studied. Two-stage extraction has been studied and found to be beneficial for improving the yield for higher amounts of beetroot. Significant 8% enhancement in % yield of colorant has been achieved with ultrasound, 80W as compared to MS process both using 1:1 ethanol-water. The coloring ability of extracted beet dye has been tested on substrates such as leather and paper and found to be suitable for dyeing. Ultrasound is also found to be beneficial in natural dyeing of leather with improved rate of exhaustion. Both the dyed substrates have better colour values for ultrasonic beet extract as inferred from reflectance measurement. Therefore, the results clearly offer efficient extraction methodology from natural dye resources such as beetroot with ultrasound even dispensing with external heating. Thereby, also making eco-friendly non-toxic dyeing of fibrous substances a potential viable option [Sivakumar V, Anna JL, Vijayeeswarri J and Swaminathan G (“Chemical Engineering Division, Central Leather Research Institute (CLRI), Council of Scientific and Industrial Research (CSIR), Adyar, Chennai – 600020, India), Ultrason Sonochem, 2009, 16(6), 782-789].

NPARR 1(1), 2010-17, The production of hypocrellin colorants by submerged cultivation of the medicinal fungus *Shiraia bambusicola*

Hypocrellin production using submerged cultivation of the medicinal fungus *Shiraia bambusicola* revealed that both glucose and (NH₄)₂SO₄ were optimal carbon and nitrogen sources. Hypocrellin production increased with increasing initial glucose concentration within the range of 10-50 g/L and (NH₄)₂SO₄ concentration in the range of 1-2 g/L. The effects of carbon and nitrogen concentration were optimized using central composite experimental design and response surface analysis; maximum hypocrellin production (196.94±6.93 mg/L) was achieved using 45.7 g/L glucose and 1.93 g/L (NH₄)₂SO₄ [Hailong Yang, Caixia Xiao, Wenxin Ma and Guoqing He (“College of Biosystem Engineering and Food Science, Zhejiang University, 268 Kaixuan Road, Hangzhou 310029, PR China), Dyes Pigments, 2009, 82(2), 142-146].

NPARR 1(1), 2010-18, *Serratula tinctoria*, a source of natural dye: Flavonoid pattern and histolocalization

In the context of new alternative crop development in Europe, flavonoids were investigated in saw-wort, *Serratula tinctoria* Linn., a perennial herb (Family-Asteraceae) which was used as a yellow dye until the 19th century. The phytochemical study described in this report indicates that leaves rather than stems should be used and harvested at the end of the plant growing cycle, when flavonoids are particularly concentrated. Microspectrofluorometry showed a specific distribution of the flavonoid aglycone, luteolin in stomatal cells whereas the corresponding glycoside (luteolin–7–O-glucoside) was observed in palisade parenchyma cells. The flavonoids luteolin–42–O-glucoside and 3-methylquercetin were isolated for the first time in *S. tinctoria* leaves and identified by NMR spectroscopy. The role of these flavonoids is discussed in this paper. Using a rapid and simple method, *i.e.* flavonoid histolocalization associated with UV, it was demonstrated that saw-wort contains high concentrations of luteolin derivatives and could be considered for use again as a natural dye [P. Guinot, A. Gargadennec, P. La Fisca, A. Fruchier, C. Andary and L. Mondolot (“Laboratoire de Botanique, Phytochimie et Mycologie, UMR 5175 CEFE, Faculté de Pharmacie, Université Montpellier 1, 15 Avenue Charles Flahault, BP 14491, 34 093 Montpellier Cedex 5, France), Industr Crops Prod, 2009, 29(2-3), 320-325].

**ESSENTIAL OILS**

*NPARR* 1(1), 2010-19, Extraction of essential oils from five cinnamon leaves and identification of their volatile compound compositions

Five cinnamon species, viz. *Cinnamomum cassia* Blume, *Cinnamomum zeylanicum* Breyne, *Cinnamomum tamala* Nees & Eberm., *Cinnamomum burmanii* Blume, *Cinnamomum pauciflorum* Nees, were chosen to prepare essential oils by hydrodistillation and to identify and quantify their volatile compound compositions. *C. cassia* was determined to have the highest yield (1.54%) of essential oil, followed by *C. zeylanicum*, *C. pauciflorum*, *C. burmanii* and *C. tamala*. Gas chromatography/mass spectrometry (GC/MS) was used to identify and quantify the volatile compound composition. The results...
indicated the apparent difference in the volatile compound compositions of essential oils between species. The total numbers of volatile compounds identified from C. cassia, C. zeylanicum, C. tamala, C. burmanii and C. pauciflorum leaves were 22, 22, 13, 6 and 21, respectively. trans-Cinnamaldehyde was found in the essential oil of each species, which was also the major volatile component of C. cassia and C. burmanii leaves. Besides trans-cinnamaldehyde, 3-methoxy-1, 2-propanediol was the main volatile compound of C. cassia leaf, while eugenol of C. zeylanicum and C. pauciflorum and C. burmanii leaves, and 5-(2-propenyl)-1, 3-benzodioxole of C. tamala leaf were also the main substances.

The essential oil of cinnamon is an important bioactive substance which has many disease prevention effects. In this work, five species of cinnamon leaves were chosen as materials to prepare the essential oils. The yield of essential oil was determined. The volatile compounds of essential oil were identified by GC/MS analysis. The results showed the significant difference of volatile compound composition between species. trans-Cinnamaldehyde was detected to exist in all the species tested as an important volatile component. This work is helpful for extensive development of this medicinal herb [Rui Wang, Ruijiang Wang and Bao Yang (‘South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, China), Innov Food Sci Emerg Technol, 2009, 10(2), 289-292].

NPARR 1(1), 2010-20. Antimicrobial activity in the vapour phase of a combination of cinnamon and clove essential oils

The antimicrobial activity of the vapour generated by a combination of cinnamon and clove essential oils against the growth of four Gram-negative (Escherichia coli, Yersinia enterocolitica, Pseudomonas aeruginosa and Salmonella choleraesuis) and four Gram-positive bacteria (Staphylococcus aureus, Listeria monocytogenes, Bacillus cereus and Enterococcus faecalis) was assessed by means of the fractional inhibitory concentration index (FIC) of the mixture. The presence of synergism or antagonism effects depended on the reference parameter used to estimate such an index. If the minimal inhibitory concentrations were applied, the vapours of the combination of essential oils exerted an antagonistic effect on the growth of E. coli, while they yielded a synergistic effect for the inhibition of L. monocytogenes, B. cereus and Y. enterocolitica when the concentrations of maximal inhibition were used. This fact revealed a clear concentration-dependent interaction.

The headspace of the cinnamon and clove essential oils and their combination was sampled by solid-phase microextraction (SPME) and the constituents identified and quantified by gas chromatography–ion trap mass spectrometry (GC/ITMS). Eugenol was the most abundant compound for the three antibacterial atmospheres. The differences in behaviour could be attributed to minor compounds. The combined headspace contained slightly larger amounts of 1, 8-cineole and camphor, which are believed to enhance the eugenol activity. The mechanisms responsible for the antagonism are, however, less known and much further investigation is required. This is the first time a combination of essential oils in the vapour phase has been tested as a preservative method to prevent microorganism proliferation [P. Goñi, P. López, C. Sánchez, R. Gómez-Lus, R. Becerril and C. Nerín (‘Department of Analytical Chemistry, Aragón Institute of Engineering Research, i3A, CPS-University of Zaragoza, María de Luna St. 3, E-50018 Zaragoza, Spain), Food Chem, 116(4), 982-989].

NPARR 1(1), 2010-21. Impact of cinnamon oil-enrichment on microbial spoilage of fresh produce

Cinnamon (Cinnamomum zeylanicum Linn.) oil (ranging between 25 and 500ppm) was tested for antifungal activity against Colletotrichum cocccodes, Botrytis cinerea, Cladosporium herbarum, Rhizopus stolonifer and Aspergillus niger in vitro. Oil-enrichment resulted in significant (P<0.05) reduction on subsequent colony development for the examined pathogens. Fungal sporule production inhibited up to 63% at 25ppm of cinnamon oil concentration when compared with equivalent plates stored in ambient air. In the highest oil concentration (500ppm) employed, fungal sporulation (except for B. cinerea) was completely retarded. In
vitro, cinnamon oil reduced spore germination and germ tube length in C. coccodes, B. cinerea, C. herbarum and R. stolonifer with the effects were dependent on oil concentration. However, cinnamon oil (up to 100ppm) accelerated spore germination for A. niger. Wound-inoculated pepper fruit accelerated B. cinerea and C. coccodes development following 3days vapour exposure to cinnamon and this effect was not persisted for longer exposure but no differences observed for tomato fruit. Pre-exposing tomato fruit to 500ppm cinnamon vapours for 3days and then inoculated with fungi, reduced B. cinerea and C. coccodes lesion development [Nikos G. Tzortzakis (Department of Hydroponics and Aromatic plants, Institute of Olive Tree and Subtropical Plants, National Agricultural Research Foundation (N.AG.RE.F.), Agrokipion, 73100 Chania, Greece), Innov Food Sci Emerg Technol, 2009, 10(1), 97-102].

NPARR 1(1), 2010-22, Impact of plant essential oils on microbiological, organoleptic and quality markers of minimally processed vegetables

The efficacy of plant essential oils (EOs) for control of the natural spoilage microflora on ready-to-eat (RTE) lettuce and carrots whilst also considering their impact on organoleptic properties was evaluated. Initial decontamination effects achieved using EOs was comparable to that observed with chlorine and solution containing oregano recorded a significantly lower initial TVC level than the water treatment on carrots (p<0.05). No significant differences were found between the EO treatments and chlorine considering gas composition, colour, texture and water activity of samples. The sensory panel found EO treatments acceptable for carrots throughout storage, while lettuce washed with the EO solutions were rejected for overall appreciation by Day 7. Correlating microbial and sensory changes with volatile emissions identified 12 volatile quality markers. Oregano might be a suitable decontamination alternative to chlorine for RTE carrots, while the identification of volatile quality markers is a useful complement to sensory and microbiological assessments in the monitoring of organoleptic property changes and shelf-life of fresh vegetables [Jorge Gutierrez, Paula Bourke², Julien Lonchamp and Catherine Barry-Ryan (School of Food Science and Environmental Health, Dublin Institute of Technology, Cathal Brugha Street, Dublin 1, Ireland), Innov Food Sci Emerg Technol, 2009, 10(2), 195-202].

NPARR 1(1), 2010-23, Production performance and milk composition of dairy cows fed extruded canola seeds treated with or without lignosulfonate

Eight multiparous Holstein cows averaging 538kg of body weight and 62 days in milk were used in a double 4×4 Latin square design with four 21-d experimental periods to determine the effects of feeding extruded versus non-extruded canola seed treated with, or without, 50g/kg lignosulfonate on apparent whole tract digestibility, feed intake, milk production, milk composition and milk fatty acid profile. Intake of dry matter (DM) and its components was similar among treatments. Extrusion had no effect on digestibility but decreased milk fat concentration. Lignosulfonate treatment of canola seeds decreased digestibility of DM and crude protein (CP). Milk production, milk concentrations of CP, lactose and total solids, and milk yields of CP and fat were similar among treatments. In general, there was no interaction between extrusion and lignosulfonate for milk fatty acid profile. Feeding extruded canola seeds increased milk fat concentration of trans 11 18:1 to a greater extent without, than with, lignosulfonate treatment (150% versus 113%). Thus, it is clear that extrusion had more effects than lignosulfonate treatment on milk fatty acid profile, but changes were small and likely of little biological importance for human health [CA Neves, WBR dos Santos, GTD Santos, DC da Silva, CC Jobim, FS Santos, JV Visentainer and HV Petit (Departamento de Zootecnia, Universidade Estadual de Maringá, Maringá, PR 87020-900, Brazil), Anim Feed Sci Technol, 2009, 154(1-2), 83-92].

NPARR 1(1), 2010-24, Stability of fatty acids in grass and maize silages after exposure to air during the feed out period

Lipids in forages are extensively hydrolysed in the silo with a concomitant increase in the level of free fatty