placebo for 3 months. A significant dose-dependent elevation was found for (-)-epicatechin-3-gallate (ECG) ($p < 0.001$, trend test) and (-)-epigallocatechin-3-gallate (EGCG) ($p < 0.05$, trend test) concentrations in plasma at both 1-month and 3-months after intervention with GTPs. No significant increase of (-)-epicatechin (EC) or (-)-epigallocatechin (EGC) was observed in plasma after GTP intervention. A mixed-effects model indicated significant effects of dose (EGCG) and dose by time interaction (ECG), but not for EC and EGC. Analysis of phase 2 metabolic conjugates revealed a predominance of free GTPs in plasma, up to 85% for EGCG, while a majority of GTPs in urine were sulfated and glucuronidated conjugates (up to 100% for EC and 89% for EGC). These results suggest that plasma ECG and EGCG concentrations are reliable biomarkers for green tea consumption at the population level.

Keywords: Green tea polyphenols; Biomarker; Intervention; Glucuronidation; Sulfation

PHYSIOLOGY OF HUMAN NUTRITION (8 JDL)

Kumi Hirokawa, Kazuko Yamazawa, Gendered information on sensory, hedonic and familiarity ratings of green tea by female Japanese students,
Appetite, Volume 51, Issue 2, September 2008, Pages 343-346, ISSN 0195-6663, DOI: 10.1016/j.appet.2008.03.015.
(http://www.sciencedirect.com/science/article/pii/S019566630800130X)
Abstract:
The purpose of the present study was to examine the effects of gendered information (masculine and feminine) on sensory, hedonic, and familiarity ratings by Japanese female undergraduate students. Japanese green tea, Chinese sweet tea, and Chinese bitter tea were used. After listening to gendered information, participants tasted samples and scored them. The results showed that participants scored the samples of Japanese green tea as more aromatic, sweet, pleasant, and familiar when they were subjected to feminine rather than masculine information. Gendered information may influence on sensory, hedonic, and familiarity ratings.
Keywords: Gendered information; Sensory/hedonic ratings; Familiarity; Masculinity; Femininity; Green tea

A. Reed, B. Raudenbush, Effects of green tea on cognition, perceived workload, mood, and endurance.,
Appetite, Volume 49, Issue 1, July 2007, Page 322, ISSN 0195-6663, DOI: 10.1016/j.appet.2007.03.164.
(http://www.sciencedirect.com/science/article/pii/S019566630700205X)
Abstract:
Previous research indicates green tea extract can have beneficial effects on health and performance. The present study was designed to determine the extent to which green tea extract significantly impacts cognitive functioning, endurance, perceived workload, and mood over time. Participants were 18 student athletes who were tested over a 6-week time period. Results of the experiment reveal athletes show a significant improvement in the number of push-ups completed when given green tea extract. No statistically significant improvements were found for cognition, mood, or perceived workload; however, the majority of these measures were greater in the green tea condition. The implication of these results is that natural, and in the case of green tea, very healthy, substances could be used to enhance endurance, rather than pharmacological methods such as caffeine and steroids.
Miklos Csala, Eva Margittai, Silvia Senesi, Alessandra Gamberucci, Gabor Banhegyi, Jozsef Mandl, Angelo Benedetti, Inhibition of hepatic glucose 6-phosphatase system by the green tea flavanol epigallocatechin gallate,
FEBS Letters, Volume 581, Issue 8, 17 April 2007, Pages 1693-1698, ISSN 0014-5793, DOI: 10.1016/j.febslet.2007.03.045.
(http://www.sciencedirect.com/science/article/pii/S001457930700316X)
Abstract:
Effect of 5-100 [mu]M epigallocatechin gallate (EGCG) on hepatic glucose 6-phosphatase (G6Pase) system was investigated. EGCG inhibited G6Pase in intact but

not in permeabilized rat liver microsomes, suggesting the interference with the transport. However, EGCG did not hinder microsomal glucose 6-phosphate (G6P) uptake. Instead, it increased the accumulation of radioactivity after the addition of [14C]G6P, presumably due to a slower release of [14C]glucose, the product of luminal hydrolysis. Indeed, EGCG was found to inhibit microsomal glucose efflux. Since G6Pase activity is depressed by glucose in a concentration-dependent manner, we concluded that EGCG inhibits G6Pase through an elevated luminal glucose level.

Keywords: Endoplasmic reticulum; Transport; Glucose; Green tea; Catechin; Epigallocatechin gallate

Ji-Young Bae, Jung-Suk Choi, Yean-Jung Choi, Seung-Yong Shin, Sang-Wook Kang, Seoung Jun Han, Young-Hee Kang, (-)Epigallocatechin gallate hampers collagen destruction and collagenase activation in ultraviolet-B-irradiated human dermal fibroblasts: Involvement of mitogen-activated protein kinase, Food and Chemical Toxicology, Volume 46, Issue 4,

Molecular and Physiological Effects of Bioactive Food Components, April 2008, Pages 1298-1307, ISSN 0278-6915, DOI: 10.1016/j.fct.2007.09.112.
(http://www.sciencedirect.com/science/article/pii/S0278691507005467)

Abstract:

Ultraviolet (UV) irradiation leads to distinct changes in skin connective tissues by degradation of collagen, which is a major structural component in the extracellular matrix most likely mediated by matrix metalloproteinases (MMP), collagenases. These changes in collagenous skin tissues have been suggested to be causes of the skin wrinkling observed in premature aging of the skin. This study mimicked the action of environmental ultraviolet on skin and investigated whether (-)epigallocatechin gallate (EGCG), a bioactive catechin component of green tea, mechanistically inhibited activation of MMP-1, MMP-8, and MMP-13 and destruction of collagen in UV-B irradiated human dermal fibroblasts by modulating cellular signaling pathways. Cell viability was moderately decreased by [greater-or-equal, slanted]30% in human dermal fibroblasts treated with 100 mJ/cm2 UV-B, accompanying a substantial generation of reactive oxygen species evidenced by DCF staining. Western blot analysis and immunocytochemical staining revealed that EGCG markedly suppressed collagen degradation enhanced in UV-B-exposed human dermal fibroblast. Pre-treatment of fibroblasts with EGCG also inhibited UV-B-induced production of collagenases, MMP-1, MMP-8 and MMP-13, in a dose-dependent manner. In addition, EGCG rapidly and substantially hampered UV-B irradiation-induced activation of ASK-1 and phosphorylation of MAPK, JNK, p38 MAPK, and ERK1/2, in dermal fibroblasts. These results demonstrate that EGCG has abilities to hamper UV-B-induced collagenolytic MMP production via interfering with the MAPK-responsive pathways. Therefore, EGCG may be a potential agent for the prevention and treatment of skin photoaging.

Keywords: Ultraviolet-B; Human dermal fibroblasts; (-)Epigallocatechin gallate; MMP; Collagen; Photoaging

Nelson Ferreira, Isabel Cardoso, Maria Rosario Domingues, Rui Vitorino, Margarida Bastos, Guangyue Bai, Maria Joao Saraiva, Maria Rosario Almeida, Binding of epigallocatechin-3-gallate to transthyretin modulates its amyloidogenicity,
FEBS Letters, Volume 583, Issue 22, 19 November 2009, Pages 3569-3576, ISSN 0014-5793, DOI: 10.1016/j.febslet.2009.10.062.
(http://www.sciencedirect.com/science/article/pii/S0014579309008503)
Abstract:
More than 100 transthyretin (TTR) variants are associated with hereditary amyloidosis. Approaches for TTR amyloidosis that interfere with any step of the cascade of events leading to fibril formation have therapeutic potential. In this study we tested (-)-epigallocatechin-3-gallate (EGCG), the most abundant catechin of green tea, as an inhibitor of TTR amyloid formation. We demonstrate that EGCG binds to TTR 'in vitro' and 'ex vivo' and that EGCG inhibits TTR aggregation 'in vitro' and in a cell culture system. These findings together with the low toxicity of the compound raise the possibility of using EGCG in a therapeutic approach for familial amyloidotic polyneuropathy, the most frequent form of hereditary TTR amyloidosis.Structured summary MINT-7294529: TTR (uniprotkb:P02766) and TTR (uniprotkb:P02766) bind (MI:0407) by comigration in non-denaturing gel electrophoresis (MI:0404)
Keywords: Transthyretin; (-)-Epigallocatechin-3-gallate; Amyloid; Aggregation

S.B. Horng, H.H. Kuo, M.Y. Lin, W.W. Lin, T.C. Wang, Human gastric cells resistant to (-)-epigallocatechin gallate show cross-resistance to several environmental pollutants,
Food and Chemical Toxicology, Volume 45, Issue 11, November 2007, Pages 2171-2178, ISSN 0278-6915, DOI: 10.1016/j.fct.2007.05.014.
(http://www.sciencedirect.com/science/article/pii/S0278691507001779)
Abstract:
After a long-term culture in (-)-epigallocatechin gallate (EGCG, 20 [mu]M), a major constituent of green tea, human gastric AGS cells developed 2.2-fold resistance to EGCG. The resistant AGS (AGS-R) cells were cross-resistant to several N-methylcarbamate insecticides, which are among the major control agents for pest insects in Taiwan. The AGS-R cells also showed protective effects against both the cytotoxicity and DNA damage induced by one of the mutagenic derivatives of N-methylcarbamate insecticide, N-nitroso methomyl, which is known to target the mammalian gastric tract. Therefore, acquisition of resistance by AGS cells through chronic exposure to EGCG implies that the tea-drinking habit of the Taiwanese is probably beneficial for the health of the gastric tract. In addition, AGS-R cells were cross-resistant to sodium arsenite and hydrogen peroxide, indicating that tolerance to oxidative stress might play a role in the development of resistance described in this investigation.
Keywords: Resistance; AGS cells; EGCG; Insecticide; Oxidative stress

Hai-Ning Yu, Sheng-Rong Shen, Jun-Jie Yin, Effects of interactions of EGCG and Cd2+ on the growth of PC-3 cells and their mechanisms,
Food and Chemical Toxicology, Volume 45, Issue 2, February 2007, Pages 244-249, ISSN 0278-6915, DOI: 10.1016/j.fct.2006.08.015.
(http://www.sciencedirect.com/science/article/pii/S0278691506002341)
Abstract:
The preventive and therapeutic effects of a major component of catechins of green tea, epigallocatechin-3-gallate (EGCG), on prostate cancer have been demonstrated in many studies. It is well known that metal ions are necessary for human health, but an imbalance in metal ions metabolism can lead to many diseases including prostate cancer. Understanding the interactions of EGCG with metal ions might elucidate its mechanism in preventing and curing prostate cancer. The present study focused on the effects of Cd2+ and EGCG on the growth of androgen-insensitive prostate cancer cell PC-3 investigated by MTT assay, the effects of EGCG and Cd2+ on absorption of Cd2+ and Zn2+ by PC-3 cells were detected by atomic absorption spectroscopy (AAS), and the interactions of EGCG with Cd2+ were determined by distribution coefficient and UV-Vis spectroscopy detection. The results showed that Cd2+ suppressed viability of PC-3 cells in concentration- and time-dependent manner, and EGCG enhanced the effect of Cd2+ on PC-3 cells. EGCG was shown to decrease the absorption Cd2+ and increase the absorption of Zn2+ by PC-3 cells, while the effects of Cd2+ on the absorption of Cd2+ and Zn2+ were opposite to that of EGCG. In the presence of both EGCG and Cd2+, absorption of Cd2+ and Zn2+ by PC-3 cells was dependent on concentrations of EGCG, Cd2+ and its order of addition. Results from the distribution coefficient determination and UV-Vis spectroscopy analysis indicated that Cd2+ might affect conformation of EGCG, while no complex of EGCG with Cd2+ was observed in the system.
Keywords: EGCG; Cd2+; Zn2+; Prostate cancer

Kuei-Meng Wu, Hanan Ghantous, Debra B. Birnkrant, Current regulatory toxicology perspectives on the development of herbal medicines to prescription drug products in the United States,
Food and Chemical Toxicology, Volume 46, Issue 8, August 2008, Pages 2606-2610, ISSN 0278-6915, DOI: 10.1016/j.fct.2008.05.029.
(http://www.sciencedirect.com/science/article/pii/S0278691508002731)
Abstract:
Toxicological studies constitute an essential part of the effort in developing an herbal medicine into a drug product. The US food and drug administration (FDA) published a guidance to assist academic and industry sponsors in the development of this unique group of drug products, and has recently approved an new drug application (NDA) based on green tea extract (Veregen(R)) for topical treatment of genital and perianal warts. In this article, current regulatory views on issues related to requirements and recommendations on various types of nonclinical toxicity studies in support of clinical trials and filing an NDA for a herbal medicine, including pharm/tox aspects of green tea extract (Veregen(R)) NDA, are discussed. Topics include nonclinical

pharmacology/toxicology perspectives on herbal nomenclature and its identification, previous human experience and initial clinical trial proposal, regulatory aspects of acute toxicity studies, chronic toxicity studies, mutagenicity studies, reproductive toxicity studies, and carcinogenicity studies on botanicals. Certain regulatory review-related issues are also presented. It is anticipated that through a proactive two-way communication between the Agency and the sponsor, toxicological development of botanical drug product can be significantly facilitated.

Keywords: Herbal; Botanical; Carcinogenicity; Genotoxicity; Reproductive toxicity; Regulatory toxicology

Helena Malhomme de la Roche, Susan Seagrove, Anisha Mehta, Preshita Divekar, Sandra Campbell, Alison Curnow, Using natural dietary sources of antioxidants to protect against ultraviolet and visible radiation-induced DNA damage: An investigation of human green tea ingestion,

Journal of Photochemistry and Photobiology B: Biology, Volume 101, Issue 2, Special issue on Solar Radiation and Human Health, 3 November 2010, Pages 169-173, ISSN 1011-1344, DOI: 10.1016/j.jphotobiol.2010.04.006.
(http://www.sciencedirect.com/science/article/pii/S1011134410000928)

Abstract:

Oral ingestion of green tea is a potent dietary source of antioxidant polyphenols. These compounds are of interest as they may be able to provide additional protection to the body to help prevent the deleterious effects of ultraviolet A and visible radiation (UVA/VIS) produced indirectly via reactive oxygen species (ROS) in sunlight exposed skin. A small clinical study was conducted in ten healthy adult volunteers. Samples of whole blood were obtained from each before and 30, 60 and 90 min following ingestion of three breakfast cups of green tea (540 ml in total) prepared in a standardised manner. Peripheral leucocytes were isolated from each blood sample and exposed to increasing periods of UVA/VIS irradiation in the laboratory (0, 9, 12 or 18 min). Alkaline single cell gel electrophoresis (the comet assay) was then conducted to determine the level of DNA damage in each sample from each individual. The findings support those of our previous pilot study and indicate that drinking green tea did significantly reduce the genotoxic effects observed in peripheral blood cells 60 min following ingestion when artificially exposed to 12 min of UVA/VIS irradiation in the laboratory. It is postulated that this protection is afforded by the polyphenol compounds (known to be contained within green tea) via scavenging or quenching of the damaging ROS induced by this form of light exposure. Further investigation should consider whether this dietary-induced protection could be extended to cells of the skin.

Keywords: Antioxidants; Comet assay; DNA damage; Green tea; Sun protection; Ultraviolet radiation

PROCESSING OF AGRICULTURAL WASTES (2 JDL)

Wieland Peschel, Wilfried Dieckmann, Marlies Sonnenschein, Andreas Plescher, High antioxidant potential of pressing residues from evening primrose in comparison to other oilseed cakes and plant antioxidants,
Industrial Crops and Products, Volume 25, Issue 1, January 2007, Pages 44-54, ISSN 0926-6690, DOI: 10.1016/j.indcrop.2006.07.002.
(http://www.sciencedirect.com/science/article/pii/S0926669006000963)
Abstract:
Evening primrose (Oenothera biennis) is increasingly cultivated for medicinal use of the [gamma]-linolenic acid rich oil. The seed cake (EPSC) - the remaining industrial residue from cold pressing - was extracted with polar solvents in order to investigate a profitable polyphenolic recovery. The extractable matter and the total phenolic content (Folin-Ciocalteu) have been compared to a black currant residue from juice production (Ribes nigrum) and seed cakes from sesame, woad (Isatis tinctoria) and burdock (Arctium lappa). The EPSC crude extracts yielded the high total phenolic content (min 228.2 +/- 11.6 to max 696.4 +/- 29.0 mg GAE g-1 dry extract) within the range of already commercialized antioxidant extracts from rosemary (RO, 142.1 +/- 1.9 mg g-1), green tea (GT, 446.8 +/- 27.4 mg g-1) and grape seed (GS 790.0 +/- 53.1 mg g-1). All extracts exhibited free radical scavenging activity (DPPH assay) with the order of potency: EPSC > GS > GT >> burdock = black currant > RO > butylated hydroxytoluene (BHT) >> woad > sesame. Accordingly EPSC extracts where very effective in scavenging superoxide anion radicals (neotetrazolium assay: GS > EPSC > GT >> BHT > burdock > woad > sesame) and inhibition of lipid oxidation (Rancimat assay: BHT >> GT > EPSC >> burdock > woad > RO > sesame > GS). Decreasing Rancimat activity from 80 [degree sign]C upwards might indicate heat sensitiveness and limited usability. However, an efficient exploitation of polyphenols from evening primrose seed cakes in terms of an uncomplicated extraction procedure, the yield and the competitive profile as a strong radical scavenger can be concluded.
Keywords: Antioxidants; Plant extracts; Phenolic content; Byproducts; Oil seeds; Evening primrose

Demirhan Citak, Mustafa Tuzen, Mustafa Soylak, Simultaneous coprecipitation of lead, cobalt, copper, cadmium, iron and nickel in food samples with zirconium(IV) hydroxide prior to their flame atomic absorption spectrometric determination,
Food and Chemical Toxicology, Volume 47, Issue 9, September 2009, Pages 2302-2307, ISSN 0278-6915, DOI: 10.1016/j.fct.2009.06.021.
(http://www.sciencedirect.com/science/article/pii/S0278691509002920)
Abstract:
A simple and new coprecipitation procedure is developed for the determination of trace quantities of heavy metals (lead, cobalt, copper, cadmium, iron and nickel) in natural water and food samples. Analyte ions were coprecipitated by using zirconium(IV) hydroxide. The determination of metal levels was performed by flame atomic

absorption spectrometry (FAAS). The influences of analytical parameters including pH, amount of zirconium(IV), sample volume, etc. were investigated on the recoveries of analyte ions. The effects of possible matrix ions were also examined. The recoveries of the analyte ions were in the range of 95-100%. Preconcentration factor was calculated as 25. The detection limits for the analyte ions based on 3 sigma (n = 21) were in the range of 0.27-2.50 [mu]g L-1. Relative standard deviation was found to be lower than 8%. The validation of the presented coprecipitation procedure was performed by the analysis certified reference materials (GBW 07605 Tea and LGC 6010 Hard drinking water). The procedure was successfully applied to natural waters and food samples like coffee, fish, tobacco, black and green tea.
Keywords: Heavy metals; Zirconium(IV) hydroxide; Preconcentration; Coprecipitation; Atomic absorption spectrometry