Pursuing ways to increase number and production efficiency of glandular trichomes in Artemisia annua by applying physical and chemical stresses

Kjær, Anders; Jensen, Martin; Grevesen, Kai; Ivarsen, Elise; Frete, Xavier; Christensen, Kathrine Bisgaard; Christensen, Lars Porskjær

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Emerging Health Issues in Fruits and Vegetables

S07.001 Optimising the (poly)phenolic composition of crop plants

Bovy, A.1,2; Ballester, A.3; de Vos, R.4; Schaart, J.5; Tikunov, Y.2; Molthoff, J.6; van Heusden, S.2; Hall, R.1,2
1Centre for Biosystems Genomics, P.O. Box 16, 6700 AA, Wageningen, Netherlands
2Ant Research International, P.O. Box 16, 6700 AA, Wageningen, Netherlands
3INRA, Versailles, France
4German Vegetable Research Institute, Wageningen, Netherlands
5Agence pour la Protection de la Nature, Brussels, Belgium
6Centre for Genes and Plants, Department of Biotechnology, Wageningen, Netherlands

Plants and their products are generally known for their high levels of antioxidants, which may contribute to the positive effects of dietary plant products for human health. Plants produce these compounds to cope with the oxidative stress environment they are growing in (e.g., UV-light, air and soil pollution, pathogens) as well as for their reproduction (e.g., pollination, pigmentation of flowers and fruits). Depending on plant species, variety and tissue, high levels of health-protecting antioxidants, such as vitamin C and E, phenolic compounds including phenylpropanoids and flavonoids, and/or carotenoids such as lycopene can be found. Flavonoids comprise a large and diverse group of polyphenolic plant secondary metabolites. They are widespread among the plant kingdom and form an integral part of the human diet. There is increasing evidence that dietary flavonoids are likely candidates for the observed beneficial effects of a diet rich in fruits and vegetables on the prevention of chronic diseases. We aim to elucidate the regulation of the flavonoid pathway in crop plants and employ different strategies to optimise the composition of flavonoids in target crops, such as tomato and strawberry. Using a metabolomics approach we observed interesting variation in both the levels and composition of flavonoids in germplasm collections of tomato, pepper and strawberry. In order to unravel the molecular mechanisms underlying the observed metabolic variation, we used different approaches to isolate and identify the key genes regulating these pathways. These genes can be turned into markers to assist in classical breeding programs, but are also used to optimise the composition of health-related compounds through genetic engineering. Several examples of the strategies used will be discussed.

S07.002 Super-Domestication of Fruits and Vegetables Lead to Improvement of Human Health

Balázs, E.
Department of Applied Genomics, Agricultural Research Institute, H-2462 Martonvásár, Brunszvik u. 1, Hungary

Vaughan et al. (2007) introduced the term super-domestication to refer to the processes that lead to a domesticate with dramatically increased yield that could not be selected in natural environments from naturally occurring variation without recourse to new technologies. Super-domesticates can be constructed with knowledge-based approaches using a wide range of current technologies, including fine resolution mapping and gene cloning of domestication-related genes, orthologues of domestication genes and their action, genome evolution, gene and genome duplication using any kind of new techniques. The array of genome manipulations that have been developed, mainly from the eighties, enable barriers to gene exchange to be overcome and have lead to super-domestication with dramatically improved quality. This high technology which gave a boost for plant breeding manifested in high nutritional value fruit and vegetables. Some of these achievements include the biofortification of bananas, the efficient selection for healthful nutritional components, the genomics of fruit and vegetable quality and the production of vitamin rich fruits and vegetables to combat nutritional deficiencies. Selection for high antioxidant content fruits and vegetables will serve better nutrition for humans.

Exploring the biological diversity of fruits and vegetables with high tech biotechnology could be the basis for improving human health.

S07.003 The Integration of Human Health and Soft Fruit Breeding

Stewart, D.1; McDougall, G.2; Abreu, I.3
1Scottish Crop Research Institute, Invergowrie, Dundee, Tayside, United Kingdom
2Centre for Diagnostics Genomics, MRC-IBB, Copyright v2007, University of Dundee, Dundee, Dundee, Scotland, United Kingdom

The agricultural policies of the developed world have meant that, for these countries at least, food is plentiful but changing eating patterns have seen an increase in the consumption of ready-made meals and food elevated with respect to sugar and fat. The knock-on effect of this is evident in the rapidly increasing level of obesity in the western world with 20% of males and 25% of females now classified as obese in the United States. Associated with this and the related dietary shift are increases in the incidence of degenerative diseases such as atherosclerosis, some cancers etc. Fundamental, clinical and epidemiological research into the basal causes and consequences of these diseases has highlighted the gross and specific benefits of including a significant level of fruit and vegetable within the diet. Polyphenols are ubiquitous in plants and, with respect to dietary plant sources, particularly prevalent in many fruit species and in particular in the common soft fruit such as strawberries, blackcurrant, raspberries etc. As a result of the putative potent health benefits of these compounds, crop (including fruit) breeding has undergone a paradigm shift with the adoption of global metabolite screening rapidly becoming an integral part of the process. Evidence will be presented to show that soft fruit extracts and components exhibit beneficial health effects in model and real systems. In additions a stratagem for integrating these targets into new and ongoing breeding programmes will be outlined using a joint molecular genetic and metabolomics approach.

S07.004 Metabolic Engineering of Carotenoid Biosynthesis in Orange Fruits

Pons, E.4; Alquézar, B.1; Rodriguez, A.1; Rodrigo, M.1; Zacarias, L.1; Pena, L.1
1Centro de Protección Vegetal y Biotecnología. Instituto Valenciano de Investigaciones Agrarias (iva), Mónaco, Valencia; 2Research Unit, iva, Valencia; 3Instituto de Agroquímica y Tecnología de Alimentos (iata-csic), Burjassot, Valencia, Spain

Carotenoids are an important group of isoprenoid-derived pigments responsible of the typical coloration of many fruits and vegetables, and then determining their quality and consumer acceptance. Carotenoids have long been recognised as essential nutrients for human nutrition and health, providing protective effects against certain cancers and cardiovascular, aging-related and degenerative diseases due to their potent antioxidant capacity and the provitamin A activity of some of them (mainly b-carotene). Moreover, some of the oxidative cleavage products of carotenoids, referred to as apocarotenoids (norisoprenoids), could contribute to generation of flavor and aromatic compounds in these plant products. Citrus is the most important fruit tree crop in the world and orange fruit is an excellent natural dietary source providing health-promoting compounds such as vitamin C, flavonoids and folic acid, in a combination and concentration unique among fruits and vegetables, but it has low provitamin A content. Recent advances in the isolation and identification of the genes responsible for carotenoid biosynthesis in citrus fruits combined with the availability of genetic engineering tools have made feasible a metabolic engineering approach to improve the content and composition of certain carotenoids in orange fruits. The goal of this work was to enhance provitamin A (b-carotene) content in orange fruit by blocking the expression of the endogenous b-carotene hydroxylase gene (b-CHX), involved in the conversion of b-carotene into xanthophylls, using either antisense or RNA interference (RNAi) technology. Transgenic plants were obtained and important changes in carotenoid content and composition was observed in both fruit peel and pulp. The increase in b-carotene in transgenic fruit was accompanied by a general decrease in the accumulation of downstream xanthophylls and also an enhanced production of flavor-related apocarotenoids. Implications of these changes in the nutritional value and volatile composition of transgenic oranges will be discussed.
S07.005 Nutrient Rich CMS Hybrid Breeding in Tropical Carrots (Daucus carota L.)

Kalia, P.

INSTITUTE OF FOOD RESEARCH, COLNEY LANE, NR4 7UA, NORWICH, NORFOLK, UNITED KINGDOM

Tropical carrot is most extensively grown vegetable crop in north Indian plains. It is cherished by one and all, rich and poor for its colour, flavour and taste in various forms like raw, cooked, pickle, candy, pudding, juice etc. Traditionally, red carrots are popularly grown for commerce by the farmers for high markets from their own retainer and maintained special maturity variety seeds. Of late, through systematic breeding for about a decade now, we have developed strains individually high in lycopene, anthocyanin, ß-carotene and lutein. These pigments represent different colours in carrot like red due to lycopene, black due to anthocyanin, yellow due to lutein and orange due to carotene. These are very powerful antioxidants which can go a long way in curbing malnutrition and fight diseases. In order to develop biofortified carrots with two pigments, cynaplastic male sterilization was integrated through backcross breeding into improved breeding lines for exploiting them in hybrid combinations. This paper reports about the prospects of new bioactive compound rich high yielding hybrids’ suitability for fresh market and fusion food industry.

S07.006 Breeding Onion and Garlic Cultivars with Higher Levels of Functional Compounds

Galmarini, C. R.

INSTITUTO NACIONAL DE TECNOLOGÍA AGRÍCOLA, 8000, CEUNA, CONCEPCION, 5007, LA CONCEPCION, MENDOZA, ARGENTINA

Allium species have been cultivated for thousands of years for its therapeutic properties, religious significance, taste, and aroma. Nowadays, the basic concept of nutrition is changing, including the potential of foods to enhance health, to improve welfare and reduce the risk of diseases. In this context appear the functional foods. Garlic and onion have phytochemicals categorized as functional foods; some of them are fructans, flavonoids and organosulfur compounds. Garlic (Allium sativum L.) and onion (Allium cepa L.) are the main vegetable crops exported by Argentina. More than 90% of the cultivars that are cropped in the country were originated by breeding programs carried out by INTA. One of the main goals of these programs is the diversification of the cultivar offer. The characterization of nine garlic and eight onion cultivars according to its organosulfur, flavonoid and fructan composition, variables related to the flavor of these species, like pungency, solids content, and functional properties, in special its antiproliferative activity, has been recently completed; as well as the correlations among these traits. Also our group carried out in vivo studies using animal models that confirmed the potential health benefits of Argentinian germplasm. This characterization allow choosing garlic clones for fresh consumption (with lowest pungency); to obtain pharmaceutical products (with highest allicin content), and for dehydration industry (with high solids content). Besides several crosses between selected onion lines have been done to produce segregating progenies for breeding purposes. The results achieved provide valuable information that will contribute to breed new onion and garlic cultivars which may contribute to reduce the incidence of cardiovascular disease among other human diseases.

S07.007 Breeding for Phytonutrient Content: New Strategies, Pitfalls, and Benefits

Davis, A. R.1; Fish, W. W. 2; Perkins-Veazie, P.3; Taylor, M.3


Visible phytonutrient compounds and compounds which are simple to quantify can be easily selected for in breeding populations. Lycopene in tomatoes and watermelon is one such compound, since the amount of red corresponds well with the quantity of lycopene produced. Because of this, breeders have developed high lycopene varieties. High antioxidant concentration in these vegetables creates new marketing tools for improved sales, premium price options, and health packed produce. Unfortunately, testing for many health promoting compounds is labor intensive and expensive. These compounds are often overlooked in breeding lines and are thus not selected for. Preliminary experiments on watermelon breeding lines showed a wide range for a specific compound within open pollinated fruits. Using new strategies and methods, it is now fairly easy to test for many of these compounds to ensure health packed products for the market place. Some of these new methods allow for the easy in screening for amino acids, vitamins, and carotenoids.

S07.008 Breeding Vegetables and Fruits to Improve Human Health: A Collaborative Effort of Multidisciplinary Scientists, Stakeholders and Consumers Using a Systems-Based Approach

Patil, B. S.; Crosby, K.; Byrne, D.

VEGETABLE AND FRUIT IMPROVEMENT CENTER, DEPARTMENT OF HORTICULTURAL SCIENCES, TEXAS A&M UNIVERSITY, 1500 RESEARCH PARKWAY SUITE 4310, COLLEGE STATION, TX 77845, TEXAS, UNITED STATES

Traditionally, breeding of fruits and vegetables (FAV) was mostly the effort of plant breeders and in some cases pathologists and entomologists were involved. Due to the consumer paradigm shift, and awareness of health benefits, breeders have been changing their objectives. In recent years, breeding programs of FAV are not only involving breeders but also multidisciplinary collaborators. While most breeding programs involve a range of experts such as breeder, molecular marker expert, physiologist, crop management expert, pathologist, and entomologist, very few breeding programs have a system approach of trans-disciplinary research, including analytical, bioactivity derived assays and biological activities including human clinical trials. In order to improve human health, modern breeding programs must develop a strategy to increase consumption of fruits and vegetables by developing cultivars that meet diverse stakeholder needs – that is, cultivars with enhanced quality (flavor and human health benefits) using sustainable crop management practices. This type of systems-approach is only possible through multi-disciplinary centers such as the Vegetable and Fruit Improvement Center. This presentation will include examples of successful breeding of certain vegetables and fruits from field to consumer including clinical trials by the partnership efforts of multidisciplinary scientists at the VFIC. Future breeding programs will have to be developed with the consumer based concept, that enhancing quality traits (flavor, health promoting bioactive content) using a system-based approach involving breeding, genomics, and sustainable crop management practices, will promote increased consumption. Further, the belief is that enhancing bioactive content will result in system-wide benefits to fruit and vegetable processors, consumers, and society at large. Quality and consumer studies (including human clinical trials), and socio-economic impacts of new cultivars released will be evaluated by the social scientists’ team, in order to meet the consumer needs of the future.

S07.009 Enhancing the Health Benefits of Broccoli

Mitthen, R.

INSTITUTE OF FOOD RESEARCH, COUNTY LANE, NR4 7CA, NORWICH, NORFOLK, UNITED KINGDOM

Epidemiological studies and experimental data from cell and animal models have provided a substantial body of evidence that diets relative rich in cruciferous vegetables such as broccoli can promote health. While these vegetables contain many compounds of potential relevance to health, they are characterised by the accumulation of sulphur-containing glycosides known as glucosinolates. These compounds degrade to produce isothiocyanates and indoles, and it is these metabolites that have been widely implicated in the health promoting properties of these vegetables. In this talk, I will provide an overview of a research programme that has led to an
enhancement of putative health-promoting glucosinolates in broccoli through conventional breeding and marker assisted selection. I will discuss the consequences of enhancing glucosinolates for other aspects of sulphur metabolism which has led to a positive effect on flavour, and then briefly comment on progress towards commercialisation of these cultivars, and regulatory aspects of health claims. I will then describe our on-going human intervention studies that have sought to obtain experimental evidence that these new cultivars will deliver health benefits, particular with regard to reducing the risk of vascular disease and prostate cancer.

S07.010 Phytochemicals: Shelf Life and Disease Resistant Elicitors

Khanizadeh, S.; Gosselin, A.; Desjardins, Y.; Fan, L.

Agriculture and AgriFood Canada, 430 Cyan, Richelieu, J8B 2G0, St. Jean sur Richelieu, Quebec, Canada.

High dietary intake of fruits and vegetables rich in phytochemicals has been linked to reduced risks of many chronic diseases including cancer and cardiovascular diseases. Value-added foods and nutraceuticals containing such bioactive phytochemicals have been popular and made available in the market. Many factors affect the phytochemical concentration in fruits including farming practices, environmental factors and post-harvest handling of the fruits and processing but the genetic factor has the greatest effect on the biosynthesis of antioxidant secondary metabolites. A large variation of antioxidant concentrations exist within apple, strawberry and raspberry cultivars and breeding lines and it is possible to use this as a marker to design specialty fruits for niche marketing. The phytochemical profiles and chemical content of fruits not only affect the fruit quality and its shelf life but also have an important function in the plant’s defense mechanisms, coping with biotic and abiotic stresses. The increase and/or decrease in phytochemicals can both be useful in designing fruits. Elevated concentration of antioxidants could extend the shelf life and reduce the incidence of post harvest diseases; and modulation of specific antioxidants can be used as a tool to change the specific quality characteristics of a fruit for example reduce the incidence of browning during or after processing. New developed raspberries and strawberries rich in phytochemical and non browning apples will be presented and discussed.

S07.011 How to Optimize Content of Bioactive Compounds – Effects of Cultivar and Processing in Root Vegetables

Olsson, M. E.; Gustavsson, K.

Department of Horticulture, Swedish University of Agricultural Sciences, P.O. Box 105, 751 05 Uppsala, Sweden.

Groups of compounds, or individual compounds, in fruit and vegetables have been pointed out as the plausible reasons for the well-established connection between a diet rich in fruit and vegetables and lower risk of some common diseases. Antioxidant effects, or other bioactive action, such as influence on some human enzyme activities, have been suggested as their possible mode of action. Since the health promoting effect has been attributed to certain compounds, individually, or in synergistic combination, it is of interest to increase knowledge of factors which influence the levels of these compounds. The differences in the content of vitamin C, polyacetylenes and carotenoids in a range of orange, red and yellow cultivars of carrot have been analysed. In addition, the effects of different processing steps were investigated in carrot, kohlrabi, parsnip, turnip and Swedish turnip. Large differences were found in the content of polyacetylenes and carotenoids between cultivars. Different processing steps were found to affect the content of vitamin C, polyacetylenes and carotenoids to different extent. In addition, the processing did not affect the different cultivars in a similar way, which might implicate a possible interaction among the investigated compounds. The results will be discussed in terms of how bioactive compounds can be optimized.

S07.012 Effects of Photoselective Nets on Phenolic Composition in Apple Fruits


Department of Agriculture, University of Bologna, Viale Fasan 46, Bologna, Italy.

Phytochemicals are of primary importance with regard to reducing the risk of vascular disease and prostate cancer. Photoselective nets is an emerging technology for physical protection and manipulation the light quantity and quality in horticultural crops, but poor information exists about the potential uses of this technology as tool to modify the synthesis of these bioactive compounds in apple fruit. This research reports on the effect of photoselective coloured nets on major pigment, flavonoid and polyphenol levels in apple. Photoselective red hail (RH), red shade (RS), pearl shade (PS), blue shade (BS) and grey shade (GS) nets were placed on ‘Fuji’ apples grown under commercial orchard conditions and arranged in a random block design with mini-plots. Preliminary results indicate that photoselective nets affect differentially the fruit pigmentation in apples. Biochemical analysis of phenolic compounds such as anthocyanins, quercetin-3-glycosides and chlorogenic acid are currently being assessed. Results of these analyses will be also presented.

S07.013 Impact of Cultivation Conditions and Postharvest Treatment on the Polyacetylene Contents of Carrots and Parsnip

Kramer, M.; Carle, R.; Butler, G.; Conrad, J.; Nothnagel, T.; Kammerer, D. R.

University of Stuttgart, Institute of Food Science and Biotechnology, Chair of Plant Foodstuff Technology, Garbenstrasse 25, 70599 Stuttgart, Germany.

Polyacetylenes have been popular and made available in the market. Many factors affect the phytochemical concentration in fruits including farming practices, environmental factors and post-harvest handling of the fruits and processing but the genetic factor has the greatest effect on the biosynthesis of antioxidant secondary metabolites. A large variation of antioxidant concentrations exist within apple, strawberry and raspberry cultivars and breeding lines and it is possible to use this as a marker to design specialty fruits for niche marketing. The phytochemical profiles and chemical content of fruits not only affect the fruit quality and its shelf life but also have an important function in the plant’s defense mechanisms, coping with biotic and abiotic stresses. The increase and/or decrease in phytochemicals can both be useful in designing fruits. Elevated concentration of antioxidants could extend the shelf life and reduce the incidence of post harvest diseases; and modulation of specific antioxidants can be used as a tool to change the specific quality characteristics of a fruit for example reduce the incidence of browning during or after processing. New developed raspberries and strawberries rich in phytochemical and non browning apples will be presented and discussed.

S07.014 How to Optimize Content of Bioactive Compounds – Effects of Cultivar and Processing in Root Vegetables

Olsson, M. E.; Gustavsson, K.

Department of Horticulture, Swedish University of Agricultural Sciences, P.O. Box 105, 751 05 Uppsala, Sweden.

Groups of compounds, or individual compounds, in fruit and vegetables have been pointed out as the plausible reasons for the well-established connection between a diet rich in fruit and vegetables and lower risk of some common diseases. Antioxidant effects, or other bioactive action, such as influence on some human enzyme activities, have been suggested as their possible mode of action. Since the health promoting effect has been attributed to certain compounds, individually, or in synergistic combination, it is of interest to increase knowledge of factors which influence the levels of these compounds. The differences in the content of vitamin C, polyacetylenes and carotenoids in a range of orange, red and yellow cultivars of carrot have been analysed. In addition, the effects of different processing steps were investigated in carrot, kohlrabi, parsnip, turnip and Swedish turnip. Large differences were found in the content of polyacetylenes and carotenoids between cultivars. Different processing steps were found to affect the content of vitamin C, polyacetylenes and carotenoids to different extent. In addition, the processing did not affect the different cultivars in a similar way, which might implicate a possible interaction among the investigated compounds. The results will be discussed in terms of how bioactive compounds can be optimized.
acetylenes in the edible parts of the aforementioned plants were determined by HPLC-DAD using the isolated reference compounds. The results demonstrate the dependence of polyacetylene levels on some of these factors. As an example, polyacetylene contents significantly increased upon abiotic stress as a result of aridity or wet conditions during plant growth. The data obtained in the present study contribute to a better understanding of polyacetylene accumulation and help to develop strategies for the production of plants particularly rich in these potentially health beneficial compounds and of crops devoid of polyacetylenes which are undesired in juices, purées and food colorants from a sensory point of view.

S07.014
Effect of Supplementary Pre-Harvest Led Lighting on the Antioxidant and Nutritional Properties of Green Vegetables

Novičkovas, A.¹; Samuoliene, G.¹; Urbanavičiūtė, A.¹; Brazaitė, A.²; Jankauskienė, J.¹; Duchovskis, P.¹; Bliznakas, Z.²; Zukauskas, A.²

¹INSTITUTE OF HORTICULTURE, LITHUANIAN RESEARCH CENTRE FOR AGRICULTURE AND FORESTRY, NAVO G. 30, LT-15425, RADAĻI, RIGA COUNTY, LATVIA
²INSTITUTE OF APPLIED RESEARCH, VILNIUS UNIVERSITY, SAVIETO AL. 8-III, LT-10222 VILNIUS, LITHUANIA

We report on the application of supplementary solid-state lighting within an industrial greenhouse for pre-harvest treatment of various green vegetables (spinach, parsley, dill, mustard, rocket, and onion leaves) grown under high pressure sodium lamps and natural solar illumination. For 3 days before harvesting, supplementary lighting from red 638-nm light-emitting diodes (LEDs) was applied within a 19-h photoperiod in such a way that the net photosynthetically active flux density of at least -300 µmol m⁻²s⁻¹ was maintained. Such a pre-harvest treatment was found to remarkably enhance antioxidant and nutritional properties of green vegetables due to the increased activity of the metabolic system for the protection from a mild photooxidative stress. However, the effect of supplementary red light was found to be species dependent. The sensitivity of a species to the lighting conditions was determined by the natural level of phenolic compounds accumulated in the leaves. Supplemental lighting evokes a metabolic disbalance in green vegetables that accumulate low amounts of antioxidative compounds, therefore the flux of red light even diminish the nutritional value of spinach and rocket. Meanwhile, application of supplemental LED lighting to dill and parsley results in the accumulation of vitamin C and carotenoids of spinoxanthin cycle and in the enhancement of free radical binding activity and the activity of nitrate-reducing enzymes.

S07.015
Antioxidant Activity, Phenolic and Free Arginine Content of Twelve Nuts

Nikolaides, P.¹; Koukourikou-Petridou, M.¹; Stylianidis, D.²; Molassiotis, A.³

¹UNIVERSITY OF THESSALONIKI, LABORATORY OF HORTICULTURE, FACULTY OF AGRICULTURE, ARISTOTELES UNIVERSITY OF THESSALONIKI, 54 124, THESSALONIKI, GREECE
²EPIKOION INSTITUTE, VARIOUS, THESSALONIKI, GREECE
³EPIKOION INSTITUTE, VARIOUS, THESSALONIKI, GREECE

Limited comparative information is available concerning the antioxidant substances (e.g. phenolics) and healthful biological factors (e.g. arginine) in nuts. Therefore, the present study aims to assess the total antioxidative activity, total phenolic content, and free arginine content of twelve common nuts. The results of this screening experiment demonstrated that there were remarkable differences in the antioxidant-related properties and free arginine content among the nuts evaluated. Walnuts, and especially the ‘Milotai’ variety, had the highest antioxidant activity and phenols content, following by pecan, and pistachio. Antioxidant activity was positively correlated with phenolic content in the plant material tested. In addition, hazelnut, pecan and walnut showed the highest content of free arginine among all the nuts examined. The comparative data presented here could be providing new knowledge about health function of nuts.

S07.016
Glucosinolates Content and Yield of Broccoli Cultivars in Different Growing Periods

Fabek, S.¹; Toth, N.¹; Herak Custic, M.²; Radojcic, I.³; Benko, B.³; Zutic, L.³

¹DEPARTMENT OF VEGETABLE CROPS, UNIVERSITY OF ZAGREB, FACULTY OF AGRICULTURE, SVETOSIMUNSKA 21, 10000, ZAGREB, CROATIA
²DEPARTMENT OF PLANT NUTRITION, UNIVERSITY OF ZAGREB, FACULTY OF AGRICULTURE, CROATIA
³UNIVERSITY OF ZAGREB, FACULTY OF FOOD TECHNOLOGY AND BIOTECHNOLOGY, CROATIA

Among the functional food of plant origin, cruciferous vegetables are the abundant natural source of essential minerals, vitamins and phytochemicals. In broccoli (Brassica oleracea L. var. italica Plenk.), the concentration of glucosinolates and their bioactive hydrolysis products depend on the genetic, environmental and agronomic factors. Research with the aim to select promising hybrid broccoli cultivars, suitable for growing in agroecological conditions of northwestern Croatia, with high values of agronomic properties and bioactive compounds, was conducted during the spring-summer (SSGP) and summer-autumn growing period (SAGP). The field trials including 13 hybrid broccoli cultivars were laid out according to four-replication randomized complete block design. Planting dates were 19 April for the SSGP and 17 July 2007 for the SAGP, while harvest period between 57 and 62 days after planting. During harvest period basic morphometrical values of broccoli top inflorescence were determined. For analysis of total and individual glucosinolates content (HPLC system), samples of top inflorescence were freeze-dried. Mass of marketable top inflorescence during the SSGP ranged from 257 (‘Agassi’) to 403 g (‘Parthenon’) and from 321 (‘Agassi’) to 506 g (‘Montop’) in SAGP. The highest values of top inflorescence yield were achieved by cultivars: ‘Parthenon’ (1.35 kg m⁻²) in SSGP and ‘Montop’ (1.5 kg m⁻²) in SAGP. In both growing periods, prevailing indolic glucosinolates in all tested cultivars were glucobrassicin and 4-methoxyglucobrassicin. The highest glucobrassicin concentrations achieved ‘Ironman’ (13.2 µmol·g⁻¹ DW) in SSGP and ‘General’ (9.5 µmol·g⁻¹ DW) in SAGP, significantly higher than other cultivars. The main aliphatic glucosinolate was glucoraphanin. There were significant differences among cultivars in total glucosinolates concentration which ranged from 12 to 22.5 µmol·g⁻¹ DW in SSGP and 5.4 to 15.5 µmol·g⁻¹ DW in SAGP. ‘General’ and ‘Marathon’ achieved high values of agronomic and chemical properties in different environmental conditions.

S07.017
Changes in Metabolites of Corchorus olitorius during Storage - Comprehensive Analysis by Orbitrap MS

Tomš, K.¹; Yasunobu, T.²; Suzuki, K.²; Okazaki, K.²; Shibata, D.²; Murakami, H.¹; Matsumura, Y.³

¹GRADUATE SCHOOL OF AGRICULTURE, KYOTO UNIVERSITY, GOKASHO, 611-0011, UKI, KYOTO, JAPAN
²UNIVERSAL ENGINEERING DIVISION, HOME APPLIANCE COMPANY, PANASONIC CORPORATION, JAPAN
³KAZUSA DNA RESEARCH INSTITUTE, JAPAN

Malolohaia (Corchorus olitorius) is a vegetable attracting human interest because it contains various useful components such as vitamins, phenolic compounds and polysaccharides with unique viscosity. After harvesting, the quality of malolohaia should change during storage. Although the previous study reported the changes in amounts of a few vitamins during the storage of malolohaia, analysis of numerous compounds or metabolites are necessary to evaluate the effect of the storage on the quality of malolohaia. In this study, the LC-Orbitrap MS system was used for the comprehensive analysis of compounds in malolohaia stored at 5 degrees Celsius. Methanol extracts from malolohaia were prepared periodically for 7 days and applied to the analysis by LC-Orbitrap MS system. Many metabolites in malolohaia could be identified, and the amounts of several metabolites of them were found to change clearly during storage. These changeable metabolites should be key compounds determining the quality of malolohaia.
S07.018
Influence of Nitrogen Supply and Storage Temperature on the Vitamin C, Folic Acid and Glucosinolate Content of Baby Leaf Rocket Species Diplotaxis tenuifolia and Eruca sativa
Hall, M. K.; Jobling, J. J.; Rogers, G. S.

University of Sydney, Faculty of Agriculture and Natural Resources, Suite 332, Biosciences Building, Scientia Avenue, 2006, Sydney, NSW, Australia

Rocket is an important new crop for the processed and fresh salad market where the leaves of the perennial and annual forms are in high demand for their characteristic flavour and attractive appearance. The impacts of nitrogen supply (0, 100, 200, and 300 kgN·ha\(^{-1}\)) and postharvest storage temperatures (0, 4, and 7 °C) on the content of vitamin C, folic acid and glucosinolates were studied over a range of varieties for Eruca sativa (annual garden rocket) and Diplotaxis tenuifolia (perennial wall rocket). After 15 days storage, the lowest nitrogen supply (0 kgN·ha\(^{-1}\)) resulted in significantly higher vitamin C levels in E. sativa compared to all N application rates. The vitamin C levels were 76.6, 68.5, and 48.7 mg×kg\(^{-1}\) at 0 °C, 4 °C and 7 °C respectively. There was no effect of nitrogen supply for D. tenuifolia. The vitamin C content of both rocket species for all nitrogen treatments was significantly higher at 0 °C than at 4 °C or 7 °C. Folic acid concentration of E. sativa was significantly higher (2.5-2.7 mg×kg\(^{-1}\)) at low rates of nitrogen supply, compared to high nitrogen supply where the folic acid concentration was 1.8-2.0 mg×kg\(^{-1}\). Storage for 15 days at 0 °C resulted in 10% higher folic acid concentrations than storage at 7 °C. No significant differences were observed for D. tenuifolia response to nitrogen, however concentrations were maintained for 15 days at 0 °C. Total glucosinolate concentration was strongly influenced by nitrogen supply for E. sativa. Nitrogen applied at 100, 200 or 300 kgN·ha\(^{-1}\) resulted in glucosinolates concentrations of 3.4 g·kg\(^{-1}\) compared to 0.8 g·kg\(^{-1}\) for nil nitrogen application. The glucosinolate levels in D. tenuifolia were not significantly influenced by nitrogen however in both species storage at 0 °C was effective in maintaining glucosinolate concentrations for 15 days after harvest.

S07.019
Glucosinolates in Chinese Brassica Vegetables and its Regulatory Mechanisms
Zhu, Z. J.; Wang, H. S.; Yang, J.; Zang, Y. X.

Department of Horticulture, School of Agriculture and Food Science, Zhejiang A & F University, Haining Chenzhou Road 88, Lin’an, Zhejiang 311300, China

Glucosinolates, a group of plant secondary metabolites, are mainly found in the family of Brassica. Their enzymatical degradation products are responsible for the characteristic flavor, pathogen defense system and insect attractants, and have been shown to possess anti-carcinogenic, cholesterol-reducing and other pharmacological effects. Plenty of species and cultivars of Chinese Brassica vegetables are largely produced and consumed in China. In this article, we summarize our recent research results about glucosinolates as following: 1) Identification and analysis of glucosinolates in pakchoi (Brassica campestri ssp. chinensis var. communis, choysum (Bras- sica campestri ssp. chinensis var. sulis), turnip (Brassia campestri ssp. rapifera), leaf mustard (Brassia junca), Chinese broccoli (Brassica alboflavida) and Chinese cabbage (Brassica campestri ssp. pekinensis); 2) Genotypic difference of glucosinolates in pakchoi and Chinese broccoli; 3) Influence of developmental stage and different organs on glucosinolates in pakchoi; 4) Effects of nutrient status (nitrogen, sulfur and phosphorus supply levels and nitrogen form) on glucosinolates in pakchoi; 5) Influence of elicitors (jasmonates and salicylic acid) on the concentration of gluco- sinolates in pakchoi; 6) Cloning and characterization of glucosinolates metabolism related genes in pakchoi.

S07.020
Cell-Based Bioassays Reveal Novel Metabolic and Anti-Inflammatory Actions of Resveratrol and Abscisic Acid in Insulin Target Cells and Macrophages: Potential for the Development of Novel FAV-Derived Anti-Diabetic Treatments
Lellis-Santos, C.; Centeno-Baez, C.; Pilon, G.; Lavigne, C.; Benson, C.; Loewen, M.; Desjardins, Y.; Abrams, S.; Marette, A.

Institute of Biomedical Sciences, University of Sao Paulo, Av. Prof. Lineu Prestes, 1524, ICMBio, Aula 125, CEP 05508-900, Sao Paulo, Brazil

Institute of Nutraceuticals and Functional Foods and Quebec Heart and Lung Institute, Laval University, Canada

The key studies that suggest that berry extracts can modulate acute glycaemic responses were partially purified and retested to confirm inhibition. We also carried out human studies that suggest that berry extracts can modulate acute glycemic responses.
after ingestion of starch-rich foods, perhaps through inhibition of these enzymes in situ. Berry polyphenols also showed potential for the inhibition of pancreatic lipase activity, which is a proven therapeutic target for the control of obesity and hyperlipidemia through reduced fat digestion (2). We present evidence for the identification of key components. We also assessed the ability of berry polyphenol-rich extracts to inhibit protease activities at levels which could affect protein digestion in the gastrointestinal tract. Taking into account the potential synergies for inhibition of starch and lipid digestion by the diversity of polyphenol components present within berry species, the inhibition of digestive enzymes may be another important mechanism for the health benefits attributed to a diet rich in fruit and vegetables.

S07.022
Ethyl Linoleate from Garlic Attenuates Lipopolysaccharide-Induced Pro-Inflammatory Cytokine by Heme Oxygenase-1 in Murine Macrophages

Choi, Y. W.; Park, S. Y.; Kim, S. G.; Park, D. J.; Yoon, M. K.; Kim, Y. H.; Lee, S. J.*
Department of Horticultural Biotechnology, Pusan National University, Gwanganri, Haeundae-gu, Busan 609-735, Republic of Korea

Garlic is a member of the lily family that has been cultivated by humans as a food plant for over 10,000 years and a folk remedy for thousands of years. Ethyl linoleate (ELA) was isolated from the clove of garlic. The structure of ELA was elucidated by spectroscopic methods including 2D-NMR techniques. In the present study, we demonstrated that ELA suppressed TNF-α and COX-2 expression and thereby reduced NO and PGE2 production in LPS induced RAW264.7 cells. ELA significantly suppressed LPS-induced production of pro-inflammatory cytokines (TNF-α, IL-1β, IL-6, and IL-12), and then these effects were mediated by the impaired translocation of NF-κB and inhibition of the phosphorylation of p38, JNK, ERK, and Akt. Interestingly, we found that ELA exerts anti-inflammatory activities in macrophages by inducing HO-1 expression. In addition, snPP (HO-1 inhibitor) abrogated the inhibitory effects of ELA on the production of NO, TNF-α, IL-1β and IL-6 in LPS induced RAW264.7 macrophages. These results suggest that induction of HO-1 by ELA may be important in the understanding of a novel mechanism for the anti-inflammatory activity of ELA.

S07.023
Antimicrobial and Antipathogenic Activities of Different Extracts of Fruits and Vegetables and their Metabolites

Truchado, P.; Ponce, A.; Tomas-Barberan, F.; Allende, A.
CEBAS-CSIC, Campus Universitario de Espinardo, 30100, Murcia, Spain

Bacterial infections remain an important problem for human health. The control of bacterial infections has been traditionally treated by inhibiting microbial growth using different types of antibiotics. However, the ability of different bacteria to resist the inhibitory action of antibiotics has become a global problem. In fact, there is an important need for the development of new antimicrobials that act on novel bacterial targets. Many pathogenic bacteria control their population and regulate gene expression in response to their cell population density using diffusible signaling compounds. This type of communication has been referred to as “quorum sensing” (QS). This phenomenon can be essential for the synchronization of the virulence production factors which make it an attractive therapeutic target. Therefore, the search of non-toxic compounds which inhibit QS and so, the virulence of pathogenic bacteria can bring new alternatives for the treatment of bacterial infections in humans. In this work, we made an attempt to screen the anti-QS activity of 15 bioactive compounds extracted from fruits and vegetables using the biosensor strain, Chromobacterium violaceum and the antimicrobial activity against a pathogenic strain, Yersinia enterocolitica. The anti-QS activity was determined quantify-

S07.024
Designed Phytochemical Synergies for Functional Foods of the Future

Scheepens, A.
The New Zealand Institute for Plant & Food Research Limited, 120 Mt Albert Rd Sandringham, 1142, Auckland, New Zealand

In the search for functional health-promoting compounds from plants, techniques including high throughput in vitro assays and activity-guided fractionation are commonly used. In vitro-active compounds are then tested in animals, or go directly into human intervention trials, which mostly fail to show specific or realistic health-promoting activity. This is primarily because phytochemicals are poorly absorbed and rapidly metabolised. Further, in vitro screening fails to detect the bioactivity of metabolites, and shows false activities of parent compounds, which may never reach circulation or their target organs at appreciable doses. Researchers have attempted to mimic the processes of biochemical absorption and metabolism using in vivo digestion systems but these are technically challenging and although they may mimic some limited and disparate mechanisms, none has convincingly modelled in vivo digestion. Amongst consumed phytochemicals, polyphenolic compounds tend to be the most bioactive. Consumed polyphenols, similarly to most pharmaceuticals, are regarded as xenobiotics by the body and must overcome many barriers, including extensive enzymatic, chemical and microbial modification during digestion and absorption. Interestingly, many polyphenols can also modify some of the processes that govern their bioavailability. Therefore, the opportunity exists to increase the bioavailability and bioactivity of beneficial polyphenols by designing specific synergistic interactions with other polyphenols. For example, the activity of plant-derived monoamines can be enhanced by the co-consumption of phytochemical monoamine-oxidase inhibitors. Likewise, bioactives that are cytochrome P450 (CYP) or multidrug efflux pump (MDR) substrates may have their bioavailability significantly increased by the co-consumption of phytochemical CYP and MDR inhibitors. Other designed synergies, especially those commonly used in modern pharmacology, may be utilised in the design of functional foods in order to improve bioavailability and bioactivity. These hypotheses will be discussed, along with examples of further mechanisms that may be targeted by designed phytochemical synergies.

S07.025
How Can We Modulate the Bioavailability of Fruit and Vegetables Phytochemicals?

Tomas-Barberan, F.
CEBAS-CSIC, Campus Universitario de Espinardo, 30100, Murcia, Spain

The health effects of fruits and vegetables are often related to their content in phytochemicals. Bioavailability of these phytochemicals is a key factor to understand the health effects of fruits and vegetables in vivo. It is known that bioavailability depends on the food matrix, and therefore fruit and vegetable processing produce relevant effects on phytochemical bioavailability. Fruit and vegetable processing technologies (pressure, temperature, enzymes, etc.) can modulate bioavailability and in some cases they can help increasing phytochemical absorption. Often, absorption depends on the presence of specific microbial strains in the colon, and therefore the health effects of these phytochemicals depend on the presence of specific microorganisms in the intestinal tract. This can be one of the explanations for the large inter-individual variability.
observed in the human intervention studies with fruits and vegetables or extracts obtained from them. In the present work, the bioavailability of some fruit and vegetable phytochemicals will be presented as well as the effect of colonic microbiota metabolism on their bioavailability and the effect of technological treatments to modulate this bioavailability and potentially their health effects.

**S07.026**

**In vitro Bioaccessibility of the Carotenoids of Leafy Vegetables**

Oliveira, G. P. R.; Rodriguez-Amaya, D.

Composition data on bioactive compounds should be accompanied by information on bioavailability. Human studies are ultimately required for this purpose, but such studies are time-consuming and complex, limiting their use to few food samples. Thus, simple and rapid in vitro methods have been developed for the initial screening of the relative bioavailabilities of carotenoids. The in vitro bioaccessibility of commercial and uncultivated native Brazilian leafy vegetables (chicory, coriander, kale, lettuce, New Zealand spinach, mint, roquette, water cress, "caruru", "ser-ralla", "taisiba") was determined. The method was that of Garrett et al. (1999), modified by Reboul et al. (2006), Chichumoonchokchai and Failla (2006), and Thakkar et al. (2007). It consisted of the oral phase (3 g homogenized vegetable + a-amylase solution, incubated in water bath with agitation for 10 min at 37 °C), gastric phase (pH adjusted to 4 + pepsin solution, incubated for 30 min) and intestinal phase (pH adjusted to 6 + a solution of bile extract, pancreatin, lipase, cholesterol esterase, incubated for 30 min). centrifugation at 5,000 g, 4 °C, 45 min followed; the aqueous phase was collected and filtered. The carotenoids were extracted, identified and quantified, using our validated HPLC method. Among the raw leafy vegetables analysed, New Zealand spinach had the highest bioaccessibility (14% for ß-carotene, 46% for lutein), followed by the lowest dietary fibre content (2.1 g/100 g). "Carura", rich in dietary fibre (4.5 g/100 g), had the lowest bioaccessibility (2.3% ß-carotene, 6.5% for lutein), although it had the highest carotenoid levels (122 µg/g ß-carotene, 136 µg/g lutein). Boiling increased the bioaccessibility. Micellarization of ß-carotene and lutein was 3.3% and 18%, respectively, in raw kale, increasing to 16% and 38%, respectively in boiled kale. The corresponding percentages in New Zealand leaves were 14% and 46% in the raw and 15% and 59% in the boiled form.

**S07.027**

**The Cooking Method of Tomatoes Influences the Particle Sizes of the Puree and Modifies the Capacity of the Carotenoids to Diffuse to an Oil Phase**

Page, D.; Degrou, A.; Georgé, S.; Reich, M.; Renard, C. M. C. G.

The bioavailability of active metabolites is defined by the proportion that leaves the food matrix and reaches their cellular target. Thus, the real nutritional benefit of one metabolite depends more on its bioavailability than on its total amount. For lycopene, the major tomato carotenoid, bioavailability is enhanced in cooked products. We made the hypothesis that this is due to the processes which render them more easily extractable. Tomatoes is often consumed with oil, either fresh in salads or processed as food bases mixed with ingredients to prepare sauces. Interestingly, the behaviour of the carotenoids in sauces containing oil mimics the very first step of the bioavailability: the easier carotenoids transfer to the lipid phase, as happen in the bolus, the more available they can be. We compared the diffusion of carotenoids from fresh, hot-break (HB) and cold-break (CB) purees toward an oil phase. Heat-treatment was achieved using microwave cooking either directly on fresh tomatoes (HB) or on crushed tomatoes (CB). Oil was added to each preparation and after 30 min of gentle shaking, carotenoids were measured in the oil phase. Inactivation of cell-wall degrading enzymes was verified for peric tunin esterase by measuring methanol liberation, and particle sizes of the purees were measured using a particle analyser. The HB purees contained roughly twice less lycopene than the fresh and CB puree. Surprisingly, results for the diffusion were inverted as oil contained three times more lycopene when mixed to HB (around 0.9 µg/mL) than when mixed to fresh and CB (around 0.3 µg/mL). The lycopene in HB was very low, indicating that PME was deactivated early during the microwave heating. HB puree contained a higher number of small particles than CB and raw puree. Lycopene bioavailability will be discussed regarding these physical properties of the purees.

**S07.028**

**Fruits, Vegetables and Antioxidants**

Halliwell, B.

National University of Singapore, Department of Biochemistry, 10 Kent Ridge Crescent, 119560, Singapore, Singapore

Fruits, vegetables and extracts derived from them play a key role in the human diet, especially in health maintenance and disease prevention. There are many constituents that could contribute to such effects, including antioxidants and (seemingly paradoxically) pro-oxidants. These agents can affect physiology and pathology both within the gastrointestinal tract and also systemically after absorption. The care that is needed to establish the true effects of fruit- and vegetable-derived antioxidants and pro-oxidants in cell culture studies and in vivo will be illustrated by a range of data from our recent studies.

**S07.030**

**Phytochemicals as Antioxidants: Chemistry and Health Effects**

Fraga, C. G.

Institutional Chemistry-Inphage, School of Pharmacy and Biochemistry, Universiti of Buenos Aires, CONICET, Buenos Aires, Argentina

Epidemiological evidence demonstrates that diets rich in fruit and vegetables promote health, and attenuate or delay, the onset of various diseases, including cardiovascular and neurodegenerative diseases, cancer, and diabetes. The chemical components involved, and the physiological and molecular mechanisms by which fruits and vegetables act on disease, are matters of intensive investigation. For example, backed by their chemical structure, plant polyphenols can in an organism interact with a number of chemical species. The reaction of these polyphenols with reactive oxygen species has been the concept behind studies of their in vitro antioxidant actions. In this regard, the understanding of the factors governing polyphenols absorption and metabolism, has reduced the enthusiasm for "direct" antioxidant reactions (free radical termination or metal chelating reactions), and has prompted the consideration of biological events that can occur at concentrations of polyphenols that are of physiological relevance. As an example of these biological events we have observed that oxidant- and inflammation-related events, as the activation of NF-kB and intracellular calcium regulation, can be modulated by polyphenols by mechanisms that do not necessarily involve an upstream free radical scavenging action.

**S07.031**

**Postharvest Variability in Fruit and Vegetable Composition and its Impact on Dietary Recommendations**

Heyes, J. A.; Pranamornkith, T.; Mawson, A. J.

Plant and Food Research, Private Bag 11 601, 4442, Palmerston North, New Zealand

Centre for Postharvest and Refrigeration Research, Massey University, Private Bag 11 222, 4442, Palmerston North, New Zealand

London South Bank University, London, United Kingdom

A diet rich in fruit and vegetables is known to reduce the risk of cardiovascular disease. Specific fruit and vegetables are now being linked to specific medical conditions, such as reducing the risk of developing type II diabetes or colorectal cancer. Some of the phytochemicals responsible for these effects and the mechanisms by which they may work are now reasonably well understood, but in general nutraceutical extracts or supplements do not have the same beneficial effects as a diet rich in fruit and vegetables.
Antioxidant Activity of Pulp and Peel Apples Extracts Evaluated by Bacteriophage and DNA Protection Methods
Almeida, D.; Cardoso, M.; Cerdeira, A.; Borges, A.; Glão, M. S.; Malcata, F. X.; Pintado, M. E.
Department of Horticultural Sciences, University of Trás-os-Montes and Alto Douro, Vila Nova de Famalicão; Institute of Biotechnology and Agro-Environmental Science, University of Porto, Porto, Portugal.

Free radicals are endogenous initiators of degenerative processes, as they damage lipids, proteins, and DNA, thus favoring the development of a number of degenerative diseases. This work aimed to evaluate the antioxidant activity of apple pulp and peel extracts, from Portuguese cultivars — Casa Nova, Gala, Granny Smith, Reinetta, Starking, Golden, Fuji and Jonagored. The antioxidant capacity was evaluated by ABTS+ and DPPH biological methods — inhibition of DNA oxidative damage and protective effect of phage P22 oxidation by 

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Modelling Health Aspects of Fruit and Vegetables
Dekker, M.; Verkerk, R.
Wageningen University - PO Box 41 6700 AE Wageningen, the Netherlands

Dealing with the health aspects of fruit and vegetables is a complex task. Epidemiological studies relating intake of fruit and vegetables with health are positive but not always consistent in their results. Fruit and vegetables contain a huge number of components that can contribute to their potential health benefits. The level and bioavailability of these components is strongly affected by processes in the supply chain. To use the various sources of information for design of healthier processes and products various challenges remain to be solved. How to deal with uncertainty and variability in the results of epidemiological studies? How to estimate the health impact of individual components? How to optimize processing and preparation methods for health? In this presentation the use of mathematical modeling for these issues will be shown by various examples. Different modeling approaches are needed for specific areas: Mechanistic Kinetic Models for process simulation, Monte Carlo Simulations for modeling epidemiological results, Bayesian Belief Networks for linking consumer aspects to product and processing variables. By these examples it will be shown that modeling can be used to use experimental data more efficiently and to improve the decision making process by combining expert knowledge and data.

S07.033
Maple Sap and Syrup Are a Rich Sources of Abscisic Acid and Polyphenols with Potential Benefits to Health
Desjardins, Y.

For centuries maple sap and syrup have been a staple of North-American native people and are consumed now-a-days throughout the world as edulcoration products. We hereby present the content of maple sap and syrup in phytosterol and especially in abscisic acid (ABA), in ABA-conjugates and their metabolites. We show that this sesquiterpene can be traced in large concentrations in both the sap and the syrup. The metabolites thus resist heat and technological processes leading to the consumable produce. Moreover, the largest form of sesquiterpene in the sap and syrup were phasic acid and dihydrophasic acid accounting for almost 90% of this class of molecules while ABA and its 7'-OH form accounted for close to 10% of this terpenoid in the sap and syrup. Recently ABA and their metabolites have been suggested to act as autocrine cytokine molecules in human granulocytes and were shown to stimulate the release of insulin by pancreatic acinar cells. The high titer of ABA in maple products may explain why they are better tolerated by those suffering from diabetes and metabolic disorders that those consuming other sources of sugars.
S07.036

Comparative Effects of Dietary Plant Extracts and Phytochemicals in Cellular and Biochemical Assays with Potential Relevance to Neurodegenerative and other Chronic Diseases

Vieira, A.; Beking, K.; Fong, V. H.; Aftab, N.; Luong, T.; Chen, S.

Numerous studies have provided evidence for decreased risk of some chronic diseases — e.g., some types of cancer, cardiovascular and neurodegenerative disorders — with increased dietary intake of vegetables, fruits, teas, spices and other plant-based foods and supplements. Two major objectives of our research are to examine (1) the relation of such diseases to plant-based dietary components at the population-public health level, and (2) the potential mechanisms by which phytochemicals (PhC; including PhC combinations, metabolites, and plant extracts) may provide protection against the initiation and development of such diseases at the molecular-physiological level. In terms of the 1st objective, we have provided evidence for an inverse relation between flavonoid consumption, especially flavonols, and risk of Alzheimer’s and other dementias among the populations of developed countries. In terms of the 2nd objective, the main topic of this report, various flavonoid and non-flavonoid PhC were tested in cellular and biochemical assays with potential relevance to such chronic diseases; in particular, potential neuroprotective effects were assessed against the pro-oxidative action of beta-amyloid (bA) and transthyretin aggregates (TTTrag), two pathological factors that contribute to some amyloidogenic diseases. Quercetin — a flavonoid abundant in dietary plants such as onions, apples, tea — was a potent antioxidant in assays that included bA or TTTrag e.g., 25-35% inhibition at 10 microM (p < 0.05 relative to controls without PhC). Various plant extracts were also tested in these and other (e.g., anti-bA aggregation) assays; the relatively potent effects of bilberry, Vaccinium myrtillus (L.) will be discussed and compared with other Vaccinium, Citrus, Capsicum, and other plant species. Overall, the current results of our ongoing studies provide novel insight into activities of plant-based products in different potential neuropathological contexts, and insight into chemical structure-function relationships of various PhC.

S07.037

Understanding Perceptions of Risk: The Outrage Factor and Fruit and Vegetable Consumption

Heyes, J. A.

Fear of pesticide residues has been identified as a contributing factor to inadequate fruit and vegetable intake in Australasia. This appears irrational: in a country like New Zealand, when 60,000 food samples were tested for a possible 240 chemical residues in 2009, 200 chemicals were undetectable and just two samples were found that moderately exceeded the maximum residue limit for one of the residues. In contrast, it has been calculated that 1,559 deaths could be attributed to inadequate fruit and vegetable intake in New Zealand in 1997. Cardiovascular disease, diabetes and colorectal cancer are amongst the major killers in most Western countries and inadequate fruit and vegetable intake is a contributing factor to all of these conditions. Peter Sandman in 1987 put his finger on the missing factor that helps us understand this extraordinary irrationality: the risk that people perceive equals the hazard itself, plus an ‘outrage’ factor. The more familiar something is, and the more control I have over it (e.g. choosing to smoke), the lower the outrage factor: the less familiar, or the less control I have over it, the higher the outrage factor. Arguably, this behaviour has contributed to human evolutionary success. There is an enormous science community devoted to understanding and manipulating the behaviour of fruit and vegetables after harvest in order to deliver fresh produce that is demonstrably high in health-promoting nutrients, bioactive compounds, minerals and fibre. Millions of dollars have been spent on “5-plus a day” public health campaigns attempting to promote fruit and vegetable consumption. What is lacking is a co-ordinated attempt to manage the ‘outrage’ factor in the public mind. This paper discusses the roles and responsibilities of scientists in their relations with the media, the government, the private sector and the public with respect to this topic.

S07.038

Study on the Separation and Determination of Capsanthin in Capsicum (Capsicum annuum L. Syn. C. frutescens)

He, H.; Han, X.; Tang, X.; Song, S.; Wang, W.

Capsanthin is a fat soluble red pigment and is synthesized during carotenogenesis and enhances liposolubility by esterifying with short-chain saturated fatty acids. Capsanthin is regarded as a functional material by antioxidative activity and anti-tumor-promotion activity. Therefore, increased intake of capsanthin rich foods may be helpful for the improvement of health. In this paper, the separation and determination of the capsanthin in capsicum was conducted. The capsanthin was separated and identified by High Performance Liquid Chromatography (HPLC) using Inertsil OD-3 (4.6x250mm, 5µm), mobile phase: Methanol-Dichloromethane, flow rate: 1ml/min, wavelength: 474nm, oven temperature: 30 °C, injection volume: 10µl. Good linear relationship between peak area and concentration of capsanthin was obtained. The regression equation of capsanthin standard curve is Y = 11426.890X + 5313.26, the correlation coefficient is 0.9982. The regression equation of Dihydrocapsaicin standard curve is Y = 63868.90X-2982.65, the correlation coefficient is 0.9999. Moreover, the purification of capsanthin was studied from hot pepper, and the effect of KOH, ether and the extract time was observed. The orthogonal & rotatable experimental design, together with statistical analysis and response surface graph analysis is also performed to get the upmost purity and optimal condition: the quantity of KOH is 5.39ml, the quantity of ether or 15.57ml, the extract time is 2.34h, the purity of capsanthin could reach 17.2%. This method could be used for rapid separation and determination of capsanthin in capsicum.

S07.039

Antioxidant Capacity and Mechanisms in Tomato Fruit at Different Ripening Stages


Fruits and vegetables consumption is important for human health, among other reasons because of their high content of antioxidant compounds. Antioxidant molecules protect the organism from the damage caused by free radicals, which have been associated with the development of chronic degenerative diseases such as cancer. Carotenoids, particularly lycopene, vitamin C, phenols and tocopherols are among the antioxidant substances present in tomato fruit. Fruit ripening has been described as an oxidative process; therefore, a balance between production of reactive oxygen species (ROS) and its removal by antioxidant systems is essential to prevent oxidative damage to macromolecules. Antioxidant systems are classified in enzymatic (e.g. ascorbate peroxidase (APX) and glutathione reductase (GR)) and non-enzymatic (e.g. citric acid and carotenoids among others). It is well known that the antioxidant content in tomato fruit depends on ripening stage, harvesting time, geographic location, environmental factors and storage conditions. In this study, antioxidant capacity, oxidative damage of proteins and enzymatic (APX and GR) and non-enzymatic (citrin acid) antioxidant systems were determined during ripening of Saladette tomato var. 7705. The results showed that antioxidant capacity was low in mature green (MG) tomato and increased as ripening progresses. On the other hand, GR and APX enzyme activities were high in MG tomato and decreased as tomato ripens, suggesting that these enzymes are essential for the MG tomato antioxidant capacity, probably by regenerating reduced antioxidants. But, their importance seems to decrease as fruit ripens and carotenoids, which have antioxidant capacity, are synthesized. Oxidative damage of proteins and citric acid levels during tomato ripening will also be discussed.
S07.040
Extraction and Quantification of Betaine in Azorean *Beta vulgaris* by HPLC. Effect on Human Health

**Paiva, L.¹; Loures, M. J.²; Lima, E.³; Baptista, J.³**

¹UNIVERSITY OF AZORES, DEPARTMENT OF SCIENCE AND TECHNOLOGICAL DEVELOPMENT, RUA DA MÃE DE DEUS, 9501-851 PONTA DELGADA, S. MICHEL, AZORES, PORTUGAL

²UNIVERSITY OF AZORES, DEPARTMENT OF BOTANY, RUA DA MÃE DE DEUS, 9501-851 PONTA DELGADA, S. MICHEL, AZORES, PORTUGAL

Sugar beet produces sucrose and many other water-soluble components that are extracted from the beets as juice. The main product is sucrose, but betaine, inositol, amino acid mixtures and individual amino acids have also been commercially separated from molasses. The extraction of betaine (sulphhydryl-containing amino acid derived from metabolic demethylation of dietary methionine) from sugar beet can be divided into three main stages: production of sugar beet molasses, extraction of betaine using water as an eluent, and finally its purification by crystallisation. In the plants, betaine acts as an osmoprotectant by adjusting the osmotic balance inside of the plant cells and tissues. By this natural defence mechanism, betaine helps plants to overcome the environmental stresses caused by cold, salinity and heat, which are the worst enemies of plant productivity. Recent research on cardiovascular diseases has shown that betaine could potentially help in the reduction of arteriosclerotic cardiovascular diseases that can eventually be caused by excess of homocysteine (Hcy) in the blood. Elevated Hcy levels are an independent risk factor for atherosclerotic cardiovascular diseases, coronary heart disease and strokes. Betaine works by donating methyl groups to Hcy to convert into methionine, consequently lowering the level of blood Hcy. Betaine is considered a safe and effective therapy to lower total Hcy in patients with inborn errors in the enzymes involved in Hcy metabolism. Another important function of betaine is acting as an osmoprotectant having stress relieving properties under various kinds of gastrointestinal stress. Betaine has also been used in some pharmaceutical applications, particularly in the treatment of human homocystinuria for several months without any harmful effects. The objective of our study is the extraction of betaine from Azorean *Beta vulgaris*, the quantification by HPLC/ELSD, and the investigation of the industrial production feasibility.

S07.041
Optimising Quality and Anthocyanin Yield of Purple (Black) Carrots

**Rogers, G. S.¹; Kimpton, T.²**

¹UNIVERSITY OF SYDNEY, SOCIETY OF AGRICULTURE FOOD AND NATURAL RESOURCES, SUITE 152, BIO MEDICAL BUILDING, SCIENTIFIC AVENUE, 200, SYDNEY, N.S.W, AUSTRALIA

²APPLIED HORTICULTURE RESEARCH, AUSTRALIA, AUSTRALIA

High anthocyanin content (black or purple) carrots are a new phytonutrient source that can be processed into an anthocyanin juice concentrate to supply the rapidly expanding health drink market. High anthocyanin carrots (*Daucus carota*) were studied over three seasons. Exposure to low growing temperature early in crop development resulted in up to 40% of plants heading prematurely (bolting) and consequent effects on anthocyanin yield could be significantly reduced by manipulating planting density. Planting densities from 40 to 160 plants/m² were evaluated in the field under cool growing conditions. Bolting was logarithmically correlated to planting density (R² = 0.93) at 10 weeks from sowing and at harvest (115+ days). The lowest rate of bolting (6%) occurred at the highest plant density of 133 and 160 plants/m² and increased to a maximum rate of 24% at the lowest density of 40 plants/m², 74 days after planting. At harvest (115 days after planting) bolting had increased to 11% and 40% for high and low density respectively. The combined effects of plant population and the indirect effect on bolting resulted in a highly significant effect of plant density on the yield of carrots and anthocyanin under cool premature-heading inducing conditions. Total yield of carrots increased significantly from 18 to 40 t/ha at plant densities of 40 and 160 plants/m² respectively. Total anthocyanin yield per ha decreased proportionally with plant spacing as a consequence of total carrot yield. There was a strong tendency for plants at the ends of rows or blocks to have a greater frequency of bolting suggesting that exposure of the apical meristem to light or cold may play a part in the density x temperature effect on premature heading.

S07.042
The Influence of the Adsorption Drying Technology on Stability and Availability of Glucosinolates in Broccoli (*Brassica Oleracea var. italica*)

**Oliviero, T.¹; Verkerk, R.²; Dekker, M.²**

¹PRODUCT DESIGN AND QUALITY MANAGEMENT GROUP, DEPARTMENT OF AGRICULTURE AND FOOD SCIENCE, Wageningen University, Boswijkweg 2, BUILD 307, P.O. BOX 8129, 6700 EU WAGENINGEN, WAGENINGEN, NETHERLANDS

²PRODUCT DESIGN AND QUALITY MANAGEMENT GROUP, DEPARTMENT OF AGRICULTURE AND FOOD SCIENCE, Wageningen University, P.O. BOX 8129, 6700 EU WAGENINGEN, NETHERLANDS

Consumption of Broccoli (*Brassica Oleracea var. italica*) is known to be associated with health benefits. The compounds responsible for this health effect are called isothiocyanates which are formed by the reaction between glucosinolates and the myrosinase enzyme during the disruption of broccoli tissues (chewing, chopping etc.). Isothiocyanates make Broccoli one of the most promising vegetable in cancer prevention. Drying technologies can have a strong impact on processed foods quality i.e. decreasing the content of naturally occurring heat promoting compounds. During drying of broccoli, glucosinolates can be broken down by means of heat or oxidation, the enzyme myrosinase can be inactivated and cellular structures can be altered. All these modifications might reduce the formation of bioactive isothiocyanates from glucosinolates, compromising the health-protective effects of broccoli. Absorption drying is a novel technology which uses low or moderate temperatures preserving the target compounds of broccoli with a limited ecological impact deriving from low energy consumption and CO₂ exhaust. The aim of this study is to set up the most suitable drying conditions that preserve the health protective effect of broccoli by using the adsorption drying technology. For this purpose broccoli batches with different water content/activity (obtained by using freeze drying process) have been thermally treated in order to investigate the influence of the water content/activity and temperature on glucosinolates content, myrosinase activity, degree of cell lysis and, as a consequence of these changes within the product, to predict the ability to form isothiocyanates upon dehydration. Based on this research the conditions during the drying process can be optimized to increase the health promoting potential of the dried product.

S07.200
Indian Fruits as Nutraceuticals

**Dwivedi, D. H.**

BB ABHILASHA UNIVERSITY, LUCKNOW, DUS, BOB ROAD, LUCKNOW - 226015 (UP), INDIA, 226015, LUCKNOW, UTTAR PRADESH, INDIA

Fruits are ‘protective foods’ since they are rich source of phytochemicals and provide the body with capacity to fight disease since they provide vitamins and minerals like Ca, Fe, P and Vit. A, C, B etc. In India, many naturally growing or cultivated horticultural crops, especially dark green and bright coloured fruits and vegetables, which are hitherto underutilized and under exploited, are rich sources of antioxidants. Fruit juices of Pomegranate (*Punica granatum*), Citrus (*Citrus sp.*), Pineapple (*Ananas comosus*), Wood apple (*Feronia limonia*), Grape (*Vitis vinifera*), Litchi (*Litchi chinensis*), Seabuckthorn (*Hippophae sp.* etc...) are effective in preventing various diseases like scurvy, night blindness, asthma, bronchitis, fever, anemia, ulcer, angular stomatitis and diabetes, cancer etc. Leaves, flower, bark and root, etc of various other fruits viz. Singhara (*Trapa natans* Rosh.), Akhand (*Euryale ferox*), Barhal (*Arctocarpus lakan) Karonda (*Carissa carandas*), Mahua (*Bassia latifolia*), Kamrakhi (*Avrera carambola*), Khirni (*Manihot esculenta*), Amra (*Anona*), *Flo- karina indica*), Halphahari (*Phylanthus acidu*), Lasooda (*Ficus benjamina*), Amra (*Feronia limonia*), Cape gooseberry (*Physalis peruviana*), Goolar (*Ficus glom- enata*), Kadam (*Anthoclepsis kadama*), Imli (*Tamarindus indica*), Kaphal (*Myri- ca naga*), Seabuckthorn (*Hippophae sp.*), Raspberry (*Rubus sp.*), Chilgoza (*Pinus gerardiana*), and Burans (*Rhododendron sp.*) etc, are used widely in therapeutics. Thus, it is important that the potential of fruits for their therapeutic value be recognized and their use as nutraceuticals be promoted to overcome malnutrition and for improving the socio-economic status of the society at large.
**S07.201**
Selecting Varieties of Broccoli for Optimal Bioactive Components: The Influence of the Saline Stress

 Moreno, D. A.; Dominguez-Perles, R.; Martínez-Ballesta, M. C.; Riquelme, F.; Carvajal, M.; García-Viguera, C.

**Abstract:**
Broccoli is an important agri-food product produced in SE Spain and is well referenced as one of health-promoting bioactive compounds. Commercial quality and bioactive components of broccoli cultivars ('Parthenon', 'Naxos' and 'Nuba') were studied in plants grown in hydroponics and administered 0, 40 and 80 mM of NaCl in the nutrient solution. Physical characteristics of the flowering heads were determined (weight at harvest, global and base head diameter and circularity of the head, and length and diameter of the stalk) and health-promoting bioactivities (glucosinolates and vitamin C). 'Naxos' variety performed better than 'Parthenon' and 'Nuba' in quality parameters and the glucosinolate content as determined by HPLC-DAD, specially at 0 mM NaCl. In the 40mM NaCl treated plants the glucosinolates contents were significantly increased. The 80mM NaCl stress increased the concentration of glucosinolates with respect to the control, but not if compared to the 40mM NaCl treatment, indicating the biphasic response to salinity observed in early studies with 'Marathon' broccoli. The vitamin C content in the three varieties was very similar and not affected by the NaCl in the florets, but highest in the leaves of the untreated controls (0 mM NaCl). 'Parthenon' and 'Naxos' are current better-performer varieties and not affected by the NaCl in the florets, but highest in the leaves of the untreated controls (0 mM NaCl). 'Parthenon' and 'Naxos' are current better-performer varieties and not affected by the NaCl in the florets, but highest in the leaves of the untreated controls (0 mM NaCl).

**Keywords:**
Broccoli, Glucosinolates, Vitamin C, Salinity, Hydroponics.

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**S07.202**
Regulation of Vitamin C Biosynthesis Using Transient Expression of Vitamin C Pathway Genes in Tobacco Leaves

 Rassam, M.; Bulley, S.; Wright, M.; Laing, W.

**Abstract:**
Kiwifruit are an excellent dietary source of vitamin C for humans, with 80 to 120 mg/100 g FW in commercial cultivars. To test how flux is altered when biosynthetic enzyme levels are changed, we cloned the kiwifruit genes for five sequential enzymatic steps in the L-galactose pathway of vitamin C biosynthesis; namely phosphophenomannose mutase, GDP-mannose pyrophosphorylase, GDP-mannose 3',5'-epimerase, GDP-L-galactose transferase and L-galactose 1-P phosphorylase and then transiently expressed them in tobacco leaves. All genes produced enzymatically active proteins when expressed in Escherichia coli and transiently in tobacco leaves. The genes were expressed transiently either individually or in combination using pGreen vectors in Agrobacterium. Enzyme activity as well as vitamin C level measurements showed >7 fold increase in vitamin C in leaves expressing GDP-L-galactose transferase phosphorylase alone. Whereas expression of GDP-mannose 3',5'-epimerase alone did not result in increased vitamin C levels, combination with GDP-L-galactose transferase and L-galactose 1-P phosphorylase acted synergistically to increase the level by more than 17 fold. No other combination of genes resulted in increased vitamin C. This assay system has the potential to identify elite alleles as well as screening for combining ability potential of selected crosses, thus aiding parental selection for this important trait.

**Keywords:**
Vitamin C, Biosynthesis, Tobacco, Transient Expression.
S07.205

Wild Edible Fruits Traditionally Used in Spain: Nutritional Aspects and Bioactive Compounds

Ruiz Rodríguez, B. M.; Morales, P.; Fernández-Ruiz, V.; Sánchez-mata, M. C.; Cámara, M.; Diez-Marqués, C.; Molina, M.; Tardío, J.

1 Universidad Complutense de Madrid, E-28040 Madrid, Spain
2 Instituto Madrileño de Investigación y Desarrollo Rural, Agrario y Alimentario, Spain

Plant domestication has lead to a progressive decline of wild food plants consumption. Nevertheless, wild plant resources are a good complement to the diet in periods of food shortages, mainly in rural populations. Some authors even report that wild species may contain higher amounts of bioactive compounds than their cultivated relatives. The aim of this research was to evaluate the nutritional value and the content of certain bioactive compounds in four wild fruit species of popular use in Spain. We selected the fruits of strawberry tree (Arbutus unedo L.), blackberry (Rubus ulmifolius Schott), blackthorn (Prunus spinosa L.) and hawthorn (Crataegus monogyna Jacq.). Samples were collected in different locations of central Spain during two consecutive years. They were analysed for proximate composition and vitamin C, in both ascorbic acid (AA) and dehydroascorbic acid (DHA) forms. Arbutus unedo stood out for its low moisture (51.71%) and ash content (0.88%), while carbohydrates and fiber levels were high. Rubus ulmifolius had high values of carbohydrates (17.86%), proteins (1.55%) and insoluble fiber (10.15%). Prunus spinosa showed a similar proximate composition to Rubus ulmifolius. The fruits of Crataegus monogyna were characterized by high moisture, ash and soluble fiber content: 70.24%, 2.49%, and 3.45% respectively. Proteins showed the more stable pattern among species and locations, and no significant differences among species were found (p<0.05). Arbutus unedo has to be emphasized for its significant values of total vitamin C (133–259 mg/100 g), higher than many of the fruits usually included in the diet. Vitamin C content of the other species ranged between 5.85 mg/100 g, in (Crataegus monogyna), and 21.18 mg/100 g in (Rubus ulmifolius). The two active forms of vitamin C showed different distribution among species, being AA the major form in Arbutus unedo and Rubus ulmifolius, and DHA in the other ones.

S07.206

Nutritional Approach of Some Wild Edible Plants from Asteraceae Family


1 Universidad Complutense de Madrid, E-28040 Madrid, Spain
2 Real Jardín Botánico de Córdoba, Spain

Wild plants have been traditionally used for human consumption. In the last decades, the intake of wild plants, especially wild vegetables, has decreased, being replaced by other vegetables easily found in markets. However, due to their important nutritional properties and the presence of bioactive compounds, the attention toward wild edible plants as potential contributors to the benefits of the Mediterranean diet has grown significantly in Europe. Recent studies supported by the European Commission have found that a high number of wild edible species have contributed markedly to total fruit and vegetable intake and have positive effects on human health, many of them belong to the Asteraceae family. In this study, six Asteraceae species have been analyzed: Chondrilla juncea L., Cichorium intybus L., Sonchus hispanicus L., Silphium marianum (L.) Gaertner, Sonchus oleraceus L., and Taraxacum sp. In these samples, a proximate composition analysis has been performed. Moisture content was determined by desiccation; total mineral content by mineralization at 450 °C; and Atomic Absorption Spectroscopy for macro and microelements analysis; Kjeldahl method was used to determine total protein content; fat content was determined by Soxhlet extraction; anthrone method was used to determine available carbohydrates; soluble sugars were quantified by HPLC; and total fiber was determined by AOAC enzymatic-gravimetric methods. Regarding their chemical composition, the different analysed species presented a wide variation. Moisture ranged between 72 and 90%, and major components of the dry matter were available carbohydrates (1.2–5.6%), proteins (0.20–0.8%), mineral fraction (1.03–2.7%) and fat (0.8–2.5%). Sugar composition is formed by fructose, glucose and sucrose, and major mineral elements were K (552–1300 mg/100 g), Ca (200 mg/100 g), Mg (20–51 mg/100 g), Na (300–1300 mg/100 g), Cu (0.01–0.27 mg/100 g), Mn (0.10–0.57 mg/100 g), Fe (0.50–2.78 mg/100 g) and Zn (0.21–0.55 mg/100 g). For all these reasons, the analysed species of the Asteraceae family have important nutritional properties and they are a good choice for a normal diet.

S07.207

Characterization of Apple Cultivars in Terms of Allergenicity


1 Research and Breeding Institute of Pomology Holovousy, Holovousy 1, 508 04, Horice, Czech Republic
2 Food Research Institute Prague, radiova 7, 103 31, Prague, Czech Republic

Growing of different apple cultivars is widespread in the territory of Central Europe. Apples are recommended by nutritionists because of its high content of vitamins and dietary fibres. Unfortunately the presence of several allergens in apple pulp and skin cause allergies problems for some consumers. Allergen Mal d1, which causes swelling of lips and oral cavity, is the most important. At present, the cultivar Golden Delicious is commercially very successful. Unfortunately a high content of allergen Mal d1 was detected in this cultivar. Using 17 selected apple cultivars, the allergenicity was studied by prick to test in patients with clinically detected apple allergy. Pressed apple juice was used for basophil activation testing. Intensity of patient’s allergic reaction to particular cultivars was confirmed by SDS-PAGE electrophoresis and immunoreaction blood of serum by Western blot method.

S07.208

Old and New Apple Varieties at the Service of Health in South Tyrol (Northern Italy)

Dalla Via, J.; Ciesa, F.; Storti, A.; Baric, S.

Research Centre for Agriculture and Forestal Economy, Lienzerallee 6, 5424, Alto Adige, Italy

South Tyrol (Northern Italy) is the largest continuous apple producing area in Europe. The annual apple production amounts to more than 1.1 million of metric tons, 95% of which are made up of only eight global cultivars. Consequently, many old, regional apple varieties with unique characteristics have disappeared from this area. In order to prevent further loss of local genetic variability, several projects were carried out in the past or are still underway. The project “Health and Nutrition – Old and New Apple Varieties at the Service of Health”, granted within the EFRE 2007-2013 programme, deals not only with the exact molecular genetic identification of a large number of old and new apple cultivars, but also focuses on the analysis of fruits to assess components relevant to human health, such as minerals, sugars, acids or polyphenols. The ultimate goal will be to identify cultivars suitable for agricultural niche production or the generation of specialised high-quality foodstuffs. The presentation will give a detailed overview of the project and show first results of the chemical analyses of apple cultivars grown in South Tyrol.

S07.209

QTL Analysis of Traits Linked to Flavour and Nutritional Quality in Lettuce

Chadwick, M. J.; Moosbrugger, A.; Trewin, H.; Gawthrop, F.; Wagstaff, C.

1 University of Reading, Whiteknights, P.O. Box 216, Food and Nutritional Sciences, Reading, Berkshire, United Kingdom
2 Pyports, Downside Bridge Road, Combe Hay, Bath, Somerset, United Kingdom

Lettuce is an important salad crop in the Asteraceae, and comprises a major part of the Western diet, especially as the population becomes increasingly concerned with salad as a part of a healthy diet. Its health benefits can be attributed to the analgesic,
anti-inflammatory and sedative effect of some sesquiterpenoid lactones, and to a range of flavonoids with emphasis on quercetin, chlormoric acid and chlorogenic acid. Primarily these act as antioxidants, but also show other health benefits such as potential anti-human immunodeficiency virus functions, raising uric acid levels and acting as transcription factors. Using a population of 102 RILs (Recombinant Inbred Lines), the progeny of a wild type (*Lactuca serriola*) and a domesticated lettuce (*L. sativa*) we employed Quantitative Trait Loci (QTL) analysis to identify regions of the genome which contain alleles likely to be responsible for high and low flavonoid content. The population was selfed and propagated to the F10 generation by single seed descent in order to fix genes into each line and render the majority of alleles homozygous. The plants were grown to baby leaf stage, harvested into liquid nitrogen and homogenised before analysis. Parameters linked to flavour and nutritional quality, such as total antioxidants, were assayed and the QTL subsequently mapped onto the lettuce genome. Results of these analyses and on-going work to identify QTL related to individual metabolites will be presented. Such information can be utilised in molecular breeding programs, using marker assisted selection (MAS) to more efficiently select for genes of interest. It is hoped that this will ultimately allow new lettuce varieties that are high in flavonoids and other beneficial metabolites to be produced, reducing the risk of oxidative-stress and its related diseases in the consumer.

**S07.210**

Antioxidant Capacity in the Peel of Eleven China-Grown Pomegranate Cultivars

**Hu, C. C.; Yang, X. Y.; Xu, J. Z.; Shao, J. Z.**

**College of Horticulture, Agricultural University of Hebei, University Street No. 189, Baoding, Hebei Province, China**

In this research, the content of total polyphenols, flavonoids, and procyandins in the peel of eleven China-grown pomegranate cultivars were investigated with the methods of Folin-Ciocalteus, NaNO2-Al(NO3)3-NaOH, and HCl-Vanillin, respectively, and total antioxidant capacity was determined using ferric reducing antioxidant capacity (FRAP) assay. The results showed that Fentian had the highest polyphenols content (71.1 mgg⁻¹ FW) followed by Danhong, Chuanhui, Xingzi, DRF-1, D3, Chonghuang, Chongfen, Baiyue, Dasuan, and Damo. By comparison of the flavonoids content in the peel of different cultivars, the following trend was observed: DRF-1 > D3 > Chuanhui > Fentian > Chonghuang > Xingzi > Danhong > Dasuan > Chongfen > Baiyue. For the procyandins content, the order of the cultivars was Fentian > Danhong > DRF-1 > Chuanhui > D3 > Xingzi > Chongfen > Damo > Dasuan > Chonghuang > Baiyue. This evidence indicates that the three antioxidants content in pomegranate peel may be cultivar specific. Among the eleven cultivars, the trend of total antioxidant capacity in the peel was Fentian > Danhong > Xingzi > D3 > Chuanhui > DRF-1 > Chonghuang > Dasuan > Baiyue > Damo > Chongfen. Correlation analysis showed that the total antioxidant capacity in the peel had a strong linear relationship with both the polyphenols (r=0.90) and procyandins content (r=0.68), indicating the antioxidant capacity of pomegranate peel might be attributed to the content of total polyphenols and procyandins. This study may help in the cultivar selection and application of pomegranate peel.

**S07.211**

Quantification of Carotenoids in Zucchini (Cucurbita pepo L. subsp. pepo) Varieties Cultivated in Almeria by Liquid Chromatography

**Del Rio-Celestino, M.; Villaroto-Pulido, M. M.; Gómez, P.; Domínguez-Pérez, I.; Font, R.**

**IENA LA MOJONERA, CARRETERA SAN NICOLÁS 1, 04745, LA MOJONERA, ALMERIA, SPAIN**

The scientific literature is consistent in evidences that it is possible to reduce the risk of acquiring some types of cancer, cardiovascular diseases, diabetes, stroke, obesity, diverticulosis, and cataracts by eating a variety of vegetables and fruits. This has been attributed to their content of antioxidants, such as carotenoids, flavonoids, and vitamins C and E. Carotenoids are natural pigments which are synthesized by plants and are responsible for the bright colors of various fruits and vegetables as *Cucurbita pepo* L. subsp. pepo (zucchini). Zucchini is easily grown in the agricultural and climatic conditions of Almeria (Spain), and it is part of the everyday food of their inhabitants. The objective of this study was to determine the content of carotenoids in peel and pulp in six varieties of zucchini currently cultivated in Almeria (Spain) by means of HPLC. The varieties of zucchini studied were Cavil, Dante, Cora, President, Cronos and Consul. Zucchini varieties were grown in controlled conditions in the greenhouse. Pulp and peel of mature fruit were weighed, frozen in freeze-dried. Extraction of carotenoids and HPLC analyses were carried out using the method described by Tadmor et al. (2000). In dependence of the variety different concentrations and distributions of α-carotene, β-carotene, violaxanthin, neoxanthin, all-trans-lutein were obtained. The total carotenoid content (expressed as dry weight) of the zucchini peel and pulp depends on the variety. Differences for quantitative and qualitative carotenoid contents have been found between the varieties of zucchini studied being some varieties valuable sources of carotenoids.

**S07.212**

Bioactive Components from the Black Sea Area Traditional Foods

**Costa, H. S.¹; Sanches-Silva, A.²; Albuquerque, T. G.²; Finglas, P.²; D Antuono, F.³**

¹INSTITUTO NACIONAL DE SAÚDE DOCTOR RICARDO JUNQUEIRA, NUTRITION DEPARTMENT, AV. PADRE CRUZ, 1546-015, LISBON, PORTUGAL
²INSTITUTE OF FOOD RESEARCH, NORFOLK, UNITED KINGDOM
³VARIETY OF FOOD SCIENCE, CHINA, UNIVERSITY OF BOLOGNA, ITALY

The three years collaborative research program BaSeFood (Sustainable exploitation of bioactive components from the Black Sea Area traditional foods) is funded by the 7th Framework Programme and it was launched on 1st April 2009. This Consortium consists of 13 partners namely Italy (2), United Kingdom, Greece, Portugal and Serbia and six Black Sea Area countries (BSAC): Russia, Ukraine (2), Romania, Bulgaria, Turkey and Georgia. BaSeFood will contribute to scientifically studying bioactive compounds of BSAC traditional foods by means of rigorous analytical and biological assays, in the context of unifying methodologies and data acquisition, but also considering a vast array of characteristics of traditional foods and consumers issues, in order to put health claims in a favourable context, to be properly understood by people and exploited by processor stakeholders. BaSeFood will contribute at scientifically studying bioactive compounds of BSAC traditional foods by means of rigorous analytical and biological assays, in the context of unifying methodologies and data acquisition, but also considering a vast array of characteristics of traditional foods and consumers issues, in order to put health claims in a favourable context, to be properly understood by people and exploited by processor stakeholders. Foods were categorized in groups: (1) cereals and cereal based foods; (2) fruits; (3) vegetables; (4) products from oilseeds; (5) herbs, spices, aromatic plants and (6) fermented products. Thirty-three foods have been selected for nutritional and proximate analysis, and thirty-five foods for bioactive components determination and retention during food preparation. Different nutrients and key bioactive compounds such as phenolics, glucosinolates, tocoherpanes, carotenoids and terpenoids were selected to be analysed, depending on the plant matrix. Guidelines for sampling and sample handling have been developed to establish a common approach for all countries and to ensure that representative food samples are analysed. The bioactive components, nutritional and microbiological characteristics of traditional foods will contribute to create the knowledge base for a sustainable economic development in the area of production and processing of traditional healthy foods.

**S07.213**

Variation of Thermal Stability of Glucosinolates in a Segregating Brassica Population

**Hennig, K.¹; Verkerk, R.¹; Dekker, M.¹; Bonnema, G.²**

¹WAGENINGEN UNIVERSITY, P.O. BOX 312, 6700 AE WAGENINGEN, NETHERLANDS
²WAGENINGEN UNIVERSITY, P.O. BOX 368, 6700 AH WAGENINGEN, NETHERLANDS

Epidemiological studies show negative associations between the consumption of *Brassica* vegetables and the incidence of certain cancers. The protected effects of *Brassicaeae* have been attributed to high levels of health-promoting phytochemicals.
such as glucosinolates (GLSs). The underlying protective mechanisms of GLSs are mainly ascribed to the induction of phase I and phase II enzymes, involved in the detoxification and excretion of carcinogens, and inhibition of cell proliferation. Plant breeders are developing Brassica vegetables richer in specific GLSs. Next to the initial GLS concentration, the ingested amount of GLSs is affected by industrial and domestic processing and storage. The described mechanisms of GLS losses are: a) enzymatic degradation by the endogenous myrosinase, b) leaching into the cooking water and c) thermal degradation. Previously, thermal treatment of five different Brassica vegetables (two B. napus and three B. oleracea types) revealed differences in the degradation velocity of GLSs. These results show that the chemical stability is influenced by the plant matrix, which is (partly) genetically regulated. Crossing of two different Brassica oleracea sub-species varying in various traits of interest, results in a segregation in the F1 generation. It is hypothesized that thermal stability of GLSs segregates as other phenotypic traits, like e.g. flowering time. Thermal degradation rates were studied in a segregating population, obtained by crossing broccoli and Chinese kale. In order to determine rate constants for the reaction velocity, homogenates of microwaved leaves were heated at 100 °C over various times and the GLS concentration was analyzed. The obtained kinetics data will be combined with molecular marker data (QTL analysis) in order to unravel the genetic regulation of thermal GLS degradation during food processing. Preliminary data showed different rate constants among the plant lines of the segregating population, which proves the hypothesis of segregation of thermal stability of GLSs.

S07.215
Quality and Nutritional Composition of Dried Figs: A Traditional Calabria Region (Italy) Product
Russo, M.; Di Sanzo, R.; Postorino, S.; Suraci, F.; Cefaly, V.; Samà, S.

1University of Reggio Calabria, Fondo di Vita, 89100, Reggio Calabria, Italy

Mediterranean Foundation of Research Terina, Area Industriale, Via Ceglie 9, 70116, Bari, Italy

Figs (Ficus carica L.) are a widespread species commonly grown, especially in warm, dry climates and it is an important crop worldwide for dry and fresh consumption. As a seasonal food, figs represent an important constituent of the Mediterranean diet. This type of diet is considered one of the healthiest and is associated with longevity. Fruit and vegetable are an important source of essential elements. Mineral nutrients and phenolics are natural components of many fruit and play an important role in maintaining fruit quality and determining nutritive value. Dried figs are an excellent source of minerals, vitamins and dietary fiber; they are fat and cholesterol-free and contain a high number of amino acids. Similarly to other fruit species, figs contain sugars and organic acids that influence their quality. They also contain phenolic substances, which contribute strongly to their quality, especially because it has been demonstrated that their consumption may have a positive effect on human health. Calabria, south Italy, is an important area for cultivation of figs and in particular for the traditional skill in dried fig productions. The aim especially because it has been demonstrated that their consumption may have a positive effect on human health. Calabria, south Italy, is an important area for cultivation of figs and in particular for the traditional skill in dried fig productions. The aim of this study introduced was the study of the variability of chemical attributes (sugar, organic acids, total phenolic, fibre and vitamins) content in dried figs grown in different Calabria areas. The results showed a very high quality of dried figs analyzed. Chromatographic, spectrophotometric and gravimetric analysis has been used to determine dried figs composition. The data obtained shown dried figs are good sources of soluble fiber (25% DRI) and carbohydrate (35% DRI), and also are source of vitamins. The organic acids and phenolics content detected in dried figs show a high content of these nutritionally important compounds. The results form a good basis for evaluating the quality and nutritional importance of dried figs by physical-chemical analysis.

S07.216
Characterization of Different 'Tropea' Red Onion (Allium cepa L.) Ecotype by Aroma Precursors, Aroma Profiles and Poliphonolic Composition
Russo, M.; Postorino, S.; Cefaly, V.; Di Sanzo, R.; Carabetta, S.; Serra, D.

1University of Reggio Calabria, Fondo di Vita, 89100, Reggio Calabria, Italy

Mediterranean Foundation of Research Terina, Area Industriale, Via Ceglie 9, 70116, Bari, Italy

Epidemiological studies have indicated that the consumption of fruits and vegetables is associated with a reduced risk for the development of chronic diseases, such as cardiovascular disease and cancer. Phytochemicals, including phenolics and flavonoids, are suggested to be the major bioactive compounds of fruits and vegetables contributing to the health benefits. Onion bulbs (Allium cepa L.) are among the richest sources of dietary flavonoids and contribute to a large extent to the overall intake of flavonoids. A particular sweet red onion, ‘Tropea Red Onion’, characterized by a large red envelope and internal white tunics and grown on Tyrrhenian Calabrian’s coast (south of Italy), for the excellent organoleptic characteristics (tenderness, crispness, sweetness), is considered the pride of Calabria’s horticultural products. Because of the few available scientific studies on this particular red onion, a large-scale study to characterize different Tropea red onion ecotype was initiated. Onions are characterized from two main chemical groups. These are the flavonoids and the alk(enyl) cysteine sulfoxides (ACSs). Two flavonoid subgroups were found in onion, the anthocyanins and flavanols as quercetin. The ACSs are the flavour precursors, which, when cleaved by the enzyme allinase, generate the characteristic odour and taste of onion (thiosulphinates, thiosulphonates, mono-, di- and tri-sulphides). The qualitative content of anthocyanins in Tropea red onion cultivars has been reported to be approximately 8% of the total flavonoid content. Altogether at most less than five different flavonoids have been characterized, quercetin derivatives are the most important ones in onion ecotype. Analogous derivatives of kaempferol and isorhamnetin have been identified as minor pigments. The dihydroxyflavonol taxifolin and taxifolin 7-glucoside have been identified bulbs of the ‘Tropea’ ecotype. The profile of aroma components corresponded with the related pattern of aroma precursors (cysteine sulfoxides), GC/MS, SPE/GC/MS, HPLC and e-nose has been used to classify different ‘Tropea’ red onion ecotypes.

S07.217
Binding Affinity of Selected Flavonoids to Bovine Serum Albumin by Fluorescence Quenching and Chromatographic Retention Factor
Cavoski, L.; D’Orazio, V.; Mondelli, D.; Caboni, P.; Miano, T.

1University of Bari, Dipartimento di Biologia e Chimica Agraria, Via G. Amendola 16/A, 70126, Bari, Italy

Università di Bari, Dipartimento di Biochimica e Chimica Agraria, Via G. Amendola 16/A, 70126, Bari, Italy

Universita di Cagliari, Dipartimento di Tecnologia, Via Ospedale 71, 09144, Cagliari, Italy

The interaction between biomacromolecules and remedies has attracted great interest among researchers for several decades. Among them, serum albumins are the major soluble protein constituents of the circulatory system with many physiological functions. Bovine serum albumin (BSA) has been studied extensively in particularly because of its close structural homology with human serum albumin. The interaction between protein and bioactive compound results in formation of a stable protein and bioactive compound complex, which may be considered as a model for increasing essential knowledge into bioactive compounds-protein binding mechanisms. Fluorescence spectroscopy is an appropriate method to determine the interaction between the small molecules and biomacromolecules. Low-molecular-weight bioactive compounds from a variety of sources represent unique structural diversity. Flavonoids are widely distributed secondary plant constituents with great structural variety and various pharmacological properties such as antibacterial, anti-proliferative activities, anti-metastatic, antioxidant activities, increase oxidative stress-resistance and longevity. Favonol (quercetin) and isoflavonoids (noretone and deguelin) were studied for their ability to bind BSA by quenching the protein inherent fluorescence. The fluorescence parameters such as the dynamic quenching constant and the binding constant were attained whereas chromatographic retention factor was determined by high-performance liquid chromatography method. Chemical structure significantly affected the binding/quenching process and results showed that hydrogen bond force play an important role in binding of flavonoid to polar groups at the BSA surface. The lipophilicity of flavonoids was less important in the binding affinity.
S07.218
The Biological Effect of Saffron Extract on the Various Forms of Retinal Degeneration

Gasimov, K. A. 1; Babayev, R. A. 2; Shukurova, P. A. 2

In this report experimental dates of the biological activity of saffron (Crocus sativus L.) extract at the treatment of various eye pathology processes are presented. It was carried out the comparative experiments on the study of curative properties of saffron extract. At the study of acute toxicity of saffron extract was found that at a single intramuscular administration of a 0.5% solution of saffron extract at a dose 5 ml did not have any toxic effect. In experiments on the chronic toxicity of saffron extract (0.5 % solution administered two times a day for two weeks at a dose 0.5 ml) it was found that the weight of the animals, the count of red cells and biochemical indices of the blood were not altered in during of whole experimental period. A treatment with 0.5% solution of saffron extract stimulated blood circulation and metabolism in the retina, thus delaying the development of dystrophy changes. It was found that granules in the pigment epithelium of the macular area is contains two carotinoids - lutein and zeaxanthin, which play a key role in the protection of the retina diseases. The research of cardiotoxic properties of saffron extract at oral administration of one at a dose of 250 mg/kg is showed its anti-ischemic and antiinflammatory effect: bioelectric stability is restored and the degree of myocardial hypoxia is reduced. It is studied the action of impact saffron extract on the dynamic of the electrical activity in several structures of the brain, the heart rhythm and behavioral responses a cross-correlation assay in experimental animals (rats, rabbits). We are observed a certain change in the electrical activity of the brain towards to stimulation of the brain structures - sensorimotor, visual cortex, and hypotalamus.

S07.219
Acquirement of Anticancer Activity and Improved Quality of Gastrodia elata Blume by Fermentation with Phellinus linteus

Choi, J. H.; Suh, S. G.; Moon, Y. S.
Yeouido University, Daegu, 711-749, South Korea

Gastrodiae elata enlarged by symbiotic Armillaria mellea has been known for an important oriental medicinal herb in Korea, Japan, and China. Even though its distinctive functions for treating diseases such as palsy, numbness limbs, epilepsy, fresh gasterdia has sickening, bitter, savory even sweet tastes, which becomes the most relevant medicinal herb. Fermentation technique was applied to eliminate these unfavorable taste and smells. Inonotus obliquus, Phellinus linteus, and Ar- pergillus oryzae were selected as putative candidates for fermentation. When fungi grew on gasterdia containing agar plates (1, 2, 3%) in order to investigate their interaction with. A. mellea, I. obliquus and P. linteus grew well regardless of the contents. Rice bran content was important as well (50, 70, 100, 130, 150, 170, and 200%). When freeze-dried gasterdia was incubated with P. linteus for 5 days at 32 °C with less than 100% (v/v) rice bran, it was fermented very well. With the results, P. linteus was very useful for gasterdia fermentation and the unpleasant taste were dramatically reduced by fermentation. In addition, fermented gasterdia showed extream inhibition of rat liver cancer cell Hepaclc7 amplification. Thus, this fermented gastrodia can be used for anticancer treatment in the future.

S07.220
Application of BTH and Methyl Jasmonate during the Ripening of Grapes (Vitis vinifera L) and its Effects on the Stilbene Content


Pre-harvest treatments of grapevine (cv. Monastrell) with the plant activator benzo-dihiazole (BTH, 0.3 mM) and methyl jasmonate (10 mM), an important intra-cellular regulator, were applied to check whether these compounds could enhanced stilbene content in berries at the moment of harvest, due to the interesting health properties of the stilbenes in grapes and wines. Both compounds were sprayed on clusters at veraison. Both compounds enhanced the level of stilbenes in grapes, the highest increase being found with the use of methyl jasmonate. Since a high est presence of stilbenes in grapes could be a protection against mould infection, the application of these compounds could, not only improved the healthiness of grapes, but also limit the use of fungicides.

S07.221
Effects of Environmental Stress on Ascorbic Acid Content in Baby Leaf Spinach (Spinacia oleracea L)

Mogren, L.; Reade, J.; Monaghan, J.
University of Technology Sydney, Sydney, New South Wales, Australia

The consumer demand for ready to eat bagged baby leaf spinach (Spinacia oleracea L) in the U.K. has increased markedly over the last 10 years. Shelf-life of spinach is a key quality factor, which may be influenced by the content of antioxidants present in the leaves at harvest. One of the main antioxidants in spinach leaves linked to post harvest quality is ascorbic acid (AA). The amount of AA in spinach has been shown to be influenced by a wide variety of external growth factors. In a two year project, a range of environmental stress treatments has been applied before harvest to glass house grown spinach cv. Revere F1. The spinach was harvested at different growth stages. The content of AA as well as dehydro ascorbic acid (DHA) in the leaves at harvest was analysed using HPLC. Short and mild heat stress, or cold stress, in close connection to harvest was found to alter the AA content. Nutritional status of the soil, as well as salt stress of the leaves, was also found to affect the AA content of spinach leaves. Some differences could be explained by changes in leaf water content due to the treatments (higher or lower dry matter content). However, a shift in the ratio of AA:DHA as well as actual increase in total AA content was also observed. The findings suggest that altered growing practise may produce spinach leaves with increased AA content. This may have benefits for shelf life as well as human nutrition.

S07.222
Health Claim Labelling for Baby Leaf Spinach and Rocket Relative to Vitamin C and Folate

Jobling, J. 1; Bokshi, A. 2; Rogers, G. 2; McMahon, A. 2; Tapsell, L. 3
1 The University of Sydney, Sydney, Australia; 2 University of Wollongong, Australia; 3 University of New South Wales, Australia

Consumers want food to be healthy and more recently some consumers want food to add “more” to their health. Marketing can take advantage of these desires and mislead consumers. New food labelling guidelines currently being developed by FSANZ (Food standards Australia and New Zealand) are tightening the guidelines in relation to health claim labelling on food. Our research looked at how these new guidelines could be applied to fresh cut baby leaf spinach and rocket. Our experiment collected data on the content of Vitamin C and Folate in baby leaf spinach (Spinacia oleracea L), wild rocket (Diplotaxis tenuifolia) and cultivated rocket (Erpas sativa) grown in different districts and seasons in Australia. The aim of this project was to generate data that would substantiate a health claim label on the packaging of these fresh cut products. Preliminary results show that baby leaf spinach could be labelled as a source of Vitamin C and Folate with more than 10% of the recommended daily intake (RDI) of these nutrients per serve and that wild rocket could be labelled as a good source of Vitamin C as it had more than 25% of the RDI per serve and that rocket was also a source of folate. Our results show that for these
products the concentration of Vitamin C and Folate declines with time in storage and when stored at temperatures above 0 °C. In our experiments the levels of these nutrients remained above 10% of the RDI per serve under the storage regimes we trialled. This work also included a focus group study with consumers to gauge their knowledge and interest in health claim labelling on baby leaf spinach and rocket. An overview of this data will also be presented.

S07.223 Flavonoids, Antioxidant and Anti-Inflammatory Activity in Sweet Cherries (Ferrovia Variety)

Negro, C.; de Bellis, L.; Miceli, A.
Università Del Salento, Via Per Monteroni, 73100, Lecce, ITALY

Sweet cherries (Prunus avium L.) are one of the most popular fruits of the temperate zone, representing an important commercial resource; they are consumed mainly non-processed as well as an ingredient in fruit cocktails, maraschino, yogurt, etc. Sweet cherries, as all the fruits and vegetables, contain polyphenolic compounds which seem be responsible of different healthy effects. In fact, different epidemiological evidences suggest an inverse correlation between high intake of plant products and cardiovascular diseases and occurrence of some cancer types. Phenols and anthocyanins, a group of flavonoids largely present in the sweet cherries, contribute to the bioactivity of this fruit, principally for antioxidant and anti-inflammatory properties. The aim of the work was to determine the total phenols, the quill-quantitative anthocyanins composition, the antioxidant and anti-inflammatory activity of Prunus avium cv. Ferrovia extracts, typically cultivated in Apulia (Sud Italy); anti-inflammatory activity was also compared with two synthetic anti-inflammatory drugs (Ibuprofen and Nimesulide). The total phenols (TP) were determined by the Folin-Ciocalteau methodology and expressed as gallic acid equivalents (GAE), HPLC-diode array detection (DAD) –mass spectrometry (MS) analyses were performed for the measuring the quill-quantitative composition of anthocyanins. Antioxidant activity (AA) was determined by the ABTS test, while the anti-inflammatory activity (AI) was measured determining the cyclooxygenase activity (COX) by a enzyme immunoassay kit (Caiman, Ann Arbor, USA). Results obtained showed that TP was 142.9 mg GAE/100 g of fresh weight (FW), while the anthocyanins was 36.4 mg/100 g FW and cyanidin-3-glucoside was the pigment most abundant. AA was equal to 48 μmol Trolox/g FW and 70% was in relation to the anthocyanins content. AI, reported as percentage of inhibition of the COX, was 40% comparable with the Ibuprofen 10 μM, a commercial and synthetic anti-inflammatory.

S07.224 Improvement the Nutritional Quality of Industrial Tomato and Lettuce Using Novatec® Solub Fertilization Technology

Casar Fernández, C.1; Muñoz-Guerra Revilla, L. M.1; Ordiales Rey, E.2
1Consejo ISOYR. Bas Department, C/ON SANTOS 19-47, 08003, BARCELONA, SPAIN
2C/DEL, CEDA, VILLAFRANCA - BARRIO EM 1, VILLAFRANCA DEL CADIZ, CADIZ, SPAIN

Nitrogen management in plant nutrition is an agronomic and environmental key factor. Under soil conditions the main fraction of N available for the plant is nitrate, independent of the N form applied by fertilizers. Nitrification inhibitors reduce the nitrification rate and increase the ammonium absorbed by the plant. This effect reduces the risk of groundwater pollution by nitrates and produce interesting effects in plant nutrition. Nitrate is dangerous for human health and can increase oxalate concentrations (anti-nutrient for humans and animals: kidney stones and reduction of Fe absorption) and decrease vitamin C content in vegetables. This paper presents the results of two trials in fertilized industrial tomato and lettuce performed by the official research centre CTAEX (Badajoz, Spain). In both trials a conventional ammonium + nitrate fertilization is compared with the application of ammonium + nitrate + nitrification inhibitor 3,4 dimethylpyrazole phosphate (DMPP; trademark NOVATEC®), using similar rates of N applied. The trial performed in industrial tomato shows that a moderate supply of ammonium stabilised with the nitrification inhibitor increase yield an average of 8% and also increase the lycopene concentration (also colour a:b ratio) from 32 mg/kg to 45 mg/kg with a mixture of nitrate + ammonium + nitrification inhibitor. The trial in fertigated lettuce compare different N doses and the use or not of the nitrification inhibitor DMPP. Results show that this technology can modify metabolical routes in plants, reducing nitrate and oxalate in leaves. Vitamin C, A and B2 were not affected by the different treatments. Conclusions of the trials are that important nutritional parameters, as nitrates, oxalates, vitamin C or lycopene can be influenced by the quantity and characteristics of the N fertilizer applied, and that a mixed nutrition nitrate / ammonium with DMPP (NOVATEC® Solub®) improves the nutritional quality of this vegetables.

S07.225 Effect of Variety, Position, Fertilizer Quantity and Low Temperature Storage on the Antioxidant Activity of Cabbages

CHICHI DISTRICT AGRICULTURAL RESEARCH AND EXTENSION STATION, 195, SONGSHENG RD., TAINTON VILLAGE, TAINTON TOWNSHIP, 11514, CHANGHUA, TAIPEI

The aim of this study was to investigate the antioxidant activity of cabbage with different variety, head position, fertilizer quantity and low temperature storage duration measured by scavenging DPPH (1,1-diphenyl-2-picrylhydrazyl) free radical activity and ferric reducing antioxidant power (FRAP). The rank of 34 cabbages according to scavenging DPPH free radical ability was ornamental cabbage, leafy cabbage, purple cabbage, seedling cabbage, sprout cabbage, savoy cabbage and green cabbage which valued from 25.13% to 4.78%. The rank of FRAP analysis was familiar with the result of DPPH which valued from 1.66 to 0.80 μmol FeSO4/g f.w., and the positive correlation existed between these two methods. Cabbage ‘K-Y Cross’ had the higher antioxidant activity in interior stem and the lower in outer leaves of head while purple cabbage ‘Scarlet’ got the opposite result. The antioxidant activity of cabbage with recommendable fertilizer quantity is higher than those with conventional quantity. Beside it, the antioxidant activity and vitamin C content dramatically increased after 1 week at 2 °C, dark storage and then decreased with the duration elongated; however, the values were still higher than non-storage cabbage.

S07.226 Gastrointestinal Digestion Affects the Phenolic Content of Fruit Juices Enriched with Pycnogenol®

Frontela, C.1; Ros, G.2; Martínez, C.2; Sánchez-Siles, L.1; Canali, R.1; Virgili, F.1
1NATIONAL RESEARCH INSTITUTE FOR FOOD AND NUTRITION, VIA ARGIATINA, 148, 00178, ROMA, ITALY
2FAVORIT OF VETERINARY SCIENCES, UNIVERSITY OF MURCIA, SPAIN

The consumption of fruit and vegetables has been shown to be associated with lower risk of cancer, cardiovascular disease, and other chronic diseases such as inflammatory bowel disease. The enrichment of foods with phenolics compounds can be considered an expedient way to obtain “functional foods” with beneficial effects on human health. Pycnogenol®, a standardized extract from the bark french maritime pine (Pinus pinaster Ait.), consists of a concentrate of water soluble polyphenols. Pycnogenol® has been reported to have strong antioxidant activity owing to its phenolic content. However, during gastrointestinal digestion, polyphenols can undergo substantial changes affecting its biological properties including antioxidant capacity. The aim of this study was to investigate the effect of in vitro gastrointestinal digestion on the phenolic profile of fruit juices enriched with Pycnogenol®. The results indicate that in vitro digestion process decreased the total phenolic content of fruit juices without Pycnogenol® addition by 50% with respect to the initial non-digested matrix. On the other hand, enriched fruit juices maintained their phenolic content by 70% and 100% with respect the samples before gastrointestinal digestion. Regarding the different phenolic compounds, chlorogenic acid content of digested samples increased by 8% compared with the samples before digestion. Caffeic acid content of both enriched and not fruit juices showed a decrease by 4% after gastrointestinal digestion. Our results suggest that fruit juices enriched with Pycnogenol®, could be a good source of phenolics compounds with a high stability to gastrointestinal digestion conditions.
S07.227
Cytoprotective Activities of Tomato Extracts Against Induced Oxidative Stress in HepG2 Cells

Garcia-Alonso, J.¹; Bravo-Lozar, S.²; García-Valverde, V.³; Periago-Caston, M. J.³

¹ University of Murcia, Dpt. Food Science and Nutrition, Veterinary Faculty, 30100, Murcia, Murcia, Spain
²University of Murcia, Dpt. Food Science and Nutrition, Veterinary Faculty, Spain
³University of Murcia, Dpt. Food Science and Nutrition, Veterinary Faculty, Spain

Tomato provides an optimal mix of hydro- and lipophilic antioxidant compounds such as phenolic compounds, ascorbic acid, vitamin E and carotenoids, mainly lycopene, which might be responsible for the proposed health benefits upon tomato consumption. The aim of this study was to evaluate the ability of hydro- and lipophilic tomato extracts to prevent tert-butylhydroperoxide (tBOOH)-induced cellular oxidative stress. For that, the human hepatoma (HepG2) cell line was incubated with tomato extracts and tBOOH. We used both lipophilic and hydrophilic tomato extracts, as well as their combinations to study possible synergistic effects between antioxidants. The extent of oxidative damage was evaluated by measuring cell viability and the intracellular reactive oxygen species (ROS) generation. Both hydro- and lipophilic tomato extracts prevented tBOOH-induced cell death in a dose dependent manner. Hydrophilic extracts were more effective in preventing cell death than lipophilic extracts. Also, extract combinations afforded protection against induced cell death but no synergistic effect was observed. As regards ROS generation, a similar behaviour was observed with hydrophilic extracts being the most effective in preventing induced ROS generation. Importantly, lipophilic tomato extracts prevented ROS generation at a physiologically attainable lycopene concentration (1,3 µM), whilst in the case of hydrophilic extracts cytoprotection was afforded at the concentration 11 µM of total phenolic compounds.

S07.228
Content of Phenolic Compounds in Apples from Organic Versus Integrated Fruit Production

Véberic, R.; Mikulic Petkovsek, M.; Slatnar, A.; Stampar, F.

University of Ljubljana, Biotechnology Faculty, Jadranska 101, 1000, Ljubljana, Slovenia

Organic fruit production is considered to be stricter compared to integrated production because of limitation in use of pesticides and mineral fertilizers. Fruit plants therefore grow in conditions where often different forms of stress occur. This reflects also on their metabolism, because they have to protect themselves from harmful ecological influences as well as from pathogen attack. We tried to evaluate the influence of different growing technologies (organic vs. Integrated) on the content of phenolic compounds in apple fruits. Apple trees are one of the most well-known species in the world and their phenolic content is considered as the most effective in preventing induced ROS generation. Importantly, lipophilic tomato extracts prevented ROS generation at a physiologically attainable lycopene concentration (1.3 µM), whilst in the case of hydrophilic extracts cytoprotection was afforded at the concentration 11 µM of total phenolic compounds.

S07.229
Initial in vitro Evaluations of the Antibacterial Activities of Phytochemicals against Listeria monocytogenes

Borges, A.¹; Dias, C.²; Simões, M.³; Bennett, R. N.²; Rosa, E. A. S.³; Saavedra, M. J.³

¹ VeCAV - University of Trás-Os-Montes & Alto Douro, Vila Real, PORTUGAL
² LIPA-DEPARTMENT OF CHEMICAL ENGINEERING, FACULTY OF ENGINEERING, UNIVERSITY OF PORTO, PORTUGAL
³ CECAV - University of Trás-Os-Montes & Alto Douro, Vila Real, PORTUGAL

Plants synthesize a diverse array of secondary metabolites (phytochemicals) known to be involved in plant defence against microbial and fungal pathogens and insect pests, and in the last few decades several classes of phytochemicals have been shown to help reduce the risk of various diseases e.g. cancer and coronary heart disease. More recently antimicrobial properties for phytochemicals, and especially essential oils, have been extensively investigated due to the increase in multi-resistance of important pathogenic microorganisms to antibiotics. New sources of effective antimicrobial compounds need to be discovered and developed. The Gram-positive bacteria Listeria monocytogenes is one of the major causes of death due to food-borne illness, and has recently been recognized as an important public health problem. Frequently implicated vehicles include foods that are ready to eat, highly processed, and cold stored. In the present study the antibacterial activity of 12 phytochemicals (glucosinolate hydrolysis products (GHP) and phenolic compounds) were tested using a modification of the disc diffusion method, against one relevant pathogenic bacteria, Listeria monocytogenes (ATCC 15313). Each product was tested at a concentration of 1000 µg/mL. Sterile filter paper discs were impregnated with 10 µL of test phytochemicals. Discs of antibiotics (gentamicin, ciprofloxacin, naldixidic acid and streptomycin) were used as positive controls and blank discs with DMSO were used as negative controls. All tests were performed in triplicate and antibacterial activity was expressed as the mean of inhibition diameters (mm) produced. Some phytochemicals were more efficient than the antibiotic controls in inhibiting the growth of Listeria monocytogenes, namely benzylisothiocyanate and 2-phenylethylisothiocyanate when compared with the antibiotics gentamicin and ciprofloxacin. In addition high antimicrobial efficiencies were seen with caffeic acid, gallic acid, ferulic acid and allylisothiocyanate, when compared with naldixidic acid. Interestingly, the phytochemicals chlorogenic acid and (−)epicatechin had no effect on Listeria monocytogenes ATCC 15313.

S07.230
Pursuing Ways to Increase Number and Production Efficiency of Glandular Trichomes in Artemisia annua by Applying Physical and Chemical Stresses

Kjaer, A.¹; Jensen, M.¹; Grevesen, K.¹; Iversen, E.³; Fretté, X. C.²; Christensen, K. B.²; Christensen, L. P.²

¹ Institutet for Horticulure, Århus University, Kirsebærsvej 10, 2863-AARHUS, DENMARK
² Institute of Chemical Engineering, Bioengineering and Environmental Technology, University of Southern Denmark, Niels Bohr Alle 1, DK-5230 ODENSE, DENMARK
³ Department of Agricultural and Environmental Engineering, University of Southern Denmark, Niels Bohr Alle 1, DK-5230 ODENSE, DENMARK

The medicinal herb Artemisia annua produces several bioactive compounds e.g. artemisinin which is used to treat human malaria. The bioactive compounds are believed to be part of the plants defence mechanisms, and are produced and stored in glandular trichomes, situated primarily on the surface of the leaves. The aim of the present study was to test the possibility of inducing A. annua plants to upgrade the defence mechanisms and thus change the immediate and long term production capability as well as the composition of bioactive compounds. During field experiments in 2009 a number of A. annua (cv. Artemis) plants were exposed to 11 different stress-related treatments, e.g. application of oligochitosan and the phytohormones Jasmonic acid and salicylic acid in different concentrations. Other treatments included leaf cutting or physically shocking selected parts of the plants. Sample harvests were conducted 5 times during a 4 week period, and consisted of picking one old leaf and one newly developed leaf. The harvested leaves were photographed under fluorescence microscope. Lateral length and number of trichomes per leaf area were recorded. The amount and composition of bioactive compounds were analyzed by HPLC (UV detection at 210 nm) and correlated to the treatments as well as the density and size of trichomes. Results include relations between the stress-related treatments, the composition and amount of secondary metabolites, and the trichome size and density in A. annua.
S07.231 Phytochemical Composition and Antioxidant Properties of Portuguese Kale and Portuguese Tronchuda Cabbage Produced in a Sustainable Agriculture Production System Are Affected by Climate Conditions

Aires, A.; Carvalho, R.; Fernandes, M. C. C.; Saavedra, M. J. F.; Rosa, E.
1 VÉCRO-AGRONOMY DEPARTMENT, UNIVERSITY OF TRÁS-OS-MONTES E AÇO DOURO, P. O. BOX 5101, 5001-801 VILA REAL, PORTUGAL;
2 VÉCRO-MOUNTAIN RESEARCH CENTRE, DECALIA SUPERIOR AGRICOLA, INSTITUTO POLITÉCNICO DE BRAGANÇA, CAMUS DE DIA AFIOLHADA, P. O. BOX 1772, 5301-551 BRAGANÇA, PORTUGAL.

The aim of this study was evaluate the biological role of Portuguese kale and tronchuda cabbage comparing with broccoli inflorescences, one of the Brassica plants with biological role already well established. Understand which the main components are directly associated with antioxidant activity and how the different climate conditions affect their average levels is another objective. The plant material used in this research was produced under field conditions in two different climate seasons, Spring-Summer (SS) and Summer-Winter (SW) during two consecutive years. The average content of total phenolics, total flavonoids, L-ascorbic acid (vitamin C), glucosinolates and minerals (Fe, Zn and Se) directly associated with the antioxidant activity were evaluated. Spectrophotometric, spectroscopy and HPLC system methods were used to measure the average contents of the above components. The antioxidant activity was evaluated using the DPPH method and respectively IC50 values were estimated by a curve dose-response. Our results showed that Portuguese Kale and Portuguese tronchuda cabbage exhibited high antioxidant activity with 80.6 and 82.2 of % inhibition of DPPH radicals respectively, and 1.49 and 1.97 mg/mL of IC50 average values respectively. These values were very similar to those obtained for broccoli (81.9 % of inhibition of DPPH radicals 1.97 mg/mL of IC50 average level). Our results showed that climate seasons affected directly (P<0.001) the concentration of the bioactive components and they are all antioxidant activity. Based on IC50 average values, all brassicas showed high antioxidant activity in SS seasons. In this season the high antioxidant activity were directly assigned to high levels of total flavonoids (P<0.001), total phenolics (P<0.01), glucobrassicin (P<0.01), glucoraphanin (P<0.01), total glucosinolates (between P<0.05 and P<0.001) and zinc (P<0.01). Based on our results we can state that Brussica plants can provide considerable amounts of bioactive components and may constitute an important source of natural dietary antioxidants.

S07.232 Effects of Temperature and Light/Dark Cycle on the Growth and Vitamin C Concentration of Lettuce

Lopez, A.; Hellín, P.; Fenoll, J.; Flores, P.

Lettuce (Lactuca sativa L.) cv. Little Gem Ferro. Plants were grown in a growth chamber with controlled-environment conditions under different temperatures day/night (23/15, 20/12 and 15/8 °C) and different light/dark cycles (16/8, 12/12 and 8/16 h). Vitamin C (AA and DHAA) was analysed using liquid chromatography tandem-mass spectrometry (LC-MS-MS) with triple quadrupole in selective reaction monitoring (SRM) mode for the simultaneous determination of AA and DHAA. Negative ion mode of ESI and MS/MS transitions of m/z 173→143 and m/z 175→115 for AA and m/z 175→115 and m/z 175→87 for DHAA were used. Lettuce growth was influenced by both light and temperature. The increase of the day/night temperature from 15/8 to 23/15 °C and the increase of the light period from 16 to 8 h led to increases in weight by 45% and 32%, respectively. The effect of temperature and amount of light during the growing period on vitamin C concentration is discussed on the basis of their effect on availability of sugars for AA synthesis.

S07.233 Soluble Sugar and Organic Acid Concentration in Lettuce as Affected by Temperature and Light/Dark Cycle

Lopez, A.; Hellín, P.; Fenoll, J.; Flores, P.

Lettuce growth was influenced by both light and temperature. The increase of the day/night temperature from 15/8 to 23/15 °C and the increase of the light period from 16 to 8 h led to increases in weight by 45% and 32%, respectively. The effect of temperature and amount of light during the growing period on vitamin C concentration is discussed on the basis of their effect on availability of sugars for AA synthesis.

S07.234 Phosphorus Sources Influence Celosia Nutritional Qualities in the Tropics of Africa

Ojo, D. O.

Several metabolic processes involved in carbon metabolism, such as the synthesis and accumulation of sugars and organic acids, may be affected by environmental factors including temperature and light. The aim of this work was to determine the effect of temperature and light/dark cycles, on sugars and organic acid accumulation in lettuce (Lactuca sativa L. cv. Little Gem Ferro). Plants were grown in a growth chamber with controlled-environment conditions under different temperatures day/night (23/15, 20/12 and 15/8 °C) and different light/dark cycles (16/8, 12/12 and 8/16 h). Soluble sugars were analysed by liquid chromatography (LC) equipped with a refraction index detector (RI). Organic acids were analysed by LC tandem-mass spectrometry (MS-MS) in negative ion mode of ESI. Sucrose, glucose and fructose were the main sugars found in lettuce. Citric, malic, tartaric and succinic acids were detected among other organic acids. An increase of the light period led to an augment in the concentration of soluble sugars, attributable to the fact that light increases photosynthetic capacity of lettuce leaves and therefore the accumulation of soluble sugars. On the other hand, the increase in day/night temperature slightly increased the concentration of glucose and fructose, while there was a slight decrease in the concentration of sucrose. As far as organic acids are concerned, their concentration decreased when the light period was extended and increased when the temperature day/night was higher than 15/8 °C.

Celosia is process into many food items, supplements and additives. Thus important for diversification and improving the food basket, thereby contributing to food security and industrial usage in sub Saharan Africa where poverty is endemic. Celosia is also drought tolerant and highly adaptable as a potential crop in the tropics. This experiment was therefore carried out to elucidate the influence of phosphorus (P) sources on amaranth productivity in the African tropics. The experiment was RCBD design with four replications. The P sources treatment: control with no phosphorus (P), single super phosphate (SSP), ogun rock phosphate (ORP) and sokoto rock phosphate (SRP) were randomly allocated. Results revealed that SSP had significant higher 1000 grain weight, protein and starch contents in the seedbut compared to the control with no P. ORP and SRP had similar no significant 1000 grain weight, protein and starch contents in seed. Percent fat and sugars contents in grain follow the order: ssp>orp>srp. Percent fibre, vitamin D and E decreased among P sources in the order control:ssp:orp:srp. SSP was therefore recommended for optimal quality value in Celosia productivity.
S07.235  Potential Nutraceuticals of Mediterranean Diet: Antiageing, Antitumoral and DNA Protecting Activities

Fernández-Bedmar, Z.1; Anter, J.1; Villatoro-Pulido, M.2; Abreu, N.1; Alonso-Moraga, A.1; Font, R.1; Del Rio-Celestino, M.2; Muñoz-Serrano, A.1; Pérez-Guisado, J.1
1UNIVERSITY OF CÓRDOBA, ARGEN MEMBRE BUILING, CAMPUS HABANALES, 41017, CÓRDOBA, SPAIN
2UNIVERSITY OF CÓRDOBA, ARGEN MEMBRE BUILING, CAMPUS HABANALES, 41017, CÓRDOBA

The distinctive elements of the Mediterranean Diet (MD) ie: monounsaturated fats, omega-3 polyunsaturated fatty acids, antioxidants (vitamins and phenols), as well fibre, show a DNA protective effect because they either help to eliminate the reactive oxygen species or prevent their elimination. The present study develops different genetic, cytological and lifespan approaches to assess the idea that some components of them. Tomato, red-grape, rocket and oils as well as some of their distinctive components were included in the pilot project. Antigenotoxicity assays were performed using the SMART Test in imaging discs of Drosophila melanogaster. This mutagenicity/antimutagenicity short-term test detects genetic damage or its inhibition between the two markers mwrh and ffr by mean of loss of heterozygosity. Longevity assays were carried out by treating at least 3 groups of 10 individuals of Drosophila for each substance and concentration during their complete life span. Median and survival curves are analyzed and compared. Cytotoxicity assays were established using the HLI00 promyelocytic cell line and obtaining the viability curves. This study is implemented by assessing on the degree of DNA fragmentation occurred in the chemotherapeutant cells which is an index of the induced apoptosis. Results:- (i) all the substances are safe with respect to keep the genetic integrity in Drosophila cells, not showing mutagenic activity; (ii) a different degree of antigenotoxicity is observed for the substances the grape skin and resveratrol the most effective agents to detoxify the reactive oxygen species derived from the mutagen hydrogen peroxide; (iii) Low-concentrations of single molecules such as lycopene can increase the life span in Drosophila transheterozygous mwrh/frr flies and (iv) most of the food and single compounds that show antigenotoxic activities are also cytotoxic inducing DNA fragmentation in the apoptotic way (i.e. resveratrol).

S07.236  Effect of Fe and Zn Treatments on Phenolic Compounds in Spinach Leaves

Oh, M.1; Grusak, M. A.2
1DEPARTMENT OF HORTICULTURE, CHIGEON NATIONAL UNIVERSITY, CHIGEON, CHIGEON 56-765, REPUBLIC OF KOREA
2USDA-ARS CHILDREN'S NUTRITION RESEARCH CENTER, DEPARTMENT OF PHARMACIES, BAYLOR COLLEGE OF MEDICINE, HOUSTON, TX 77030-2600, UNITED STATES

Both minerals and phenolics play a crucial role in maintaining and promoting human health. Although many studies to enhance the concentration of minerals or phenolic compounds in plant-based foods have been conducted, there are few studies elucidating the relationship between minerals and phenolics in plants. Thus, the objective of this study was to monitor the variation of phenolic concentration in spinach (Spinacia oleracea cv. Melody) when grown hydroponically with high Fe or Zn concentration. One week-old spinach seedlings grown with water were cultivated with normal nutrient solution for another week and then transferred and cultivated with nutrient solution containing 5 to 200 µM Fe(III)-EDDHA or 2 to 50 µM ZnSO4 for 2 additional weeks. Elevated Fe application inhibited Fe acquisition in spinach roots and subsequently did not have a significant impact on the accumulation of Fe in spinach leaves. In addition, no significant differences in growth characteristics were observed between control and high Fe treated plants. However, the concentration of total phenolics and individual phenolic compounds decreased along with elevated Fe treatments. Dissimilar with Fe, spinach plants subjected to high-Zn nutrient solution significantly accumulated Zn in the leaves compared to controls. The Zn concentration (1784 µg/g DW) of spinach leaves, following a 50 µM ZnSO4 treatment was over 6 times higher than that in control. With treatments up to 8 µM Zn, Zn concentration of spinach leaves increased without a reduction in growth or phenolic compounds. However, significant growth reduction and chlorosis were observed with Zn treatments ≥ 20 µM. In conclusion, these results suggest that Fe concentration of spinach leaves was highly regulated by roots, and certain Zn treatments induced Zn accumulation without growth reduction and did not affect phenolic concentration in spinach leaves.

S07.237  Effect of Iron-Chelate Treatments during Imbibition on the Concentration of Minerals and Phenolic Compounds in Three Edible Sprouts

Oh, M.1; Mandapat, C.2; Grusak, M. A.2
1DEPARTMENT OF HORTICULTURE, CHIGEON NATIONAL UNIVERSITY, CHIGEON, CHIGEON 56-765, REPUBLIC OF KOREA
2USDA-ARS CHILDREN'S NUTRITION RESEARCH CENTER, DEPARTMENT OF PHARMACIES, BAYLOR COLLEGE OF MEDICINE, HOUSTON, TX 77030-2600, UNITED STATES

Fe is an essential micronutrient involved in fundamental biological processes in humans as well as in plants. In particular, Fe is known as a very important mineral due to its frequent deficiency in humans. The objectives of this study were to increase Fe concentration in three species of sprouts (alfalfa, broccoli and radish) by soaking the seeds with high Fe solution and subsequently to monitor the concentration of other minerals and phenolic compounds which are rich in sprouts and also beneficial for human health. Seeds were soaked in either Fe(III)-EDTA or Fe(III)-citrate in concentrations of 2.5 mM, 5.0 mM, or 10 mM for 5-8 hours and then were maintained with distilled water in a commercial sprouter for 5 days. Soaking treatment significantly increased Fe concentration in 5- day-old alfalfa sprouts. Alfalfa sprouts soaked with 10 mM Fe(III)-EDTA or Fe(III)-citrate had 1.8 or 1.7 times higher iron concentration compared to control, respectively. For broccoli and radish sprouts, there was a trend towards higher Fe concentration, but no significant difference was observed between control and Fe treatments. The accumulated Fe in alfalfa sprouts by soaking seed with high iron solutions was negatively associated with other minerals such as Ca, Mg, Mn, Na or Zn. Alfalfa sprouts soaked with either Fe solution showed 8.0-36.6% significant increase in total phenolic concentration compared to control sprouts. Broccoli and radish sprouts did not accumulate additional phenolic compounds in response to the iron treatment. In conclusion, soaking seeds with Fe-chelates enhanced the Fe concentration of sprouts, especially alfalfa sprouts, and also had a positive or no adverse impact on the concentration of phenolic compounds suggesting that this can be a potential strategy to improve the mineral nutritional quality of certain species used for sprouts.

S07.238  Effect of Potassium Fertilization on Agronomic, Functional and Antinutritional Characteristics in Vegetable Soybeans

Oliveira, S. F.1; Castoldi, R.2; Charlo, H. C. O.1; Carrão-Panizzi, M. C.1; Braz, L. T.1
1UNIVERSIDADE ESTADUAL PAULISTA - FCAV/UNESP, VIÇOS DE ACERVO PROF. BOLSO DONATO CASTELLANI, UNI, ZONA RURAL, DEPARTAMENTO DE PRODUÇÃO VEGETAL, 14849-900, JABOTICABA, SÃO PAULO, BRAZIL
2UNIVERSIDADE ESTADUAL PAULISTA - FCAV/UNESP, VIÇOS DE ACERVO PROF. BOLSO DONATO CASTELLANI, UNI, ZONA RURAL, DEPARTAMENTO DE PRODUÇÃO VEGETAL, 14849-900, JABOTICABA, SÃO PAULO, BRAZIL

The production and quality of soybeans depend on proper fertilization and utilization of nutrients and adequate doses, among other factors, favoring the accumulation of essential elements for the production of dry matter and of functional nutrients. Therefore, the aim of the present study was to evaluate the response of vegetable soybeans with respect to agronomic, functional and antinutritional characteristics, under different doses of potassium. The experiment was conducted in the field, at UNESP-FCAV in Jaboticabal-SP. A randomized block design was adopted with five treatments (doses of potassium), and five repetitions. Each experimental plot consisted of four planting rows 6 m long, with 0.60 m between rows and 0.15 m between plants, where 20 plants per plot were evaluated. The genotype used for study was JLM019. The doses of potassium were calculated in accordance
with soil analysis, which were 0, 50, 100, 150 and 200% of that recommended. Seeding was carried out on January 13, 2009, directly in the field. Harvesting was on April 28, 2009, when the vines were in reproductive stage R6. The following parameters were determined: plant height, height of insertion of first vine, mean number of vines per plant, fresh weight of vines per plant; length of vines, mean number of seeds per vine, fresh weight of 100 seeds, total estimated productivity of immature grains (kg ha⁻¹), and levels of moisture content, proteins, lipids, ash, carbohydrates, isolavones and Kunitz soybean trypsin inhibitors (KSTI). For all the characteristics evaluated, there was no significant difference, except for the number of seeds per vine and carbohydrates. The results showed that an increase of 50% to 100% of the recommended dose is viable, since the increase in cost of production is small in view of a 25% increase in production.

S07.239
Yield, Nitrate and Steviol Content of Stevia (Stevia Rebaudiana Bertoni) Leaves as Affected by Fertilization Rate

Novak, B.; Spicnagel, A. M.; Benko, B.; Mesic, M. A.; Fabek, S.¹

¹DEPARTMENT OF VEGETABLE CROPS, UNIVERSITY OF ZAGREB, FACULTY OF AGRICULTURE, SITOVŠTENJSKA 15, 10000 ZAGREB, CROATIA

Stevia (Stevia rebaudiana Bertoni) is cultivated for the sweet taste leaves, which are, after drying and grinding used as a substitute for artificial sweeteners. The aim of a study was to determine the effect of fertilizer dose on the fresh leaves yield, nitrate and steviol content. Plants were grown in a 5 L pots on the two types of acid soil (pH 4.0 and 5.0), which were different supplied with major nutrients. Five doses (0 to 1.6 g/plant) of mineral fertilizer Multi-Comp Base 14:13:20+2MgO+ME were applied. The highest fresh leaves yields (30.28 and 30.98 g/plant) were achieved by application of 1.6 and 0.8 g of fertilizer on soil with pH 4.0 and 5.0, respectively. These yields were 21.6 and 39.8% higher than the yield achieved at unfertilized control. Increased fertilization intensity resulted with increased amount of total nitrogen in stevia leaves. Depending on the soil type, amounts between 14.32 and 20.61 g kg⁻¹ of dry matter (DM) were determined. At the soil with pH 4.0, fertilization rate increasing, caused decreasing of N-NO₃⁻ in leaves from 18.16 to 10.05 mg kg⁻¹ DM. At pH 5.0, only the fertilization with 1.6 g/plant resulted in a higher nitrate amount in leaves than the unfertilized control (14.14 compared to 13.69 mg kg⁻¹ DM). The amount of N-NH₄⁺ in the leaves showed the opposite trend. Increased fertilization rates resulted with higher ammonia amounts in leaves, from 214.55 to 387.83 mg kg⁻¹ DM. Average steviol content was between 42.56 to 46.18 mg SEag⁻¹ of dry leaves. Stevia cultivation on the soil with higher pH value and medium fertilization rate resulted with economically effective yield of leaves which contained significant steviol amount.

S07.240
Antioxidant Activity of Major Herb Essential Oil

Park, K. W.; Woo, J. H.

SCHOOL OF HORTICULTURE, UNIVERSITY OF BOSU, SEOUL, SOUTH KOREA, 156-781, SOUTH KOREA

The study measured EDA% of quality followed by antioxidant activity of essential oil of lavender, rosemary, eucalyptus and peppermint collected in Korea through DPPH method and examined their quality. As the results, lavender (2.6-9%), rosemary (4.8-96%), eucalyptus (3.5-76.4%) and peppermint (5.7-97.8%) had remarkable differences by each specimen. In the event of lavender, essential oil collected in domestic offline and essential oil from Switzerland had high antioxidant activity. In the event of eucalyptus, essential oil collected in Europe offline and essential oil from Australia had high antioxidant activity. In the event of peppermint, essential oil collected in domestic offline and essential oil from England had high antioxidant activity.

S07.241
Master Document: Criteria and Benchmarks for the Evaluation of Food Included in the Spanish Recommendations of Fruit and Vegetable Consumption "5 a Day"

Montino, M.²; Cervera, P.; Baladía, E.; Marques-Lopes, L.³; Miret, F.¹; Russoillio, G.¹; Farran, A.⁴; Martinez, A.⁴; Astiasarán, I.⁵; Palou, A.⁶; Ballesteros, J.A.⁷; Salas, J.¹; Bonany, J.¹; Alonso, M.¹; Polanco, L.¹; Romero de Ávila, L.¹; Campos, J.¹; Pérez, J.¹; Agudo, A.¹; Boix, R.¹; García, G.¹; Pérez, F.¹; Martínez, N.¹; Riquelme, F.¹; Gilabert, V.¹

²SCIENTIFIC COMMITTEE OF THE ASSOCIATION FOR PROMOTING THE CONSUMPTION OF FRUITS AND VEGETABLES "5 A DAY"; ²SWEDISH ASSOCIATION OF DIETITIANS-NUTRITIONISTS (ADD); ³MERCHANDISED ZONA COMMERCIAL, LOCAL CI, 10183, MADRID, SPAIN; ⁴UCID (UNIVERSITY OF THE AZORES); ⁵DEPARTMENT OF AGRICULTURE, FOOD AND RURAL ACTION; ⁶CENIMAB (CENIMAB); ⁷ADAY, ASSOCIATION OF DIETITIANS-NUTRITIONISTS, SPAIN; ⁸HIGHER EDUCATION CENTER FOR NUTRITION AND DIETICS, UNIVERSITY OF BARCELONA, SPAIN; ⁹UNIVERSITY OF NAVARRA; ¹⁰UNIVERSITY OF KABARLIC ISLAND; ¹¹UNIVERSITY OF BOVISA (VLING); ¹²UNIVERSITY OF VALLADOLID; ¹³UNIVERSITY OF MADRID; ¹⁴AEDIV; ¹⁵AEDIV; ¹⁶DEPARTMENT OF EPIDEMIOLOGY AND QUALITY OF LIFE; ¹⁷ERVEGENIE; ¹⁸ACZA; ¹⁹PARABOL; ²⁰A DAY; ²¹A DAY

The new foods based on fruit and vegetables (FAV) and the reality of current consumers, are a confounding factor for people, when following the recommendations of eating FAV marked by WHO on 5 servings a day (600g/day) and promoted in Spain by the Association for Promoting the Consumption of Fruits and Vegetables "5 a Day". The Master Document, prepared by the Scientific Committee, is made to facilitate the association and the food industry, the promotion of consumption of FAV in line with a healthy diet. Set qualitative and quantitative parameters to include food on the recommendations "5 a day". - Establish diets and nutritional criteria to evaluate recipes and menus. - Facilitate relationship between the Association and the food industry. The Scientific Committee of "5 a day" after reviewing the scientific literature and numerous nutritional profiles, and based on legal, technological, nutritional, dietetics and health promotion criteria, has agreed the basic parameters to categorize foods included in the recommendations of consumption of FAV in Spain. The consumer can thus recognize foods with the logo "5 a day" as a portion of FAV. Also frequency and presence criteria of foods groups have been established for recipes. Have been distinguished 3 categories of foods: category I includes fresh unprocessed FAV; the II groups processed FAV with 100%, included juices, no added sugars and controlled-sodium (<120mg/100g), and finally, category III includes foods that contain a portion of FAV with <200mg sodium/100g, <400kcal per serving, <30% of its energy from fat and <10% from saturated fatty acids, among other parameters. Since its adoption in Valencia (April 2007) have been evaluated 12 creams of vegetables, 3 sauces, 2 jams, 7 juices, 1 milkshake, 2 concentrates and 4 smoothies.

S07.242
Acceptance among Children of White Asparagus Modified by Increased Bitterness and Sweetness

Brueckner, B.¹; Schroeder, R.²

¹LIBRARY INSTITUTE FOR VEGETABLE- AND ORNAMENTAL CROPS, THUERING,LIGHTHOUSE WEG 1, 45975, GIESERSBORN, GERMANY; ²KOENIGS GABRIEL ABBE IMPERIAL, 1, 45426 WERDER (HANDEL), GERMANY

Trained descriptive sensory panellists assessed the flavour, mouthfeel and after-taste profile of white asparagus ("GiÌnlinc") pieces marinated for two hours with solutions of sugars (fructose, glucose and sucrose) and Epsom salt. Resulting sugar concentrations in the asparagus pieces ranged from 2.5 to 4.8 g/100g FM, the concentration of Epsom salt ranged from 0 to 93 mg/100g FM. As expected, increased amount of bitter substances increased bitter sensations of asparagus. Additional sweetness led to a lowering of perceived bitterness intensity, but only at low bitter levels. In very bitter samples even increased bitterness was perceived with addition of sugars. Sweetness was clearly dependent on sugar concentrations; increased concentration of bitter compounds lowered the sweetness intensity. Each of 100 children invited to the sensory acceptence test received 9 asparagus samples with 3 levels of sugars and 3 levels of bitter compounds. Samples without additional bitter...
components were liked well, added sugars (1.2 g) further increased liking, another 1.1 g resulted in intermediate liking results. At the second level of the bitter compound concentration no lower acceptance was found when no sugar was added. With added sugars acceptance was lower with increased sugar amount. The reason probably was an impairing of the flavour sensations. This assumption is supported by the fact, that simultaneously higher values for too sweet and too bitter tastes were assessed partly at both: higher bitter and sweet levels. In addition to the acceptance of the asparagus pieces mixtures of bitter and sweet solution were ranked by the children for their liking. Comparison of solution and sample liking can give insights on individual preferences and their consequences for asparagus, vegetable and fruit appreciation, which was assessed using a questionnaire.

S07.243 Treatments with Natural Compounds to Maintain Quality and Bioactive Compounds during Postharvest Storage of Sweet Cherry


University of Miguel Hernández, Ctra. Beniel. Km. 3.2, 03312, Orihuela, Alicante, Spain

Sweet cherry (Prunus avium L. cv. ‘Cristalma’) was harvested at commercial ripening stage and then treated with oxalic acid, salicylic acid or acetyl salicylic acid at concentration 1 μM by dipping in solutions for 5 minutes and allowed to dry at room temperature. Then, fruits were stored at 2 °C during 5, 10, 15 and 20 days. All treatments significantly delayed the ripening process during storage, manifested by higher firmness and acidity retention, lower accumulation of soluble solids and colour changes. Control cherries were considered as unacceptable after 15 days of storage, while treated fruits maintained acceptable organoleptic quality after 20 days, especially for salicylic acid treatment. The bioactive compounds, such polyphenols, anthocyanins, as well as the antioxidant activity increased along storage in treated fruits, while significant reductions were obtained for control cherries from day 10 of storage. In conclusion, these innovative treatments based on natural compounds, could be a promising postharvest technology to preserve the sweet cherry organoleptic and functional compounds with antioxidant activity.

S07.244 Biological Activities in the Extract of Lythrum salicaria L.

Kim, K. H.¹; Kim, H. Y.¹; Lim, S. H.⁵; Park, Y. H.¹; Ham, H. J.³; Jeong, H. N.¹; Lee, K. J.;¹ Park, D. S.²

¹Department of Crop Science, Gyeongsang National University, Rep. of Korea
²Crop Science Center, University of Hawaii at Manoa, USA
³Department of Herbal Crop Research, National Institute of Horticultural & Herbal Science, RDA, Republic of Korea

In this study, we investigated the biological activity of anti-cancer, anti-inflammatory, anti-oxidative, anti-microbial, anti-diabetic of Lythrum salicaria L., which, using water and ethanol were extracted. The growths of both human prostate cancer (DU145) and in human colonic carcinoma cell (HT29) were inhibited up to 60% by adding 10 mg/ml of ethanol extracts (EEL) from Lythrum salicaria L. The anti-inflammatory activity of water extracts (WELS) and ethanol extracts (EELS) from Lythrum salicaria L. have been evaluated on lipopolysaccharide (LPS) induced release of nitric oxide (NO) by the macrophage RAW 264.7 cells. WELS and EELS inhibited inflammatory by 57.3% and 46.9% in 10 mg/ml, respectively. In the anti-oxidative activity, SOD-like activity was 75.7% by adding 10 mg/ml of EELS and DPPH radical scavenging activity was respectively 72.9% and 68.6% by adding 10 mg/ml of WELS and EELS. On the paper disc assay, on detectable antimicrobial activity in WELS and EELS was shown. In the anti-diabetic activity, α-amylase inhibitory activity was respectively 62.4%, 32.6% and α-glucosidase inhibitory activity was 5.4%, 88.3% by adding 10 mg/ml of WELS and EELS. In the anti-obesity, lipase inhibitory activity was 4.1%, 11.4% by adding 10 mg/ml of WELS and EELS. It suggests that Lythrum salicaria L. could be potentially used as a resource of bioactive materials for health functional foods.

S07.245 Ascorbic Acid Accumulation, Biosynthesis and Recycling during Tomato Fruit Ripening

Melidou, I.; Keulemans, J.; Kanellis, A.; Davey, M. W.

¹Labor of Fruit Breeding and Biotechnology, Lu Leuven, W. de Cleynstraat 41, B-3001, Heverlee, Belgium
²Group of Biotechnology of Pharmaceutical Plants, Division of Pharmaceutical Sciences, Aristotle University of Thessaloniki, 541 14, Thessaloniki, Greece

L-Ascorbic acid (AsA, vitamin C), is known for its vital role in plant antioxidant stress defence metabolism and for its important nutritional and health benefits for the consumer. In the last decade, studies on plant AsA biosynthesis and metabolism in several plant species have indicated that biosynthesis proceeds primarily via a pathway involving L-galactose. Alternative biosynthetic routes utilising myo-inositol, D-galacturonate, and/or GDP-L-gulose have also been suggested, but their potential contribution in planta still has to be clarified. Additionally though our understanding of the genetic factors underlying the regulation or accumulation of AsA in plant species and different tissues – particularly fruit – and during development is still far from complete. In principle these differences could be due to variations in the relative AsA biosynthetic capacities, the rate of degradation and/or the capacity for AsA regeneration. The aim of the present work was to determine the relative contribution of these different processes in fruit of two tomato cultivars differing substantially in their AsA contents (cv. Santorini and Alisa Craig). Feeding experiments with nonlabelled and radiolabelled precursors of AsA biosynthesis were carried out at different ripening stages. This data was compared with changes in fruit AsA contents, and the activities of key related enzyme activities. Results demonstrate that fruit AsA contents vary significantly between these cultivars throughout ripening and that the observed differences between the genotypes can at least partly be explained by the differences in the relative biosynthetic and recycling capacities of the tissues. Interestingly though, the variety with the higher AsA and glutathione (GSH) contents exhibits a greater capacity for AsA recycling, but a lower rate of AsA biosynthesis. This data supports the importance of AsA-GSH recycling pathway in maintenance of AsA pools, and the possible existence of feedback control of AsA biosynthesis during ripening.

S07.246 Biological Activities of the Extracts of Beaked Hazelnut (Corylus cornuta) Twigs

Royer, M.; Diouf, P. N.; Stevanovic, T.

Laval University, 2425, Rue de la Terrasse, G1v0a6, Quebec, Canada

Beaked hazelnut (Corylus cornuta) is an indigenous species of Quebec. The Native American tradition claims the calming effects of wearing the necklaces made with hazel twigs. The effects of hazelnut twigs extracts (tea) have been demonstrated on several pathologies. The participation of reactive oxygen and nitrogen species (ROS/RNS) in the etiology and pathophysiology of many diseases is well documented. ROS/RNS play an important physiological role. However, beside their beneficial biological functions, the high reactivity of the reactive species adds important toxic properties to these reactive oxygen species. The overproduction of ROS/RNS which is called “oxidative stress” is responsible for oxidative damages to various biomolecules including proteins, lipids, lipoproteins and DNA. Moreover, ROS/RNS play an important role in the initiation, progression and amplification of inflammatory response. Many studies have shown that phenolic compounds display strong antioxidant activity as a result of their capacity to scavenge free radicals, to chelate metal ions and to improve the antioxidant endogenous system. The aim of our study was to evaluate various biological activities of Corylus cornuta twigs extracts rich in polyphenols. Extractions were carried out with “green” solvents, water and ethanol, and following properties of the extracts were determined: a) antiradical and antioxidant capacities in vitro against several reactive species involved in oxidative stress; b) capacity to inhibit enzymes involved in different pathologies: the elastase which participates in skin aging by causing a loss of skin elasticity (responsible for wrinkle formation), the α-amylase and α-glucosidase which are involved in diabetes I (polysaccharide hydrolysis). Phenolic composition of the most active extracts was determined by
S07.247 Effects of 5-Aminolevulinic Acid on Chlorophyll, Photosynthesis, Sugar and Flavonoids of Ginkgo biloba

Xu, F.; Zhu, J.; Cheng, H.; Li, L. L.; Cheng, S. Y.

The effect of 5-aminolevulinic acid (ALA), a key precursor in the biosynthesis of porphyrins, at low levels (10 and 100 mg l\(^{-1}\)) on photosynthetic rate, chlorophyll and soluble sugar contents, flavonoid accumulation and flavonoid enzyme activity in Ginkgo biloba leaves were investigated. The results showed that photosynthetic rates of leaves that treated with both concentrations of ALA, increased significantly at day 4 compared with that of the control, and remained so for 12 days. ALA at concentrations of 10 and 100 mg l\(^{-1}\) significantly increased the contents of chlorophyll and soluble sugar (P<0.05) at day 4 and these increments keeping increase tendency until day 16, while the ratio of Chl a/b remained constant after ALA treatment. ALA-treatment enhanced the contents of total polyphenols, flavonoids and anthocyanins, as well as phenylalanine ammonia-lyase, chalcone synthase and chalcone isomerase activities from day 4 to 16. These results suggest that foliar treatment with a low concentration of ALA might provide a useful means of improving pharmacological properties in G. biloba leaves.

S07.248 Antioxidant Dietary Fibre (ADF) in Lipid-Rich Fruits: Adapted Methodology for Quantification and Characterization

Rufino, M. S.; Taberner, M.; Pérez-Jiménez, J.; Alves, R. E.; Brito, E. S.; Saura-Calixto, F.

The effect of 5-aminolevulinic acid (ALA), a key precursor in the biosynthesis of porphyrins, at low levels (10 and 100 mg l\(^{-1}\)) on photosynthetic rate, chlorophyll and soluble sugar contents, flavonoid accumulation and flavonoid enzyme activity in Ginkgo biloba leaves was investigated. The results showed that photosynthetic rates of leaves that treated with both concentrations of ALA, increased significantly at day 4 compared with that of the control, and remained so for 12 days. ALA at concentrations of 10 and 100 mg l\(^{-1}\) significantly increased the contents of chlorophyll and soluble sugar (P<0.05) at day 4 and these increments keeping increase tendency until day 16, while the ratio of Chl a/b remained constant after ALA treatment. ALA-treatment enhanced the contents of total polyphenols, flavonoids and anthocyanins, as well as phenylalanine ammonia-lyase, chalcone synthase and chalcone isomerase activities from day 4 to 16. These results suggest that foliar treatment with a low concentration of ALA might provide a useful means of improving pharmacological properties in G. biloba leaves.

S07.249 Physiologically Activity of Rakkyo (Allium chinense G. Don) against a Zinc-Induced Neuronal Cell Death


The effect of 5-aminolevulinic acid (ALA), a key precursor in the biosynthesis of porphyrins, at low levels (10 and 100 mg l\(^{-1}\)) on photosynthetic rate, chlorophyll and soluble sugar contents, flavonoid accumulation and flavonoid enzyme activity in Ginkgo biloba leaves was investigated. The results showed that photosynthetic rates of leaves that treated with both concentrations of ALA, increased significantly at day 4 compared with that of the control, and remained so for 12 days. ALA at concentrations of 10 and 100 mg l\(^{-1}\) significantly increased the contents of chlorophyll and soluble sugar (P<0.05) at day 4 and these increments keeping increase tendency until day 16, while the ratio of Chl a/b remained constant after ALA treatment. ALA-treatment enhanced the contents of total polyphenols, flavonoids and anthocyanins, as well as phenylalanine ammonia-lyase, chalcone synthase and chalcone isomerase activities from day 4 to 16. These results suggest that foliar treatment with a low concentration of ALA might provide a useful means of improving pharmacological properties in G. biloba leaves.

S07.250 The Effect of Selenium on Yield Quality of Leaf Vegetables

Alsinu, I.; Dubova, L.; Duma, M.; Stroksa, L.; Smiltnita, Z.

In human and animal cells Se plays an essential role in antioxidative defense system, but it is toxic at high dietary intake. In many countries as well in Latvia soils are low in bioavailable Se. Selenium enters the food chain through the plants which take it up from soil. Se concentration in plants depends on the chemical form of Se, its concentration and bioavailability in soil. The aim of the study was to detect the effect of sodium selenite and selenate on physiological properties of lettuce, garden cress and spinach. Two varieties of lettuce plants (Lactuca sativa) - iceberg lettuce ‘Tarzan’ and lettuce ‘Ripa’, garden cress (Lepidium sativum) and spinach (Spinacia oleracea) were grown in 1L pots with peat substratum. All vegetables during growth season were once treated with 50 mg m\(^{-2}\). 100 mg m\(^{-2}\) or 200 mg m\(^{-2}\) of sodium selenite or selenate. Control- without treatment. Fresh and dry weight of plants, pigment content, ascorbic acid content and antiradical activity were tested three times during vegetation period. Plants treated with selenium had higher leaves pigment content in comparison with untreated ones. The correlation between selenium concentration and antiradical activity was observed. Ascorbic acid content depended on vegetable and sampling time. No effect of selenium was observed on plant weight.

S07.251 Modelling the Processing of Brassica Vegetables to Predict the Level and Bioavailability of Phytonutrients

Kruse, I.; Verkerk, R.; Dekker, M.

The development of health products containing Garrya racemosa twig extracts could represent therefore an interesting way to valorize the by-products of hazelnuts harvest.
Glucosinolates are an important group of health promotion phytochemicals in various Brassica vegetables. Five cooking methods (blanching, boiling, steaming, stir-frying and microwave) combined with varied treatment time were used to investigate the influence of cooking on glucosinolates (GSs) in pakchoi (Brassica campestris L. ssp. chinensis var. communis). The results showed that the loss of GSs was the lowest by blanching in cooked pakchoi, and then followed by steaming, microwave and stir-frying. The concentrations of glucoraphanin, glucobrassicin, glucobrassicanapin and glucosinarturin were not significantly affected by blanching. Boiling caused the biggest loss of GSs, and significant losses for individual GSs except for 4-methoxy-glucobrassicin were observed after boiling. After the treatment of 5 min boiling, the concentrations of glucoraphanin, glucobrassicin, glucobrassicanapin and glucobrassican were decreased by over 50%. It indicated that different cooking methods had different influences on individual GSs. The most stable components after steaming and stir-frying were glucoraphanin and glucobrassicin, which belonged to aliphatic GSs. Compared to aliphatic and aromatic GSs, more indolyl GS was reduced by stir-frying. In contrast, microwave caused the least loss of indolyl GS, especially at short time treatment (within 1 min). The ratio of aliphatic to total GS was mostly kept stable during the cooking process (ranging from 83% to 85%), however, it was considerably reduced by boiling. The ratio of aromatic to total GS was kept by about 10%, and increased to 15% when boiling in water for 10 min. The results indicate that the methods and time of cooking affect the concentrations and profiles of GSs in pakchoi.

S07.252 Nutritional and Organoleptic Characterization of Nectarine and Peach of Organic and Integrated Production Systems in Lleida (Spain)

Huancu Gutierrez, W. S. 1; Soria, Y. V. 2; Casero, T. 3
1 Post-Harvest Department, High Juice Department, University of Lleida, Spain
2 Post-Harvest Department, High Juice Department, University of Lleida, Spain
3 Post-Harvest Department, High Juice Department, University of Lleida, Spain

Nectarines (Prunus persica (L.) Batsch var. Nucipersica) of the ‘Big Top’ cultivar and peaches (P. persica) of the ‘Rich Lady’ cultivar, of organic (OP) and integrated production (IP) obtained in Lleida (Spain) under similar conditions of soil and climate, were evaluated at harvest and after 7, 14 and 21 days of conventional cold storage at 0.5 °C plus 3 days at 20 °C, respectively for each treatment. The parameters evaluated were ethylene production, weight, diameter, colour, firmness, titrable acidity (TA), and contents of soluble solids (SS) and ascorbic acid (AA). The content of macro and micronutrients was also determined at harvest. The ethylene production was lower in OP fruits. IP nectarines showed higher values in weight and diameter than OP ones; whereas, firmness, SS and TA were higher in OP fruits. There were no significant differences in mineral content, except for Cu, Fe, Mg, and N where OP was greater than IP. In both production systems there was a sudden drop of firmness from the first cold storage period while TA remained relatively similar in OP and IP. In both production systems there was a sudden drop of firmness from the first cold storage period while TA remained relatively similar in OP and IP. In both production systems there was a sudden drop of firmness from the first cold storage period while TA remained relatively similar in OP and IP. In both production systems there was a sudden drop of firmness from the first cold storage period while TA remained relatively similar in OP and IP. In both production systems there was a sudden drop of firmness from the first cold storage period while TA remained relatively similar in OP and IP.
physiological effects proposed for Brassica vegetables in different types of studies, including *in vitro*, animal, human and epidemiological studies. Glucosinolates co-exist with, but are physically separated from, a plant thioglucosidase, myrosinase, within a "glucosinolate-myrosinase system". The myrosinase-mediated hydrolysis of glucosinolates generates a wide range of bioactive metabolites, including isothiocyanates, thiocyanates, indoles, nitriles and cyanoepithioalkanes. Brassica vegetables are exposed to various processes along the food supply chain which may modify the glucosinolate-myrosinase system as a result of e.g. inactivation of plant myrosinase, loss of enzymic cofactors, thermal breakdown and/or leaching of glucosinolates and their metabolites or volatilization of metabolites. In this overview we will elaborate various actors and relevant steps in the food supply chain of Brassica vegetables and their influence on intake and bioavailability of glucosinolates and bioactive breakdown products in relation to human health. By analyzing various steps of the supply chain of Brassica vegetables we identified four critical points that have the biggest impact on the level of glucosinolates in the final products: 1. Cultivar selection - Storage and packaging - Industrial processing - Consumer preparation A general strategy for production and supply chain management for optimizing glucosinolate intake and improving human health will be proposed.

S07.256
Glucosinolate Concentration Is Affected by Different N Competition and S Utilisation in Sole and Intercrops of Broccoli and Lettuce

Stavridou, E.; Schreiner, M.; Thorup Kristensen, K.; Krumbein, A.

1AARHUS UNIVERSITY, DEPARTMENT OF AGRICULTURE, KRISTIHERREGADE 10, DK-4030, ARKELT, DENMARK 2INSTITUTE OF VEGETABLE AND ORNAMENTAL CROPS GROSSMUNKERUP, S, UNIVERSITY OF COPENHAGEN Numerous studies proposed that the protective effect of cruciferous vegetables against cancer may be due to their relatively high content of sulfur-containing glucosinolates. Nitrogen (N) and sulfur (S) supply has significantly affected glucosinolate concentrations in plants. Total S requirement differs between crop species; in general a S demand of Cruciferae is high. S supply has an impact on the total glucosinolate concentration but also on the relative proportions on the individual glucosinolates. Investigations showed that in broccoli plants, total glucosinolate concentrations were high at insufficient S supply, independent of the S level. This study aimed to improve the nutritional value of broccoli (*Brassica oleracea var. italica*) by intercropping. A competitive broccoli-lettuce intercropping system was designed in order to assess how the single intercrop component species utilize and compete for N and S resources and how these dynamics are altered in response to changes in nutrient availability. Lettuce expected to reduce the available N for broccoli without influence S availability. The first experiment consisted of 6 treatments, combinations of two levels of N (50 and 220 kg/ha) fertilization and three cultivation systems (broccoli-lettuce intercropping, sole broccoli and sole lettuce). In the second experiment also two levels of S (0 and 65 kg/ha) were included and the total number of treatments was 12. In the soil depths 0-25 and 25-50 cm the distribution of N and S was differed significant among the treatments. Lettuce yields were reduced significant (p<0.0001) when grown in intercropping with broccoli, whereas broccoli was less affected by cropping system. In addition, treatments influenced both S and N uptake, and glucosinolate concentration.

S07.257
Increasing the Intake of Fruit and Vegetable to 400 g per day by Modelling Is Not Sufficient to Reach an Optimal Nutritional Pattern

Vieux, F.; Maillot, M.; Soler, L.; Amiot, M. J.; Darmon, N.

1TREX 1216, FACULTE DE MEDECINE, CHAUSSEE DE LA TIMONE, 27 BOULEVARD JEAN MOULIN, 13385 MARSEILLE CEDES 51, MARSEILLE, FRANCE 2TREX 1331 -ALIMENTATION ET SCIENCES SOCIALES, PARIS Fruit and vegetables (FV) are an important food group of a healthy diet, and the consumption of a minimum of 400 g of FV per day is recommended. Our aim was to quantify the nutritional benefit of increasing FV intake up to 400 g per day. Dietary data (7-day records) of adults from the French INCA2 survey who consumed less than 400 g/d of FV (N=929 among 1918 participants) were used. Starting from each observed diet, a modelled diet that contained 400 g/d of FV (including nuts and processed FV) was designed. Deviation from each individual food intake pattern was minimized and the energy content was set equal to the observed intake. To compensate for the increase in energy from FV, a reduction of high-fat high-sugar foods (namely animal fat, salted "aperitif" foods and/or sweets) was allowed. To raise the FV content of each diet up to 400 g/d while keeping total energy constant, a mean decrease of 67 kcal from high-fat high-sugar foods was needed. Energy density (solid foods) decreased from 185 to 163 kcal/100g and the mean adequacy ratio for 20 nutrients increased from 77.1 to 80.8%. Intakes were improved for most nutrients but this was not sufficient to fulfill the estimated average requirements (EAR). For instance, the percentage of modelled diets fulfilling the EAR for vitamin C (>85 mg/d) only increased from 23% to 52%, and for vitamin B9 (>254 mg/d) for men and >231 mg/d for women) increased from 44% to 66%. In a recent study, a higher level (approx. 550 g/d) was needed to respect a full set of nutrient recommendations in individually-optimized diets (Maillot et al. Am J Clin Nutr, 2010). Increasing the intake of FV up to 400 g/d is likely to improve the overall pattern of nutrient intakes but is not sufficient to fully optimize nutritional quality.

S07.258
The Examination of Saffron Extract on Free Radical Oxidation of Lips and Activity Transport Adenosinediphosphatase in Retina

Babayev, R. A.; Shukurova, P. A.; Gasimov, K. M.

1INSTITUTE OF PHYSIOLOGY AZERBAIJAN NATIONAL ACADEMY OF SCIENCES, SHAREJ-SAR, 2, AZ-1100, BAKU, AZERBAIJAN 2INSTITUTE OF BOTANY AZERBAIJAN NATIONAL ACADEMY OF SCIENCES, PATAMDART ST., QU, AZ-1017, AZERBAIJAN Saffron extract contains multiple complex components of biologically active substances. But however, pharmacology and biochemistry properties of saffron extract had not been studied. Lipid oxidation of cell membranes is playing a pivotal role in pathogenesis of many inflammatory diseases in the organism. Stimulation of lipid peroxidation (LP) processes in the cells leads to change one of the most important physiological functions as the membrane conductivity. For to be provide base for application of saffron extract in treatment of retinal degeneration was studied influence on the metabolism of LP products and the activity of transport ATP in the photoreceptor cells. In control animals on the 10th and 15th days of the experiments is intensified of LP processes. In his case is increase of LP processes which leads to decrease in the ATP activity. The control experiments are demonstrated that the level of LP products in the animals with retinal degeneration was higher by 9-25% at the average in comparison with intact controls. The results have shown that LP processes are enhanced at retinal degeneration, which is accompanied by suppression of Na+, K+-ATP activity. In the experimental group of animals had been retrobulbar injection of the 0.5% aqueous solution of saffron extract every day. At the retinal degeneration, the activity of transport ATP decreased from the 1st day of the experiment. This tendency is observed on the 10th and 15th days of the experiment as well. The administration of saffron extract leads to a decrease of LP products in retina, which in turn restores activity of ATP on the 20th day of the experiment and is close to the intact control.

S07.259
Quality Analysis and Determination of Oxalic Acid Content of Star Fruit

Zhong, Y.; Yi, J. G.; Jiang, H. N.

1INSTITUTE OF FRESH TREE RESEARCH, CHONGQING ACADEMY OF AGRICULTURAL SCIENCES, NO.50 STREET 2 OF DAHE IN CHONGQING, 400033, CHONGQING, PR, CHINA Oxalic acid on human health hazards are increasingly a cause for concern and the most carambola fruits contain a high amount of oxalic acid. In our study, fruits quality and the oxalic acid content of sixteen carambola varieties were analysed respectively by routine analysis and ion-chronomtography. At the same time, the changes of the oxalic acid content during the star fruits growth and the oxalic acid
content in different fruit's parts were studied. The results showed that: (i) The soluble solids content of their star fruits showed no significant difference, but the titratable acid content of different varieties of carambola showed significant difference. (ii) The difference of the antioxidant content of most of carambolas was extremely significant and the soluble oxalate content in Local-acid-carambola was as 1051 times as it in Singapore Single-skin-5 carambola. (iii) The fruits of Singapore single-skin carambola fruit was good quality and low oxalate. (iv) The soluble oxalate content of young fruits was increasing up very quickly Within 20 days after flowering, from 2000mg/Kg to 4000mg/Kg in a sweet variety of carambola. Then, the oxalic acid content of fruit decreasing until fruit ripening, about two months, from 4000mg/Kg to no more than 300mg/Kg. (v) Different parts have different quantity oxalic acid in a same ripe star fruit. The oxalic acid content in endocarp was 5 times as in pulp (mesocarp), and it in epicarp was nearly 3 times as it in pulp.

S07.260 Antioxidant Effects of Saffron Extract in the Rat Retina under Dystrophy

Shukurova, P. A.; Babayev, R. A.
INSTITUTE OF PHYSIOLOGY AZERBAIJAN NATIONAL ACADEMY OF SCIENCES, BAKU-1101, BAKU, AZERBAIJAN; AAUP, REVODON, AZERBAIJAN

In the present work is studied the impact of saffron extract the levels of lipid peroxidation (LPO) products in the damaged rat photoreceptor cell. The experiments were conducted on white albino Wistar rats weighing 180-200 g. The moderate experimental dystrophy of the retina was induced by an injection of 4% monoiodo-acetic acid into the caudal vein. 0.5% solution of saffron extract was administered at a dose of 0.1-0.3 ml, using peribulbar injection. The activation of lipid peroxidation processes in cell membranes causes a number of pathological conditions. Retinal dystrophy is accompanied with a considerable and significant activation of LPO reactions, manifested in an increase in the levels of hydroperoxide and malondialdehyde in the photoreceptor cell. Saffron extract decreased the levels of LPO products and thus facilitated the correction of structural and functional changes, acting as a natural antioxidant. It is generally known that certain pathological conditions, such as dystrophic damages, aging, ionizing radiation etc. are accompanied by changes in the condition of SH groups. Our results indicated that dystrophy intensifies LPO processes which, through the oxidative modification of sulfhydryl (SH) groups by free radical oxidation products, lead to a decrease in the levels of all SH groups. An administration of saffron extract facilitated the stabilization of LPO processes and prevented the decrease in the levels of SH groups. Therefore, our results indicated that saffron extract, which has a diverse and unique chemical composition, has antioxidant properties, manifested in the efficient suppression of LPO processes.

S07.261 Functional Characterisation of Old Cultivars of Long Storage Tomatoes

Atkinson, D. J.; Kelman, D.; Crompton, P.; Masters, J.; Smith, E.
L. var. 1; Babayev, R. A.
FONDATION MINOPRIO, VIA RAIMONDI 54, 22070 ALESSANDRO MINOPRIO, COMO, ITALY

The tomatoes selected (‘Minervino’, ‘Tricase’, ‘Botrugno’, ‘Brindisi Pirunella’, ‘Korea Short’, ‘Miramar’, ‘Serrano Giglio’, ‘Serrano Rosso’, ‘Marcondo’, ‘Palmariggi’, ‘Serranovia Gallo’, ‘Serrano Rosso’) were characterised quantifying the carotenoids, flavonoids and phenolic components by HPLC/DAD. The total antioxidant activity (AA) was determined on the lipophilic and hydrophilic fractions (DPPH assay), and on the hydrophilic fraction (ABTS test). The results showed that the carotene varied between 9.6 and 36.6 mg/kg fresh weight (FW), lycopene changed between 8.9 and 106.5 mg/kg FW while lutein varied between 1.7 and 5.1 mg/kg. When compared with commercial cherry tomatoes, the cultivars analysed showed high amounts of lutein [up to three times higher]. Total phenols ranged between 68 and 290 mg/kg FW, rutin content between 56 and 109 mg/kg FW. DPPH test showed that hydrophilic fraction AA was significantly higher than the lipophilic fraction AA, corresponding, on average, to about 40%. The ABTS assay on the hydrophilic fraction, found high AA values (about 30-90%). These ancient tomato varieties are rich in numerous compounds with high biological activity: for this reason, they should be protected and valued as a natural source of phytochemicals.

S07.262 Antioxidant Phytochemicals in Savoy Cabbage

Brassica oleracea L. var. sabauda L

Fernández-León, M. F.; Fernández-León, A. M.; Lozano Ruiz, M. A.; Ayuso Yuste, M. C.; González, J. A.; González-Gómez, D.

Instituto Tecnológico Agrario de Extremadura, Ctra. Mérida-Cáceres km 63, 10797 Badajoz, Spain; Centro de Investigación Agraria Finca la Orden-Valdesquera, Autónoma Sancho-López, 64, 06317 Gómezdaza, Spain; Brassicaceae is a wide botanical family with a great number of edible members. These vegetables are highly regarded for their nutritional value providing high amounts of vitamin C, soluble fiber, minerals and antioxidants, nutrients with potent anti-cancer properties. Some of the most common brassicas include broccoli, Brussels sprouts, cabbage, cauliflower, swedes, and turnips, while broccoli raab, collards, cress, kale, kohlrabi, mustard, and bok choy are less familiar. Cabbages are one of the oldest of the brassica vegetables in Europe and they are classified as either green or red, although colour ranges from nearly white to reddish-purple. Savoy cabbage is an excellent source of antioxidant compounds, therefore the aim of this work was to evaluate the content of these compounds, such as the vitamin C, b-carotene, lutein and total phenol content, in these brassica vegetables. Savoy cabbages were grown at the experimental fields located in Finca la Orden-Valdesquera in Extremadura (Spain) during the first week of February 2009. After their harvest they were rapidly transported to the INTAEX laboratory for their analysis. The contents of the main phytochemical compounds measured in Savoy cabbage were 49.06 mg/100 g fresh weight of vitamin C, 0.367 mg/100 g fresh weight of b-carotene and 0.182 mg/100g fresh weight of lutein. Finally, the total phenolic compounds measured as equivalent of chlorogenic acid was 102.71 mg/100 g fresh weight.

S07.263 Characterization of Some Qualitative Traits in Different Perilla Cultivars

Martinetti, L.; Ferrante, A.; Bassoli, A.; Borgonovo, G.; Tosca, A.; Spoleto, P.

INSTITUTO DE BIOMOLECULAR E FISICOQUIMICA, IBIOPF, UNIVERSIDADE DE SÃO PAULO, JULIOTIPOU, BRAZIL; INSTITUTE OF BIOMOLECULAR AND PHYSICAL CHEMISTRY, UNIVERSITY OF MILAN, MILAN, ITALY; ITC-ITALIAN TECHNOLOGICAL INSTITUTE, LUGANO, SWITZERLAND; UNIVERSITY OF MILAN, MILAN, ITALY; TECHNOSTAR, ALLAN FERGUSON, 3’, 1 CANADA, MONTREAL, CANADA; INSTITUTO TECHNOLOGICO AGROALIMENTARIO DE MEXICO, TECAMACHALCO, MEXICO

Perilla frutescens (L.) Britt. (Fam. Lamnaceae) is widely used in Asian countries both as culinary herb, and medicinal plant. Perilla leaves are reported to be rich in phenolic compounds, which are beneficial for human health, whereas seeds contain an oil rich in alpha-linolenic acid (omega-3 fatty acid), useful in the human diet, too. Perilla frutescens (L.) Brit. (Fam. Lamnaceae) is widely used in Asian countries both as culinary herb, and medicinal plant. Perilla leaves are reported to be rich in phenolic compounds, which are beneficial for human health, whereas seeds contain an oil rich in alpha-linolenic acid (omega-3 fatty acid), useful in the human diet, too. Since perilla is almost unknown in Europe, we started a trial aiming at evaluating the suitability of this species to be grown in our environments. As first step, we estimated the antioxidant properties and major component content of different cultivars, in order to explore the existing variability. Five red and green leaved commercial genotypes of perilla (‘Qing su’ and ‘Zi su’ of Agrohaitai, ‘Ao shiso’ and ‘Ako shiso’ of Tokita, ‘Korean perilla of Kitazawa Seed) were grown at the Minoprio Foundation experimental station (Vetere mate, Como, Italy). Seeds were sown in...
S07.264 Quantification and Characterization of Extracted Lutein of Flowers of Tagetes patula L. and Calendula officinalis L.

Stringheta, P. C.¹; Nachtigall, A. M.²; Stringheta, A. C. O.³

¹UNIVERSIDADE FEDERAL DE VIÇOSA, DEP. TECNOLOGIA DE ALIMENTOS, CAPOJUÍ, VIÇOSA, MG, BRAZIL;
²UNIVERSIDADE FEDERAL DE VIÇOSA, DEP. TECNOLOGIA DE ALIMENTOS, VIÇOSA, MG, BRAZIL;
³UNIVERSIDADE FEDERAL DE VIÇOSA, Brazil

The contents of lutein and characterization of the chromatographic profile of carotenoids from the yellow, orange and brown Tagetes patula L. (marigold) as well as the yellow and orange Calendula officinalis L. (marigold) flowers were determined by UV-visible spectra and High Performance Liquid Chromatography (HPLC). The brown T. patula L. showed the highest content of lutein (1230.6 mg/100g), which significantly differed from the others. However, the concentration of lutein in C. officinalis L. (29.80 mg/100g) was similar to the concentration found in yellow T. patula L. (59.7 mg/100g). The carotenoids profile from the orange T. patula L. was similar to that obtained from brown T. patula L. flowers. This profile was different from those obtained from the yellow T. patula L. flowers and yellow and orange C. officinalis L. Lutein was the main carotenoid present in the African marigold, although the same was not observed in marigold. This result shows the potential use of T. patula L. as a source of lutein.

S07.265 Quantification of Anthocyanins in Fruits and Vegetables

Stringheta, P. C.¹; Ozela, E. F.²; Stringheta, A. C. O.³

¹UNIVERSIDADE FEDERAL DE VIÇOSA, DEP. TECNOLOGIA DE ALIMENTOS, VIÇOSA, MG, BRAZIL;
²UNIVERSIDADE FEDERAL DE VIÇOSA, DEP. TECNOLOGIA DE ALIMENTOS, VIÇOSA, MG, BRAZIL;
³UNIVERSIDADE FEDERAL DE VIÇOSA, Brazil

Anthocyanins from different fruits and vegetables including acerola (Malphigia glabra L.), açai (Euterpe oleracea Martius), plum purple (Prunus domestica), blackberry (Rubus fruticosus), barbados (Orangecapus minor Mart.), eggplant (Solanum melongena), camu-camu (Myrciaria dubia), onion (Allium cepa), figo (Ficus spp.), jaboticaba (Myrciaria cauliflora), red jambo (Syzygium malaccensis L.), black plum (Syzygium cumini L.), apple (Malus pumila), red passion fruit (Passiflora edulis), strawberry (Fragaria spp.), cabbag (Brassica oleracea), pomegranate (Punica granatum), grape (Vitis vinifera), were extracted with ethanol 70% (v/v) and spectro-photometrically quantified by at 535 nm. The solution was adjusted to pH 2.0 and 3.0 with chloric acid (HCl) 0.03%, and to pH 3.0 with citric acid 0.93%. The higher amount of pigments from most of the fruit and vegetables were obtained by extraction with ethanol 70% acidified with HCl at pH 2.0, which contributed to minimize degradation. The exceptions were black plum and eggplant, where ethanol 70% acidified with citric acid was the most efficient. These results indicate that jaboticaba, açai, black plum, grape, prune, purple cabbag, barbados, blackberry, red jambo, eggplant, acerola and camu-camu can be used as potential sources of natural colorants, mainly jaboticaba, açai and black plum, which showed a total content of anthocyanins higher than 1200 mg/100g.

S07.266 Ultrastructure of Sweet Orange Ripening Fruit and the Role of Hydrolases in Dietary Fibre Degradation

Dong, T.¹; Xia, R. X.²; Yi, G. J.³

¹INSTITUTE OF FRUIT TREE RESEARCH, GUANGDONG ACADEMY OF AGRICULTURAL SCIENCES, DEFENG ROAD, TANHUI DISTRICT, GUANGZHOU, 511456, GUANGDONG, CHINA;
²COLLEGE OF AGRICULTURE AND FORESTRY SCIENCES, SHANDONG AGRICULTURAL UNIVERSITY, WEIHAI 264207, HUANGHUA PROVINCE, P.R. CHINA

Dietary fibre and anthocyanins of sweet orange (Citrus sinensis L. Osbeck) fruit were studied. The results showed that polygalacturonase (PG) was largely responsible for pectin depolymerization and solubilization, but PG-mediated pectin depolymerization requires pectin to be de-methyl-esterified by pectinesterase (PE). All these pectin-modifying proteins affect the integrity of the middle lamella, which controls cell-to-cell adhesion and thus influences fruit texture. In contrast, the primary cell wall changes caused by beta-galactosidases (BG) and cellulase (Cx), which may restrict or control the activities of other ripening-related enzymes necessary for the fruit softening process. Together, we could consider that the changes of dietary fibre concentration and composition were caused by the solubilisation and depolymerisation of pectins in middle lamella and the disintegration of the primary cell wall.

S07.267 Dynamic Chemical Profiling in Semi-Fermented Tea Manufacturing Process

Lin, S.¹; Chen, L.¹; Chen, K.²; Chen, Y.²

¹NATIONAL TAIWAN UNIVERSITY, 1, 4TH SEC., ROOSEVELT ROAD., 106, TAIPEI, TAIWAN;
²TEA RESEARCH AND EXTENSION STATION, TAPRO

The manufacturing process of semi-fermented tea is an art and experienced work. Dynamic changes in chemical volatiles are the useful index during each key step in tea manufacturing. Semi-fermented tea samples were made from Camellia sinensis var. sinensis cv. Chin-sing dah-pang at 5 unique stages, which were fresh leaves, greeny flavor emitting during fermentation, floral flavor developing during fermentation, before puffing, and tea product brewing in hot water. The volatile compounds collected by solid-phase microextraction (SPME) and direct dry heated extraction were investigated by GC-MS analysis. The proportions of the compounds with fresh grassy flavor, trans-2-hexenal and cis-3-hexenol, were higher in samples of fresh leaves and of grassy flavor in fermentation, while they declined when floral flavor arisen during fermentative process. The compounds represented floral flavor were trans-2-hexenal, geraniol, 8-myrcene; sweet flavor were linalool and its oxide; and fruity flavor most come from benzylandehyde. Before puffing, which is the fixation of tea product, the volatile compounds showing floral and fruity flavors were the major constituents. Volatiles of semi-fermented tea product with distillation extraction showed more than 90% balanced floral small compounds but less fresh and woody odor compounds such asl-tetone and nerolidol. The results of dynamic profiling with SPME GC-MS analysis showed the alternative changes in volatile compounds during manufacturing process of semi-fermented tea.

S07.268 Antioxidant Properties of Mushrooms Clavaria fennica and Clavaria pistilaris

Mujic, I.¹; Zekovic, Z.²; Lepojevic, Z.²; Vidovic, S.²; Zivkovic, J.²; Ramic, M.²; Jokic, S.²; Prigomet, Z.²; Albablic, V.²

¹COLEGIO FRIENSCNO INSTITUCION DE REBA, KARLA MUSECA 6, 51449, NOBRE, CROATIA;
²FACULTY OF TECHNOLOGY, BULVAR CARA LADAR 1, 2100 NOVY SAD, SERBIA AND MONTENEGRO;
³MEDICAL FACULTY OF UM, DEPARTMENT OF PHARMACY, 1100 OSIJEK, SERBIA AND MONTENEGRO;
⁴FACULTY OF FOOD TECHNOLOGY, 1100 OSIJEK, CROATIA

For many centuries mushrooms have been used for their medicinal properties
S07.269

Evolution of Nutrients during Some Leafy Vegetables Growth

Agbo, E. A.; Fondio, L.; Nemlin, J. G.; Kouame, C. 1
1UNIVERSITY OF ABIDJAN-ADJAME, Côte d’Ivoire
2NATIONAL AGRONOMIC RESEARCH CENTER, CÔTE D’IVOIRE
3WORLD VEGETABLE CENTER, CAMEROON

In Côte d’Ivoire several leafy vegetables are grown and consumed. However, their
maturity stages for consumption are not really defined. So, six leafy vegetables (litospinach, jute mallow, roseale, spinach, black nightshade and amaranth) were
grown during 2 months at the Agronomic Research Station of Anguededou. They
were analysed each weeks for the determination of pH, oxalic acid, proteins, sugars,
fibers, vitamin C, ß-carotene, phosphorus and minerals. The results revealed that
roselle was the most acid leafy vegetable and had the highest oxalic acid rate. Pro-
tein level decreased during leafy vegetables growth. Total sugars level was constant
between 2nd and 5th weeks. Lagos spinach had the most elevated fibers rate at 3th
week (37.17 % for soluble fiber and 66.1 % for insoluble fiber). Amaranth and
black nightshade offered the highest vitamin C content at 7th week (64.44 and
66.67 mg / 100 g fresh weight (FW) respectively). Moreover, the most elevated ß-carotene rate was contained in roseale (64.12 mg / 100 g FW, at 5th week).
Phosphorus content of amaranth and black nightshade was high at 6th week with
respectively 0.45 mg / 100 g dry matter (DM) and 0.33 mg / 100 g DM. Magnesium
level was constant during leafy vegetables growth. Spinach and jute mallow had
the highest iron rate at 5th week (70 and 88.8 mg / 100 g DM). The most elevated
calium level was found in spinach (3.68 g / 100 g DM at 6th week) and in Lagos
spinach (4.8 g / 100 g DM at 8th week). On the other hand, the less potassium rate
was in roseale (1.84 g / 100 g DM at 8th week). The propitious period for leafy
vegetables consumption is between the 3th and the 5th weeks of growth because
nutrients levels are maxima.

S07.270

Morphological Characterization and Determination of Pungency in Capsicum spp.

Santos, V. S. F.; Fernandes, J. D.; Vasconcelos, M. T. C.; Leitão, A. E. B.; Almeida, M. H. 1
1INSTITUTO SUPERIOR DE AGRONOMIA, TANHA DA AQUA, AGRONOMIA TROPICAL, 1539-007, LISBOA, PORTUGAL
2INSTITUTO DE INVESTIGAÇÃO CIENTÍFICA TROPICAL, PORTUGAL

Peppers belong to the genus Capsicum, and include about 30 species, whose cultivation
is widespread due to their rich content in vitamins and capsaicinoids, responsible for their pungency. Quantification of pepper pungency is important for the consumer, as a base ingredient in food preparation, for pharmacetics formulation, and for the global industry market. The purpose of this paper is the identification of species in a population of 71 plants from various countries, grown in plas-
tic pots at Instituto Superior de Agronomia, Portugal, and the quantification of capsaicinoid content with subsequent determination of fruit pungency in South American varieties (SHU). For the identification of species, accessions of Capsicum were morphologically characterized, using descriptors according to the guidelines of the Community Plant Variety Office and others from the International Plant Genetic Resources Institute. Morphophysiological characterization lead to the identification of samples in a population that included all five cultivated species: C. annuum, C. baccatum, C. chinense, C. frutescens and C. pubescens. The record of the descriptors of each plant was performed from seed to fruit maturity, aiming not only the identification of the species but also the determination of a narrower group of more useful characteristics that would allow that identification. Results of hierarchical cluster analysis showed that the most useful characteristics needed for the correct identification are: seed and corolla color, presence of spots on petals, and the presence or absence of ring constriction. Capsaicinoids were quantified by HPLC. Values between 88 and 14 814mgkg-1 were registered for capsaicin, and between 4 and 5860mgkg-1 for dihdrocapsaicin resulting in a range of 1417 SHU for C. annuum ‘Pardão’ to 324 928 SHU for C. chinense ‘Scotch Bonnet’. No direct relationship between pungency and species was found, although C. chinense reached the highest levels.

S07.271

Effect of Processing Techniques on the Phenolic Compounds and Antioxidant Activity of Pomegranate Leaf Tea

Zhang, Y.; Zhang, L.
1STATE KEY LABORATORY OF CROP BIOLOGY, SHANDONG AGRICULTURAL UNIVERSITY, DASHING ROAD NO.61, 275518, TAISHAN, SHANDONG, CHINA

The objective of this study was to investigate the effect of processing techniques on the pomegranate leaf and antioxidant activity of pomegranate leaf tea. The fresh leaves after spaying one month were oven-drying as control tea, the green tea and red tea were made with traditional techniques. Results show that the contents of total phenolics and catechin in green tea kept unchanged compared to the dried leaves, but the contents in red tea decreased significantly with the percentage of 30.8% and 60.3%, respectively. Correspondingly, the antioxidant activity of red tea decreased obviously. The contents of thearubigin and theaflavin in green tea were not significantly increased, but respectively increased 165% and 181.3% in red tea. In addition, the content of elagic acid was not markedly decreased both in green tea (6.3%) and in red tea (9.3%). Therefore, green tea made from pomegranate leaves exhibited significantly higher content of total phenolics and antioxidant activity.

S07.272

Studies on the Extraction, Identification, Stability and Antioxidant Capacity of Anthocyanins in Purple Radish

He, H.; Lu, F.; Tang, X.; Song, S.; Wang, W.
1BEIJING VEGETABLE RESEARCH CENTER, KAOJING, RADIAD DISTRICT, P.R.O. 100097, BEIJING, CHINA

Anthocyanins are responsible for the orange to blue coloration of plant. They are beneficial to human health and widely used as food colorants. Extraction of anthocyanins from purple radish was studied using ultrasound as the assisted method. Orthogonal test design was used to ascertain the optimum technologies of ultrasonic extraction after 2h shaking. The optimum conditions for ultrasonic extracting were as follows: The extraction time is 20min; the concentration of acetone solution is 70%; the ratio of material to reagent is1: 60. PC can be used as an assistant method in pigments component analysis by Xin Hua No.3 filter paper. HPLC methods were well determined for pigments in purple radish. of those the column: inertsil® ODS C18 (5um, 4.6 x 250mm); Elution conditions: grade elution; detection wavelength: 416nm. The record of the descriptors of each plant was performed from seed to fruit maturity, aiming not only the identification of the species but also the determination of a narrower group of more useful characteristics that would allow that identification. Results of hierarchical cluster analysis showed that the most useful characteristics needed for the correct identification are: seed and corolla color, presence of spots on petals, and the presence or absence of ring constriction. Capsaicinoids were quantified by HPLC. Values between 88 and 14 814mgkg-1 were registered for capsaicin, and between 4 and 5860mgkg-1 for dihdrocapsaicin resulting in a range of 1417 SHU for C. annuum ‘Pardão’ to 324 928 SHU for C. chinense ‘Scotch Bonnet’. No direct relationship between pungency and species was found, although C. chinense reached the highest levels.
tion at 520nm. The anthocyanins of purple radish are identified preliminary by comparison with data in the literatures. The results show that the anthocyanin of purple radish may compose of pelargonidin-3,5-diglucose. In vitro antioxidant activities of anthocyanins from purple sweet potatoes and purple cabbages extracts were studied and evaluated. Comparing antioxidant abilities among them by DPPH method, it was found that their IC50 value on scavenging DPPH free radical were 0.0121mg/ml, 0.0165mg/ml, 0.0187mg/ml respectively. Assessing inhibition ability on oxidation, induced by Fe²⁺, of lecithin liposome system of anthocyanins among them, the antioxidant activities of the different pigment extracts were found to vary as follows: purple sweet potatoes > purple radishes > purple cabbage.

S07.273
D-Pinitol Content of Carob Beans (Ceratonia siliqua L.)

Karhan, M.; Tetik, N.; Turhan, I.; Oziyci, H. R.
Akdeniz University, Faculty of Engineering, Department of Food Engineering, 07070, Antalya, Turkey

Carob (Ceratonia siliqua L.) is a tree that has been widely grown in the Mediterranean region for a long time. It belongs to the Caraganaeae family of the family Leguminaceae. Turkey is located within the region where the plant originated and has "cultivated types" and many "wild types". Several products are produced from the seed and pod of carob, and the economic importance of the crop results from the use, by industry, of locust bean gum that is obtained from the seed. The pod of the carob fruit has long been used as a feed for livestock and in human nutrition, including sweets, biscuits and processed to pekmez; a traditional concentrate. The pod of the carob fruit is the main ingredient of locust bean gum (Cassia Gum), which contains the polymeric dextrin pinitol (D-pinitol), a trisaccharide sugar with the potential applications in the food, pharmaceutical and cosmetic industries. The aim of this study was to determine the D-pinitol content of the carob fruits from Antalya, Turkey, and to compare the values with the latest studies.

S07.274
The Characteristics of Polyphenol Oxidase in Small Cherry Tomato (Solanum lycopersicum) Cultivated in Kurdistan of Iran

Saeidian, S.; Rashidzadeh, B.
Inside Noor University, Kurdistan-Sazeh, 66815/355, Islamic Republic of Iran

Polyphenol oxidase (EC 1.14.18.1) (PPO) is a copper-containing enzyme which can be found throughout the phylogenetic tree. PPO is the rate-limiting enzyme in the melanin biosynthesis pathway. It hydroxylates and oxidizes phenols to o-quinone. PPO activity was determined, using catechol (dihydroxyphenol) and pyrogallol (trihydroxyphenol) as substrate, in extracts prepared from small cherry tomato (Solanum lycopersicum) cultivated in kurdistan (Iran). pH profile for crude extracts showed that one optimum pH exists for catechol as well as pyrogallol. The optimum pH for PPO activity has been found at pH 8. Kinetics parameters at pH 8 indicated that the apparent Km and Vmax per mg protein were, respectively, 27 mM and 0.11 Unit/ml, 1.5 mM and 45 Unit/ml with hyperbolic curves for catechol and pyrogallol. Catalytic efficiency, calculated per mg extract protein, was respectively 0.004 per 30 min-1 for extracts prepared from small cherry tomato. A strong substrate inhibition was observed with catechol and pyrogallol. In all activity assays, the oxidation product of catechol was detectable after a lag period. In the presence of different concentrations of catechol, the oxidation rate of catechol increased while the length of the lag period was decreased. This was probably interpreted as the release of the latent form of the enzyme to its active form in addition to a facilitated substrate access. During substrate inhibition with increase of catechol concentration, lag time increased. On the other hand, in the presence of pyrogallol as second substrate, oxidation of substrate showed no lag time. In general lag time of enzyme depended on the enzyme and substrate concentration, the pH and the presence of catalytic amounts of substrate. Phenolic compounds are thought to be sequestered in cell vacuoles and simple phenols as well as most of the phenolic compounds are intermediates and derivates of the shikimate and phenyl propanoid pathways.

S07.275
Apple: Extraction Optimization of Antioxidant Compounds and Determination of Total Phenolic Amount and Antioxidant Activity on Products and Co-Product

Vizzotto, M.¹; Fetter, M. D. R.²; Pereira, M. C.³; Corbelini, D. D.²
Universidade Catolica do Parnaiba, Brazil

Apple (Malus domestica) is one of the most commercialized fruit in Brazil, having great importance to the Brazilian fresh fruit market. The main destination to the apple Brazilian production is the fresh market; however new alternatives are being sought since the fresh consumption has not increased in the last few decades. The alternatives to develop new products pass through the food, pharmaceutical and cosmetic industries. Beverages such as apple juice concentrate, extraction of pectin, apple flour to make cakes, breads and shakes and cosmetics are good examples of high added value products made of apple fruits. Apples have a series of bioactive compounds, also called phytochemicals, which can prevent chronic non-communicable diseases. Genetic factors, as well as environmental factors may affect the content of these bioactive compounds. To increase the knowledge of apples produced in Brazil, Embrapa Temperate Agriculture, Pelotas, has been conducting research activities on chemical composition and antioxidant activity of the main cultivars produced in Brazil and some co-products. Some products and co-products were analyzed such as the cultivar Fuji, apple flour, concentrate apple juice and fruits from the pollination apple (Malus everest) plant. Also, a methodology to extract the antioxidant compounds from apple was developed. Regarding to the results, fruits from the pollination apple plant show the highest antioxidant activity among all the studied products and co-products. This is important information to the farmers and to the industries since this product is not usually commercialized. Cosmetic industry can use this material to extract antioxidant compounds to be used as natural extract on cosmetic formulations. Regarding to the methodology to extract the antioxidant compounds, several solvents and mixtures of solvents were tested and a mix of acetone and ethanol was the most efficient to extract antioxidant compounds from apples.

S07.276
Anthocyanin Profile of Two Italian Cichorium intybus L. Cultivars

D`Evoli, L.¹; Lucarini, M.¹; Valentini, M.²; Ritotta, M.²; Sequi, P.²; Lombardi-Boccia, G.¹
National Research Institute for Food and Nutrition (INN), Via Moriggia 546, 00178, Rome, Italy

Cichorium intybus L. consists of many varieties, two typical Italian crops are the red (Radicchio Rosso di Treviso) and the red-spotted (Radicchio di Castelfranco) chicories belonging to the folosum variety, both representative of Italian cultural realities related to a specific territory. These leafy vegetables are cultivated in north-east Italy. Radicchio Rosso di Treviso is cultivated according to traditional growing technique involving leaves tying during growth and a bleaching process at harvesting. Both cultivars are recognized with the PGI label (Protected Geographical Indication) from European Union. The aim of this study was to examine the qualitative and quantitative compositional profile of anthocyanins, the main phytochemical characterizing and distinguishing both the red and red spotted Italian variety of Cichorium intybus L. Radicchio Rosso di Treviso was sampled in 4 different locations and Radicchio di Castelfranco in 3. Anthocyanins were separated by HPLC, and NMR spectroscopy was used to identify their profile, 1D- and 2D-NMR experiments allowed the recognition of some compounds for which standards for HPLC are not available. The red cultivar (Radicchio Rosso di Treviso) showed a marked variability in anthocyanins concentration among the
four localities studied. Pelargonidin-3-glucoside, cyanidin-3-glucoside, delphynidin-3-O-(6-malonyl)-glucoside and cyanidin-3-O-(6-malonyl)-glucoside were the main anthocyanins found, the last showed the highest concentration. The red-spotted cultivar (Radicchio di Trento) showed a similar anthocyanin profile with markedly lower concentration compared to the red cultivar. The research aimed at a systematic study of the anthocyanin profile of both Radicchio Rossa di Trento and Radicchio di Castelfranco as function of their production areas. Our findings gave a fingerprint of the red and red-spotted Italian PGI cultivar of Radicchio. Further studies need to elucidate the contribution of both environmental factors and traditional treatment applied during growth to the compositional variability observed.

S07.277
The Effect of TTES no.13 Paochung Tea Caffeine and Catechins Content by Using Different Roasting Methods
Fan, C. C.; Chen, I. Z.; Liao, Y. Y.
National Taiwan University, Department of Horticulture, No. 1, Sec. 4, Roosevelt Road, Taipei, 10617 Taiwan (R.O.C.), Taipei, Taiwan.

Roasting methods profoundly influence the chemical composition of Paochung tea. In this study, Paochung teas were produced from TTES No.13. The processing parameters under investigation included temperature (80 °C, 100 °C, 120 °C), duration (1, 3, 6, 9, 12 h) and the number of times. Summer tea of 2008 was used and first roasting was done in the autumn of 2008. Second and third roasting were done in 2009. After roasting, caffeine and catechins were analyzed by HPLC. Caffeine content increased after first roasting. While decreased after second and third roasting. Catechins content of tea increased with increasing of roasting duration and times.

S07.278
Correlation of Lutein and β-Carotene Content with Total Chlorophyll Concentrations in Green Leafy Salads
Reif, C.; Wallquist, L.; Kläui, J.; Baumgartner, D.; Schärer, H.; Arrigoni, E.; Bozzi Nising, A.
Agricultural Research Station of the Canton of Zug, 6100 Zug, Switzerland.

Due to their antioxidative properties and postulated beneficial outcomes to health which are associated with a diet rich in carotenoids, green leafy vegetables can play an important role in a balanced and healthy diet. The major pigments accumulated in green leaves - beside chlorophylls - are the yellow coloured xanthophylls lutein and the orange β-carotene. Lutein is reputed to have a protective effect against several eye diseases, whereas β-carotene is especially known for the provitamin A properties. There is some evidence, that high chlorophyll concentrations in green leaves are related to elevated lutein and β-carotene contents. Therefore, we investigated the relationship between carotenoids and chlorophylls in salads. 45 leaf salads divided in common eaten Asteraceae (red and green lettuce cultivars and baby leaf) and old Asteraceae cultivars (chicago, sugar leaf) were selected. For each cultivar one quarter per head (n=12) were deep frozen with liquid nitrogen at day of harvest and crushed to a frozen powder. The samples were extracted with methanol:acetone (1:1 v/v) and lutein, β-carotene, chlorophyll a and b were quantified by HPLC-DAD. Separation was achieved in 30min on a C30-column with methanol:acetone (1:1 v/v) and lutein, β-carotene, chlorophyll a and b were quantified by HPLC-DAD. Separation was achieved in 30min on a C30-column with methanol:MTBE gradient. We identified a strong correlation between the total carotenoids and chlorophylls of R2>0.9. Concerning the lutein/chlorophyll ratio we observed two groups. In the group of old Asteraceae the carotenoid/chlorophyll ratio was approximately 1:1 whereas in the common eaten cultivars we determined a ratio of 1:18. In contrast, we found for the β-carotene/chlorophyll relation a fix ratio of 1:26 for all cultivars. As a conclusion we figured out that lutein is responsible for the two groupings between the carotenoid/chlorophyll ratio in the different salad cultivars. As a further objective, we intend to implement leaf colourisation measurements which may develop into a fast screening tool for carotenoid contents.

S07.279
Long-Time Heating Improves the Functionality of Chinese Quince and Quince Fruit Products
Hamauzu, Y.; Nakamura, K.; Ooji, Y.
Shinshu University, E354 Minami-ku, 399-0298, Matsumoto, Nagano, Japan

Chinese quince (Pseudocydonia sinensis) and quince (Cydonia oblonga) are rich in polyphenols and dietary fiber and have been used traditionally as a folk medicine or a medicinal foodstuff. These fruits are often subjected to long-time heating when they are processed or treated for extraction of active ingredients. However, the changes in components of the fruits during long-time heating and the phytochemical composition of the extracts are unclear. We investigated: 1) the functional characteristics of boiling-water extracts of Chinese quince and quince fruit, 2) the effect of boiling time on the polyphenol and polyuronide content of fruit jelly made from the boiling-water extracts, and 3) changes in polyphenols during heat treatment. The experimental data showed, the boiling-water extracts of Chinese quince and quince fruits were rich in polyphenols and polyuronides and showed in vitro b-acyl acid binding, antioxidant and anticancerous properties. Concerning the characteristic of the fruit jellies made from the extracts, the intensity of reddish color, polyphenol and polyuronide content, viscosity and DPPH radical scavenging activity all increased with the boiling time. The polyphenol content of the jelly made from Chinese quince fruit was approximately 530-820 mg/100g and it was 3-4 times higher than that of quince jelly (120-240 mg/100g). Meanwhile both polyuronide content of the jellies were almost similar (140-300mg/100g). Polyphenols seemed to contribute to the viscosity of the jelly. Low molecular polyphenols in the boiling-water extracts were increased by heat treatment. In conclusion, boiling is an effective method to extract and improve the functionality of Chinese quince and quince fruits, and the functional characteristic of the extracts or the jellies seemed to be controlled with boiling time.

S07.280
Changes in Saponins, Alkaloids, Nucleosides and α-Glucosidase Inhibitory Activity in Jujube during Acetification Process
1Department of Food Science, Beijing Agricultural College, Beijing, 102206, China
2College of Bioscience and Biotechnology, Beijing Forestry University, Beijing, 100083, China

In this study, we demonstrated for the first time the influence of hydrolysis of pectin, alcohol and acetic acid fermentation on the bioactive substances and α-glucosidase inhibitory activity (GIA) of Chinese jujube. The analyzed components included total soluble sugar, total phenolics, total saponins, total alkaloids, nucleosides (AMP and cGMP), and triterpenoids (ursolic acid, oleanolic acid, betulin and jujuboside B). Investigations showed that the hydrolysis of pectin had no obvious effects on the contents of total soluble sugar, total phenolics and total alkaloids, while it significantly released total saponins, nucleosides and triterpenoids (p < 0.05). The alcohol fermentation caused the decreases in all of these bioactive components, and the followed acetic acid fermentation continued to decrease the soluble sugar, total phenolics, total saponins and nucleosides until the entire fermentation was finished. It was necessary to emphasize that the contents of the total alkaloids and triterpenoids were decreased slightly at the beginning of acetic acid fermentation, while they were significant increased at the end of the fermentation. The α-glucosidase inhibitory activity (GIA) of jujube was also affected significantly (p < 0.05) by these processes. The results of analysis showed that GIA was significantly increased (p < 0.05) after hydrolysis of pectin, and was decreased after alcohol fermentation. GIA had no significant difference (p > 0.05) at the beginning of acetic acid fermentation, whereas it increased significantly at the 7th day of the fermentation (p < 0.05). Significant correlation (r² = 0.997, p < 0.05) was found between GIA and the alkaloids and triterpenoids. Although the neutralized vinegars were lower than the non-neutralized vinegars in GIA, it still had strong
GIA. These results suggest that these bioactive compounds play an important role in GIA of jujube vinegar, and Chinese jujube could be exploited for development of an anti-diabetic food by acidification process.

S07.281
Polyphenol Content and Antioxidant Activity of Fruit Tea Samples Made of Berries

Varga, Z.; Pintér, E.
Semmelweis University, Vas U. 17., H-1101, Budapest, Hungary

Recently polyphenols have gained much more attention, owing to their antioxidant capacity and their possible beneficial implications in human health. Berries are rich in polyphenols and there are many studies about their quantity and quality. Fruit teas are becoming more and more popular products that are often made of berries too. We don’t have enough data on the amount of the components in tea infusion made of berries. The aim of our work was to examine the polyphenol content and the antioxidant activity of fruit tea samples made from berries. We measured tea samples made from rosehip (Rosa canina), blackberry (Rubus niger), cranberry (Vaccinium macrocarpon). We measured both of filtered products and products made of fruit sarcocarp. Tea infusions were prepared with pouring hot water (100 °C) and soaking, in different temperatures. Tea samples were bought in herb shops and food stores. Polyphenol content was measured with Folin–Ciocalteau reagent. Antioxidant content was measured by spectrophotometer directly. Data were evaluate by t test at p<0.05. There were significant differences between the tea samples made of filtered products and the samples made of fruit sarcocarp. The polyphenol content and antioxidant activity were higher in samples made of fruit sarcocarp. There were significant differences between the samples prepared by pouring hot water and the samples prepared by soaking. The polyphenol content was higher in samples prepared by soaking.

S07.282
Determination of Various Chemical Properties, Total Phenolic Contents, Antioxidant Capacity and Organic Acids in Laurocerasus officinalis Fruits

Sahan, Y.1; Cansev, A.2; Celik, G.3; Cinar, A.4
1LINCE UNIVERSITY, FACULTY OF AGRICULTURE, DEPARTMENT OF FOOD ENGINEERING, GÖMELEK CAMPUS, 16030, Bursa, TURKEY
2LINCE UNIVERSITY, FACULTY OF AGRICULTURE, HORTICULTURE DEPARTMENT, TURKEY
3THE SCIENTIFIC AND TECHNOLOGICAL RESEARCH COUNCIL OF TURKEY, SIRSA TEST AND ANALYSIS LABORATORY, (SİRSA TEST), TURKEY
4BRIAN UNIVERSITY, DEPARTMENT OF BIOSCIENCES, UNITED KINGDOM
Laurocerasus officinalis (cherry laurel), also known as Taflan or Karayemiş, is the fruits of the officialins species in the Rosaceae family and Prunusideae subfamily. It is mostly consumed as fresh fruit but may also be dried, pickled, and processed to produce jam, marmalade, and fruit juice. The nutritional value of cherry laurel fruit arises from its phenolic content and other chemical properties. In addition, both fruits and seeds of cherry laurel have been used in the treatment of stomach ulcer, digestive system illness, bronchitis (seeds), eczemas, haemorrhoids and as a diuretic (fruits) and analgesic agent in traditional medicine in Turkey. Pulps of the fruit were tested for chemical composition (protein, sugar, fat, moisture, ash), total antioxidant capacity, total polyphenol content; in addition organic acid (malic, acetic acid, fumaric acid, oxalic acid, citric acid, L-Ascorbic acid, succinic acid) of the fruit were tested for chemical composition (protein, sugar, fat, moisture, ash), total antioxidant capacity, total polyphenol content; in addition organic acid (malic, acetic acid, fumaric acid, oxalic acid, citric acid, L-Ascorbic acid, succinic acid) of the fruit were determined. Total polyphenol content was estimated using Folin–Ciocalteau assay. The antioxidant activity of cherry laurel was assessed by scavenging 2,2-diphenyl-1-picrylhydrazyl (DPPH). An ion chromatography with UV detection was used for determination of organic acids in fruits. On a fresh weight basis, cherry laurel fruit exhibited a significantly (P < 0.01) high phenolic and antioxidant activity. Since it is a rich source of chemical compounds, total phenolic and antioxidant contents as well as organic acid contents, L. officinalis has important health benefits and might be considered as a functional food.

S07.283
From Producing Fields of Huelva to the Market: Qualitative Assessment of Strawberry’s Antioxidant and Nutritional Properties

Gálvez, A. C.1; Medina, J. J.2; Domínguez, P.2; Soria, C.2; Miranda, L.2; López-Andrade, J. M.2; Vilchez, C.2; de la Morena, B. A.1; Casal, C.1
1“DIVISIÓN DE SONDOS ATMÓSFERICOS ‘El Arenosillo’, Dpto. OBSERVACIÓN DE LA TIERRA, TELEMETRÍA Y ATMÓSFERA, INSTITUTO NACIONAL DE TECNICA AERONÁUTICA (INTA), CTRA. SAN JUAN DEL PUERTO – MAGELANICAS KM. (3), 11710, MÁLAGA, SPAIN
2INSTITUTO ANDALUZ DE INVESTIGACIÓN Y FORMACIÓN AGRARIA (IAIISA), CONSEJERÍA DE AGRICULTURA Y PESCA (CAP), JUNTA DE ANDALUCÍA, AYTA. ISAAC NEWTON 1, 41092, SEVILLA, SPAIN
3UNIVERSIDAD DE SEVILLA. AYTA. TREES DE MARCO 1, 11171, SEVILLA, SPAIN
In the last few years, most of strawberry growers have shown an increasing concern about the future’s sector. Among the major demands they have, a reasonable fruit price for strawberries before shipping in producing fields, it can be stand out. Prices normally undergo an important rise throughout the distribution and commercial chain, whereas in many cases, profits scarcely cover producing costs. This usually takes place when markets get to be saturated of fruit coming from others countries. Furthermore, the predominance of adequate quality and traceability controls in some cases is insufficient yet. For above reasons, it is more and more necessary to enhance both nutritional and bioactive value of strawberries, consumption of which, supplies healthy benefits. Most of them seem to be linked to the antioxidant properties and free radical scavenging capacity of several phytochemical compounds contained in fruits, just like have pointed out many studies. The objective of this work has been to evaluate changes in the nutritional and antioxidant character of strawberries (‘Camarosa’, ‘Candonga’ and ‘Fuenteepin’ cultivars) produced in the region of Huelva after being subjected to a post-harvest treatment simulating transport from producing fields to European markets. Periodical analyses of brin-grade, pH, titratable acidity, carbohydrates, total phenolic compounds, anthocyanins, antioxidant capacity of extracts (DPPH) and antioxidant enzymatic activities were performed. The effect of temporary storage at ~20 °C on antioxidant properties and possible correlations between parameters has been also discussed.

S07.284
Effect of Cooking on the Nutritional Characterization of Nopal Milpa Alta and Atlixco Varieties (Opuntia ficus indica L Miller)

Ramirez-Moreno, E.; Diez-Marqués, C.; Sanchez-Mata, M. C.; Gohi, I.
21 GRUPO DE BIOTECNOLOGÍA DE ALGAS, FACULTAD DE CIENCIAS EXPERIMENTALES, UNIVERSIDAD DE HUELVA.
22ESTACIÓN DE SONDEOS ATMOSFÉRICOS “EL ARENOSILLO”, DPTO. OBSERVACIÓN DE LA TIERRA, TELEMETRÍA Y ATMÓSFERA, INSTITUTO NACIONAL DE TECNICA AERONÁUTICA (INTA), CTRA. SAN JUAN DEL PUERTO – MAGELANICAS KM. (3), 11710, MÁLAGA, SPAIN
23AVDA. KM. 33, 21130, MAZAGON, HUELVA, SPAIN

Beside the widely spread use of the cactus pear fruit, the part of the cactus consumed as a vegetable is the young stem known as cladode or “nopal”. Cladodes have been a traditional fresh green vegetable in the Mexican diet, which is eaten after a culinary process. Chemical composition of Milpa Alta and Atlixco varieties were investigated. Analyses were conducted in raw and cooked plants by common household practices (boiled during 20 min in distilled water). Cladodes were analyzed for moisture, ash, minerals and protein as per the standard AOAC methods. Minerals concentrations were determined after dry ash at 550 °C in a microwave oven. The mineral content in the diluted acidified samples was determined by Atomic Absorption Spectrophotometer. Nitrogen content was estimated by Kjeldhal method and was converted to protein using factor 6.25. Soluble sugars concentration and the proportion of succharose, glucose and fructose in soluble sugar were measured by HPLC. The amount of soluble dietary fibre (SDF), insoluble dietary fibre (IDF) and total dietary fibre (TDF), was determined by a gravimetric enzymatic method. Analysis of variance (ANOVA) was used to compare any significant differences between samples (p<0.05). In this study, moisture, minerals and carbohydrates were relevant in the nutritional composition of cladodes studied. Potassium was the most abundant mineral in both varieties of cladodes studied, followed by Ca and Mg. Dietary fibre was the most important carbohydrate fraction followed by soluble sugars. Total fibre represents almost 50% of dry matter in this plant, and...
insoluble fraction was the most important fraction of total fibre. Low protein content was observed. No significant differences were observed between the cladodes varieties. Cooking of vegetables, produce an important decrease in soluble sugars, protein and minerals by leaching into the cooking water.

S07.285
Evaluating Some Biochemical Components in Fruits Juice, Pulp and Peel of Lime and Lemon Fruits

Talae, A.; Zandkarimi, H.; Reza, F.
DEPARTMENT OF AGRICULTURAL SCIENCES, FACULTY OF AGRICULTURE, UNIVERSITY OF TABRIZ, TABRIZ, IRAN

Lime and lemon are the most important of citrus product crops. The large parts of lime and lemon product are used to produce juice or dried fruits. All parts of Citrus (pulp, peel, seed and leaf) are known to be rich in polyphenols, antioxidant compounds and Carotenoid, pectin and dietary fibers. In this investigation some biochemical components in some parts of two local genotypes of lime (Persian lime, Bikhare lime) and lemon (Mayer, Lisbon) fruits were evaluated. The contents of total polyphenol, pectin content, carotenoid and dietary fiber in peel and pulp of fruits were determined. The some characteristics of juice such as ascorbic acid, antioxidant activity, pH, EC, TSS, titration acidity was also determined. The analysis of variance showed no significant difference in the contents of total dietary fiber in the genotypes but the contents of total dietary fiber in peel were significantly higher than in pulp (p<0.05% in all cases). The highest total phenolic content was absorbed in fruit’s peel with range of 64.72, 60.16 mg gallic/Gallic/100 g DW and then in pulp of fruits. The analysis of carotenoid and pectin show the existence of significant difference in the parts and genotypes. In all four fruits, the peels and carotenoid contents in peel were significantly higher than pulp. Lemons juice fruits showed higher antioxidant activity, TSS and pH than limes, but they show lower ascorbic acid, EC, titration acidity than limes juice fruits. In conclusion all parts of lemon genotypes have highest polyphenol content. Peel and pulp of lime fruits show highest pectin. The peel of all genotypes is rich in dietary fiber and total carotenoid.

S07.286
Nutritional Parameters and Sensory Quality in Cooked Vegetables in MAP

Rocha, S.1; Barbosa, C. D.; Oliveira, M.B.P.P.; Alves, M.R.1,2
1BTCG - EPUC AV. DO ATLANTICO, 666, 60.451-970 VIANA DO CASTELO, PORTUGAL
2REQUIME - MIRI - VIA ANÁLISE, 810 - 4990-901 PORTO, PORTUGAL

Ready-to-eat (RTE) products are an essential component of modern lifestyle. Modified atmosphere packaging (MAP) has become a popular form of extending the shelf life of fresh food products because they are easier and faster to prepare. Also fresh or cooked vegetables are popular as side dishes in Atlantic and Mediterranean diets, being considered healthy due to the fact that they are important sources of micronutrients and of a large variety of bioactive compounds. There is now strong evidence that these compounds are effective in preventing cancer and coronary diseases. They are also important in keeping organoleptic characteristics during shelf life. Therefore monitoring these compounds during storage is of maximum importance for producers to choose the best gas mixtures (O2, CO2), will affect the activities related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits.

S07.287
Bioactive Compounds and Total Antioxidant Activity during the Development of Sapodilla Fruit

Oliveira, L. S.; Rodrigues, D. C.; Moura, C. F. H.; Miranda, M. R. A.1
1FEDERAL UNIVERSITY OF CEARA, DEPT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY, ILHEUS, 60.415-970, SOUZA, BRAZIL
2CENTRAL ATLANTIC ADMINISTRATION, 1 Dr. Miguel Pereira, 6303.905-080, BRAZIL

The total antioxidant activity (TAA) of fruits can be influenced by several factors, so that fruits from the same species can vary in activity values due to cultivation system and developmental stage. This work aimed to analyze the influence of the developmental stage on bioactive compounds and TAA of sapodilla (Manilkara zapota L.) fruits. Fruits of the two cultivars ‘Sapoti Iparacu’ (BRS 227)’ and ‘Sapota tropical (BRS 228)’ were harvested at different stages: 90, 120, 150, 180 (physiologically mature) days, ripe, and analyzed for total soluble polyphenols (TSP), vitamin C, yellow flavonols and total antioxidant activity according to the ABTS+ method. The TSP content decreased during development period and varied between cultivars, as ‘Sapoti’ started at 1663.83 and reduced to 67.01 mg gallic/gallic/100 g, meanwhile ‘Sapota’ maintained higher levels, from 2090.90 to 163.15 mg gallic/gallic/100 g. The vitamin C content decreased from 23.62 to 11.41 mg/gallic/100 g and 25.23 to 12.16 mg/gallic/100 g for ‘Sapoti’ and ‘Sapota’ fruit, respectively. The yellow flavonol content decreased from 11.44 to 3.16 mg/gallic/100 g and 6.91 to 1.70 mg/gallic/100 g for ‘Sapoti’ and ‘Sapota’ fruit, respectively. However, there were no statistical differences found in the vitamin C and yellow flavonol results between cultivars. The TAA decreased from 2382.90 to 33.54 µM Trolox/g and 2481.99 to 132.92 µM Trolox/g for ‘Sapoti’ and ‘Sapota’ fruit, respectively. These results show that during the development of the sapodilla cultivars studied, there was a decrease of the analyzed bioactive compound contents and of TAA, thus indicating that developmental stages influences the antioxidant quality of sapodilla.

S07.288
Phenolic Compounds in Olive Tree Leaves: Analysis of Extracts, Infusions and Natural Supplements

Silva, S. D.1; Chambel, B.; Monteiro, A. P.; Graca, C.; Vilas Boas, L.; Bronze, M. R.1,2
1BTCG - EPUC AV. DO ATLANTICO, 666, 60.451-970 VIANA DO CASTELO, PORTUGAL
2REQUIME - MIRI - VIA ANÁLISE, 810 - 4990-901 PORTO, PORTUGAL

Phenolic compounds are plant secondary metabolites, which play an important role in disease resistance, protection against pests and species dissemination. The interest on these compounds is related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits.

S07.289
Phenolic Compounds in Olive Tree Leaves: Analysis of Extracts, Infusions and Natural Supplements

Vilas Boas, L.; Bronze, M. R.1,2

Phenolic compounds in olive tree leaves. Commercial dried leaves of different origins were evaluated in terms of their potential as natural antioxidants and health-promoting compounds. Phenolic compounds are plant secondary metabolites, which play an important role in disease resistance, protection against pests and species dissemination. The interest on these compounds is related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits. The interest on phenolic compounds has raised attention for its effect on these compounds is related with their antioxidant activity and promotion of health benefits.
S07.289 Characterization of Secoiridoids in Olive Seeds Using MALDI-TOF Mass Spectrometry

Silva, S. D.; Coelho, A. V.; Vilas Boas, L.; Bronze, M. R.

1I.T.E.R., APADAP, 12, 2781-901 ÉVORA, PORTUGAL
2I.Q.B., AV. DA REPÚBLICA, 2780-117 ÉVORA, PORTUGAL
3UNIVERSIDADE DE ÉVORA, DEPARTAMENTO DE QUÍMICA, 7000 ÉVORA, PORTUGAL
4FEL, AV. DOS FORÇAS ARMADAS, 1640-019 LISBOA, PORTUGAL

The olive tree belongs to the genus Olea of the Oleaceae family. Members of the Oleaceae family are characterized by the presence of secoiridoids. These compounds have in their structure enolic acid or one of its derivatives. While phenolic acids, phenolic alcohols and flavonoids occur in many fruits and vegetables belonging to various botanical families, secoiridoids are present exclusively in plants belonging to the Oleaceae family which includes Olea europaea L. Oleuropein, ligstroside and nüzenhede are the most abundant secoiridoids in olives [1]. Some phenolic compounds have been identified in olive seeds like salidroside, nüzenhede, hydroxytyrosol, nüzenhede 11-methyl oleoside, oleuropein, tyrosol, and demethyloleuropein [1]. In previous works we reported the analysis and chemical characterization of seed extracts from Olea europaea L. using reversed phase HPLC, with electrochemical and diode array detection, hyphenated with mass spectrometry (electrospray ionization). Nüzenhede and nüzenhede 11-methyl oleoside among other 11-methyl oleosides are the most important compounds detected in olive seeds [1,2]. The indication of the presence of seeds of secoiridoids compounds with higher molecular mass than nüzenhede 11-methyl oleoside – nüzenhede di and tri (11-methyl oleoside) – lead us to MALDI-TOF mass spectrometry assays in order to characterize secoiridoids in olive seeds.

S07.290 Chemical Composition and Antimicrobial Activity of Feverfew (Tanacetum parthenium L) Essential Oil

Izadi, Z.; Esnaashari, M.; Piri, K.; Ahmadvand, G.; Gholami, M.

1BU-ALI SINA UNIVERSITY, FORMER POSTGRADUATE STUDENT, DEPARTMENT OF AGRICULTURE, FACULTY OF AGRICULTURE, BU-ALI SINA UNIVERSITY, HAMEDAN, ISLAMIC REPUBLIC OF IRAN
2DEPARTMENT OF HORTICULTURAL SCIENCES, FACULTY OF AGRICULTURE, BU-ALI SINA UNIVERSITY, HAMEDAN, ISLAMIC REPUBLIC OF IRAN
3IBET, APARTADO 12, 2781-901 ÉVORA, PORTUGAL

In this study, the aerial parts of feverfew (Tanacetum parthenium L.) were collected from Hamedan and Tehran regions at the vegetative, flowering and seeding stages. Essential oils from the whole aerial parts as well as stem/leaf, inflorescence and ripe seeds were isolated through hydro-distillation. The amount of essential oil obtained when 150 kg nitrogen/ha applied on 8 plants/m².

S07.291 The Effect of Nitrogen and Plant Density on the Essential Oil Content and Composition of Peppermint (Mentha piperita L)

Izadi, Z.; Esnaashari, M.; Ahmadvand, G.; Piri, K.; Gholami, M.

1BU-ALI SINA UNIVERSITY, FORMER POSTGRADUATE STUDENT, DEPARTMENT OF AGRICULTURE, FACULTY OF AGRICULTURE, BU-ALI SINA UNIVERSITY, HAMEDAN, ISLAMIC REPUBLIC OF IRAN
2DEPARTMENT OF BIOTECHNOLOGY, FACULTY OF AGRICULTURE, BU-ALI SINA UNIVERSITY, HAMEDAN, ISLAMIC REPUBLIC OF IRAN

In order to study the effect of different amounts of nitrogen and plant density on the essential oil content and composition of peppermint, an experiment was conducted in 2008 at the Experimental Field of the Agricultural Faculty of Bu-Ali Sina University. The experiment was a split plot based on a randomized complete block design with three replications. The main plots included the amounts of 100, 150 and 200 kg nitrogen/ha. The sub-plots were also considered for the plant densities as 8, 12 and 16 plants/m². Cuttings of peppermint were provided by the Research Department of Medicinal Plants, Jilad Daneshgahi Center, Tehran province. After isolating essential oil from dried leaves through the hydrodistillation method, composition of essential oil were identified by gas chromatography (GC) and GC/Mass spectrometry analysis. As many as 37 compositions were identified in essential oil. Piperitine oxide, ß-Terpinen, Menthol, trans-Carveol, isomenthone and ß-Caryophyllene showed the highest amounts compared to the other essential oil compositions. According to the results, nitrogen treatment and plant density had a significant effect on essential oil percentage and its composition. Interaction of nitrogen and plant density had also a significant effect on essential oil percentage only. Final results showed that the highest amount of essential oil and its composition was obtained when 150 kg nitrogen/ha applied on 8 plants/m².

S07.292 Characterisation of Peach Cultivars by HPLC Analysis of Polyphenol Compounds

Simeone, A.; Nota, P.; Del Toro, A.; Ceccharelli, D.; Caboni, E.; Fideghelli, C.

CRA-FRUIT TREE RESEARCH INSTITUTE, VIA DI FORNACELLO, 12, 00146 ROMA, ITALY

Peach cultivars were compared for polyphenolic content in fruits by HPLC-DAD analysis. Skin and flesh of fruits of either white or yellow flesh cultivars, at the same ripening stage, were separately analysed. The chromatographic protocol allowed to separate all the main polyphenolic compounds. Neohesperidin, chlorogenic acid, procyanidin, catechin, epicatechin, quercetin and anthocyanins were identified by comparison with commercial standard and UV spectra. The total content and relative distribution were dependent upon cultivar. The highest content in flavan-3-ol, and in general in polyphenols, (0.211 and 0.331 mg/g fw, respectively) in flesh was found in the cv. Silvette, while the cv. Snow Queen was found to be the cultivar with the highest levels in the skin. Cv. Farlaine showed the highest content of hydroxycinnamic compounds both in flesh and skin (0.191 and 0.430 mg/g fw) and in Redop and Gilda Rossa fruits was found the highest concentration of anthocyanins in flesh (0.066 mg/g fw) and skin (0.485 mg/g fw). Concerning flavonols, the highest concentration in flesh was found in Snow Queen (0.016 mg/g fw), while Farlaine showed skin with the highest content (0.176 mg/g fw). No overall difference was found in the polyphenol content between yellow and white flesh peaches. In general, the skin was confirmed to have higher total polyphenol content than flesh in all cultivars, however, the abundance of neohesperidin acid was not significantly different between epicarp and mesocarp.
S07.293
Harvest Maturity Influences the Antioxidant Activity in Jalapeno Chilli


1. Centre for Postharvest and Reﬁergeration Research, Massey University, Private Bag 11 222, 4442, Palmerston North, New Zealand
2. University of Queensland, School of Food Science and Technology, Brisbane, Australia

Chillies are good sources of phytochemical compounds. The concentration of these compounds varies depending on the genotype, harvest maturity, location within the fruit, and the conditions during growth and postharvest handling. Jalapeno chillies were tagged at ﬂowering and harvested at different maturities to study the antioxidant capacity. Two assays, the ferric-reducing antioxidant power (FRAP) assay and scavenging of dihydroxy-picolinic (DPDP) radicals were used to assess the antioxidant activity while the Folin-Ciocalteau assay was used to measure total polyphenol content (TPC). Two extraction solvents were tested, water and 50% ethanol. The FRAP values signiﬁcantly increased (P<0.01) in water extracts as the fruit matured. In contrast, harvest maturity had no inﬂuence on TPC or free radical scavenging activity in either solvent. Both FRAP and TPC values were signiﬁcantly lower (P<0.01) in ethanol extracts than in water extracts. The results showed that the antioxidant activity as measured by the FRAP assay correlated positively with the TPC in both extracts indicating that the polyphenols are the major contributors to the antioxidant activity. Overall, maturity at harvest of ‘Jalapeno’ chilli is an important factor for health-beneﬁt properties with fully mature fruit (i.e. 6 weeks after ﬂowering) having the highest antioxidant activity measured by FRAP assay.

S07.294
Vitamin C and Anthocyanine Content in Fresh and Processed Berries

Gilingerné, P. M.; Varga, Z.; Dula, G.; Füstös Z.

1. Semmelweis University, Faculty of Health Sciences, Dept. Dietsetics and Nutritional Sci., Budapest, Hungary
2. Central Agricultural Office, Budapest, Hungary

The berries contain big quantity of pigments, which mainly are ﬂavonoids belong to the anthocyanin group with high antioxidant capacity. The high vitamin C content has signiﬁcant antioxidant activity too. Our target was to test the antioxidant capacity of fresh berries species and the popular products made from berries consumed in Hungary. We got the raw samples from CAO fruit variety-test station. The samples contained intact, healthy fruits on same ripening level. The tested fruits were elderberry, black currant, blackberry, blueberry, josta, gooseberry, raspberry, cranberry, redcurrant, white currant. After the measuring antioxidant components of fresh fruits different products were made in the departments’ practicing kitchen. We used classical home-made or small-scale methods for quality products keeping the nutrition value of fresh fruit. Our working team used traditional spectrophotometric methods to determine the antioxidant activity, vitamin C and pigment content of samples: C-vitamin: water solution, ferri-chloride, dipiridil reagent. Anthocyanine. We solved from the samples the pigment colour with sulfuric-acid-stain mix. After direct measurement of absorbance we counted the whole quantity of ﬂavonoids with the equivalence of the main anthocyanin component (cyanidin-3-glucoside). Antioxidant activity: classical DPPH method. The results gave us a numerical comparison of the different berries related with the nutrition value. Among the examined fruits contained the biggest antioxidant activity: elderberry, black currant and blackberry. The processed products were keeping the quality of fruit in different ratio. The data we got from the fruit products were very diverse since the fruit content and the method and time of heat treatment. It is important to consider the raw material maturity and quality as well. Highest value we measured in black currant jam processed with low sugar and short heating. To conclude, with the results we can recommend these fruits to the people who are interested in continue a healthy diet.

S07.295
Quality, Bioactive Compounds and Antioxidant Activity in Fruits of a Seedless Peach Palm Selection from Acre, Brazil

Dos Santos Matos, N. M.; Facanha, R. V.; de Souza, K. O.; Moura Rufino, M. D. S.; Alves, R. E.; de Brito, E. S.; Alvare, V. D. S.; Maciel, V. T.

1. Embrapa Tropical Agricultura Tropical, R. Rua. Sarg. Minerva, 2170, PORTO ALEGRE, Brazil
2. Food Technology Department

The peach palm (Bactris gasipaes) is native to the Amazon region, but is widely distributed in tropical forests throughout South and Central America. The fruit is yellow or orange, contains large amounts of carotenoids and is a popular local food mostly consumed in cooked form. The vast majority of peach palm trees, whether cultivated or natural, produce seedless fruits, but parthenocarpy is a relatively common phenomenon. The objective of the present study was to evaluate the quality, bioactive compounds and total antioxidant activity of a selection of seedless peach palm drupes from Acre, Brazil. The selected drupes were frozen to the Laboratory of Physiology and Post-Harvest Technology (Embrapa Agroindústria Tropical, Fortaleza, Ceará) for determination of total mass (TM), pulp mass (PM), peel mass (PM), pulp yield (PY), length (L), diameter (D), color, moisture, total lipids (TL), protein, pH, total acidity (TA), soluble solids (SS), SS:TA ratio, starch, reducing sugars (RS), vitamin C (VC), total carotenoids (TC), total anthocyanins (TAC), yellow ﬂavonoids (YF), 6-carotene, total extractable polyphenols (TEP), total antioxidant activity (TAA) by the 2,4-carotene/linoleic acid method, and minerals. The average weight of the fruits was 11.3 g and the pulp yield was high (75%). The most important ﬁndings include: TL=47%; protein=3.97%; starch=14.11%; SS:22.93%Brix; VC=16.5mg/100g; TA=3.1mg/100g; YF=24.78mg/100g; 6-carotene=0.35mg/100g; TAC=54.88mg/100g; TAA, expressed as percentage inhibition of oxidation (OI), was 79.81% and 64.64% for the concentrations 5.0g/L and 2.5g/L, respectively. Overall, the fruit of the peach palm presents a considerable market potential based on its quality proﬁle and bioactive compounds, especially with regard to antioxidant activity.

S07.296
Melatonin and an Isomer Are Present in Different Monovarietal Wines

Rodriguez-Naranjo, M. I.; Gil-Izquierdo, A.; Troncoso, A. M.; Cantos, E.; Garcia-Parrilla, M. C.

1. Departamento de Ciencia y Tecnología de Alimentos, Calidad, Seguridad y Bioactividad de Alimentos Vegetales, CREA-CIE, Anatomía de Corceles 15-4, Espinardo 30120, Murcia, Spain
2. Área de Tecnología, Postcosecha e Industria Agroalimentaria, Instituto de Investigación y Formación Agroindustria y Pesquera (IFAPA). Rancho de La Merced, Crta. Trebujena, Km 3.2, Jerez de la Frontera 11471, Cádiz, Spain
3. Instituto de Investigación y Formación Agroindustria y Pesquera (IFAPA). Rancho de La Merced, Crta. Trebujena, Km 3.2, Jerez de la Frontera 11471, Cádiz, Spain

Melatonin (N-acetyl-3-(2-aminoethyl)-5-methoxyindole) is an indoleamine synthesized in the pineal gland metabolism via serotonin. It is considered a neuro-hormone, and a chronobiotic and antioxidant compound. Due to its presence in vegetable tissue, MEI has been evaluated as a food component thanks to the cited biological activity. In order to determine its contribution as a bioactive compound, it is necessary to set up and design suitable methods for its qualitative and quantitative analysis. This paper aimed to detect accurately melatonin in wine for the first time by LC-ESI-MS/MS and multiple reactions monitoring mode (MRM). Melatonin was detected in wines by comparison of its retention time and MS, MS2 and MS3 spectra with its commercial authentic marker. In addition to melatonin, LC-ESI-MS/MS, analyses revealed the occurrence of a compound with an identical fragment pattern (positive mode ESI). The major mass fragmentation ions of the other [M+H]⁺ (233) at m/z 216, 174.1 and 159.1 was tentatively identiﬁed as a melatonin isomer (not previously described in wines). It appeared in certain monovarietal wines (Jaen Tinto, Merlot and Palomino Negro) whilst melatonin was the only compound in others (Petit Verdot and Syrah) and a third group of wines showed both of them (Cabernet Sauvignon, Prieto Picudo and Tempranillo).
**S07.297**

Melatonin Is Synthesized during Vinification Process

Rodriguez-Naranjo, M. I.; García-Parrilla, M. C.; Troncoso, A. M.; Cantos, E.; Gil-Izquierdo, A.

1 Área de Nutrición y Bromatología, Facultad de Farmacia, C/ Profesor García González nº 2, Sevilla 41012, Spain
2 Área de Tecnología, Postcosecha e Industria Agroalimentaria, Instituto de Investigación y Formación Agraria y Pesquera (IFAPA), Rancho de la Merced, Crta. Trebujena, Km 3.2, Jerez de la Frontera 11.471, Cádiz, Spain
3 Departamento de Ciencia y Tecnología de Alimentos, Calidad, Seguridad y Bioactividad de Alimentos Vegetales, CEBAS-CSIC, Apartado de Correos 164, Espinardo 30100, Murcia, Spain

Grapes and wines are a great source of biologically active compounds but little is known about others such as indoleamines. Melatonin (N-acetyl-3-(2-aminoethyl)-5-methoxyindole), an indoleamine produced by pineal gland, is present in different plant materials. This work aimed to detect the presence of melatonin in grape (skin, seeds and pulp), and during wine production. Five red and a white grape varieties were studied. No melatonin was detected in any part of the grape (peel, pulp and seeds) using different extraction solvents (methanol: water (1:1), chloroform and ethyl acetate) and by multiple reaction monitoring mode (MRM) by LC-ESI-MS/MS. However, melatonin occurred during the vinification process as was confirmed by LC-ESI-MS/MS analyses. The winemaking steps of this study were: destem-crush vatt, press and racking for red wines and destem-crush, dejuice and racking for the white wine. Mel appears in press for red wines and in the juice used for the white wine just when yeast was added. Further studies are needed to explain the role of yeasts in the melatonin synthesis and to know the best parameters for the production of this compound.

**S07.298**

Extraction of Nutraceutical Active Compounds from Broccoli By-Products

Leonhart, S.; Kamel, A. M.; Desjardins, Y.; Angers, P.; Gosselin, A.

Centre de Recherche en Horticulture, Université Laval, Québec, Canada, GY 0A3

Glucosinolates and sulforaphane were extracted from blanching broccoli by-products (Brassica oleracea var. italica) using different ratio between ethanol and water (95% ethanol, 70% ethanol, 50% ethanol, 30% ethanol and 100% water and by double extraction system). The effect of time and temperature of extraction was also studied on the concentration of glucosinolates and sulforaphane. All glucosinolates (Glucoraphanin, sinigrin, glucobrassicin, progoitrin and 4-OH glucobrassicin and sulforaphane contents were determined by HPLC and HPLC-MS/MS analyses. The obtained data showed that degradation of glucoraphanin to sulforaphane is correlated with the temperature and time of extraction. Less than one hour of extraction is sufficient to extract all amounts of glucosinolate compounds. Sulforaphane was mainly extracted by 70% ethanol in the short time (0.5hr) or by 95% ethanol in the long time. On the other hand, over 40 °C, all sulforaphane compound is degraded.