

# INTERNATIONAL FLAVOR CONFERENCE XIII

## 5th GEORGE CHARALAMBOUS MEMORIAL SYMPOSIUM

**AKS Hinitsa Bay Hotel**  
**Porto Heli, Greece**  
29 May – 1 June 2012

Hosted by the Agricultural & Food Chemistry Division  
of the American Chemical Society



### Contents

|                       |    |
|-----------------------|----|
| Program               | 2  |
| Abstracts             | 7  |
| Poster/Presenter List | 28 |

Grateful acknowledgement is made of generous contributions towards the Conference's expenses by International Flavors & Fragrances, American Chemical Society, Pepsi Corporation, and Eastern Michigan University.

Website: [www.emich.edu/csie/flower](http://www.emich.edu/csie/flower)

## CONFERENCE PROGRAM

**TUESDAY - MAY 29, 2012**

**1400 - 1800**  
**1830 - 2030**

**REGISTRATION; POSTER SETUP**  
**POSTER SESSION; COCKTAIL HOUR**

- P-01 The application of thermal desorption-GC (MS) and associated specialist sampling techniques for the identification of flavor compounds in food and beverages. **Gareth Roberts**, Nicola Watson and Dan Cooper
- P-02 Effect of high pressure processing on the flavor profile of carrot purees. **R. M. Delgado**, F. Manzoni and J. S. Elmore
- P-03 Effect of high pressure processing on the composition of carrot purees. **F. Manzoni**, R. M. Delgado and J. S. Elmore
- P-04 Effect of enzyme treatment on volatile profile of white and red wines from Macedonia by using HS-SPME-GC/MS. **Sanja Kostadinović-Veličkowska**, Sebastian Tolle, Saša Mitrev, Recep Goek and Peter Winterhalter
- P-05 Biotransformation of proanthocyanidin A2 to small phenolic compounds by rat intestinal microbiota. Wen-Chien Lu and **Lucy Sun Hwang**
- P-06 Peracetylated (-)-epigallocatechin-3-gallate (AcEGCG) potently suppresses dextran sulfate sodium-induced colitis and colon tumorigenesis in mice. **Yi-Shiou Chiou**, Nianhan Jia-Lin Ma, Shengmin Sang, Chi-Tang Ho, Ying-Jan Wang and Min-Hsiung Pan
- P-07 Investigation on the non-volatile components as contributors of the beef flavor in glutathione Maillard reaction products using non-targeted approach. **Sang Mi Lee**, Nahyun Kim, Dongho Lee, Kwang-Ok Ki and Young-Suk Kim
- P-08 What can be found from oligopeptide-specific Maillard reaction liquid phase by LC-TOF/MS? Chao Yang, Ran Wang and **Huanlu Song\***
- P-09 Expression of vitreoscilla hemoglobin in aurantiochytrium enhances the productivity of astaxanthin and fatty acids. **Y. L. Suen**, M. Wan, J. C. Huang and S. F. Chen
- P-10 Volatile compounds of probiotic feta-type cheese produced by free or immobilized lactobacillus Casei ATCC 393 on whey protein as starter cultures. D. Dimitrellou, P. Kandyliis and **Y. Kourkoutas**
- P-11 *Nigella sativa L.* (black cumin): a review of heavenly plant. **Hoda Akhondan**, Mohammad Reza Ehsani and Mehdi Mirza
- P-12 Influence of oxidized fat on volatiles generated from sugar-degradation. Z. Yang, L. X. Jin, **J.-C. Xie** and B-G. Sun
- P-13 Validation and application of QuEChERS to flavor and fragrance R&R. N. Harmuth, F. Fang and G. Reiner
- P-14 Profile of aroma-related volatile compounds isolated by probiotic dry-fermented sausages produced with free or immobilized *L. Casei* using SPME GC/MS analysis. Marianthi Sidira, Maria Kanellaki and **Yiannis Kourkoutas**
- P-15 Study of flavor volatile profile in microencapsulated Greek saffron products. **Charikleia Chranioti**, Stephanos Papoutsakis and Constantina Tzia

- P-16 Quality improvement of a white and a red wine with less sulphur dioxide by the addition of a mixture of glutathione, caffeic acid and gallic acid. **I. G. Roussis, J. M. Oliveira, M. Patrianakou, A. L. Cerdeira and A. Drossiadis**
- P-17 Identification of volatile flavor constituents of the peel (flavedo) from five Greek citrus varieties cultivated in the area of Arta. **P. G. Demertzis, A. I. Passa and K. Akrida-Demertzi**
- P-18 Volatile flavor constituents of chamomile from eight different areas of Greece. **P. C. Gournas, P. G. Demertzis and K. Akrida-Demertzi**
- P-19 Studying the aroma profile of Lebanese Syrah red wine using gas chromatography coupled to mass spectrometer and olfactometer. **N. Estephan, S. Azzi, N. Ouaini and D. Rutledge**
- P-20 The influence of *Filipendula* and *Agrimonia* plant extracts on amino acid catabolism to aroma compounds by resting cells of *Lb. helveticus*. **Milda Pukalskene**
- P-21 Characterization of aroma of coriander (*Coriandrum sativum* L.) leaves in terms of limited odor unit method. **Hirotooshi Tamura, Yoshida Eri and Madoka Kori**
- P-22 Isolation of aroma compounds from blackcurrant buds by supercritical carbon dioxide. **P. R. Venskutonis, I. Mackéla and A. Šipailienė**
- P-23 Composition of essential oil and radical scavenging of extracts from *Tanacetum vulgare* L. cultivated in Lithuania. **Petras Rimantas Venskutonis, R. Baranauskienė, R. Kazernavičiūtė and R. Maždzierienė,**
- P-24 Monitoring of volatile components and oxidation indices changes of virgin olive oils during storage in the dark and in the light. **Kotsiou Kali and Maria Tasioula-Margari**
- P-25 Effect of addition of cryoprotectants on frozen/thawed mashed potatoes flavor by sensory evaluation. **Nantia Bikaki and Constantina Tzia**
- P-26 Oil and phytochemicals from small fruit seeds. **Fereidoon Shahidi and Nishani Perera.**
- P-27 Yogurt flavor and sensory characteristics derived from milk treated by high intensity ultrasound. **Panagiotis Sfakianakis and Constantina Tzia**
- P-28 Effect of *Laurus Nobilis* (Bay Leaf) essential oil on the formulation, oxidative stability and sensory characteristics of o/w/o olive oil microemulsions. **Vasiliki Polychniatou and Constantina Tzia**
- P-29 Hydroxylated form of 5,6,7,8,4-pentamethoxyflavone, exhibited higher anti-tumor-promoting activity in DMBA/TPA-induced mouse skin carcinogenesis. **Chieh-Han Chung, Shiming Li, Chi-Tang Ho and Min-Hsiung Pan**

---

## WEDNESDAY - MAY 30, 2012

0800  
0850

### REGISTRATION WELCOMING REMARKS

### TECHNICAL SESSION I

**Moderators: Young-Suk Kim and Chi-Tang Ho**

- 0900 O-I-01 Non-targeted approach for determination of key volatile and non-volatile components related to beef flavor in glutathione Maillard reaction products. **Young-Suk Kim** and Sang Mi Lee
- 0925 O-I-02 Formation mechanism of meat flavors from peptide-Maillard reaction. **Huanlu Song, Ran Wang and Chao Yang**
- 0950 O-I-03 Decoding the key aroma compounds of bartlett pear brandies by application of the molecular sensory science concept. **B. Willner, M. Granvogl and P. Schieberle**

- 1015** O-I-04 Identification of characteristic aroma-active compounds from roasted lavers. **Hyung Hee Baek** and Jin Yeong Choe
- 1040** **BREAK**
- 1110** O-I-06 White button mushroom aroma: new insights into enzymatic odorant formation. S. Großhauser, **M. Steinhaus** and P. Schieberle
- 1135** O-I-07 Differentiation of sesame oil and perilla oil by profile changes of volatiles using SPME-GC/MS and electronic nose techniques. M. J. Kim, B. S. Noh and **J. H. Lee**
- 1200** O-I-08 Aroma compounds in white asparagus: differences induced by cooking. **Veronika Mall**, Julia Scherb and Peter Schieberle
- 1230** **LUNCH**
- 1400** **TECHNICAL SESSION II**  
**Moderators: Mingfu Wang and Fereidoon Shahidi**
- 1400** O-II-01 Impact of phloretin and phloridzin on the formation of Maillard reaction products in model systems. **M. F. Wang** and J. Y. Ma
- 1425** O-II-02 Bioactive peptides and human health. **Fereidoon Shahidi** and Quanqun Li
- 1450** O-II-03 Evaluation of melamine analysis using GCMS versus LCMSMS. **J. Broekmans** and H. Leijts
- 1515** O-II-04 Resolution of racemic  $\gamma$  ( $\delta$ )-lactones by packed column supercritical fluid chromatography. **J. C. Xie**, J. Cheng, H-L. Han, L. Sun and B-G. Sun
- 1540** **BREAK**
- 1610** O-II-05 Impact of selected dietary polyphenols on caramelization in model systems. **X.C. Zhang**, S.F. Chen and M.F. Wang
- 1635** O-II-06 *In vivo* hypolipidemic mechanisms of flavor compounds from herbal essential oils. **Sung-Joon Lee**, Hee-jin Jun, Ji Hae Lee, Yaoyao Jia and Minh-Hien Hoang
- 1700** O-II-07 Flavor chemistry of methylglyoxal. **Chi-Tang Ho**

**EVENING FREE (TAVERNA NIGHT)**

---

**THURSDAY - MAY 31, 2012**

**TECHINCAL SESSION III**

**Moderators: Min-Hsiung Pan and Chi-Tang Ho**

- 0900** O-III-01 Overexpression of lysyl oxidase involved in human breast cancer cell metastasis is attenuated by magnolol through the down-regulation of focal adhesion kinase and the paxillin signaling pathway. Chih-Hsiung Wu, Wen-Sen Lee and **Yuan-Soon Ho**
- 0925** O-III-02 Molecular targets of 6-shogaol: Its potential roles in cancer chemoprevention. **Min-Hsiung Pan**, Min-Chi Hsieh and Chi-Tang Ho

- 0950** O-III-03 Inhibitory effect on *Helicobacter pylori*-induced inflammation in human gastric epithelial AGS cells of *Ixeris chinensis* extracts. **Chin-Kun Wang**
- 1015** O-III-04 2,4,5-Trimethoxybenzaldehyde suppresses adipogenesis through downregulation of MARKs, C/EBPs, PPAR $\gamma$ , and acetyl-COA carboxylase. **Chiafeng Kuo**, Man-Ru Wu and Ya-Lin Lin
- 1040** **BREAK**
- 1110** O-III-05 A study for antistress and arousal effects of blending essential oils in humans and rats. **Hong Keun Oh**
- 1135** O-III-06 Viscous emulsions enhanced bioefficacy of poorly-soluble polymethoxyflavones (PMF) in colitis-related mouse colon carcinogenesis induced by AOM/DSS. **Yuwen Ting**, Shiming Li, Min-Hsiung Pan, Chi-Tang Ho, Qingrong Huang
- 1200** O-III-07 Total phenolics, antioxidant and antibacterial activity of commercial pomegranate based juices from Greece. E. Ch. Zorgafou, A. Kallimanis, K. Akrida-Demertzi and **P. G. Demertzis**
- 1230** **LUNCH**
- AFTERNON FREE (OPTIONAL TOUR)**
- GREEK NIGHT BANQUET**

---

**FRIDAY – JUNE 1, 2012**

**TECHNICAL SESSION IV**

**Moderators: Chin-Kun Wang and Fereidoon Shahidi**

- 0900** O-IV-01 Suppression of the deformation of RAJI cells by (*E*)-2-alkenals, aroma components of coriander (*Coriandrum sativum* L.) leaves, and behavior and absorption of (*E*)-2-dodecenal in rat blood. Shunsuke Kano, Kazunori Maeyama, Yueming Wang, Akira Kondo, Toshio Furumoto, Hiroshi Fukui and **Hirotoishi Tamura**
- 0925** O-IV-02 Omega-3 oils and their beneficial health effects. **Fereidoon Shahidi**
- 0950** O-IV-03 Inhibitory effect of some fruit flavors on acetylcholinesterase activity and some pro-oxidant induced lipid peroxidation in rats' brain. G. Oboh, A. J. Akinyemi and **A. O. Ademiluyi**
- 1015** O-IV-04 Antihypertensive actions of fermented buckwheat sprout in normotensive Sprague-Dawley rats. **K. Nakamura**, Y. Yuzawa and Y. Koyama
- 1040** **BREAK**
- 1110** O-IV-05 Tea-drinking as a good strategy to prevent smoking and hormone-induced human breast cancer cells proliferation through inhibition of  $\alpha 9$ -nicotinic acetylcholine receptor. **Yuan-Soon Ho**
- 1135** O-IV-06 Tetrahydrocurcumin (THC) potently suppresses azoxymethane-induced colon carcinogenesis in mice. **Min-Hsiung Pan**, Jia-Ching Wu, Ching-Shu Lai, Vladimir Badmaev, Kalyanam Nagabhushanam and Chi-Tang Ho
- 1200** O-IV-07 Improvement of tea polyphenol milk on liver and skin. **Chin-Kun Wang**
- 1230** **LUNCH**

## TECHNICAL SESSION V Moderators: Cynthia Mussinan and Ellene Tratras

- 1400** O-V-01 Sustainability in the food industry. **Sara J. Risch**
- 1425** O-V-02 Decrease of wine aroma esters by Fe II and Fe-H<sub>2</sub>O<sub>2</sub>. **M. Patrianakou** and I. G. Roussis
- 1450** O-V-03 Identification of odor active compounds of *Viburnum opulus* and *Aronia melanocarpa* fruits by gas chromatography and olfactometry. V. Kraujalytė, **P. R. Venskutonis** and E. Leitner
- 1515** O-V-04 Inhibitory activities of vitamins on 7-ketocholesterol formation in both chemical model systems and beef patties. **Daniel Wong**, Kawing Cheng and Mingfu Wang
- 1540** **BREAK**
- 1610** O-V-05 Analysis of the aroma profile of food products using a micro chamber thermal extraction system and thermal desorption (TD) GC-TOF (MS) detection. **Gareth M. Roberts**, Paul Morris, Daniel Cooper and Stephen Smith
- 1635** O-V-06 Evaluation of processing conditions in savory flavor development. **S. Ramakrishnan**, B. Oladipupo, R. Kolli, M. Teasdale, N. Guthrie, J. Benning, P. Moeller and R. Telman
- 1700** O-V-07 Enzymatic modification of wheat proteins for flavor generation. **Marissa Villafuerte Romero** and Chi-Tang Ho
- 1720** **CLOSING REMARKS**
- 2000** **FAREWELL BANQUET**

## ABSTRACTS

### Poster Presentations

**(P-1) THE APPLICATION OF THERMAL DESORPTION-GC (MS) AND ASSOCIATED SPECIALIST SAMPLING TECHNIQUES FOR THE IDENTIFICATION OF FLAVOR COMPOUNDS IN FOOD AND BEVERAGES.** *Gareth Roberts, Nicola Watson and Dan Cooper, Markes International Ltd., Gwaun Elai Medi Science Campus, Llantrisant, RCT, CF72 8XL, UK, garethroberts@markes.com*

The analytical technique of thermal desorption (TD) is widely used within the food and beverage industry for the identification of both flavor and odor compounds. The inherent pre-concentration of both volatile and semi volatile (VOC/SVOC) chemicals derived from a sample allows trace level detection of ultra low threshold flavor/fragrance compounds. Specialist sampling techniques used in combination with TD extend both the range of samples to be analyzed and enhance levels of detection. This facilitates detailed chemical analysis of VOC/SVOC compounds from a variety of samples. This presentation discusses the TD based analytical techniques and accessories supplied by Markes International used in combination with GCMS for flavor/aroma analysis, these include: Sorptive Extraction (SPE-tD) - Used to identifying flavor compounds in liquid/homogenate based samples. The analysis uses a small (3cm (L) x 2mm (od)) hollow Titanium bar coated internally/ externally with polydimethylsiloxane (PDMS) which is mixed with a sample for a defined period of time and temperature. After sorptive extraction of analytes into the PDMS phase, the bar is placed inside a conventional TD tube and desorbed into a GC/GCMS system for VOC/SVOC analysis. Examples will be shown for flavor analysis of beer, wine and fruit juices. Direct Desorption - For small volumes (mg, µl) of solid, liquid or gel based samples, desorption of material directly from a TD tube into the GC/GCMS provides a simple but comprehensive screening technique for a broad range of VOC/SVOC components. Examples will include the flavor constituents of Betel nuts used extensively as a snack in Asia and a variety of spices looking at different brands. Headspace-TD - This technique interfaces a headspace analyzer directly to the cold focusing trap of the UNITY TD system. Multiple extractions from the same vial into the cold trap allow ultra trace level detection. Examples showing ppt levels of detection are demonstrated.

**(P-2) EFFECT OF HIGH PRESSURE PROCESSING ON THE FLAVOUR PROFILE OF CARROT PUREES.** *R. M. Delgado, F. Manzoni and J. S. Elmore, University of Reading, Reading, United Kingdom, r.m.delgadosanchez@reading.ac.uk*

In recent years, the application of high-pressure processing (HPP) has been studied, in order to preserve fruit- and vegetable-based foods, with minimal modifications in nutritional and sensory quality. High-hydrostatic-pressure processing uses water as a medium to transmit pressures to foods, extending shelf life. Due to non-thermal stress, it is generally assumed that flavors are not affected by HPP. However, HPP can enhance and retard enzymatic and chemical reactions, and it could indirectly alter the composition of the final product. Nowadays, the use of oils in foods to improve the bioavailability of nutrients due to the character lipophilic of some nutrients has been reported. However, the flavor profile could be also affected by the presence of these oils. For this reason, we will analyze the effect of HPP on carrot purees with or without different vegetable oils (sunflower and olive oils). The effect of HPP on the flavor profile of carrot purees and the differences in flavor caused by supplementation with oils will be studied. The flavor profile of carrots is mainly due to terpenes and sesquiterpenes. The change in flavor content by the presence of oils and the HPP will be determined by SPME (solid-phase microextraction)-GCMS and related with the sugar and amino acid composition of the final product.

**(P-3) EFFECT OF HIGH PRESSURE PROCESSING ON THE COMPOSITION OF CARROT PUREES.** *F. Manzoni, R. M. Delgado and J. S. Elmore, University of Reading, Reading, United Kingdom, f.manzonidesequeira@reading.ac.uk*

In recent years, the application of high-pressure processing (HPP) has been studied, in order to preserve fruit- and vegetable-based foods. High-hydrostatic-pressure processing uses water as a medium to transmit pressures to foods, extending shelf life, with minimal modifications in nutritional and sensory quality. Carrots are a particularly good source of carotenoids and phenols, which have protective effects against cardiovascular disease, diabetes and stroke. Although the effect of HPP in the bioavailability of carotenoids in carrot emulsions has been reported, the influence in the carotenoid content in these emulsions by HPP has not been studied before. For this reason, we will analyze the effect of HPP on carrot emulsion with different vegetable oils (sunflower and olive oils). Concentrations of different nutrients (phenols and carotenoids) as well as antioxidant activity and color will be determined in the samples. Carotenoids are important aroma compound precursors and the effects of changes in carotenoid composition on flavor formation will be discussed.

**(P-4) EFFECT OF ENZYME TREATMENT ON VOLATILE PROFILE OF WHITE AND RED WINES FROM MACEDONIA BY USING HS-SPME-GC/MS.** Sanja *Kostadinović-Veličkova*<sup>1,2</sup>, Sebastian Tolle<sup>1</sup>, Saša Mitrev<sup>2</sup>, Recep Goek<sup>1</sup> and Peter Winterhalter<sup>1</sup>, <sup>1</sup>*Institute of Food Chemistry, Technische Universität Braunschweig, Germany,* <sup>2</sup>*Department for Plant and Environmental Protection, Faculty of Agriculture, “Goce Delčev” University, 1000 Štip, Macedonia*

The flavor of wines is due to a complex mixture of many volatile compounds. In this study the volatile profiles of fifteen samples of the most famous Macedonian white and red wines were examined. For isolation of glycosidically-bond volatile compounds, a solid phase extraction was performed by using XAD-2 resin. A head space solid-phase microextraction (HS-SPME) procedure was applied for extraction of free volatile compounds in white and red wines from Macedonia followed by separation and identification with GC-MS. Separation of the compounds was performed on a Carbowax column after the injection of the CRB-DVB-PDMS fiber in splitless mode. The liberation of the glycosidically-bond volatiles was performed by application of enzymes “Endozyme Aromatic” and “AR 2000”. The study confirmed that during production of wines from “Muscat de Frontignan” variety was necessary to include enzymatic treatment in order to release the bound volatiles and to increase the level of the terpenes such as limonene, *p*-cymene, linalool, geraniol, nerol, and citronellol. Liberated geraniol and nerol in concentrations of 1526.4 µg/L and 1688.2 µg/L indicated that enzymatic treatment is necessary for improving the volatile profile of Muscat wines. The highest impact of enzyme “AR 2000” was detected on the level of alcohols, esters and fatty acids in wines produced from “Riesling”, “Chardonnay”, “Merlot”, “Vranec” and “Cabernet Sauvignon” grape variety.

Principal component analysis of chemical data indicated the effect of enzyme treatment as more significant in comparison to the variety of grapes. Type of enzyme was not significant since the wines treated with “Endozym Aromatic” and “AR 2000” were classified in the same group of treated wines.

**(P-5) BIOTRANSFORMATION OF PROANTHOCYANIDIN A2 TO SMALL PHENOLIC COMPOUNDS BY RAT INTESTINAL MICROBIOTA.** Wen-Chien Lu and Lucy Sun Hwang, Graduate Institute of Food Science and Technology, National Taiwan University, Taipei, Taiwan, lshwang@ntu.edu.tw

*Dimocarpus longan* Lour., known as longan (dragon eye) in the Orient, belongs to the Sapindaceae family. Longan is a subtropical fruit widely grown in Taiwan, China and Southeast Asia. Previous studies in our laboratory indicated that the major antioxidative compounds against LDL oxidation in longan flower were (-)-epicatechin and proanthocyanidin A2 (PA2). Proanthocyanidins (PAs) are polyphenolic compounds present in human diet and may have health beneficial activity. However, PAs are believed to be poorly absorbed. Intestinal microbiota might play an important role in their digestion and absorption. The current knowledge of the metabolites of PAs by intestinal microbiota is quite limited. The objective of this study was to investigate the metabolites of PA2 by rats' cecum microbiota. Urine samples were collected after injection of PA2 (100 mg/kg BW) directly into cecum. The metabolites were extracted from urine with ethyl acetate and analyzed by LC/MS<sup>n</sup> and Thermo Exactive LC/MS. The major metabolites were found to be 3-(3'-hydroxyphenyl)propionic acid (3-HPP). Other metabolites were 3,4-dihydroxyphenylpropionic acid (3,4-diHPA) and 3 or 4-hydroxyphenyl- acetic acid (3 or 4-HPA). Our results showed that intestinal microbiota could convert PA2 to a number of smaller phenolic compounds. The health potential of these metabolites should be further studied in order to understand the effect of PA2, since the PA2 concentrations in plasma and other tissues are very low.

**(P-6) PERACETYLATED (-)-EPIGALLOCATECHIN-3-GALLATE (AcEGCG) POTENTLY SUPPRESSES DEXTRAN SULFATE SODIUM-INDUCED COLITIS AND COLON TUMORIGENESIS IN MICE.** Yi-Shiou Chiou,<sup>1,5</sup> Nianhan Jia-Lin Ma,<sup>2</sup> Shengmin Sang,<sup>3</sup> Chi-Tang Ho,<sup>4</sup> Ying-Jan Wang,<sup>\*5</sup> and Min-Hsiung Pan<sup>\*1</sup>, <sup>1</sup>*Department of Seafood Science, National Kaohsiung Marine University, Taiwan,* <sup>2</sup>*Institute of Systems Biology and Bioinformatics, National Central University, Taiwan,* <sup>3</sup>*Center for Excellence in Post-Harvest Technologies, North Carolina Agricultural and Technical State University, United States,* <sup>4</sup>*Department of Food Science, Rutgers University, United States,* <sup>5</sup>*Department of Environmental and Occupational Health, National Cheng Kung University Medical College, Taiwan,* *chiouyishiou@gmail.com*

Previous studies reported that peracetylated (-)-epigallocatechin-3-gallate (AcEGCG) has antiproliferative and anti-inflammatory activities. Here, we evaluated the chemopreventive effects and underlying molecular mechanisms of dietary administration of AcEGCG and EGCG in dextran sulfate sodium (DSS)-induced colitis in mice. The mice were fed a diet supplemented with either AcEGCG or EGCG prior to DSS induction. Our results indicated that AcEGCG administration was more effective than EGCG in preventing the shortening of colon length and the formation of aberrant crypt foci (ACF) and lymphoid nodules (LN) in mouse colon stimulated by DSS. Our study observes that AcEGCG treatment inhibited histone 3 lysine 9 (H3K9) acetylation but did not affect histone acetyltransferase (HAT) activity and acetyl- CREB-binding protein (CBP)/p300 levels. In addition, pretreatment with AcEGCG decreased the proinflammatory mediator levels by down-regulating of PI3K/Akt/NFκB phosphorylation and p65 acetylation. We also found that treatment with AcEGCG increased heme oxygenase-1 (HO-1) expression via activation of extracellular signal-regulated protein kinase (ERK)1/2 signaling and acetylation of NF-E2-related factor 2 (Nrf2), thereby abating DSS-induced colitis. Moreover, dietary feeding with AcEGCG markedly reduced colitis-driven colon cancer in mice. Taken together, these results demonstrated for the first time the *in vivo* chemopreventive efficacy and molecular mechanisms of dietary AcEGCG against



inflammatory bowel disease (IBD) and potentially colon cancer associated with colitis. These findings provide insight into the biological actions of AcEGCG and might establish a molecular basis for the development of new cancer chemopreventive agents.

**(P-7) INVESTIGATION ON THE NON-VOLATILE COMPONENTS AS CONTRIBUTORS OF THE BEEF FLAVOR IN GLUTATHIONE MAILLARD REACTION PRODUCTS USING NON-TARGETED APPROACH.** Sang Mi Lee<sup>1</sup>, Nahyun Kim<sup>2</sup>, Dongho Lee<sup>2</sup>, Kwang-Ok Kim<sup>1</sup> and Young-Suk Kim<sup>\*1</sup>, <sup>1</sup>Department of Food Science and Engineering, Ewha Womans University, Seoul 120-750, Korea, <sup>2</sup>School of Life Sciences and Biotechnology, Korea University, Seoul 136-713, Korea, arnica78@hanmail.net

The non-targeted analysis, combining ultra performance liquid chromatography-quadrupole- time-of-flight mass spectrometry (UPLC-Q-TOF/MS) and sensory analysis, was applied to investigate non-volatile components related to sensory attributes in glutathione-Maillard reaction products (GSH-MRPs). We performed a UPLC-Q-TOF/MS method using both C18 (octadecyl) and HILIC (hydrophilic interaction chromatography) columns. The partial least square-discriminant analysis (PLS-DA) was employed to observe the differences among the samples. Also, the specific non-volatile components that were significantly associated with beef flavor attribute were selected based on partial least square (PLS) regression (correlation coefficients of > 0.8). Some specific non-volatile components were determined as major contributing components related to beef flavor.

**(P-8) WHAT CAN BE FOUND FROM OLIGOPEPTIDE-SPECIFIC MAILLARD REACTION LIQUID PHASE BY LC-TOF/MS?** Chao Yang, Ran Wang and Huanlu Song<sup>\*</sup>, Beijing Key Laboratory of Flavour Chemistry, Beijing Technology and Business University, China, songhuanlu@yahoo.com.cn

As is known to all, the chemistry of the Maillard reaction is considered extremely complex in the field. Even more insolvable, the analysis of Maillard reaction liquidus products is the most formidable part, because it lacks suitable database of Maillard-targeted compounds. Many relevant experiments have been built on the step-by-step intermediate products by model system. However, a macroscopical universal exploration is extremely urgent. This study is a review of liquidus products exploration upon peptide level by LC-TOF/MS and statistic software and method, eg. linear discrimination analysis (LDA) etc.. After analyzing, an embryonic analyzing method containing compounds identification, end products grouping and formation pathway prediction performing on peptide-specific Maillard reaction liquidus products has been built. Further, the aim of this paper is, while simplifying the analysis process, to build up an applicable method of on-going hardware- and software- based automatic analysis to refer to Maillard reaction.

**(P-9) EXPRESSION OF VITREOSCILLA HEMOGLOBIN IN AURANTIOCHYTRIUM ENHANCES THE PRODUCTIVITY OF ASTAXANTHIN AND FATTY ACIDS.** Y. L. Suen<sup>1</sup>, M. Wang<sup>1</sup>, J. C. Huang<sup>2</sup> and S. F. Chen<sup>3</sup>, <sup>1</sup>The University of Hong Kong, Hong Kong, China, <sup>2</sup>Kunming Institute of Botany, Chinese Academy of Science, Yunnan, China, <sup>3</sup>Peking University, Beijing, China, h0524708@hku.hk

The marine heterotrophic *Stramenopiles thraustochytrids* have been widely studied for their potential in the food industry for the large scale production of the carotenoids and docosahexaenoic acid (DHA), which are known for their health benefits and highly valued in the market as food supplements. The production of these compounds depends on the availability of oxygen. However, under the industrial high-cell density cultivation of thraustochytrids in fermentors, the availability of dissolved oxygen in the culture medium is often low, due to the low solubility of oxygen, and a vigorous competition for dissolved oxygen by high densities of cells. Hence the objective of this study is to solve the problem of limited availability of oxygen during the large scale production of astaxanthin and DHA, through the heterologous expression of *Vitreoscilla* hemoglobin (VHb) gene in *Aurantiochytrium* sp. SK4, a genus of thraustochytrids which was isolated from Sai Keng, Hong Kong. VHb is hypothesized to bind oxygen and hence increase the availability of oxygen to the host cells. As a result, VHb-expressing *Aurantiochytrium* sp. SK4 enhanced about 40% higher total cellular fatty acid content when compared to the wild type, although there was no significant change in the proportion of DHA in the cells. There was also 9 times of increase in the cellular astaxanthin content compared to the wild type. It was suggested that the conversion of carotenoids precursor, for example,  $\beta$ -carotene, to astaxanthin has been promoted by the expression of VHb in *Aurantiochytrium* sp. It is concluded that the heterologous expression of VHb enhances the biosynthesis of astaxanthin and fatty acids in *Aurantiochytrium* sp., which implies a potential application in the food industry.

**(P-10) VOLATILE COMPOUNDS OF PROBIOTIC FETA-TYPE CHEESE PRODUCED BY FREE OR IMMOBILIZED LACTOBACILLUS CASEI ATCC 393 ON WHEY PROTEIN AS STARTER CULTURES.** D. Dimitrellou<sup>1</sup>, P. Kandyli<sup>2</sup> and Y. Kourkoutas<sup>1</sup>, <sup>1</sup>Applied Microbiology and Molecular Biotechnology Research Group, Department of Molecular Biology & Genetics, Democritus University of Thrace, Alexandroupolis, Greece, <sup>2</sup>Food Biotechnology Group, Department of Chemistry, University of Patras, Greece, ikourkou@mbg.duth.gr

Nowadays an upsurge of interest in developing novel foods containing probiotic microorganisms is observed. Such functional foods have a great potential in promoting human health. Maintenance of the intestinal microbial homeostasis, prevention of pathogenic infections, stabilization of the gastrointestinal (GI) barrier function and production of anti-cancer and anti-mutagenic compounds are included among the beneficial effects of probiotic-based foods, mainly yogurt and other dairy products. To deliver the health benefits, probiotics need to contain an adequate amount of live bacteria (at least 6 logcfu/g), able to survive the acidic conditions of the upper GI tract and proliferate in the intestine, a requirement that is not always fulfilled. Since it is well established that cell immobilization enhances the viability of starter cultures, the aim of the present study was to investigate the aroma-related compounds in probiotic Feta-type cheese produced by free or immobilized *L. casei* ATCC 393 on whey protein. Noticeably, microbiological and strain-specific multiplex PCR analysis confirmed that the levels of the adjunct strain in both products at the end of the ripening period were above the minimum concentration for conferring the probiotic effect. For evaluation of the volatile compounds, samples produced with *L. casei* ATCC 393 starter cultures were analyzed by the SPME-GC-MS technique and compared to cheese produced with no starter culture. The most important groups of compounds identified were esters, organic acids, alcohols, carbonyl compounds and lactones. Cheese samples produced with the probiotic culture presented an improved profile of aroma-related compounds. Principal component analysis of the results indicated that the volatile composition of the different cheese types was dependent on the nature of the starter culture. From a quantitative point of view, cheese produced by the immobilized *L. casei* ATCC 393 contained significantly higher concentrations of total volatiles followed by cheese with free cells and by cheese with no starter culture. The highest amount of esters, alcohols and carbonyl compounds was detected in cheese produced with free *L. casei* ATCC 393 cells, whereas the immobilized cells resulted in significantly higher concentration of organic acids. Both free and immobilized *L. casei* ATCC 393 lead to a significant increase of lactones. Finally, the preliminary sensory evaluation ascertained the soft and fine taste of the novel cheese samples produced with the probiotic cultures, as they were accepted by the panel.

**(P-11) NIGELLA SATIVA L. (BLACK CUMIN): A REVIEW OF HEAVENLY PLANT.** *Hoda Akhondan*<sup>1</sup>, *Mohammad Reza Ehsani*<sup>1</sup> and *Mehdi Mirza*<sup>2</sup>, <sup>1</sup>*Department of Food Science and Technology, Faculty of Agriculture and Natural Resources, Science and Research Branch, P.O. Box 14515/775, Islamic Azad University, Tehran, Iran,* <sup>3</sup>*Research Institute of Forests and Rangelands, Tehran, Iran,* *hoda.akhondan@gmail.com*

Medicinal and aromatic plants gained momentous consideration in the recent era for their effective chemical constituents. Black cumin (*Nigella Sativa* L.) is native to southwest Asia. Whole black cumin seeds give off little odor, but when ground they release a vaguely oregano-like scent. Seeds as well as black cumin have a long history of folklore usage in various systems of medicines. There are extensive studies on effectiveness of black cumin nutritional value and its biological activities. The diversity of applications to which black cumin can be put gives this oil seed great industrial importance. The present review mainly focuses on pharmacognosy, nutritional and nutraceutical properties of the plant.

**(P-12) INFLUENCE OF OXIDIZED FAT ON VOLATILES GENERATED FROM SUGAR-DEGRADATION.** *Z. Yang, L. X. Jin, J.-C. Xie and B-G. Sun, Beijing Key Laboratory of Food Flavor Chemistry, Beijing Technology & Business University, Beijing 100048, P.R. China, xjchun@th.btbu.edu.cn*

In the recent years, development of meat flavor via the thermal reaction of sugar, amino acid, and fat oxidized has been studied in our research group. In this study, to understand influences of fat oxidized on sugar-degradation volatiles, the model reaction of “glucose with oxidized chicken fat” compared to the blank “glucose only” was performed in a sealed tube at pH 5.5, and 140 °C for 2h, where the peroxide value (P.V.) of fat oxidized was approximate 300 meq.O<sub>2</sub>/kg.fat. The reaction products were analyzed by solid phase micro extraction (SPME), and gas chromatography-mass spectrometry (GC-MS) on HP-5 column using 1, 2-dichlorobenzene as the internal standard. The SPME fiber used was carboxen/PDMS 75µm, the absorption was carried out at 60°C for 40 min. Compounds identified from the blank were furfural (536.0 ng), 2-pentylfuran (27.8 ng), 1-(2-furanyl) ethanone (6.9 ng), and 2-methylfuran (6.1 ng). However, for “glucose with oxidized chicken fat”, the amount of volatiles from sugar degradation decreased markedly, that was furfural (274.4 ng), 2-pentylfuran (42.0 ng), and 2-methylfurfural (1.1 ng). Even 1-(2-furanyl) ethanone was not found. Conclusively, due to carbonyl volatiles and hydroperoxides present in oxidized fat, the generation of volatiles from sugar degradation was considerably inhibited, leading to organoleptic characteristics of the reaction product modified. This helped to optimize the technology of meat flavor prepared by Maillard reaction and oxidized fat appended. Acknowledgements: Supported by National Natural Science Foundation of China (31171755) Beijing Natural Science Foundation (21222013) and Beijing Municipal Education Commission Science and Technology Development Plan Key Project (KZ201010011011).

**(P-13) VALIDATION AND APPLICATION OF QuEChERS TO FLAVOR AND FRAGRANCE R&D.** *N. Harmuth, F. Fang and G. Reiner, International Flavors & Fragrances, R&D, 1515 Highway 36, Union Beach, NJ 07735*

This presentation will highlight the initial validation process and application of QuEChERS to suit R&D needs in the flavor and fragrance industry. It will discuss the general theory behind QuEChERS, how this theory can be applied to flavors and fragrances, and the overall benefits the technology provides to R&D. Many R&D inquiries require the quantification of flavor and fragrance components in a sample. This is generally done by the use of external standards and requires the use of harmful solvents such as methylene chloride and toluene. In addition, the liquid-liquid extraction generally takes over an hour. Through the use of QuEChERS,

we have been able to eliminate some of the more harmful solvents, decrease the loss of highly volatile compounds, and significantly reduce extraction times. Furthermore, many samples have complex matrices that require multi-step extractions with varying solvents. This has generated a need for variations in methods with detailed tables specifying the appropriate reagents to use. In a setting where sample matrices are constantly evolving and changing, this approach can only allow the chemist to go so far, leading to a constant need for method development. QuEChERS has provided a universal method that addresses diverse sample types. The QuEChERS method was modified to suit our needs, and parity was established to ensure accurate and reproducible results. Overall, employing QuEChERS has reduced resources and provided a faster method of analysis, allowing us to increase sample throughput and decrease turn-around-times... all great benefits in today's laboratory environment.

**(P-14) PROFILE OF AROMA-RELATED VOLATILE COMPOUNDS ISOLATED BY PROBIOTIC DRY-FERMENTED SAUSAGES PRODUCED WITH FREE OR IMMOBILIZED *L. CASEI* USING SPME GC/MS ANALYSIS.** *Marianthi Sidira*<sup>1,2</sup>, *Maria Kanellaki*<sup>1</sup> and *Yiannis Kourkoutas*<sup>2\*</sup>, <sup>1</sup>*Food Biotechnology Group, Section of Analytical Environmental and Applied Chemistry, Department of Chemistry, University of Patras, GR-26500 Patras, Greece,* <sup>2</sup>*Applied Microbiology and Molecular Biotechnology Research Group, Department of Molecular Biology & Genetics, Democritus University of Thrace, Alexandroupolis, 68100, Greece, ikourkou@mbg.duth.gr*

Dry fermented sausages are typical Mediterranean meat-products, the acceptability of which is strongly influenced by their quality. Probiotic lactic acid bacteria (LAB) play an important role in meat fermentation, as they induce flavor and texture changes, together with a preservative effect, resulting in an increase of the product's shelf life, while they may provide specific health benefits. To deliver the beneficial effects, probiotics need to contain an adequate amount of live bacteria (at least 10<sup>6</sup> cfu/g) at the time of consumption, able to survive the acidic conditions of the upper GI tract and proliferate in the intestine, a requirement that is not always fulfilled. Since it is well established that cell immobilization enhances the viability of cultures, the aim of the present study was to assess the volatile compounds in probiotic dry-fermented sausages produced with free or immobilized *L. casei* ATCC 393 on wheat. Of note, microbiological and molecular analysis confirmed that the levels of the adjunct strain in the new products after 66 days of ripening were above the minimum concentration for conferring the probiotic effect. SPME GC/MS analysis of volatiles suggested an improved profile of aroma-related compounds in sausages containing the immobilized cells. In total, 124 compounds were detected and the most important volatile by-products identified were esters, organic acids, alcohols, and carbonyl compounds. Principal Component Analysis of the semi-quantitative data revealed that the nature of the starter culture affected significantly the volatile composition. Finally, the overall high quality of the novel probiotic products was ascertained by the preliminary sensory test and an indication of increased shelf-life was evident, in contrast to sausages containing no starter culture. Our study demonstrated the application and efficacy of cell immobilization for the production of high quality novel probiotic products in meat industry.

**(P-15) STUDY OF FLAVOR VOLATILE PROFILE IN MICROENCAPSULATED GREEK SAFFRON PRODUCTS.** *Charikleia Chranioti, Stephanos Papoutsakis and Constantina Tzia\**, *National Technical University of Athens, Greece, cchranioti@chemeng.ntua.gr*

Saffron is the commercial name of the dried stigmas of *Crocus sativus* L. flowers. It is cultivated in many countries such as Greece, Spain, Iran, India, and Jordan. Since ancient times, saffron has been considered the most precious and expensive of spices due to laborious harvest and post-harvest processing. It is used both as a spice in foods and as a drug in traditional medicine. In Greek traditional medicine, a small quantity of saffron is thought to enhance brain activity whereas its biological activity as a natural preventing substance in anticancer research is in development. In food, saffron performs the functions of a spice, adding its faint, delicate aroma, pleasing flavor, and magnificent yellow color. It is typically used as a spice in a wide range of culinary, bakery and confectionery preparations as well as in alcoholic and non alcoholic beverages. Saffron's quality is determined by its color, taste, and aroma. Responsible substances for the above quality characteristic are crocins, picrocrocin, and safranal, respectively. Safranal, the main volatile component of the distilled essential oil of saffron, is a monoterpene aldehyde, responsible for its characteristic aroma. In order to protect the volatile components from the losses, chemical changes and undesirable interactions during storage and processing, microencapsulation techniques can be employed. Moreover, flavor microencapsulation can provide physical characteristics to the encapsulated product that will improve its technological and application properties. Since there is no information about the effect of microencapsulation on the volatile profile of saffron, an attempt has been made to investigate it. The main objective of this work was to determine the volatile components in Greek saffron microencapsulated products. In addition, sensory evaluation was performed, the resulted sensory characteristics of which were related with the overall saffron chemical volatile profile, obtained by analytical techniques (GC-MS).

**(P-16) QUALITY IMPROVEMENT OF A WHITE AND A RED WINE WITH LESS SULPHUR DIOXIDE BY THE ADDITION OF A MIXTURE OF GLUTATHIONE, CAFFEIC ACID AND GALLIC ACID.** *I. G. Roussis*<sup>1</sup>, *J. M. Oliveira*<sup>2</sup>, *M. Patrianakou*<sup>1</sup>, *A. L. Cerdeira*<sup>3</sup> and *A. Drossiadis*<sup>4</sup>, <sup>1</sup>*University of Ioannina, Greece,* <sup>2</sup>*Universidade do Minho, Braga, Portugal,* <sup>3</sup>*CVRVV, Porto, Portugal,* <sup>4</sup>*Oenoforos Winery, Egio, Greece, iroussis@uoi.gr*

The effect of a mixture of glutathione, caffeic acid and gallic acid, at 20, 60 and 20 mg/L respectively, on the quality of a white and a red wine with less than the typical SO<sub>2</sub> was studied. The mixture was added in Vinho Verde white wine containing 20 mg/L free SO<sub>2</sub>

at bottling. Wine quality was evaluated in comparison with wine with 20 mg/L and control wine with typical (35 mg/L) free SO<sub>2</sub>. By the storage time, wine in which the mixture was added appeared to be of better quality than that with 20 mg/L free SO<sub>2</sub>. It exhibited higher scores in sensory attributes and lower degree of oxidation as indicated by the chromatic characteristics L\*, b\* and C\*. Wine with typical SO<sub>2</sub> exhibited higher scores in sensory analysis than the others. The same mixture was also added into a Merlot-Cabernet Sauvignon blend red wine at bottling. Wine quality was evaluated during storage in comparison with wine with 25 mg/L and control wine with typical (35 mg/L) free SO<sub>2</sub>. By the storage time, wine in which the mixture was added appeared to be of better sensory quality than that with 25 mg/L free SO<sub>2</sub>. Moreover, it exhibited higher concentrations of some aroma esters compared to wine with less SO<sub>2</sub>, similar to those of wine with typical SO<sub>2</sub>, as determined by SPME/GC-MS analysis. Wine with typical SO<sub>2</sub> exhibited better aroma than the others.

**(P-17) IDENTIFICATION OF VOLATILE FLAVOR CONSTITUENTS OF THE PEEL (FLAVEDO) FROM FIVE GREEK CITRUS VARIETIES CULTIVATED IN THE AREA OF ARTA.** P. G. Demertzis\*, A. I. Passa and K. Akrida-Demertzi, University of Ioannina, Department of Chemistry, Laboratory of Food Chemistry, GR-45110, Ioannina, Greece, pdemertz@uoi.gr

Citrus is one of the world's most important fruit crops with a total world production of approximately 105 million metric tons. The citrus fruit consists of the following fundamental parts: the flavedo (external colored part of the peel), the albedo (white internal part of the peel), the pericarp which contains the above mentioned parts, and the pulp containing the juices and the seeds, called endocarp. The flavedo is composed mainly of cellulosic material and contains other components such as essential oils, non-volatile fraction of the essential oil (paraffin waxes, steroids, fatty acids, flavones etc.), and additional components such as pigments, bitter compounds (limonin) and enzymes. In the present study the volatile flavor constituents of the peel (flavedo) from five Greek citrus varieties cultivated in the area of Arta (Zambetakis lemon variety, Navelina oranges, Valencia oranges, common orange variety and bitter oranges) have been characterized by headspace solid-phase microextraction (HS-SPME) in conjunction with gas chromatography-mass spectrometry (GC-MS). For HS-SPME method a 100- $\mu$ m PDMS fiber coating was utilized. GC-MS separations of volatile compounds were made using a 60m x 320 $\mu$ m I.D. x 1 $\mu$ m film thickness DB5 (non polar) column. Eighty two (82) compounds were totally identified in citrus peel samples. More specifically, a total of 52, 57, 54, 53 and 36 compounds were found in Zambetakis lemon variety, Navelina oranges, Valencia oranges, common orange variety and bitter oranges, respectively. The identified compounds belong to the group of esters, alcohols, aldehydes and mainly sesquiterpene hydrocarbons. Limonene was the most abundant component in all samples, followed by sabinene,  $\beta$ -pinene,  $\beta$ -myrcene and linalool.

**(P-18) VOLATILE FLAVOR CONSTITUENTS OF CHAMOMILE FROM EIGHT DIFFERENT AREAS OF GREECE.** P. C. Gournas, P. G. Demertzis and K. Akrida-Demertzi, University of Ioannina, Department of Chemistry, Laboratory of Food Chemistry, GR-45110, Ioannina, Greece, kakrida@uoi.gr

Chamomile is a well-known medicinal plant species belonging to the Asteraceae (Compositae) family. Nowadays, chamomile is a highly favored and much-used medicinal plant in folk and traditional medicine throughout the world and can therefore be considered as an important medicinal species. It is an annual herb, growing up to 20-60 cm tall with branching stems. It has a typical compositae flower, with white rays and yellow conical center that is hollow. Although there are numerous varieties of chamomile, the two most popular are Roman chamomile (*Chamaemelum nobile*) and German or wild chamomile (*Matricaria chamomilla* L. or *Chamomilla recutita*). *Matricaria chamomilla* is the only variety of this family that thrives in Greece. The objective of this study was to identify the volatile constituents of chamomile (dried chamomile flower heads and chamomile infusions) from eight areas of Greece (Rodopi, Corfu, Ioannina, Karditsa, Evritania, Fthiotida, Chania and Rhodes). Chamomile samples were collected in two different time periods (during May of 2009 and 2010). The identification of volatile components was performed using headspace solid-phase microextraction (HS-SPME) coupled to gas chromatography - mass spectrometry (GC-MS). For the HS-SPME sampling two SPME fibers, coated with divinylbenzene/carboxen/polydimethylsiloxane (DVB/CAR/PDMS 50/30  $\mu$ m) and carboxen/polydimethylsiloxane (CAR/PDMS 75  $\mu$ m) were used. Each analysis was carried out in triplicate. Individual volatile compounds were identified by comparison of their retention indices (RIs) with those found in the literature and by comparison of the mass spectra of each compound with the Wiley mass spectral library as well as with the NIST mass spectral library. Sixty-nine compounds were totally identified in the dried chamomile flower heads, whereas fewer (twenty-six) compounds were identified in chamomile infusions. Between the two SPME fibers evaluated, the DVB/CAR/PDMS 50/30  $\mu$ m fiber was shown to be the best choice for all the samples.

**(P-19) STUDYING THE AROMA PROFILE OF LEBANESE SYRAH RED WINE USING GAS CHROMATOGRAPHY COUPLED TO MASS SPECTROMETER AND OLFACTOMETER.** N. Estephan<sup>1</sup>, S. Azzi<sup>1</sup>, N. Ouaini<sup>1</sup> and D. Rutledge<sup>2</sup>, <sup>1</sup>Department of Chemistry and Life Sciences, Faculty of Sciences, Holy Spirit University of Kaslik, BP 446 Jounieh, Lebanon, <sup>2</sup>Laboratory of Analytical Chemistry, AgroParisTech, 16 rue Claude Bernard, 75005 Paris, France, nathalieestephan@usek.edu.lb

Among local wine varieties in Lebanon, Syrah is more often cultivated for the production of red wines. The aromas of this wine appear to be very complex, essentially through the aroma notes « green pepper » and « cassis ». Few studies were undertaken till now

considering this wine variety. And so, the knowledge concerning its aromatic potential is so limited. Thus, conscious of the quality of Syrah wine and concerned about improving its wine value, this present study has the objective to analyze its aroma profile necessary for the production and quality improvement. The quality control and the aromatic typicality of wine involve the use of an appropriate analytical procedure because of the matrix complexity. The Gas Chromatography coupled to Mass Spectrometer (GC-MS) is the more suitable technique used to identify and quantify aroma and more recently the GC-O (GC coupled to Olfactometer). In this paper, it will be presented the study carried on different vintages of Syrah wine. After optimization of the Micro Extraction in Solid Phase (SPME) of volatile and semi-volatile aroma, the analysis of Syrah vintages was performed using GC-MS and GC-O. Digital data of the chromatograms and olfactometer signals were treated by chemometrics. Results showed that four flavors seem to differ from vintage to another: ethyl acetate, 3-methyl-1-butanol, ethyl octanoate, and diethyl succinate.

**(P-20) THE INFLUENCE OF *FILIPENDULA* AND *AGRIMONIA* PLANT EXTRACTS ON AMINO ACID CATABOLISM TO AROMA COMPOUNDS BY RESTING CELLS OF *LB. HELVETICUS*.** *Milda Pukalskene, Department of Food Technology, Kaunas University of Technology, Kaunas, Lithuania, milda.skemaite@ktu.lt*

Aromatic and medicinal plants containing various phytochemicals are an important source of functional ingredients. However, together with health benefits they may have some negative effects, e.g. associated with off-flavors, by changing pathways of flavor development in foods by microorganisms. The main aim of this study was to determine whether the methanol extracts isolated from *Agrimonia* and *Filipendula* possess any effects on the ability of *Lb. helveticus* CNRZ 32 cells to produce aroma compounds from amino acids leucine and phenylalanine and both amino acids in combination. The results obtained in this study were expected to be used for a preliminary assessment of the possibilities to add selected medicinal plant extracts in the production of some fermented milk products. The catabolism of phenylalanine, leucine and their mixtures by *Lb. helveticus* CNRZ 32 was studied in different reaction mixtures containing investigated plant extract. The samples were analyzed after mixing (0h) and after 72h incubation at 37°C. The formation of phenylalanine and leucine derived volatiles were studied using solid phase microextraction combined with GC-MS. Amino acid degradation was analyzed by HPLC. 3-Methylbutanal and isovaleric acid were the main volatiles produced from leucine, while benzaldehyde and phenylacetaldehyde were the main compounds generated from phenylalanine. In general, the concentration of the measured compounds increased after 72 hours of incubation except benzaldehyde which amount slightly decreased in a mixture without plant extracts. This assumption is supported by the remarkably higher content of phenylacetaldehyde in the same system. Isovaleric acid was detected only in the incubated samples containing examined extracts. Analysis of amino acid degradation after 72h incubation at 37°C showed that *Lb. helveticus* degraded less phenylalanine and produced less aroma compounds. However leucine decreased and produced a major amount of aldehyde and carboxyl acid. Preliminary it may be assumed that plant extracts stimulate phenylpyruvate decarboxylase converting phenylpyruvate to phenylacetaldehyde.

**(P-21) CHARACTERIZATION OF AROMA OF CORIANDER (*CORIANDRUM SATIVUM* L.) LEAVES IN TERMS OF LIMITED ODOR UNIT METHOD.** *Hirotohi Tamura, Yoshida Eri and Madoka Kori, Graduate School of Agriculture, Kagawa University, Kagawa, Japan, tamura@ag.kagawa-u.ac.jp*

Objectives of this works are to develop and apply Lod method for characterization of aroma profile of volatile oils of coriander leaves. Coriander aroma from *Coriandrum sativum* L. leaves, having a strong oriental scent was characterized by using new techniques, limited odor unit (Lod), and odor impact spectrum (OIS) that was developed as a standardized indices and visualization tool of the aroma profiles. OIS is expressed as square root of odor unit divided by square root of the maximum of odor unit values as shown in following equation:  $OIS = U_o^{0.5}/U_{o_{max}}^{0.5}$ . Initially forty-two volatile compounds from the extracts collected by modified solvent extracts were identified by GC/MS (60m x 0.25 mm i.d. DB-WAX) and retention indices. (*E*)-2-Tetradecenal was a major component (40.6% of the total oil). Secondary odor thresholds for 42 compounds identified in this oil were mostly determined by sensory tests and some of them were collected from the database of odor thresholds to show OIS values. Thirdly, OIS values were clarified that the most key compounds of coriander oil were (*E*)-2-dodecenal, being 6.6% in the oil, (*E*)-2-tetradecenal and (*E*)-2-tridecenal (1.19%). Finally, sensory test of different concentrations of coriander oils indicated that the most preferable concentration for coriander leave oil was between 1000 ppm and 60 ppm. Lod analysis at 1000 ppm and 60 ppm revealed important chemicals that will contribute to the preference judgment of assessors. In conclusion, the combination of sophisticated GC/MS analysis of volatile compounds and sensory test for determination of odor threshold made it possible to select some chemicals as character-impact aroma compounds. Actually assessors clearly judged that (*E*)-2-dodecenal has right aroma as the key aroma compounds.

**(P-22) ISOLATION OF AROMA COMPOUNDS FROM BLACKCURRANT BUDS BY SUPERCRITICAL CARBON DIOXIDE.** *P. R. Venskutonis, I. Mackēla and A. Šipailienė, Kaunas University of Technology, Kaunas, Lithuania, rimas.venskutonis@ktu.lt*

Various anatomical parts of blackcurrant biosynthesize an array of valuable compounds, including volatile aroma constituents and bioactive phenolics. The most important industrial product of blackcurrant is berries; however leaves and buds also found some applications. The most important raw material of *Ribes nigrum* for the isolation of flavor substances is their dormant buds. The composition of hydrodistilled blackcurrant bud essential oil was comprehensively studied; however until now supercritical fluid extraction (SFE) has not been applied to this material. The main aim of this study was to assess the possibilities of using supercritical

carbon dioxide extraction (SC-CO<sub>2</sub>) for the isolation of blackcurrant aroma constituents from the dormant buds. Central composite design (CCD) was used for experimental planning by using the following parameters: pressure – 100/175/250 bar, temperature – 30/45/60 °C and extraction time – 30/60/90 min. CO<sub>2</sub> flow rate was kept constant, 1 L/min, the mass of the ground freeze or heat-dried buds was 5 g. Response surface methodology (RSM) was used to optimize the extraction parameters and it was estimated that the maximum yield (8.3%) is obtained at 249 bar, 60 °C and 68 min. Theoretical value was in good agreement with the experimentally recovered extract yield. The difference in the yield between freeze and heat dried buds was not remarkable, since the actual yield of the heat dried buds was 8.1%. For comparison, the yield of hydrodistilled essential oil from the frozen and freeze-dried buds was only 1.12 and 1.9 % (v/m), respectively. The composition of the hydrodistilled essential oil and SC-CO<sub>2</sub> extract was compared by GC/MS, while hydrodistillation and SC-CO<sub>2</sub> extraction residues were evaluated for their antioxidant activity. It may be concluded that selection of a proper processing method may give valuable volatile (aroma) and nonvolatile (antioxidants) ingredients from blackcurrant buds. Funded by Research Council of Lithuania, SVE-06/2011.

**(P-23) COMPOSITION OF ESSENTIAL OIL AND RADICAL SCAVENGING OF EXTRACTS FROM *TANACETUM VULGARE* L. CULTIVATED IN LITHUANIA.** *Petras Rimantas Venskutonis, R. Baranauskienė, R. Kazernavičiūtė, R. Mažždienė, Kaunas University of Technology, Kaunas, Lithuania, rimas.venskutonis@ktu.lt*

Tansy (*Tanacetum vulgare* L.) is an aromatic plant spread in the northern Europe. Due to the strong essential oil (EO) odor tansy has been used as antiseptic and insecticidal plant. EO components are also of potential interest as aroma chemicals in perfumery. Tansy preparations possess strong biological and medicinal activities, it is a good source for natural antioxidants. The leaves of tansy have been used for replacing such spices as cinnamon and Muscat nuts. Occasionally, it has been cultured in gardens and used in salads, omelets, cakes and spices. In this study the EO was obtained by hydrodistillation of dried herb and analyzed by GC-FID and GC-MS. The EO were complex mixtures of 48 compounds representing 99.8% of total EO. *T. vulgare* grown in Lithuania depends to  $\beta$ -thujone (86.1%) chemotype, other qualitatively important components were sabinene (2.5%) and  $\alpha$ -thujone (2.5%), while *p*-cymene, bornyl acetate, germacrene D,  $\alpha$ -terpinene and  $\alpha$ -pinene were present in smaller amounts. The production of EO results in ~99% of by-products, which usually remain unused. Distillation residues were separated into liquid and solid fractions. Liquid fraction was freeze-dried to obtain water extract (WE). Solid fraction was dried and extracted with acetone to obtain deodorized acetone extract (DAE), while acetone oleoresin (AO) was extracted from the whole plant. Tansy extracts were tested for their antioxidant activity (AA) using DPPH<sup>•</sup> and ABTS<sup>•+</sup> radical scavenging assays. AA was determined as follow WE>DAE>AO>EO; the EC<sub>50</sub>DPPH of WE and EO was 1.33 and 85.93 mg/ml, respectively. The total phenolic content (TPC) was measured with Folin-Ciocalteu reagent using gallic acid as a standard. The highest TPC was in WE (32.67±1.96 mg GAE/g dried herb), while in EO it was only 0.046±0.002 mg GAE/g. AA of tansy extracts was also tested in rapeseed oil by the Oxipres method. Funded by Research Council of Lithuania, SVE-06/2011.

**(P-24) MONITORING OF VOLATILE COMPONENTS AND OXIDATION INDICES CHANGES OF VIRGIN OLIVE OILS DURING STORAGE IN THE DARK AND IN THE LIGHT.** *Kotsiou Kali and Maria Tasioula-Margari, Department of Chemistry, Section of Industrial and Food Chemistry, University of Ioannina, Ioannina 45110, Greece, mtasioul@cc.uoi.gr*

Virgin olive oils from three Greek varieties (Koroneiki, Lianolia and Asporolia) were stored in the dark at 14 ± 3 °C for 24 months and in the light at ambient temperature (20 ± 3 °C) for 3 months and the evolution of their volatile compounds and oxidation indices were monitored. The changes in volatile compounds composition were studied using SPME GC/MS technique. Quality indices such as peroxide values, K232 and K270 did not significantly change during storage in the dark. The main volatile compounds present in the olive oil samples were C6 derivatives: [*E*]-2-hexenal, (*Z*)-3-hexenal, hexanal, [*E*]-2-hex-1-enol, 1-hexanol, (*Z*)-3-hexenyl acetate, hexyl acetate and C5 derivatives: 1-penten-3-ol, 1-penten-3-one, 3-pentanone, pentanal, (*Z*)-2-penten-1-ol. Concentrations of most of those compounds did not change. (*Z*)-3-hexenal was reduced up to 90-100% after 12 months of storage whilst hexanal, pentanal and some aldehydes such as *n*-heptanal, (*E*)-2-heptenal and nonanal (which are present in trace amounts or not detected in fresh oils) gradually increased during 24 months. At the same time compounds which are responsible for olive oil off flavours, such as diethyl ether, hexane, heptane and chloroform were formed in significant amounts after 18 months of storage. Even though the quality indices did not significantly increased oxidation processes started after 12 months of storage consequently, the initially pleasant sensory characteristics gave way to unpleasant sensory attributes. During storage in the light for 3 months peroxide values, K232 and K270 exceeded the upper limits accepted by the EU regulation in most of the samples. The main volatile compounds which are responsible for the positive aroma perceptions in olive oil reduced up to 50% while aldehyde off-flavor compounds (hexanal, pentanal, *n*-heptanal, (*E*)-2-heptenal and nonanal) were remarkably increased. Moreover, a high amount of octane, a potent off-flavor, was formed in all samples.

**(P-25) EFFECT OF ADDITION OF CRYOPROTECTANTS ON FROZEN/THAWED MASHED POTATOES FLAVOR BY SENSORY EVALUATION.** *Nantia Bikaki and Constantina Tzia, Laboratory of Food Science and Technology, Department of Chemical Engineering, National Technological University of Athens (NTUA)*

Frozen purees made from vegetables are a relatively new kind of high-quality and functional product, offering extended shelf life, better manufacturing, distribution flexibility and food safety. Mashed potatoes may be suitable for freezing as a ready-meal

component or as a single product. However, freezing and thawing adversely affect the cells and cell components of mashed vegetables causing textural changes and more importantly degradation of sensory properties. The quality of mashed potatoes is influenced by various factors but more importantly by the sensory characteristics which are significant for consumer selection and acceptability. Recent studies have demonstrated that incorporation of cryoprotectant blends, such as non-starchy hydrocolloids, to starch based products like mashed potatoes is effective for ameliorating the detrimental effects of freezing and thawing. Hydrocolloids offer a protection to cells and cell components against the deleterious effects of thawing in particular, such as starch retrogradation, syneresis etc, since they interact with water and have been reported to slow down the rate of ice crystal growth and alter crystal shapes. Moreover, studies have proved the dependency between the structure of starch and the flavor of thawed potato products, affecting also the taste, texture, color and odor of these products. Recently, is attempted to incorporate prebiotic agents and dietary fiber as they enhance flavor and products become more appealing to consumers pursuing a healthy diet. The purpose of this research was to investigate the effect of addition of cryoprotectants on frozen/thawed mashed potatoes flavor and texture properties examined by sensory evaluation. The frozen/thawed samples were stored for two months and the change of flavor and texture during storage was monitored. The cryoprotectant materials that were investigated, were polysaccharides ( $\kappa$ -carrageenan, xanthan gum, chitosan), oligosaccharides (inulin), disaccharides (trehalose), dietary fiber (oat, potato fiber) and hydrocolloids (HPMC) and were incorporated in samples individually or as blends. The samples of frozen/thawed mashed potatoes were subjected to a quantitative descriptive profile analysis. Sensory evaluation was conducted by an eight-member panel with specific training on completing the tests. The assessors scored separately 5 sensory characteristics of texture, such as gummy, cohesive, flavor and odor using a 10-point scale. Also, a pleasure scoring for the Overall Acceptance (OA) of the samples was carried out based on all sensory attributes using also a 10-point scale. Finally, statistical analysis of sensory data was carried out for further processing of results and conclusions.

**(P-26) OIL AND PHYTOCHEMICALS FROM SMALL FRUIT SEEDS.** *Fereidoon Shahidi and Nishani Perera, Department of Biochemistry, Memorial University of Newfoundland, St. John's, NL, Canada A1B 3X9*

By-products from agricultural sources may be used for the production of a myriad of value-added products. In the production of juice from small fruits, primarily berries, the left-over seeds may be used to produce an oil (11-23%) and a seed meal (flour). The oils so produce contain a high proportion of polyunsaturated fatty acids and a high antioxidant content with good oxidative stability and anti-inflammatory activity. These oils are rich in  $\alpha$ -linolenic acid with a favourable n-6/n-3 FA ratio compared with vegetable oils. A wide variety of phytochemicals, such as phenolic acids, anthocyanin, flavonol and carotenoids are also present in both the oil and the seed flour. All berry seed oils contain a high amount of *p*-coumaric acid followed by tyrosol, vanillic acid, ferulic acid, sinapic acid and vanillin. The tocol content of the oils varies widely in both the oil and seed flour and contributes to the good storage stability of products. These products are of special interest for health promotion and disease risk reduction and may be used in a variety of applications in foods as well as cosmetics and pharmaceutical products.

**(P-27) YOGURT FLAVOR AND SENSORY CHARACTERISTICS DERIVED FROM MILK TREATED BY HIGH INTENSITY ULTRASOUND.** *Panagiotis Sfakianakis and Constantina Tzia, Laboratory of Food Chemistry and Technology, School of Chemical Engineering, National Technical University of Athens, 5 Iroon Polytechniyo St., 15780 Athens, Greece, psfakian@central.ntua.gr*

High intensity ultrasound (US) treatment has been proven to homogenize milk and reduce its microbial load while simultaneously assist in the formation of volatiles that affect its flavor and aroma. Additionally, high intensity US treatment has positive effect on the formation of yogurt curd and improve some of its quality and sensory characteristics. The current work aims to the study the sensory characteristics of yogurt produced from milk treated by high intensity US, furthermore to characterize the volatile components produced during fermentation process. Yogurt samples were produced by bovine milk (3,5% fat content and 3,3% protein content) that was previously ultrasonicated (frequency of 20kHz and intensity range 150-750W) for 10min, using industrial starter culture (*Streptococcus thermophilus* and *Lactobacillus delbrueckii subsp. Bulgaricus*). After the end of fermentation process (pH = 4,7) samples were stored at 4 °C overnight. Volatile components were analyzed by using solid phase microextraction headspace analysis in combination with gas chromatography/mass spectrometry. The compounds that were identified belonged mostly to three categories carboxylic acids (hexanoic acid, octanoic acid), ketones (2,3 butadienone, 2-heptanone, 2-nonanone) and aliphatic hydrocarbons. Sensory evaluation was conducted on the yogurt samples for flavor, texture and overall acceptance. Results proved that milk treated by high intensity US led to acceptable yogurt with superior texture characteristics (cohesiveness, hardness, firmness) and inferior taste and flavor (off flavors). The volatile compounds that affect aroma and flavor are formed during the US treatments of the milk, due to high localized temperature and cavitation phenomena as well as during fermentation.

**(P-28) EFFECT OF LAURUS NOBILIS (BAY LEAF) ESSENTIAL OIL ON THE FORMULATION, OXIDATIVE STABILITY AND SENSORY CHARACTERISTICS OF O/W/O OLIVE OIL MICROEMULSIONS.** *Vasiliki Polychniatou and Constantina Tzia, Laboratory of Food Chemistry and Technology, School of Chemical Engineering, National Technical University of Athens.*

The aim of the present work was the preparation and characterization of o/w/o, co-surfactant free, olive oil microemulsions with *Laurus Nobilis* (Bay leaf) oil, in order to obtain a system that could provide a controlled, sustained product with desirable sensory

characteristics and prolonged oxidative stability. Microemulsions are of great interest in the food industry, since they are suitable as microreactors for the synthesis of food flavors, as a vehicle for the solubilization of water or oil insoluble nutraceuticals and as the delivery system for water-soluble nutrients, flavors and colorants in foods. Olive oil, the basic traditional vegetable oil of Greece, was chosen as the main phase of the microemulsions, because it is of high nutritive value and it has been also recognized as a functional food product with health benefits. Moreover, olive oil contains a variety of compounds with antioxidative activity presenting great stability against oxidation compared to other vegetable oils. Bay leaf essential oil has high nutrition value, attributed to antiparasitic, antioxidant, anti-inflammatory, digestive, astringent, diuretic and antiallergenic properties. Bay leaf is also an antifungal and antibacterial, and has been used to treat rheumatism, amenorrhea, colic and stomach ulcers. Olive oil/water/Bay leaf oil o/w/o microemulsions were formulated in different ratios. The oxidative stability along with the sensory properties of the microemulsions was tested in accelerated oxidative storage conditions. The degradation of the volatile components of the microemulsions was determined with analytical techniques (GC-MS). Sensory evaluation was performed and the results were related with those of objective analysis. The degradation of the total phenolic components was examined and related with the peroxide value of the microemulsions. It was concluded that stable olive oil/Bay leaf oil microemulsions can be obtained with high oxidative stability. Moreover, the role of the addition of Bay leaf oil in the sensory and stability properties of the olive oil microemulsions was determined.

**(P-29) HYDROXYLATED FORM OF 5,6,7,8,4'-PENTAMETHOXYFLAVONE, EXHIBITED HIGHER ANTI-TUMOR-PROMOTING ACTIVITY IN DMBA/TPA-INDUCED MOUSE SKIN CARCINOGENESIS.** *Chieh-Han Chung<sup>1</sup>, Shiming Li<sup>2</sup>, Chi-Tang Ho<sup>2</sup> and Min-Hsiung Pan<sup>1</sup>, <sup>1</sup>Department of Seafood Science, National Kaohsiung Marine University, Kaohsiung, Taiwan, <sup>2</sup>Department of Food Science, Rutgers University, New Brunswick, NJ, USA*

Tangeretin (5,6,7,8,4'-pentamethoxyflavone, TAN) is well documented to have various bio-functionalities. However, recent emerging researches discovered that hydroxylation of TAN at C<sub>5</sub> position transform TMF into its hydroxylated counterpart, 5-hydroxy-6,7,8,4'-tetramethoxyflavone (5-HTMF), which may exhibit higher bio-efficacy. In this study, the anti-carcinogenesis activities of TAN and 5-HTMF were comparably evaluated by 7,12-dimethylbenz[a]anthracene (DMBA) and 12-*O*-tetradecanoylphorbol-13-acetate (TPA) induced two-stage mouse skin carcinogenesis model. From result of this study, 5-HTMF (5 μmol) treatment decreases tumor incidence by ~36%, while TAN (5 μmol) decreases tumor incidence by ~25%. Mechanistic studies reveal that 5-HTMF reduced the expression of inflammatory enzymes, nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2), in skin tumor. In DMBA/TPA-stimulated mouse skin tumor, 5-HTMF significantly attenuated the DNA binding of nuclear factor-κB (NF-κB), one of the transcription factors that regulate COX-2 and iNOS expression. As NF-κB is a downstream target of phosphatidylinositol 3-kinase (PI3K) and AKT, administration of 5-HTMF to mouse skin also exhibited higher suppression of DMBA/TPA-induced activation of PI3K, phosphorylation of Akt than TAN. Modulation of PI3K/Akt signaling pathway may be partly account for its anti-tumor-promoting activity since 5-HTMF reduces DMBA/TPA-induced NF-κB activation, and, thus, iNOS and COX-2 expression. In addition to its anti-proliferation activity, 5-HTMF also induces apoptosis in two-stage mouse skin carcinogenesis. 5-HTMF applications induced the expression of pro-apoptotic protein Bax with concomitant decrease in anti-apoptotic protein Bcl-2. Alteration in Bax/Bcl2 ratio by 5-HTMF treatment resulted in apoptosis, which is associated with the release of cytochrome *c* and appearance of cleaved caspase-3 fragments. These findings demonstrate that 5-HTMF induces apoptosis through regulation of Bax/Bcl-2 ratio in mouse skin tumors. Taken together, our results clearly illustrated that 5-HTMF impart better suppressive activity than TAN since it posses superior anti-proliferation activity while, at the same time, induces tumor cell apoptosis. In conclusion, 5-HTMF in comparison to TMF may be more effective in development of novel dietary chemoprevention/ therapy treatment to skin cancer.

## **Oral Presentations**

### **Wednesday AM (May 30<sup>th</sup>)**

**(O-I-1) NON-TARGETED APPROACH FOR DETERMINATION OF KEY VOLATILE AND NON-VOLATILE COMPONENTS RELATED TO BEEF FLAVOR IN GLUTATHIONE MAILLARD REACTION PRODUCTS.** *Young-Suk Kim\* and Sang Mi Lee, <sup>1</sup>Department of Food Science and Engineering, Ewha Womans University, Seoul 120-750, Korea, yskim10@ewha.ac.kr*

Some novel volatile and non-volatile components related to sensory attributes of glutathione-Maillard reaction products (GSH-MRPs) prepared under different reaction conditions were investigated by non-targeted analysis. The non-target analysis was performed using gas chromatography-time-of-flight mass spectrometry (GC-TOFMS) and ultra performance liquid chromatography-quadrupole-time-of-flight mass spectrometry (UPLC-Q-TOFMS) combined by sensory analysis. Volatile and non-volatile components in GSH-MRPs contributing to the sensory attributes were determined based on partial least-squares (PLS) regression method. Volatile components such as 2-methylfuran-3-thiol, 3-sulfanylpentan-2-one, furan-2-ylmethanethiol, 2-propylpyrazine, 1-furan-2-ylpropan-2-one, 1H-pyrrole, 2-methylthiophene, and 2-(furan-2-ylmethylsulfanylmethyl)furan could be identified as key contributors to the beef flavor attribute of GSH-MRPs. Also, some non-volatile components were selected as major components contributing to beef flavor. In this



study, we demonstrated that the unbiased non-targeted analysis based on metabolomic approach allowed the determination of key volatile and non-volatile components related to the beef flavor attribute in GSH-MRPs.

### **(O-I-2) FORMATION MECHANISM OF MEAT FLAVORS FROM PEPTIDE-MAILLARD REACTION.**

*Huanlu Song, Ran Wang and Chao Yang, Beijing Key Laboratory of Flavor Chemistry, Beijing Technology and Business University, Beijing 100048, China, songhuanlu@yahoo.com.cn*

Maillard reaction refers to the interaction between amino and carbonyl compounds, which leads to complex changes in the biological and food systems. Peptides or enzymatic protein in foods have been recognized as important flavor precursors of the Maillard reaction, but the chemistry and mechanisms of production of aroma compounds by peptides have not been investigated to an appreciable extent. In this paper, formation mechanism of meat flavors formed from peptide (glutathione and glutathione-related oligopeptides)-xylose Maillard reaction was studied, including the impact of the composition and the amino acid sequence of the peptide chain to the Maillard reaction. In the optimal condition,  $^{13}\text{C}_5$ -Xyl and Xyl (1:1) and peptides or free amino acid run the Maillard reaction, then the key meat flavor compounds were analyzed and identified with the technologies of Gas Chromatography-Olfactometry- Mass Spectrometer (GC-O-MS), High Performance Liquid Chromatography (HPLC) and High Performance Liquid Chromatography-Mass Spectrographic (HPLC-MS), and their formation ways were concluded. Furthermore, the products in liquid were detected, which were used to infer the cleaving capability and position of the oligopeptide participating in the Maillard reaction, thus, the reaction course and mechanism of the key meat flavor compounds formed from oligopeptide-xylose Maillard reaction.

### **(O-I-3) DECODING THE KEY AROMA COMPOUNDS OF BARTLETT PEAR BRANDIES BY APPLICATION OF THE MOLECULAR SENSORY SCIENCE CONCEPT.**

*B. Willner, M. Granvogl and P. Schieberle, Technical University of Munich, Chair for Food Chemistry, Freising, Germany, Bianca.willner@lrz.tum.de*

The overall aroma is one of the most important quality markers of distilled beverages, such as Bartlett pear brandy. The name of the spirit is trademarked and is only used for brandies manufactured from Bartlett pears, due to their distinct aroma. The manufacturing process involves fermentation of the mashed fruits, distillation and ageing. However, although it is known that the raw material and the manufacturing process have an important influence on aroma formation, data on the key aroma compounds contributing to the overall flavor of the pear brandy are scarcely available. Thus, it was the aim of this study to identify the key aroma compounds in two commercial brandies, significantly differing in their overall aroma profile. In the first step, odor-active compounds were separated from the bulk of odorless volatiles by application of an aroma extraction dilution analysis (AEDA). After identification of the most odor-active compounds, quantitation was carried out by means of stable isotope dilution assays (SIDA). A total of fifty aroma-active volatiles were identified of which more than twenty-five were rated to be key compounds, based on their odor activity values (OAV) (ratio of concentration to odor threshold). Among them, besides the well-known "Bartlett flavor compound" ethyl (*E,Z*)-2,4-decadienoate, also (*S*)-ethyl 2-methylbutanoate, (*E*)- $\beta$ -damascenone, ethyl hexanoate and 2,3-butandione were established as the most important odorants. A comparison of the concentrations of the key aroma compounds in both Bartlett brandies revealed clear differences in several aroma compounds, e.g., ethyl (*E,Z*)-2,4-decadienoate, 2-phenylethanol, 1-hexanol, and phenylacetaldehyde. Finally, an aroma recombinant consisting of all key odorants in their natural concentrations confirmed the analytical approach. The results will be discussed with special emphasis on aroma compound formation during processing.

### **(O-I-4) IDENTIFICATION OF CHARACTERISTIC AROMA-ACTIVE COMPOUNDS FROM ROASTED**

**LAVERS.** *Hyung Hee Baek and Jin Yeong Choe, Dankook University, Cheonan, Republic of Korea, baek@dankook.ac.kr*

Laver is popular Korean-style edible seaweed, which is used as a wrap for cooked rice in the form of either dried or roasted lavers and a common garnish or flavoring in noodle and soups. Seaweed-like aroma of raw laver is changed to distinct aroma by roasting; however, characteristic aroma-active compounds of roasted laver were not fully understood. The objective of this study was to evaluate characteristic aroma-active compounds using solid phase microextraction (SPME) and solvent assisted flavor evaporation (SAFE)-gas chromatography-mass spectrometry-olfactometry. One hundred sixty four and 111 volatile flavor compounds were identified in roasted laver by SAFE and SPME, respectively. 3-Hydroxy-2,4,4-trimethylpentyl-2-methylpropanoate was the most abundant, followed by (1-hydroxy-2,4,4-trimethylpenten-3-yl)-2-methylpropanoate, dihydro-2(3H)-furanone, and 3-ethyl-2,5-dimethylpyrazine. Eleven pyrazine compounds were identified as characteristic aroma-active compounds, which give nutty note to roasted laver. Methional (potato,  $\log_2\text{FD}=10$ ), 2-ethyl-5-methylpyrazine (coffee,  $\log_2\text{FD}=6$ ), 2-ethenyl-5-methylpyrazine (popcorn,  $\log_2\text{FD}=2$ ), 3-ethyl-2,5-dimethylpyrazine (potato,  $\log_2\text{FD}=5$ ), 2-ethyl-3,5-dimethylpyrazine (nutty,  $\log_2\text{FD}=8$ ), and 2,3-diethyl-5-methylpyrazine (cocoa,  $\log_2\text{FD}=9$ ) were considered characteristic aroma-active compounds of roasted laver with high  $\log_2\text{FD}$  factors and nutty note. Pyrazine compounds were not found in raw laver and increased dramatically by roasting. Aroma-active compounds of raw, dried, and roasted lavers harvested in three different cultivation areas (Haenam, Jebudo, and Seocheon) were analyzed and compared. Cultivation area affected volatile flavor compounds of raw, dried, and roasted lavers. Volatile flavor compounds with green note were the most abundant in Haenam raw laver. For dried lavers, Jebudo dried laver contained higher amounts of nutty compounds when compared with those in other cultivation areas. Pyrazine compounds had the highest  $\log_2\text{FD}$  factors in Jebudo roasted laver.

When laver (*Porphyra yezoensis*) was compared with rocklaver (*Porphyra seriata*), the rocklaver contained higher amounts of (Z)-1,5-octadien-3-one and 1-octen-3-ol, whereas laver contained higher amounts of pyrazines. These results could be applied to improve aroma quality of roasted laver in food industry.

**(O-I-5) WHITE BUTTON MUSHROOM AROMA: NEW INSIGHTS INTO ENZYMATIC ODORANT FORMATION.** *S. Großhauser, M. Steinhaus and P. Schieberle, Deutsche Forschungsanstalt für Lebensmittelchemie (German Research Center for Food Chemistry), Freising, Germany, ms@lrz.tum.de*

Due to easy cultivation and superior flavor characteristics, common white button mushrooms (*Agaricus bisporus* (LGE.) Imbach0) are one of the most popular edible fungi in the world. They are widely used in soups, gravies and as pizza topping, but also consumed in the raw state, e.g. as ingredient in fresh salads. Application of an aroma extract dilution analysis to an extract obtained from sliced fresh white button mushrooms revealed 41 odor-active compounds in the FD factor range of 4 - 4096. High FD factors were obtained for methional (3-(methylsulfanyl)propanal), 3-methylbutanal, phenylacetaldehyde, sotolon (3-hydroxy-4,5-dimethyl-2(5H)-furanone), and phenylacetic acid, followed by 1-octene-3-one, which is commonly regarded as the character impact odorant of mushrooms (1). Using stable isotope dilution assays, the concentrations of 24 odorous compounds were determined. Based on the concentrations obtained, the odor activity value (OAV) of each compound was calculated as ratio of concentration and odor threshold in water. High OAVs were particularly found for 3-methylbutanal, 1-octen-3-one, phenylacetaldehyde, methional, and 1-octen-3-ol. Studies on the formation of these odorants confirmed the tissue disruption initiated, enzymatic generation of 1-octen-3-ol and 1-octen-3-one already reported before (2). Further model experiments using stable isotope labeled precursors finally also unraveled the enzymatic formation pathways of the other highly odor-active compounds.

1. Fischer KH, Grosch W (1987) *Lebensm Wiss Technol* 20, 233-236
2. Wurzenberger M, Grosch W (1984) *Biochim Biophys Acta* 794, 18-24

**(O-I-6) DIFFERENTIATION OF SESAME OIL AND PERILLA OIL BY PROFILE CHANGES OF VOLATILES USING SPME-GC/MS AND ELECTRONIC NOSE TECHNIQUES.** *M. J. Kim<sup>1</sup>, B. S. Noh<sup>2</sup> and J. H. Lee<sup>1</sup>, <sup>1</sup>Sungkyunkwan University, Suwon, Korea, <sup>2</sup>Seoul Women's University, Seoul, Korea, s3hun@skku.edu*

Sesame oil (SO) and perilla oil (PO) consumed in Korea are usually prepared by roasting seeds and pressing the roasted seeds without further refining process. Roasting process gives unique volatile flavor in SO and PO, which are generally 10 times expensive than refined vegetable oils. The objective of this study was to discriminate SO and PO from different roasting process using volatile profiles. Headspace volatiles of SO from sesame seeds roasted at nine different conditions were analyzed by a combination of solid phase microextraction (SPME)-gas chromatography/mass spectrometry (GC/MS), electronic nose/metal oxide sensors (MOS), and electronic nose/MS. Volatiles from PO from perilla seeds roasted at 150, 170, 190, and 210°C and for 15 and 30 min were determined by SPME-GC/MS. As roasting temperature increased from 213 to 247°C, total headspace volatiles and pyrazines increased significantly ( $P < 0.05$ ). Pyrazines were major volatiles in SO and PO and furans, thiazoles, aldehydes, and alcohols were also detected. 2,5-Dimethylpyrazine and 2-furancarboxaldehyde were two major volatiles in PO. Roasting temperature was more discrimination factor than roasting time for the volatiles in SO through the principal component analysis (PCA) of SPME-GC/MS, electronic nose/MOS, and electronic nose/MS. Electronic nose/MS showed that ion fragment 52, 76, 53, and 51 amu played important roles in discriminating volatiles in SO from roasted sesame seeds, which are the major ion fragments from pyrazines, furans, and furfurals. Results of PCA of volatiles showed the first principal component (PC1) and the second principal component (PC2) express 56.64 and 22.72% of the volatile variability in PO, respectively, which can differentiate PO prepared from roasting conditions clearly. SO and PO prepared from different roasting conditions can be differentiated from each other on the base of volatile distribution. In conclusions, SPME-GC/MS technique can differentiate SO and PO successfully prepared from different roasted seeds.

**(O-I-7) AROMA COMPOUNDS IN WHITE ASPARAGUS: DIFFERENCES INDUCED BY COOKING.** *Veronika Mall, Julia Scherb and Peter Schieberle, DFA – German Research Center for Food Chemistry, Lise-Meitner-Str. 34, 85354 Freising, Germany, Veronika.mall@lrz.tum.de*

Due to its delicate aroma, cooked white asparagus became a well-accepted delicacy in the past decades. However, studies on the key aroma compounds of asparagus, and in particular on changes induced by a degradation of odorless precursors during cooking are scarcely available. Nevertheless, extended knowledge on the key aroma compounds and their formation during processing are prerequisites to improve the sensory quality of the vegetable, e.g. by optimized breeding or cultivation regimes. The aim of the study was, therefore, to identify the key odorants in cooked and raw white asparagus by means of the molecular sensory science approach. First, the aroma extract dilution analysis (AEDA) revealed 31 aroma-active areas in a distillate obtained from cooked asparagus. The highest flavor dilution (FD) factors were found for 3-(methylthio)propanal and (*E,E*)-2,4-decadienal, followed by 1-octen-3-one, 2-acetyl-1-pyrroline, two tautomers of 2-acetyltetrahydropyridine and 4-hydroxy-3-methoxybenzaldehyde. Quantitation by stable isotope dilution assays and an aroma recombination experiment completed the identification. To get a first insight into the precursors of the aroma compounds, raw asparagus of the same batch was also subjected to an AEDA. Among the 19 aroma active areas detected, three 2-methoxypyrazines predominated with high FD factors besides *trans*-4,5-epoxy (*E*)-2-decenal with a metallic odor. In total, 18 odorants were newly generated during the thermal treatment. The results revealed a particular importance of dimethyl sulfide

in the overall aroma of cooked asparagus. Data on the quantitation of its precursor in raw asparagus and a comparison between asparagus samples from different origins will be presented and discussed.

### **Wednesday PM (May 30<sup>th</sup>)**

**(O-II-1) IMPACT OF PHLORETIN AND PHLORIDZIN ON THE FORMATION OF MAILLARD REACTION PRODUCTS IN MODEL SYSTEMS.** *M. F. Wang and J. Y. Ma, The University of Hong Kong, Hong Kong, China. mfwang@hku.hk*

Maillard reaction is of great importance in food industry. Some flavonoids from natural plants have been found to possess inhibitory effects on harmful advanced glycation end-products (AGEs). However, few studies paid attention to effects of these natural AGE inhibitors on the Maillard reaction happening under thermal conditions. In the present work, we aimed to investigate effects of the two apple phenols, phloretin and phloridzin, on the Maillard reaction taking place in both thermal and non-thermal models. It was found that either phloretin or phloridzin could inhibit the formation of Maillard-type volatiles in various thermal Maillard model systems (glucose-lysine, glucose-lysine derivatives with  $\alpha$ -amino group blocked, and ribose-cysteine, respectively). In addition, both phloretin and phloridzin could obviously affect color development induced by Maillard reaction. For the study of non-thermal Maillard reaction, effects of phloretin and phloridzin were evaluated in methylglyoxal (MGO)-induced glycation systems consisting of amino acids, peptides and protein (creatine kinase), respectively. Arginine residue was found as an active site for glycation, and the addition of phloretin and phloridzin could significantly inhibit the arginine-site glycation. Interestingly, the addition of phloretin could promote the consumption of cysteine residue exposed to MGO, while cysteine residue kept unchanged when incubated solely with MGO. The promoting effect of phloretin on cysteine residue consumption is caused by the condensation reaction among phloretin, MGO and cysteine residue. Based on findings given in the work, phloretin and phloridzin could play multiple roles in the Maillard reaction by trapping reactive carbonyl species, which may give us an alternative way to better understand the potential effects of natural flavonoids on food processing and human health.

**(O-II-2) BIOACTIVE PEPTIDES AND HUMAN HEALTH.** *Fereidoon Shahidi and Quanqun Li, Department of Biochemistry, Memorial University, St. John's, NL, Canada A1B 3X9, fshahidi@gmail.com*

Peptides released from food proteins are generally bioactive and are known to have regulatory and modulatory functions in humans and can be used as nutraceuticals and functional food components for promotion of human health and for disease risk reduction. Therefore, interest in identification and characterization of bioactive peptides from plant and animal sources has increased in past decades. Depending on their structural properties, bioactive peptides possess different functionalities, such as antihypertensive, antioxidant, anticancer, hypocholesterolemic, antimicrobial, immunomodulatory, and hence are multifunctional. Based on the most current literature, this review presents a comprehensive account of advances in bioactive peptides and their bioactivities, sources, technological properties, applications, bioavailability and safety issues.

**(O-II-3) EVALUATION OF MELAMINE ANALYSIS USING GCMS VERSUS LCMSMS.** *J. Broekhans and H. Leijs, IFF International Flavors and Fragrances, Tilburg, The Netherlands, joost.broekhans@iff.com*

As of 2007, melamine has been reported as an adulterant in both human and pet food. It is being used to make food materials low in protein-content appear higher in content when tested using simple total nitrogen tests such as Kjeldal. The FDA published a GCMS based analysis method involving extraction of melamine and related materials from suspected samples followed by a trimethylsilyl derivatization. The derivatives are analyzed by GCMS in SIM mode. This GCMS based method was developed for screening for presence not only of melamine, but also for cyanuric acid, ammelide and ammeline. The MRL for this method is 10 mg/kg. Rapidly, a MRL of 1 mg/kg was required by the food industry and adjustment of the FDA method was required in order to meet these needs. In this specific case, standard addition was applied to be able to correctly identify and quantify the target analytes by correcting for matrix effects originating from the diverse nature of the obtained extracts. Melamine and related materials can be analyzed accurately and precise by the GCMS method as described, provided a number of preventive measures are correctly executed as proven by validation results, internal quality control procedures and proficiency test results. However, the analysis is time consuming and frequent preventive instrument maintenance is required. Alternatively, a LCMSMS based method can be applied lacking the above drawbacks. This manuscript describes the comparison of the FDA based GCMS method and an internally developed LCMSMS method.

**(O-II-4) RESOLUTION OF RACEMIC  $\gamma$  ( $\delta$ )-LACTONES BY PACKED COLUMN SUPERCRITICAL FLUID CHROMATOGRAPHY.** *J. C. Xie, J. Cheng, H-L. Han, L. Sun and B-G. Sun, Beijing Key Laboratory of Food Flavor Chemistry, Beijing Technology & Business University, Beijing 100048, P.R. China, xjchun@th.btbu.edu.cn*

$\gamma$  ( $\delta$ )-Lactone are valuable flavor and fragrance substances present in nature and approved using in a wide variety of foods such as ice cream, soft beverage, candy, and sweet cakes. However, odor characteristics of  $\gamma$  ( $\delta$ )-lactones depend to a large extent on their chiral configurations and enantiomeric compositions. In raspberries, peaches, coconuts, and various dairy products,  $\gamma$  ( $\delta$ )-lactones are found naturally in a particular enantiomeric composition while the *R*- isomer is dominant, which makes optically active  $\gamma$  ( $\delta$ )-lactone prerequisite if to investigate potential uses of the single enantiomers in food or to simulate the natural flavor artificially. The resolution of racemic  $\delta$  and  $\gamma$ -lactone flavors by diastereomeric derivation and especially biocatalysis had been widely studied. However, direct chromatographic separation of enantiomers on a chiral stationary phase (CSP) is more desirable due to its simpleness and rapidness. The chiral separation by packed column supercritical fluid chromatography (pSFC) has pronounced advantages due to its enhanced efficiency and reduced solvent consumption. In the present work, seven racemic  $\gamma$ -lactones ( $\gamma$ -C<sub>6</sub> ~  $\gamma$ -C<sub>12</sub>) and six racemic  $\delta$ -lactone (C<sub>7</sub> ~ C<sub>12</sub>) flavors were successfully resolved in less than 15 min each by pSFC. Baseline or near baseline separations were achieved for the substances of  $\gamma$ -C<sub>8</sub> ~  $\gamma$ -C<sub>12</sub>, and  $\delta$ -C<sub>7</sub> ~  $\delta$ -C<sub>10</sub>. The polysaccharide CSP of Chiralpak AD-H (for the  $\gamma$ -lactones), and Chiralcel OB-H (for the  $\delta$ -lactones), and the organic modifier of isopropanol were selected. The column temperature, column pressure, content of isopropanol in mobile phase and flow rate of mobile phase were optimized while their influences on capacity factor, enantioselectivity factor and resolution factor were discussed. The optimum chiral separations of the seven  $\gamma$ -lactones and six  $\delta$ -lactones were achieved. Otherwise, the length of alkyl chain showed a determined influence on the enantioselectivity. Among the series of  $\gamma$ -lactones studied it was  $\gamma$ -C<sub>9</sub>, and among the series of  $\delta$ -lactones studied it was  $\delta$ -C<sub>8</sub> that gave the largest  $\alpha$  value. Finally, several milligrams of enantiomers, with an optical purity of 100%, were obtained by scaling up the analytical method to preparative separation. Supported by National Natural Science Foundation of China (31171755), Beijing Natural Science Foundation (21222013) and Beijing Municipal Education Commission Science and Technology Development Plan Key Project (KZ201010011011).

**(O-II-5) IMPACT OF SELECTED DIETARY POLYPHENOLS ON CARAMELIZATION IN MODEL SYSTEMS.** X.C. Zhang<sup>1</sup>, S.F. Chen<sup>2</sup> and M.F. Wang<sup>1</sup>, <sup>1</sup>The University of Hong Kong, Hong Kong, China, <sup>2</sup>Peking University, Beijing, China, h1092013@hku.hk

Polyphenols are nowadays commonly consumed as dietary antioxidants which may contribute to health benefits associated with a lower risk of cardiovascular disease and cancer. Caramelization products which contribute to food color and flavor are also reported to possess antioxidant activities. In this research, six kinds of polyphenols (phloretin, naringenin, quercetin, epicatechin, rosmarinic acid, chlorogenic acid) belonging to different polyphenol categories were investigated of their effects on the caramelization process of fructose. The fructose solution with or without polyphenol was heated at 120 °C for two hours at neutral (pH=7) or alkaline conditions (pH=10). The browning intensity (A<sub>420</sub>) of the caramelization product was found to be elevated by addition of polyphenols, especially phloretin, naringenin and epicatechin. Liquid chromatography analysis of the intermediate degradation products at 280 nm indicated that no detectable amount of furfural or 5-(hydroxymethyl)furfural was formed from fructose degradation under the conditions used. The amount of polar degradation intermediates was much higher at alkaline condition and significantly decreased upon addition of chlorogenic acid and rosmarinic acid. Besides, naringenin and phloretin were greatly consumed during caramelization process, possibly forming complex with sugar degradation intermediates. The antioxidative activity of the caramelization products was quantified by Trolox-equivalent antioxidant capacity assay. The results showed that all polyphenols tested significantly increased the antioxidant capacity of the caramelization products. When comparing the value with that of polyphenol equivalent heated alone, results were variable depending on both the pH and the polyphenol category, indicating the complexity of the interaction between polyphenol and sugar during caramelization process worthy further examination in order to provide constructive advice upon food processing.

**(O-II-6) IN VIVO HYPOLIPIDEMIC MECHANISMS OF FLAVOR COMPOUNDS FROM HERBAL ESSENTIAL OILS.** Sung-Joon Lee, Hee-jin Jun, Ji Hae Lee, Yaoyao Jia and Minh-Hien Hoang, Division of Food Bioscience and Technology, Korea University, Seoul, Republic of Korea, junelee@korea.ac.kr

We investigated the hypolipidemic effects of several herbal essential oils *in vitro* and *in vivo*. Essential oils from *Plantago asiatica* and its major compound showed hypocholesterolemic effects *in vitro* and *in vivo* mainly by down-regulation of sterol regulatory element binding protein-2, a key transcription factor in cellular cholesterol homeostasis. *Melissa officinalis* essential oil (MOEO) showed both anti-diabetic and lipid-regulating effects. Especially, orally administration of MOEO (12.5  $\mu$ g/d) to hypertriglyceridemic mice for 2 wk showed significant reductions in plasma triglyceride concentrations than in vehicle-treated group. Cellular triglyceride and cholesterol concentrations were also significantly decreased in a dose (400 and 800 mg/L)- and time (12 and 24 h)-dependent manner in HepG2 cells stimulated with MOEO compared with controls. Mouse hepatic transcriptome analysis revealed MOEO feeding rewired several lipid metabolic pathways including bile acid and cholesterol synthesis, and fatty acid metabolism. In HepG2 cells, the rate of fatty acid oxidation, as assessed using [1-<sup>14</sup>C]palmitate, was not changed, however, the rate of fatty acid synthesis quantified with [1-<sup>14</sup>C]acetate was significantly decreased by stimulation of 400 and 800 mg/L MOEO compared with untreated controls. This reduction was due to the reduced expression of *SREBP-1c* and its responsive genes in fatty acid synthesis including *FAS*, *SCD1*, and *ACCI*. Subsequent chromatin immunoprecipitation analysis also confirmed that the binding of PCAF, a coactivator of *SREBP-1c*, and histone H3 lysine 14 acetylation at the *FAS*, *SCD1*, and *ACCI* promoters were significantly reduced in the livers of hypertriglyceridemic mice and HepG2 cells with MOEO compared with their controls. In addition, MOEO stimulation in HepG2 cells induced bile acid synthesis and reduced the nuclear form of *SREBP-2*, a key transcription factor in hepatic cholesterol synthesis. These findings suggest that the intake of phytochemicals with pleasant scent could have beneficial metabolic effects.

Methylglyoxal (MGO), one of the most common reactive carbonyl species (RCS), can be generated endogenously and exogenously (human body and food system). RCS are attracting increased attention because of their relationship with diabetes and flavor generation. We will discuss MGO characteristics relating to flavor chemistry. MGO can be detected in food systems by GC and HPLC after derivatization. MGO formed in the Maillard reaction play important roles as precursors of aroma and color compounds, especially in Strecker degradation, a major flavor generation reaction. When combined with amino acids it undergoes Schiff base formation, decarboxylation and  $\alpha$ -aminoketone condensation leading to heterocyclic aroma compounds such as pyrazines, pyrroles and pyridines. It attacks amine groups in amino acids, peptides and proteins to form advanced glycation end products (AGEs) and cause carbonyl stress followed by oxidative stress and tissue damage. Therefore, many studies about scavengers of MGO are seen. The influence of these scavengers on flavor generation will be discussed.

### **Thursday AM (May 31<sup>st</sup>)**

**(O-III-1) OVEREXPRESSION OF LYSYL OXIDASE INVOLVED IN HUMAN BREAST CANCER CELL METASTASIS IS ATTENUATED BY MAGNOLOL THROUGH THE DOWN-REGULATION OF FOCAL ADHESION KINASE AND THE PAXILLIN SIGNALING PATHWAY.** *Chih-Hsiung Wu<sup>1,2,3,\*</sup>, Wen-Sen Lee<sup>4,\*</sup>, and Yuan-Soon Ho<sup>3,5,6,\*</sup>. <sup>1</sup>Department of Surgery, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, <sup>2</sup>Department of Surgery, Taipei Medical University-Shuang Ho Hospital, Taipei, Taiwan, <sup>3</sup>Center of Excellence for Cancer Research, Taipei Medical University, Taipei, Taiwan, <sup>4</sup>Graduate Institute of Medical Sciences, Taipei Medical University, Taipei, Taiwan, <sup>5</sup>School of Medical Laboratory Science and Biotechnology, College of Medicine, Taipei Medical University, Taipei, Taiwan, <sup>6</sup>Department of Laboratory Medicine, Taipei Medical University Hospital, Taipei, Taiwan, [hoyuansn@tmu.edu.tw](mailto:hoyuansn@tmu.edu.tw)*

The extracellular matrix (ECM) plays a critical role in the development and invasion of primary breast tumors. However, the function of the ECM components and the signaling that occurs between a permissive ECM and invasive breast cancer cells is not fully understood. Lysyl oxidase (LOX), which is an extracellular matrix remodeling enzyme, appears to have a role in promoting cancer cell motility and invasiveness. To ascertain whether LOX overexpression in Asian breast tumor tissues was associated with decreases in both metastasis-free and overall survival in breast cancer patients, the mRNA levels of LOX were examined in tumor/normal paired tissue samples with an real-time RT-PCR analysis (n = 246). To test whether specific LOX targeting by either the inhibition of its activity (beta-aminopropionitrile,  $\beta$ -APN; LOX inhibitor), mRNA expression (SiRNA), or protein expression (magnolol, 25  $\mu$ M) could attenuate the invasiveness of the breast cancer (MDA-MB-231) cells, a cancer cell migration assay was performed. Interestingly, only 78.5% (n=193) of the breast cancer tumors displayed detectable LOX expression. Nearly 60% (n=120) of the cases fell into Group 1 (tumor > normal, T>N), in which the LOX expression in the tumor cells was 20.2-fold greater than that of the normal cells. However, in Group 2 (normal > tumor, N>T), the LOX expression level in most of the normal tissues (80%, 59/73) was determined to be less than five-fold greater than the level in the tumor tissues. We further demonstrated that the LOX-induced invasive and metastatic properties of breast tumor cells resulted from hydrogen peroxide-mediated FAK/Src activation. The increased level of active LOX in the invasive breast cancer (MDA-MB-231) cells was accompanied by the phosphorylation of FAK Tyr-576 and paxillin Tyr-118. We also found that addition of  $\beta$ -APN (300  $\mu$ M) synergistically potentiated the migration and invasiveness inhibition of the MDA-MB-231 cells by magnolol (25  $\mu$ M). These results describe for the first time the higher expression level of a LOX protein in Asian breast tumor patients. Moreover, the results indicate that the inhibition of LOX by magnolol may represent a desirable strategy for breast cancer therapy than  $\beta$ -APN.

**(O-III-2) MOLECULAR TARGETS OF 6-SHOGAOL: ITS POTENTIAL ROLES IN CANCER CHEMOPREVENTION.** *Min-Hsiung Pan<sup>1,\*</sup>, Min-Chi Hsieh<sup>1</sup> and Chi-Tang Ho<sup>2</sup>, <sup>1</sup>Department of Seafood Science, National Kaohsiung Marine University, Kaohsiung 811, Taiwan, <sup>2</sup>Department of Food Science, Rutgers University, New Brunswick, New Jersey 08901, USA, [mhpan@mail.nkmu.edu.tw](mailto:mhpan@mail.nkmu.edu.tw)*

We previously reported that 6-shogaol strongly suppressed lipopolysaccharide-induced up-expression of inducible NO synthase (iNOS) and cyclooxygenase-2 (COX-2) in murine macrophages. In this study, we further compared curcumin, 6-gingerol, and 6-shogaol's molecular mechanism of action and their anti-tumor properties. We demonstrated that topical application of 6-shogaol more effectively inhibited TPA-stimulated transcription of iNOS and COX-2 mRNA expression in mouse skin than curcumin and 6-gingerol. Pretreatment with 6-shogaol has resulted in the reduction of TPA-induced nuclear translocation of the nuclear factor- $\kappa$ B (NF $\kappa$ B) subunits. 6-Shogaol also reduced TPA-induced phosphorylation of I $\kappa$ B $\alpha$  and p65, and caused subsequent degradation of I $\kappa$ B $\alpha$ . Moreover, 6-shogaol markedly suppressed TPA-induced activation of extracellular signal-regulated kinase (ERK)1/2, p38 mitogen-activated protein kinase (MAPK), JNK1/2, and phosphatidylinositol 3-kinase (PI3K)/Akt, which are upstream of NF $\kappa$ B and

AP-1. Furthermore, 6-shogaol significantly inhibited 7,12-dimethylbenz[a]anthracene (DMBA)/TPA-induced skin tumor formation measured by the tumor multiplicity of papillomas at 20 weeks. Presented data for the first time reveal that 6-shogaol is an effective anti-tumor agent that functions by down-regulating inflammatory iNOS and COX-2 gene expression in mouse skin. It is suggested that 6-shogaol is a novel functional agent capable of preventing inflammation-associated tumorigenesis.

**(O-III-3) INHIBITORY EFFECT ON *HELICOBACTER PYLORI*-INDUCED INFLAMMATION IN HUMAN GASTRIC EPITHELIAL AGS CELLS OF *IXERIS CHINENSIS* EXTRACTS.** *Chin-Kun Wang, Chung Shan Medical University, Taichung, Taiwan, wck@csmu.edu.tw*

*Ixeris chinensis* (Thunb.) Nakai, a traditional herb medicine, is found as a pain relief and detoxification. The goal of this study was to evaluate the inhibition on the adhesion/invasion of *Helicobacter pylori* to AGS cells. Results showed that boiling water extract (BWE) of *Ixeris chinensis* exhibited better antioxidation than those of ethanol extracts (EE) and chloroform extracts (CE). BWE also contained high levels of phenolics and flavonoids. The lag time of human low-density lipoprotein (LDL) oxidation induced by copper was greatly increased by BWE, EE and CE. CE showed inhibition and bactericidal effect on *H. pylori*. However, the effect on *H. pylori*-induced gastric epithelial cells inflammation was found by BWE and CE. Especially, strong inhibition on the levels of nitric oxide and interleukin 8 were found. In addition, BWE could increase the numbers of probiotics (*Lactobacillus* spp. and *Bifidobacterium* spp.), BWE and CE could inhibit the growth of *Clostridium perfringens* and *Escherichia coli*.

**(O-III-4) 2,4,5-TRIMETHOXYBENZALDEHYDE SUPPRESSES ADIPOGENESIS THROUGH DOWNREGULATION OF MAPKs, C/EBPs, PPAR $\gamma$ , AND ACETYL-COA CARBOXYLASE.** *Chiafeng Kuo, Man-Ru Wu and Ya-Lin Lin, Department of Food Science, Nutrition, and Nutraceutical Biotechnology, Shih Chien University, Taipei, Taiwan, drfanniekuo@yahoo.com.tw*

Obesity is a global health problem. Due to the high costs and side effects of obesity-treatment drugs, the potential of natural products (extracts as well as single compounds) as alternatives for treating obesity is under exploration. *Antrodia camphorate* (also named Niuchangchih) is a native fungus in Taiwan that grows only on the endemic *Cinnamomum kanethirai*. *A. camphorate* is one of the most valuable medicinal fungus, the extracts of fruiting body and fermentation mycelia of *A. camphorate* has been widely developed as anti-inflammatory, anti-cancer, and liver-protective nutraceuticals in Asia; however, its anti-obesity effect has never been studied. The major volatile compound of *A. camphorate* fruiting body, 2,4,5-trimethoxybenzaldehyde (2,4,5-TMBA), was reported to be a significant inhibitor of cyclooxygenase-2 (COX-2) catalytic activity. Because COX-2 is associated with differentiation of preadipocytes, the murine 3T3-L1 cells were co-cultured with 0, 0.5 or 1.25 mM of 2,4,5-TMBA during differentiation to study the effect of 2,4,5-TMBA on adipogenesis. Oil Red O staining and triglyceride assay revealed that 2,4,5-TMBA dose-dependently inhibited the formation of lipid droplets. During differentiation, 2,4,5-TMBA down-regulated the protein levels of adipogenic signaling molecules and transcription factors extracellular signal-regulated kinase (ERK), c-Jun amino-terminal kinase (JNK), CCAAT/enhancer binding protein (C/EBP) $\alpha$ ,  $\beta$ ,  $\delta$ , peroxisome proliferator-activated receptor (PPAR) $\gamma$  as well as the rate-limiting enzyme of lipid synthesis, acetyl-CoA carboxylase (ACC). Moreover, 2,4,5-TMBA suppressed the expression of perilipin, the protein required for the formation of lipid droplets in adipocytes. These results showed for the first time that the constituent of *Antrodia camphorate* has anti-adipogenic effect.

**(O-III-5) A STUDY FOR ANTISTRESS AND AROUSAL EFFECTS OF BLENDING ESSENTIAL OILS IN HUMANS AND RATS.** *HongKeun Oh, Jeonju University, Jeonbuk, Korea, haroma@nate.com*

This study was performed to evaluate the antistress and arousal effects of essential blending oil I including *Cedrus atlantica*, *Citrus aurantium*, *Mentha piperita* and so on. Aroma blending oil II was composed of *Citrus bergamia*, *Rosemarinus officinalis*, *Citrus aurantium*, and so on. Aroma blending oil III included *Rosemarinus officinalis*, *Citrus limonum*, *Ocimum basilicum* and so on. The subjects were 20 (10 for men, 10 for women) for human and 25 for rat, respectively. They were divided into 4 groups such as those for non aroma inhalation, aroma blend I, aroma blend II, and aroma blend III in humans. On the other hand, 5 groups were composed of normal, control with water stress, aroma blend I, aroma blend II, and aroma blend III in rats. Vital factors (blood pressure, pulse, respiratory rate), electroencephalography, psychological tests (SACL, STAI) were applied for men and serum catecholamine and liver PCOOH for experimental rats. In conclusion, aroma III and II were significantly valuable in antianxiety effect whereas aroma I and III showed the highest antistress effect statistically. The most effective antistress, antianxiety and arousal states were exhibited in aroma III. Increased serum catecholamines and liver PCOOH levels by water stress were normalized after inhalation of each three aroma oils in experimental rats.

**(O-III-6) VISCOUS EMULSIONS ENHANCED BIOEFFICACY OF POORLY-SOLUBLE POLYMETHOXYFLAVONES (PMF) IN COLITIS-RELATED MOUSE COLON CARCINOGENESIS INDUCED BY AOM/DSS.** *Yuwen Ting<sup>1</sup>, Shiming Li<sup>1</sup>, Min-Hsiung Pan<sup>2</sup>, Chi-Tang Ho<sup>1</sup> and Qingrong Huang<sup>1</sup>,*

Polymethoxyflavones (PMFs) and corresponding hydroxylated PMFs are phytochemicals documented to show promising anti-inflammatory, anti-cancer, anti-atherosclerosis, and selective anti-proliferative activity to cancer over normal cells. Due to low aqueous solubility and rapid metabolic activities, the bioavailability of PMFs is usually far below the effective dosage for meaningful biofunctionality to occur. Therefore, utilizing delivery system to enhance the solubility and/or modulate metabolic activities may be an effective means to augment bioefficacy of PMFs. Simple viscous emulsion systems containing PMFs have been designed. Tangeretin (5,6,7,8,4'-pentamethoxyflavone) and its corresponding hydroxylated PMF, 5-demethyltangeretin (5-hydroxy-6,7,8,4'-tetramethoxyflavone) have been used as model compounds for the development of delivery systems. Chronic inflammation that causes ulcerative colitis is commonly linked with increase risk of colorectal cancer (CRC) development. To mimic human colitis related colon carcinogenesis, we chemically induced CRC in mouse model using combination of azoxymethane (AOM) and dextran sulfate sodium (DSS). In this experiment, PMF emulsion and PMF oil suspension (100 mg/kg) was gavage administered to 5-week-old male ICR mice 1 week before receiving single dose of AOM intraperitoneal injection (10 mg/kg) followed by 2% (w/v) DSS in drinking water for 7 days. Together with 1 week pretreatment and 10 weeks of post AOM/DSS gavage administration of PMFs, mice were sacrificed at end of 11 weeks for pathological analysis. Oral administrations of PMFs emulsion were more potent to inhibit AOM/DSS induced inflammatory and proliferative protein expression than PMF oil suspensions. In comparison with oil suspended PMFs, tumor incidence decreased 18% for tangeretin emulsion and 33% for 5-demethyltangeretin emulsion. Reduction in tumor multiplicity was also observed in emulsion processed PMFs. Results from the experiment indicate the potential of delivery system as effective mean to augment bioefficacy of PMFs as well as allow the easier incorporation of these health-promoting lipophilic compounds into novel food products.

**(O-III-7) TOTAL PHENOLICS, ANTIOXIDANT AND ANTIBACTERIAL ACTIVITY OF COMMERCIAL POMEGRANATE BASED JUICES FROM GREECE.** *E. Ch. Zorgafou, A. Kallimanis, K. Akrida-Demertzi and P. G. Demertzis\**, University of Ioannina, Department of Chemistry, Laboratory of Food Chemistry, GR-45110, Ioannina, Greece, [pdemertz@uoi.gr](mailto:pdemertz@uoi.gr)

Pomegranate (*Punica granatum*) is a fruit that increasingly is becoming recognised for its health properties, prompting the development of derivate products that attempt to keep the main properties of the raw fruit. Pomegranate can be consumed as a fruit or is used for the production of juices, jams, jellies, flavorings for drinks etc. Pomegranate juices may also be combined with other fruit juices. In the present study, five commercial pomegranate-based juices (natural pomegranate juice, natural pomegranate-strawberry juice, and natural pomegranate-blackberry juice, pomegranate juice from concentrate and pomegranate-grape juice from concentrate) were analyzed for total phenolics, antioxidant and antibacterial activity. The amount of total phenolics was measured with the Folin-Ciocalteu reagent and the antioxidant capacity was determined by the scavenging activity against 2,2-diphenyl-1-picrylhydrazyl (DPPH). The antibacterial activity of the juices was screened using two Gram-positive bacteria (*Staphylococcus aureus*, *Listeria monocytogenes*) and one Gram-negative (*Escherichia coli*). Results showed that the juices from concentrate contained noticeably higher total phenolics than the other juices. Furthermore, the addition of other fruit juices (blackberry, strawberry) to the natural pomegranate juice increased the amount of the phenolics. The DPPH method revealed that higher concentration of phenolic content of the juices is associated with higher radical scavenging activity. In the microbiological assay, the most sensitive bacteria to the juices tested were *S. aureus* and *E. coli*. Little or no inhibitory effect was observed against *L. monocytogenes*.

### **Friday AM (June 1<sup>st</sup>)**

**(O-IV-1) SUPPRESSION OF THE DEFORMATION OF RAJI CELLS BY(E)-2-ALKENALS, AROMA COMPONENTS OF CORIANDER (*CORIANDRUM SATIVUM* L.) LEAVES, AND BEHAVIOR AND ABSORPTION OF (E)-2-DODECENAL IN RAT BLOOD.** *Shunsuke Kano<sup>1</sup>, Kazunori Maeyama<sup>2</sup>, Yueming Wang<sup>2</sup>, Akira Kondo<sup>2</sup>, Toshio Furumoto<sup>2</sup>, Hiroshi Fukui<sup>2</sup> and Hirotoshi Tamura<sup>1,2</sup>*, <sup>1</sup>United Graduate School of Agricultural Sciences, Ehime University, <sup>2</sup>Graduate School of Agriculture, Kagawa University, Kagawa, Japan, [tamura@ag.kagawa-u.ac.jp](mailto:tamura@ag.kagawa-u.ac.jp)

(E)-2-alkenals (C<sub>10</sub>-C<sub>16</sub>) that were isolated from leaves of coriander (*Coriandrum sativum* L.), have anti-deforming activity of Raji cells carrying the genome of Epstein-Barr virus (EBV) early antigens. Investigation on their active intensity (C<sub>6</sub>-C<sub>14</sub>) reveals that the activity is correlated with the length of carbon chain of the unsaturated aldehydes. Furthermore, analysis of (E)-2-decenal and its derivatives having the same carbon length showed that (E)-2-decenal is one of the strongest chemicals for the activity. We suppose that the combination of the carbonyl oxygen atom at the C<sub>1</sub> position with the conjugated double bond at the C<sub>2</sub> position as well as the length of the carbon chain might be important for the activity of decreasing of deformed Raji cells with TPA, one of cancer promoter. Furthermore, behavior of (E)-2-dodecenal in rat blood was also monitored by sampling of bloods from a plastic tube, so called a cannular. After the administration of (E)-2-dodecenal in blood was collected over a period of time, (E)-2-dodecenal disappeared immediately in blood. In addition, rats were placed in a closed chamber

Omega-3 fatty acids are present in both terrestrial and aquatic species. The long-chain omega-3 fatty acids, namely eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and to a lesser extent docosapentaenoic acid (DPA) are best known for the effects in lowering the serum level of triacylglycerols and reducing the incidence and the intensity of arrhythmias. These fatty acids are present in algal species as well as in the oil from fish and shellfish as well as marine mammals. More recent literature has also demonstrated their use in alleviating metal disorders as well as a variety of other hormone-like-dependent ailments. The presentation will provide an overview of the topic and also examines the beneficial effect of complex molecules that contain these fatty acids and could potentially render health benefits.

**(O-IV-3) INHIBITORY EFFECT OF SOME FRUIT FLAVORS ON ACETYLCHOLINESTERASE ACTIVITY AND SOME PRO-OXIDANT INDUCED LIPID PEROXIDATION IN RATS' BRAIN.** *G. Oboh, A. J. Akinyemi and A. O. Ademiluyi, Department of Biochemistry, Federal University of Technology, Akure, Nigeria, P.M.B., 704, Akure 340001, Nigeria, goboh2001@yahoo.com*

This study sought to investigate the inhibitory effect of some commonly used fruit flavors on acetylcholinesterase (AChE) activity and some pro-oxidants (FeSO<sub>4</sub> and Quinolinic acid) induced lipid peroxidation in rat brain - *in vitro*. The flavorants; Orange, Lemon, Pineapple, Banana and Strawberry flavors were prepared (1:10 v/v) and subsequently the antioxidant activities as typified by their DPPH free radical scavenging ability, ABTS<sup>++</sup> scavenging ability, reducing power and *in vitro* inhibition of Fe<sup>2+</sup> and quinolinic acid induced lipid peroxidation in rat's brain was determined thereafter their inhibitory effect on acetylcholinesterase activity was determined.

**(O-IV-4) ANTIHYPERTENSIVE ACTIONS OF FERMENTED BUCKWHEAT SPROUT IN NORMOTENSIVE SPRAGUE-DAWLEY RATS.** *K. Nakamura<sup>1</sup>, Y. Yuzawa<sup>1</sup> and Y. Koyama<sup>2</sup>, <sup>1</sup>Department of Bioscience and Biotechnology, Graduate School of Agriculture, Shinshu University, Nagano, Japan, <sup>2</sup>Department of Bioscience and Food Production Science, Interdisciplinary Graduate School of Science and Technology, Shinshu University, Nagano, Japan, knakamu@shinshu-u.ac.jp*

"Fermented Buckwheat Sprout (FBS)" is a fermenting product of crushed buckwheat sprouts by *Lactobacillus*. FBS makes an excellent antihypertensive effect on spontaneously hypertensive rats (SHRs) through endothelium-dependent vasorelaxation and ACE inhibitory activity *in vivo*. In a single oral administration to SHRs, 0.01 mg/kg dose of FBS significantly decreased blood pressures, and the maximum blood pressure lowering effects were  $-22.2 \pm 3.5$  mmHg (mean  $\pm$  S.E.) in systolic blood pressure (SBP) and  $-14.2 \pm 1.7$  mmHg in diastolic blood pressure (DBP) compared to a control group. FBS demonstrated dose-dependent vasorelaxation on phenylephrine-precontracted thoracic aorta rings of SHRs. The effective concentration causing 50% relaxation (EC<sub>50</sub>) was  $8.3 \pm 1.4$   $\mu$ g/ml and 50  $\mu$ g/ml of FBS produced a relaxation of 82.8% in the rings. In a single oral administration of 10 mg of FBS, ACE activities in heart, kidney, liver, lung, and thoracic aorta of SHRs were significantly inhibited. The ACE inhibitory activities of FBS in each tissue were 61.6, 16.1, 60.6, 21.9, and 36.4%, respectively. On the other hand, FBS did not effect on blood pressures of normotensive Sprague-Dawley (SD) rats. FBS was single orally administrated to SD rats at a dose of 10 mg, which was 1000 times more amount of effective dose to SHRs, and both SBP and DBP did not changed compared to control group. FBS demonstrated weak vasorelaxation on phenylephrine-precontracted thoracic aorta rings of SD rats only at a low concentration. A relaxation of  $8.2 \pm 2.3\%$  in the rings was observed at 5  $\mu$ g/ml of FBS. ACE activities in local tissues of SD rats did not affected by a single oral administration of 10 mg of FBS. It was suggested that these differences in the antihypertensive actions of FBS were caused by differences of vasoregulation systems between SHR and SD rat.

**(O-IV-5) TEA-DRINKING AS A GOOD STRATEGY TO PREVENT SMOKING AND HORMONE-INDUCED HUMAN BREAST CANCER CELLS PROLIFERATION THROUGH INHIBITION OF  $\alpha$ 9-NICOTINIC ACETYLCHOLINE RECEPTOR.** *Yuan-Soon Ho<sup>1,2,3</sup>, <sup>1</sup>School of Medical Laboratory Science and Biotechnology, College of Medicine, Taipei Medical University, Taipei, Taiwan, <sup>2</sup>Department of Laboratory Medicine, Taipei Medical University Hospital, Taipei, Taiwan, <sup>3</sup>Center of Excellence for Cancer Research, Taipei Medical University, Taipei, Taiwan, hoyuansn@tmu.edu.tw*

The aim of this research was to explore whether the tea extract and its polyphenol (-)-epigallocatechin-3-gallate (EGCG) could be used as a potential agent for blocking smoking (nicotine, Nic)- or hormone (estradiol, E2)-induced breast cancer cell proliferation through inhibition of a common signaling pathway. We found that Nic (>0.1  $\mu$ M, 24 h) and E2 (>1 nM, 24 h) significantly increased  $\alpha$ 9-nicotinic acetylcholine ( $\alpha$ 9-nAChR) mRNA and protein expression levels in human breast cancer (MCF-7) cells. We then hypothesized that tea or agents with inhibitory effects on  $\alpha$ 9-nAChR protein levels could be used to block the Nic- or E2-mediated carcinogenic signals. Our results indicated that treatment with tea extract or polyphenol (-)-epigallocatechin-3-gallate (EGCG, 1  $\mu$ M) profoundly decreased Nic- and E2-induced MCF-7 proliferation by down regulating  $\alpha$ 9-nAChR expression. We further demonstrated



that oral administration of tea powder (2000 mg/day) profoundly inhibited the  $\alpha 9$ -nAChR expression in human peripheral blood cells. This study provides the novel antitumor mechanisms of tea polyphenols and such results may have significant applications for chemopreventive purpose in human breast cancer.

**(O-IV-6) TETRAHYDROCURCUMIN (THC) POTENTLY SUPPRESSES AZOXYMETHANE-INDUCED COLON CARCINOGENESIS IN MICE.** *Min-Hsiung Pan<sup>1</sup>, Jia-Ching Wu<sup>1</sup>, Ching-Shu Lai<sup>1</sup>, Vladimir Badmaev<sup>2</sup>, Kalyanam Nagabhushanam<sup>3</sup> and Chi-Tang Ho<sup>4</sup>, <sup>1</sup>Department of Seafood Science, National Kaohsiung Marine University, Kaohsiung 81143, Taiwan, <sup>2</sup>Laboratory of Applied Pharmacology, 1440-6 Forest Hill Road, Staten Island, NY 10314, USA, <sup>3</sup>Sabinsa Corporation, 20 Lake Drive, East Windsor, NJ 08520, USA, <sup>4</sup>Department of Food Science, Rutgers University, New Brunswick, New Jersey 08901, USA, mhpan@mail.nkmu.edu.tw*

In this present study, we investigated the chemopreventive effects and underlying molecular mechanisms of dietary administration of curcumin and THC in azoxymethane (AOM)-induced colon carcinogenesis in mice. All mice were sacrificed at 6 and 23 weeks, and colonic tissue were collected and examined. We found that dietary administration of both curcumin and THC could reduce aberrant crypt foci (ACF) and polyps formation, while THC showed a better inhibitory effect than curcumin. At the molecular levels, the results from western blot analysis and immunohistochemistry staining showed that dietary curcumin and THC exhibited the anti-inflammatory activity by decreasing the levels of inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2) through down-regulation of extracellular signal-regulated protein kinase (ERK)1/2 activation. In addition, both dietary curcumin and THC significantly decreased AOM-induced Wnt-1 and  $\beta$ -catenin protein expression, as well as the phosphorylation of GSK-3 $\beta$  in colonic tissue. Moreover, dietary feeding with curcumin and THC markedly reduced the protein level of connexin-43 (Cx-43), an important molecule of gap junction, indicating both curcumin and THC might interfere the intercellular communication of crypt cells. Taken together, these results demonstrated for the first time the *in vivo* chemopreventive efficacy and molecular mechanisms of dietary THC against AOM-induced colonic tumorigenesis.

**(O-IV-7) IMPROVEMENT OF TEA POLYPHENOL MILK ON LIVER AND SKIN.** *Chin-Kun Wang, Chung Shan Medical University, Taichung, Taiwan, wck@csmu.edu.tw*

Tea polyphenols showed health benefits. To provide the dairy calcium and nutrients, and also give the function of tea polyphenols, this study was focused on the health benefits of combined tea polyphenols and milk. Antioxidation, antiaging and the improvement on liver and skin were determined. This was a randomized, placebo controlled, double blind and cross over design. 42 subjects (17 males and 25 females, separated into two groups) were completely involved in this study. Total experimental period was thirteen months. One group of the subjects took placebo in initial six months and tea polyphenol milk in later six months, one month between the two periods was wash-out period. The other group was a opposite design. Anthropometric measurements, blood collection, abdominal ultrasonic and skin examination was given at initial, 3<sup>rd</sup>, 6<sup>th</sup>, 10<sup>th</sup>, 13<sup>th</sup> month during this testing period. Results revealed that subjects taking 2 packs of tea polyphenol milk (35g/pack in 240 mL water) for six months showed no difference in anthropometric characteristics. However, total antioxidant capacity of plasma was significantly increased and TBARs values were greatly reduced. In addition, the levels of total phenols, glutathione and ascorbic acid in plasma were significantly increased. Enzyme activity such as glucose-6-phosphate dehydrogenase, catalase, glutathione peroxidase, glutathione reductase and glutathione S-transferase in erythrocytes were greatly increased. No effect on liver and kidney were found. Skin elasticity for people over 60 years old was significantly improved and skin roughness also greatly reduced after the use of tea polyphenol milk.

### **Friday PM (June 1<sup>st</sup>)**

**(O-V-1) SUSTAINABILITY IN THE FOOD INDUSTRY.** *Sara J. Risch, Popz Europe, sjrisch@sbcglobal.net*

While the concept of sustainability has been around for a number of years, it has gotten much more attention in the food industry recently. One early definition, which came out of a 1987 UN conference, was that we be able to “meet present needs without compromising the ability of future generations to meet their needs”. There are several main areas in which the food industry can focus to be sustainable. One of the first is in agricultural practices. An example of one major effort is specifically for palm oil where companies have formed the Roundtable for Sustainable Palm Oil (RSPO). The organization has established standards to certify palm plantations as sustainable. Another area is packaging. This brings out one important consideration in that packaging is designed to protect the product and while one package may be bio-based or bio-degradable, it cannot compromise the quality of the product. Water is also a major consideration in agriculture and food processing. All of these as well as other factors influencing decisions on how the food and flavor industry can be sustainable will be addressed.

**(O-V-2) DECREASE OF WINE AROMA ESTERS BY Fe II AND Fe-H<sub>2</sub>O<sub>2</sub>.** *M. Patrianakou and I. G. Roussis, Laboratory of Food Chemistry, University of Ioannina, Greece, iroussis@uoi.gr*

The effect of the addition of Fe II and of Fe II along with H<sub>2</sub>O<sub>2</sub> on wine volatile esters was studied. FeCl<sub>2</sub> 4H<sub>2</sub>O, and also FeCl<sub>2</sub> 4H<sub>2</sub>O along with hydrogen peroxide were added into Chardonnay white wine and wines analyzed during storage for up to 270 and 40 days respectively, in comparison with control. Volatile esters were evaluated using SPME/ GC-MS, while the absorbance at 420 nm was also measured as index of oxidative browning. In control wine, by the time, the absorbance at 420 nm increased and the concentrations of several esters decreased. The addition of Fe II, and also of Fe II along with hydrogen peroxide led to increased oxidative browning in comparison with control. Moreover, led to decreased concentrations of most esters, mainly of ethyl decanoate, ethyl octanoate, ethyl hexanoate and ethyl acetate which exist in higher concentration and play a significant role in wine aroma. The decrease of esters can be attributed to oxidation by hydroxyl radicals, since it is accepted that at the pH of wine, Fe II transforms oxygen to hydrogen peroxide and then to hydroxyl radicals. Present results indicate that during wine aging and storage ester oxidation occurs along with hydrolysis and esterification phenomena, and that significant part of wine aroma can be lost by oxidation.

**(O-V-3) IDENTIFICATION OF ODOR ACTIVE COMPOUNDS OF VIBURNUM OPULUS AND ARONIA MELANOCARPA FRUITS BY GAS CHROMATOGRAPHY AND OLFACTOMETRY.** V. Kraujalytė<sup>1</sup>, P. R. Venskutonis<sup>1</sup> and E. Leitner<sup>2</sup>,  
<sup>1</sup>Kaunas University of Technology, Kaunas, Lithuania, <sup>2</sup>University of Technology, Graz, Austria, rimas.venskutonis@ktu.lt

Berry fruits are widely consumed in human diet due to their beneficial health effects and distinct flavour. The growing interest in natural food ingredients in recent years has been an important factor in expanding the studies of less common horticultural plants. *In vitro* studies confirmed that European cranberry bush (*V. opulus*) and black chokeberry (*A. melanocarpa*) berries exhibit antioxidative and anticarcinogenic effects, which are associated with high concentration of phenolics. Therefore they may be regarded as a promising source of bioactive compounds for wider applications in foods and nutraceuticals. However, regardless the presences of healthy compounds, consumer preferences are highly influenced by sensory characteristics. *V. opulus* berries possess some typical smell notes, which are disliked by the consumers, while raw *A. melanocarpa* berries possess bitter-almond smell and astringent taste and therefore has a limited use on industrial scale. The main objective of this study was to identify odor active compounds of *V. opulus* and *A. melanocarpa* fruits. For this purpose volatile and odor active compounds of five cultivars of *V. opulus* and two cultivars of *A. melanocarpa* juices were studied by solid phase microextraction of headspace volatiles and subsequent analysis by gas chromatography, mass spectrometry and olfactometry (SPME-HS-GC-MS-O). Volatiles identified in the headspace of *V. opulus* and *A. melanocarpa* juices were mainly breakdown products of fatty acids, followed by amino acid derivatives and terpenoid derivatives. Odor active compounds were detected and characterised by a trained panel of judges in the course of GC-O by using detection frequency analysis. 3-methyl-butanoic and 2-methyl-butanoic acids as well as linalool and ethyl decanoate were found to be the main odor active components in *V. opulus* aroma. Ethyl-2-methyl-butanoate, ethyl-3-methyl-butanoate, nonanal, ethyl decanoate and one unknown compound were recognized as the most important odor active components in *A. melanocarpa* aroma. Funded by Research Council of Lithuania SVE-04/2011.

**(O-V-4) INHIBITORY ACTIVITIES OF VITAMINS ON 7-KETOCHOLESTEROL FORMATION IN BOTH CHEMICAL MODEL SYSTEMS AND BEEF PATTIES**  
Daniel Wong, Kawing Cheng and Mingfu Wang, School of Biological Sciences, The University of Hong Kong, Hong Kong, h0722341@hku.hk

Cholesterol Oxidation Products (COPs), produced by Cholesterol oxidation, are a family of oxidative products generated in high-temperature processing and prolonged storage. COPs could be differentiated into two distinct origins – enzymatic and non-enzymatic source. They are implicated in various food sources, and known to exert certain chemical effects like toxicity, HMG-COA reductase inhibition and atherogenesis effect on human. Considerable researches were conducted to develop strategies as to reduce the associated risk. Yet, direct evidence regarding their effects on COPs formation is still lacking. The formation pathways of COPs have partially elucidated. However, there is still controversy over the inhibition mechanism on COPs formation. The objective of the present study is to identify potent inhibitors of COPs formation from 15 vitamins using chromatographic methods in beef patties. Moreover, the roles of pyridoxamine (the most potent inhibitors) in the formation of 7-ketocholesterol is characterized. The detailed mechanism involved in cholesterol oxidation model system is elucidated. To conclude, vitamin C, A, E and PM can significantly lower the formation of 7-ketocholesterol. Their antioxidant activities only make minor contribution to their inhibitory activities. Their inhibitory activities are mainly mediated via their direct participation in Cholesterol oxidation: direct trapping of the final secondary oxidative product – 7-ketocholesterol.

**(O-V-5) ANALYSIS OF THE AROMA PROFILE OF FOOD PRODUCTS USING A MICRO CHAMBER THERMAL EXTRACTION SYSTEM AND THERMAL DESORPTION (TD) GC-TOF (MS) DETECTION.**  
Gareth M. Roberts, Paul Morris, Daniel Cooper and Stephen Smith, Markes International Ltd., Gwaun Elai Medi Science Campus, Llantrisant, RCT, CF72 8XL, UK, garethroberts@markes.com

The ability to characterise the aroma profile of food products is commercially important for several reasons. These include product quality/consistency, consumer attraction (flavor indicators) and off-odour analysis as a measure of decay or contamination. To study this profile, a micro chamber/thermal extraction system ( $\mu$ -CTE) is described which enables the volatile and semi volatile organic chemicals (VOC/SVOC's) to be monitored from a variety of food products. This will include the odor profile of pork meat and cheese

(Brie, Stilton, Cheddar) for both fresh and aged samples and the identification of pyrazine flavor compounds in potato crisps. Sample preparation, analysis and detection employs a multi hyphenated approach combining dynamic headspace extraction ( $\mu$ -CTE), thermal desorption (TD) preconcentration with a new high sensitivity GC/TOF MS system. The  $\mu$ -CTE can accommodate bulk (grms) samples, which are placed into a series of chambers, heated (optional) and purged with an inert gas. The effluent from each chamber is subsequently trapped by a thermal desorption sample tube containing selective sorbents allowing the whole VOC/SVOC profile to be monitored, including Sulphur compounds. The ability of the TD system to quantitatively recollect a (split) proportion of the sample after desorption from the TD tube and/or cold trap is described which enables re-analysis of the same sample. This provides a technique to look at both the high concentration components (high split), followed by a low split method for trace level analysis. Detection using the BenchTOF-dx (ALMSCO International) GC based time-of-flight MS system provides sensitivity equivalent to Quadrupole systems in SIM mode but with full spectrum data from 1-1000 Da. This provides the optimum screening detector for both target and unknown compounds and the classical EI spectra derived from the TOF enables identification of chromatographically resolved compounds using commercially available libraries e.g. NIST, Wiley.

**(O-V-6) EVALUATION OF PROCESSING CONDITIONS IN SAVORY FLAVOR DEVELOPMENT.** *S. Ramakrishnan, B. Oladipupo, R. Kolli, M. Teasdale, N. Guthrie, J. Benning, P. Moeller and R. Telman, AFB International, #3 Research Park Drive, St. Charles, Missouri 63304, USA, sramakrishnan@afbinternational.com*

This study attempts to correlate various process conditions used in savory flavor creation in the presence of a mixture of proteins and sugars at varying pH, time, and temperature. The products were generated using a Taguchi  $L_{12}$  screener Design to understand the impact of process variables on sensory score in pet food. The data from this screener design was further used to understand processing parameter impacts on generation of various functional classes of compounds through the reaction. This work helped to demonstrate the application of Design of Experiment tool to evaluate and identify important parameters for generating processed flavors. The approach provides a tool to evaluate multiple factors for product development in an efficient way along with providing data for further mechanistic investigation through modeling.

**(O-V-7) ENZYMATIC MODIFICATION OF WHEAT PROTEINS FOR FLAVOR GENERATION.** *Marissa Villafuerte Romero and Chi-Tang Ho, Department of Food Science, Rutgers University, 65 Dudley Road, New Brunswick, NJ 08901, ho@aesop.rutgers.edu*

Wheat gluten was modified by enzymatic hydrolysis only or in combination with enzymatic deamidation. When subjected to Maillard reaction, the hydrolysates generated important flavor compounds such as pyrazines and furans. Umamizyme or Flavourzyme was used for hydrolysis whereas Glutaminase Daiwa was used for deamidation. Isolation of volatile compounds was conducted by solid-phase microextraction (SPME) followed by identification by gas chromatography-mass spectrometry (GC-MS). Single or double enzymatic treatment produced same volatiles but in general, deamidation increased the quantities. The major pyrazines identified were methylpyrazine, 2,5-dimethylpyrazine, 2-ethylpyrazine, and 2-methyl-6-propylpyrazine whereas the major furans include 2-furfural, 2-acetylfuran, 2-furfuryl alcohol, and 5-methyl-2-furfural. Although similar volatile profiles were obtained in Umamizyme and Flavourzyme systems, much greater amounts of flavor compounds were observed in the former.

## POSTER/PRESENTER LIST

| <u>Last Name</u>             | <u>First Name</u> | <u>Country</u>  | <u>Presentation</u><br><u>O-oral; P-poster</u> |
|------------------------------|-------------------|-----------------|--|
| Ademiluyi,                   | A. O.             | Nigeria         | O-IV-3   |
| Akhondan                     | Hoda              | Iran            | P-11   |
| Akrida-Demertzi              | Konstantoula      | Greece          | P-18   |
| Baek                         | Hyung Hee         | Korea           | O-I-4  |
| Bikaki                       | Nantia            | Greece          | P-25   |
| Broekhans                    | Joost             | The Netherlands | O-II-3   |
| Chiou                        | Yi-Shiou          | Taiwan          | P-6  |
| Chranioti                    | Charikleia        | Greece          | P-15   |
| Chung                        | Chieh-Han         | Taiwan          | P-29   |
| Delgado                      | Rosa María        | UK              | P-2  |
| Demertzis                    | Panagiotis G.     | Greece          | P-17, O-III-7                                  |
| Estephan                     | Nathalie          | Lebanon,        | P-19   |
| Ho                           | Chi-Tang          | USA             | O-II-7, O-V-7                                  |
| Ho                           | Yuan-Soon         | Taiwan          | O-III-1, O-IV-5                                |
| Hwang                        | Lucy              | Taiwan          | P-5  |
| Kali                         | Kotsiou           | Greece          | P-24   |
| Kim                          | Young-Suk         | Korea           | O-I-1  |
| Kostadinović-<br>Veličkovska | Sanja             | Macedonia       | P-4  |
| Kourkoutas                   | Yiannis           | Greece          | P-10, P-14                                     |
| Kuo                          | Chiafeng          | Taiwan          | O-III-4  |
| Lee                          | JaeHwan           | Korea           | O-I-6  |
| Lee                          | Sang Mi           | Korea           | P-7  |
| Lee                          | Sung-Joon         | Korea           | O-II-6   |
| Mall                         | Veronika          | Germany         | O-I-7  |
| Manzoni                      | Filipa            | UK              | P-3  |
| Nakamura                     | Kozo              | Japan           | O-IV-4   |
| Oh                           | HongKeun          | Korea           | O-III-5  |
| Pan                          | Min-Hsiung        | Taiwan          | O-III-2, O-IV-6                                |
| Patrianakou                  | Maria             | Greece          | P-16, O-V-2                                    |
| Polychniatou                 | Vasiliki          | Greece          | P-28   |
| Pukalskene                   | Milda             | Lithuania       | P-20   |
| Ramakrishnan                 | Sreekumar         | USA             | O-V-6  |
| Risch                        | Sara J.           | USA             | O-V-1  |
| Roberts                      | Gareth            | UK              | P-1, O-V-5                                     |
| Sfakianakis                  | Panagiotis        | Greece          | P-27   |
| Shahidi                      | Fereidoon         | Canada          | P-26, O-II-2, O-IV-2                           |
| Song                         | Huanlu            | China           | P-8, O-I-2                                     |
| Steinhaus                    | Martin            | Germany         | O-I-5  |
| Suen                         | Yung Lee          | Hong Kong       | P-9  |
| Tamura                       | Hirotooshi        | Japan           | P-21, O-IV-1                                   |
| Ting                         | Yuwen             | USA             | O-III-6  |
| Venskutonis                  | Petras Rimantas   | Lithuania       | P-22, P-23, O-V-3                              |
| Wang                         | Chin-Kun          | Taiwan          | O-III-3, O-IV-7                                |
| Wang                         | Mingfu            | Hong Kong       | O-II-1   |
| Willner                      | Bianca            | Germany         | O-I-3  |
| Wong                         | Daniel            | Hong Kong       | O-V-4  |
| Xie                          | Jianchun          | China           | P-12, O-II-4                                   |
| Zhang                        | Xinchen           | Hong Kong       | O-II-5   |

## **CONFERENCE COMMITTEE**

**Chi-Tang Ho**

Rutgers University  
ho@AESOP.Rutgers.edu

**Cynthia Mussinan**

International Flavors & Fragrances  
cynthia.mussinan@iff.com

**Fereidoon Shahidi**

Memorial University of Newfoundland  
fshahidi@gmail.com

**Ellene Tratras**

Eastern Michigan University  
econtis@emich.edu

## NOTES