electricity production and stand-alone production of motor fuels. Increased energy efficiency in refining of thermomechanical pulp gives CO₂ savings more efficiently than stand-alone production of electricity from biomass. Newsprint from thermomechanical pulp would require slightly less biomass and have lower costs than paper from chemical pulp, per metric tonne (t) product, when the systems are also required to render the same oil use and CO₂ emission reductions. Substituting mineral fillers for 25% of the chemical pulp changes the balance in favour of the chemical pulp paper. At an oil price of 40 US$/barrel, all studied pulp and paper mill technology improvements give unchanged or reduced monetary costs also when oil use and CO₂ emissions are not balanced with stand-alone bioenergy plants [Joelsson JM and Gustavsson L, CO₂ emission and oil use reduction through black liquor gasification and energy efficiency in pulp and paper industry, Resour Conserv Recycl, 2008, 52(5), 747-763].

**Spices**

**Biochemical changes and antioxidant activity of Mango ginger rhizomes during postharvest storage at different temperatures**

Mango ginger *(Curcuma amada Roxb.)* is a unique species having mango flavour in its rhizomes and is of high medicinal importance. Its shelf-life and quality is governed by storage temperature and time. The scientists at Central Food Technological Research Institute (CFTRI), CSIR, Mysuru, India performed studies to biochemical changes and antioxidant activity in mango ginger rhizomes during storage. No significant changes were observed in pH, titrable acidity and TSS of the rhizomes stored at different temperatures, viz. room temperature (RT, 25°C), low temperature (LT, 14°C) and chilling temperature (CT, 4°C). Total protein decreased initially from 11.2 to 7.9mg/100g rhizome up to 70 days, followed by a rapid increase to 10.6mg on the 120th day of storage at RT. In contrast, total protein content increased at LT from 10 days onwards. The highest accumulation of total phenolic contents from 20.8 to 57.4mg/100g rhizome in juice and from 380 to 568mg/100g in pulp was observed in LT storage. The DPPH scavenging activity of mango ginger juice and pulp decreased sharply to 30 and 33%, respectively at RT, when compared with a steady activity of around 56% in juice and 72% in pulp at LT. Mango ginger rhizome could be stored for 4-5 months at LT compared with 2-3 months

**Effect of air drying temperature on the quality of rehydrated dried Red Bell Pepper**

The researchers at Universidad de La Serena, Chile, Washington State University, Pullman, USA and Universidad Politécnica de Valencia, Valencia, Spain dried Red pepper samples *(Capsicum annuum* Linn. cv. ‘Lamuyo’) at four air inlet temperatures from 50 to 80ºC and rehydrated in water at 30ºC to study the influence of air drying temperature on the quality and microstructural properties of the rehydrated tissue. A determination was made on the effects of sample pretreatment on the drying process; samples were immersed in a solution containing NaCl, CaCl₂ and Na₂S₂O₅ prior to drying at 70ºC. At the end of the rehydration process several quality parameters were analyzed, including the rehydration ratio, water retention capacity, colour, firmness, vitamin C content and microstructure. The results showed that the best quality product was obtained when samples were pretreated before drying. Microscopic examination of the rehydrated pepper samples suggested that damage to cellular structure was minimized by pretreatment of samples; and the resulting rehydrated peppers displayed comparatively improved vitamin C retention, colour and firmness [Vega-Gálvez A, Lemus-Mondaca R, Bilbao-Sáinz C, Fito P and Andrés A, Effect of air drying temperature on the quality of rehydrated dried red bell pepper (var. Lamuyo), J Food Eng, 2008, 85(1), 42-50].
Cryogenic grinding of black pepper at different temperatures and feed rates was conducted by the researchers at Central Food Technological Research Institute (CFTRI), CSIR, Mysuru, India. It was compared with that of conventional grinding at ambient temperature to ascertain the different quality parameters employing subjective and objective methods. The loss of volatile oil in the case of ambient grinding was about 50% as compared to cryogenic grinding. The loss of monoterpenes was high in ambient grinding, as there was a loss of volatile oil in terms of every monoterpenes compound. Cryogenic grinding technique was superior to ambient grinding in terms of monoterpenes retention in the powder. Sensory assessment of the ground samples indicated that cryogenically ground samples were distinctly high in top notes which represented freshness and marginally high in basic notes also.

A pilot plant model pin mill was employed for cryogenic grinding of black pepper at different feed rates and product temperatures. These two variables had significant effects on dependent variables, viz. volatile oil and monoterpenes and sesquiterpenes contents. The optimum cryogenic conditions for maximum volatile oil content and a reasonable quantity of monoterpenes were 47 to 57kg/h of feed rate, and –20 to –15°C of product temperature [Murthy CT and Bhattacharya Suvendu, Cryogenic grinding of black pepper, J Food Eng, 2008, 85(1), 18-28].

Enzyme-assisted liquefaction of Ginger rhizomes for the production of spray-dried and paste-like condiments

A novel process for the production of spray-dried ginger (Zingiber officinale Rosc.) powder and paste-like ginger condiments was developed by the researchers at Hohenheim University, August-von-Hartmann-Strasse, Stuttgart, Germany on pilot plant scale. The process includes the operations of fine grinding, enzymatic hydrolysis, finishing, pasteurization and spray-drying, respectively. Before scaling-up the enzymatic hydrolysis was optimized on laboratory scale using D-optimal design and analyzed by response surface methodology considering the individual and interactive effects of temperature (40-55°C), pH (4.0-6.0) and enzyme concentration (500-5000ppm) on the reduction of viscosity of the ginger homogenate. In-process determination of gingerols and shogaols demonstrated that pungency is hardly influenced by cell wall degrading enzymes, but significantly affected by temperature and pH. An enzyme mixture composed of cellulolytic and pectinolytic activities at a 2:1 ratio yielded maximal tissue digestion and highest retention of pungent principles within 2h, applying a dosage of 5000ppm at 40°C and pH 4.0. During processing the amounts of 4-, 6-, 8- and 10-gingerol slightly diminished, while 6- and 8-shogaol faintly increased. The ginger digest obtained after finishing turned out to be a valuable raw material to be processed into various ginger products. Pasteurization and spray-drying resulted in homogenous paste-like ginger preparations and spray-dried ginger powder, respectively. Additionally, the solid residue contained large amounts of pungent principles, which enables its
application as a flavouring agent. Consequently, the process described in this study allows an exhaustive utilization of ginger rhizomes for the production of various ginger products [Ute Schweiggert, Silke Hofmann, Mareike Reichel, Andreas Schieber and Reinhold Carle, Enzyme-assisted liquefaction of ginger rhizomes (Zingiber officinale Rosc.) for the production of spray-dried and paste-like ginger condiments, *J Food Eng*, 2008, **84**(1), 28-38].

**Effect of spices on rumen fermentation, methanogenesis and protozoa counts**

Spices have been used by human beings as a source of anti-microbial agents for maintaining a balanced microbial ecosystem of the gastrointestinal tract, especially in the tropical regions of the world. The effects of water, methanol and ethanol extracts of *Foeniculum vulgare* Mill. (Fennel), *Syzygium aromaticum* (Linn.) Merril (Clove) *Allium sativum* Linn. (Garlic), *A. cepa* Linn. (Onion) and *Zingiber officinale* Rosc. (Ginger) on rumen fermentation, methanogenesis and ciliate protozoa counts were studied in *in vitro* gas production test by researchers at Centre of Advanced Studies in Animal Nutrition, Indian Veterinary Research Institute, Izatnagar, India. Gas production was reduced (*P*<0.05) on addition of ethanol and methanol extracts of fennel and clove. Water extract of garlic and all the three extracts of onion caused higher (*P*<0.05) gas production. Ethanol and methanol extracts of cloves and garlic and methanol extract of fennel inhibited methane production. However, water extracts of these products and all extracts of onion and ginger had no effect on methane production. Total volatile fatty acids were higher (*P*<0.05) in the medium on inclusion of extracts of garlic and onion. All extracts of garlic and methanol extract of fennel caused a decrease in molar proportion of acetate and acetate to propionate ratio. Methanol and ethanol extracts of clove decreased dry matter degradability (DMD). The ethanol and methanol extracts of clove caused a decrease (*P*<0.05) while extracts of onion, ginger and garlic caused an increase (*P*<0.05) in protozoa numbers. Plant secondary metabolites extracted in ethanol and methanol from garlic appear to have a potential to reduce rumen methanogenesis without affecting rumen fermentation adversely. The results indicated that clove and garlic have strong anti-methanogenic activity but garlic is superior to clove since it did not affect rumen fermentation and dry matter degradation adversely. Among the three solvents tested, methanol was the most effective followed by ethanol and water was ineffective [Patra AK, Kamra DN and Agarwal Neeta, Effect of spices on rumen fermentation, methanogenesis and protozoa counts in *in vitro* gas production test, *Int Cong Ser*, 2006, **1293**, 176-179].

**Antioxidant and free radical scavenging activities of phenols from Onion**

Onions, *Allium cepa* Linn. are widely used all over the world and their outer dry layers go to waste. Hence, the scientists at National Botanical Research Institute, CSIR, Lucknow, India investigated different layers of four onion varieties (red, violet, white and green) for their total phenolic contents (TPC), antioxidant (AOA) and free radical scavenging activities (FRSA) and protection of DNA damage caused by free radicals. The TPC varied from 4.6 to
74.1mg/g GAE, AOA varied from 13.6 to 84.1% and FRSA showed wide range in terms of IC$_{50}$ (inhibitory concentration) from 0.1 to 15.2mg/ml, EC$_{50}$ (efficient concentration) from 4.3 to 660.8mg/mg and ARP (antiradical power) from 0.15 to 23.2. The outer dry layers of red and violet varieties showed better inhibition of lipid peroxidation assayed by ammonium thiocyanate than α-tocopherol. The non-site-specific inhibition of hydroxyl radical induced deoxyribose degradation was also higher in the outer dry layers of red and violet varieties than in their middle and inner layers. The outer layers were also potential inhibitors of nitroblue tetrazolium chloride (NBT) reduction caused by superoxide anions. On the other hand the ferrous ion chelating capacity of the red and violet varieties was highest in the inner layers. Specific phenolic composition performed through HPLC and LC-MS/MS showed the presence of gallic acid, ferulic acid, protocatechuic acid, quercetin and kaempferol. The unutilised outer layers of the red variety were a rich source of quercetin (5110µg/g) with high AOA, FRSA and also showed significant protection of DNA damage caused by free radicals [Dhan Prakash, Singh Brahma N and Upadhyay Garima, Antioxidant and free radical scavenging activities of phenols from onion (Allium cepa), Food Chem, 2007, 102(4), 1389-1393].

### Effect of diallyl trisulfide-rich Garlic oil on blood coagulation and plasma activity

The role of garlic in preventing cardiovascular diseases has been studied extensively over the last decade. Several studies have indicated that whole garlic and garlic aqueous extract were able to inhibit platelet aggregation through multiple mechanisms, and could be considered as an antithrombotic material and diallyl disulfide and diallyl trisulfide, two major organosulfur compounds derived from garlic, could inhibit platelet thromboxane formation and hence platelet aggregation. A few studies have addressed in garlic’s effect on blood coagulation, therefore, an in vivo study was designed by researchers at Taiwan to further examine the effect of organosulfide-containing garlic oil on blood coagulation and anticoagulation factors.

Diallyl trisulfide (DAT)-rich garlic oil was fed to Sprague-Dawley rats and the effects of this DAT-rich garlic oil on bleeding time, clotting time and anticoagulation factors were examined. Garlic oil supplement at 5 or 50mg garlic oil/kg body weight significantly prolonged bleeding time and thrombin time and enhanced anticoagulation factor activity, such as antithrombin III and protein C ($P<0.05$). These results suggested that the anticoagulant action of DAT-rich garlic oil was due to inhibition and/or inactivation of thrombin. In addition, DAT-rich garlic oil benefits blood anticoagulation factors, which might further prevent the development of thrombus formation. However, the intake of garlic oil at high dose significantly increased plasma fibrinogen concentration ($P<0.05$) and affected the levels of several haematological parameters such as erythrocyte count, haemoglobin and platelets ($P<0.05$). The adverse effect of high doses of garlic oil might further influence the haemostatic balance. Therefore, the concentration of DAT-rich garlic oil should be carefully considered in its application. Supplementation of garlic oil at 5mg/kg body weight has shown anticoagulation effect during this animal study [Chan Kung-chi, Yin Mei-chin and Chao Wan-ju, Effect of diallyl trisulfide-rich garlic oil on blood coagulation and plasma activity of anticoagulation factors in rats, Food Chem Toxicol, 2007, 45(3), 502-507].
Inhibitive effect of Black Pepper extract on the sulphuric acid corrosion of mild steel

The researchers at Gandhigram Rural University, Gandhigram, Tamil Nadu, India evaluated the corrosion inhibitive effect of the extract of black pepper on mild steel (MS) in 1M H₂SO₄ media by conventional weight loss studies (303-323K), electrochemical studies, viz. Tafel polarization, ac impedance and scanning electron microscope (SEM) studies. The weight loss study has shown that black pepper extract acts as a good inhibitor even at high temperatures. The inhibition is through adsorption which is found to follow Temkin adsorption isotherm. Tafel polarization method revealed the mixed mode inhibition of black pepper extract. Analysis of impedance data has been made with equivalent circuit with constant phase angle element for calculation of double layer capacitance value. SEM studies provide the confirmatory evidence for the protection of MS by the green inhibitor [Pandian Bothi Raja and Mathur Gopalakrishnan Sethuraman, Inhibitive effect of black pepper extract on the sulphuric acid corrosion of mild steel, *Mat Letters*, 2008, 62(17-18), 2977-2979].

Antioxidant activity of natural plant sources in dairy dessert (Sandesh) under thermal treatment

The researchers at Jadavpur University, Kolkata, West Bengal, India used natural sources of antioxidant, viz. beet root (*Beta vulgaris* Linn.), mint (*Mentha spicata* Linn.) and ginger (*Zingiber officinale* Rosc.) to fortify Sandesh (a heat desiccated product of coagulated milk protein mass chhana which is in turn a heat and acid coagulated product of milk, analogous to cottage cheese). Three sets of experiments, viz. antioxidant activity, peroxide value and ultra-violet absorbance were done to evaluate the effectiveness of natural antioxidants in reducing lipid oxidation in sandesh as compared to synthetic antioxidants like tertiary butyl hydroquinone (TBHQ), butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) under thermal treatment. Among the natural sources, ginger has the highest antioxidant activity and it was similar to TBHQ and BHA-BHT combined. Results of the antioxidant activity differed from those of the oven test at 63°C particularly for ginger and BHA-BHT combined. Control sandesh (without any antioxidants) showed the highest peroxide value and ultra-violet absorption. All the natural sources and their combinations significantly improved the oxidative stability of sandesh and their effectiveness was comparable with synthetic antioxidant TBHQ, a combination of BHA and BHT. Among the natural sources, although ginger had the highest antioxidant activity but mint showed better effectiveness in the inhibition of lipid oxidation. Regarding antioxidant activity and lipid oxidation, combination of mint or ginger with beet root showed better result as compared to beet root alone. Besides, sensory evaluation of freshly prepared natural source fortified sandesh samples was done as compared to control sandesh in order to commercialize the herbal sandesh in market. Sandesh containing beet, ginger, combination of beet root with ginger or mint, or combination of mint with ginger were more acceptable to panelist than control sandesh [Bandyopadhyay Mahuya, Chakraborty Runu and Raychaudhuri Utpal, Antioxidant activity of natural plant sources in dairy dessert (Sandesh) under thermal treatment, *LWT - Food Sci Technol*, 2008, 41(5), 816-825].
Inhibitory effect of Onion extract on polyphenol oxidase and enzymatic browning of Taro

The inhibitory effect of onion extract on polyphenol oxidase and enzymatic browning of taro (*Colocasia antiquorum Schott* var. *esculenta*) was investigated by scientists at Department of Food Science and Nutrition, Dong-A University, Hadan-Dong, Saha-Gu, Busan, Republic of Korea. The polyphenol oxidase from taro was strongly inhibited by various reducing agents, such as l-ascorbic acid, l-cysteine, dithiothreitol, glutathione and sodium pyrosulfite. The enzyme was also inhibited by addition of onion extract. Regardless of substrates used, the addition of heated onion extract at 100°C for 10min, gave a stronger inhibitory effect on taro polyphenol oxidase activity than did fresh unheated extract. The inhibitory effect of onion extract was dependent on heating temperature and time. The addition of glucose, glycine, or both to the onion extract, during heating, stimulated the inhibitory effect of the onion extract, suggesting that non-enzymatic browning products, produced during heating, might be responsible for the stronger inhibitory action of the heated onion extract [Lee Min Young, Lee Min Kyung and Park Inshik, Inhibitory effect of onion extract on polyphenol oxidase and enzymatic browning of taro (*Colocasia antiquorum* var. *esculenta*), *Food Chem*, 2007, 105 (2), 528-532].

Immunomodulatory activities of common vegetables and spices of Apiaceae

Carrots, celery, coriander, fennel and parsley of the Umbelliferae (Apiaceae) family have been used as common vegetables and spices in many different cultures of the world. Scientists at Department of Internal Medicine, China Medical University, Beigang Hospital/China Medical University, Taichung, Taiwan and Faculty of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan, Republic of China evaluated the immunomodulatory activities of coumarins and flavonoids obtained from the above foods on human peripheral blood mononuclear cells (PBMC). Studies were conducted on lymphocyte transformation, ELISA assay and flow cytometry. Results provided the evidence of a health-modulating effect of these vegetables and spices which possessed a direct role in immunomodulatory function. Some of non-nutritional constituents of these foods such as coumarins and flavonoids also exhibited a similar immunomodulatory activity. At non-cytotoxic concentrations, the above phytoconstituents exhibited three types of immunomodulation including type 1 of PHA, ConA and quercetin (increased lymphocyte activation and IFN-γ secretion); type 2 of isopimpinellin (enhanced lymphocyte activation) and type 3 of rutin, bergapten and xanthotoxin (elevated IFN-γ secretion). The augmentation of lymphocyte proliferation was closely correlated to an increase in the number of lymphocyte cells including CD8+ T cells and activated PBMC, whereas elevation of IFN-γ secretion was due to the activated CD8+ T cells [Cherng Jaw-Ming, Chiang Wen and Chiang Lien-Chai, Immunomodulatory activities of common vegetables and spices of Umbelliferae and its related coumarins and flavonoids, *Food Chem*, 2008, 106 (3), 944-950].

A rapid HPLC method for determination of Sudan dyes and Para Red in red chilli Pepper

A rapid high-performance liquid chromatography (HPLC) system consisting of an ultraviolet-visible (UV-VIS) detector was developed by scientists at TÜBİTAK Marmara Research Centre, Food Institute, Gebze/Kocaeli, Turkey for the separation and determination of Sudan dyes (I, II, III and IV) and Para Red in red chilli peppers. The chromatographic separation was achieved...
Neuroprotective effect of methanolic extracts of Onions

Onions (*Allium cepa* Linn.) possess a high level of antioxidant and anti-inflammatory activity, which is attributed to the flavonoids and organosulfur compounds but the effect of onion extracts on cerebral stroke has not been evaluated. Hence, researchers at Department of Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala, Punjab, India carried out studies to investigate the effect of methanolic extract of outer scales and edible portions of *A. cepa* bulb on ischemia and reperfusion-induced cerebral injury. Global cerebral ischemia was induced by bilateral carotid artery occlusion for 10 min followed by reperfusion for 24 h.

Pretreatment with methanolic extract of outer scales (100 mg/kg and 200 mg/kg) and edible portions (100 mg/kg and 200 mg/kg) of bulb markedly reduced cerebral infarct size and attenuated impairment in short-term memory and motor coordination. The protective effect of methanolic extract of outer scales and edible portions of *A. cepa* bulb was accompanied by a marked decrease in mitochondrial TBARS [Richa Shri and Bora Kundan Singh, Neuroprotective effect of methanolic extracts of *Allium cepa* on ischemia and reperfusion-induced cerebral injury, *Fitoterapia*, 2008, 79 (2), 86-96].

**Determination of Sudan I dye in hot Chili powder by using an activated glassy carbon electrode**

A novel electroanalytical method is proposed by scientists of Department of Chemistry, University of Science and Technology of China, Hefei and Department of Chemistry, Shangqiu Normal College, Shangqiu, People's Republic of China for the determination of Sudan I in hot chili powder. Sudan I was firstly pre-concentrated by adsorption and then electroreduced at the electrochemically activated glassy carbon electrode (AGCE). A linear relationship between the reduction current and concentration of Sudan I was obtained over the range from 2.4 × 10^{-4} mol/l to 1.8 × 10^{-3} mol/l with a correlation coefficient of 0.9981. The detection limit was estimated to be about 7.1 × 10^{-7} mol/l [Du Meiju, Han Xiaogang, Zhou Zihao and Wu Shouguo, Determination of Sudan I in hot chili powder by using an activated glassy carbon electrode, *Food Chem*, 2007, 105 (2), 883-888].

**Neuroprotective effect of methanolic extracts of Onions**

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