

chemical and physical characteristics were determined by chemical methods, gas chromatography and size exclusion chromatography with laser light scattering. Deoxyribose assay, photoreduction of Nitro Blue Tetrazolium (NBT) assay and lipid peroxidation inhibition assay were applied to test the antioxidant activities of tea polysaccharide conjugates *in vitro*. The results indicated that the three polysaccharide conjugates were heteropolysaccharides bounded with protein. TPC-1 was composed of l-

arabinose (Ara), d-ribose (Rib), d-xylose (Xyl), d-glucose (Glc), d-galactose (Gal) and d-mannose (Man). TPC-2 was only composed of four monosaccharides: Ara, Rib, Glc and Man. There was no Man detected in TPC-3. The protein contents of TPC-1, TPC-2 and TPC-3 were 2.8%, 3.8% and 4.0% and the molecular weights were 26.8×10^4 , 11.8×10^4 and 4.2×10^4 , respectively. TPC-3 showed the highest antioxidant activities among the three fractions of polysaccharide conjugates, with an IC_{50} of 182 $\mu\text{g/ml}$ for the

deoxyribose assay and 93 $\mu\text{g/ml}$ for the photoreduction of NBT assay, values which were lower than those of TPC-1 and TPC-2 ($P < 0.01$). The effects of the molecular weight and protein content of the polysaccharide conjugates on the improvement of the bioactivities appeared to be significant [Chen Haixia, Zhang Min, Qu Zhishuang and Xie Bijun, Antioxidant activities of different fractions of polysaccharide conjugates from green tea (*Camellia sinensis*), *Food Chem*, 2008, **106**(2), 559-563].

Donkey's milk protein fractions characterization

Donkey's milk may be considered a valid alternative, for infant nutrition, to powdered milk, soybean milk or other formulas, since its composition in lipids and proteins is very close to human milk. The aim of a study conducted by researchers in Italy was to characterize donkey's milk product, especially with regard to the protein fractions. Three different chromatographic approaches for donkey's milk proteins separation were

described, based on their different isoelectric points, hydrophobicity and molecular mass. The proteins obtained were further separated by sodium dodecyl sulphate polyacrylamide gel electrophoresis and identified by N-terminal sequencing. α S1- and β -caseins, lysozyme, α -lactalbumin and β -lactoglobulin were identified. Furthermore, the content of α -lactalbumin, β -lactoglobulin and lysozyme in donkey's milk was determined by a

reversed-phase HPLC method. The β -lactoglobulin and α -lactalbumin content was 3.75 and 1.8 mg/ml, respectively (mean values). The study showed nutritional properties of donkey's milk characterized by low casein and high lysozyme content (1.0 mg/ml) compared with other kinds of milk [Silvia Vincenzetti, Paolo Polidori, Pierluigi Mariani, Natalina Cammertoni, Francesco Fantuz and Alberto Vita, Donkey's milk protein fractions characterization, *Food Chem*, 2008, **106**(2), 640-649].

Dye

Anthocyanin dyes extracted from grape pomace for the purpose of textile dyeing

Anthocyanins are found in a large number of plant tissues. Berries such as blackcurrants, blueberries, grapes and chokeberries represent an important source of these red/violet/purple pigments. The majority of the coloured compounds are collected in the corresponding product

(food, juice, beverage). Extracts from these berries can also serve as food colourants and food additives owing to the antioxidant activity of the anthocyanin compounds. The researchers at Leopold Franzens University of Innsbruck, Hoehcherstra, Dornbirn, Austria studied pomace from

different grape varieties with regard to the content of extractable anthocyanins. Total anthocyanin concentrations of 24.5-126 mg/dm^3 were found in the extracts. The amount of extractable pigment was dependent on the variety of grape. The extracts were applied in textile dyeing

operations using cotton fabric pre-mordanted with tannin as textile substrate. Red/violet shades were obtained that showed good water-fastness; however, limited light-fastness indicated need for improvement to fulfil requirements for textile application. Colour measurement

by means of CIE-Lab coordinates and Kubelka-Munk value showed a direct correlation between extractable anthocyanin concentration and colour depth of the dyed material. Thus, the analytically determined concentration of anthocyanins in the aqueous extract can

serve as a measure of quality of grape pomace as raw material for textile dyeing application [Bechtold Thomas, Mahmud-Ali Amalid and Mussak Rita, Anthocyanin dyes extracted from grape pomace for the purpose of textile dyeing, *J Sci Food Agric*, 2007, **87**(14), 2589-2595].

Adsorption kinetic study of lac dyeing on cotton

Adsorption kinetics study of lac dyeing on cotton were carried out by researchers at Thailand and Australia under dyeing conditions of pH 3.0, MLR 1:100 and an initial dye concentration 480 ± 10 mg/l. Pseudo first- and second-order kinetic models were used to examine the adsorption kinetic data. It was found that the adsorption kinetics of lac dyeing on cotton with pH control followed the pseudo second-order kinetic model with an activation energy of 42.4 kJ/mol [Chairat Montra, Rattanaphani Saowanee, Bremner John B and Rattanaphani Vichitr, Adsorption kinetic study of lac dyeing on cotton, *Dyes Pigments*, 2008, **76**(2), 435-439].



Dyeing of jute and cotton fabrics using Jackfruit wood extract

Conventionally bleached jute and cotton fabrics have been subjected to pre-mordanting with selective single and double mordants using myrobalan (*harda*) and other mordants (metallic salts) followed by dyeing with aqueous extract of jackfruit wood and then studied for their mechanical and dyeing properties by researchers at Institute of Jute Technology, Kolkata and Department of Chemical Engineering, Jadavpur University,



Kolkata, India. It was observed that the application of 10-20% myrobalan followed by 10-20% of $Al_2(SO_4)_3$ or $FeSO_4$ in sequence have been identified as two most prospective mordanting systems. The study on the effect of dyeing process variables on surface colour strength indicated that the 90 min dyeing time, 70-90°C dyeing temperature, 11.0 pH , 1:30 material-to-liquor ratio, 20-30% mordants concentration, 30-40% dye concentration and 15 gpl common salt are the optimum values with minor differences among the different fibre-mordant systems studied. Colour fastness to washing, rubbing and exposure to sunlight, in general and dyeing- pH sensitivity, in particular, for selective fibre-mordants-dye systems have also been assessed and compared. Dyeing at pH 11.0 for both the double pre-mordanting systems offers overall good colour fastness properties.

In another study by the researchers bleached jute and cotton

fabrics have been double pre-mordanted applying 20% myrobalan (*harda*) as 1st mordant and 20% $\text{Al}_2(\text{SO}_4)_3$ or 20% FeSO_4 as 2nd mordant and subsequently dyed with aqueous extract of jackfruit wood under optimized conditions of dyeing. The physico-chemical parameters of dyeing, such as dyeing affinity, rate of dyeing, absorption isotherms and associated thermodynamic parameters like heat of dyeing (ΔH), entropy of dyeing (ΔS) and Gibb's free energy (ΔG), have been assessed to explain the interaction among different fibre-mordant-dye systems. It was

observed that all of these dyeing processes are endothermic, ΔH values being positive. Among different fibre-mordant-dye systems studied, jute fabric double pre-mordanted with *harda* and FeSO_4 shows a non-linear Langmuir type dye-absorption isotherm, while dye-absorption isotherms of all other fibre-mordant-dye systems are found to be linear following Nernst absorption isotherm, indicating the formation of co-ordinated complex in jute-*harda* + FeSO_4 -dye sample and hydrogen bonding in all other cases of fibre-mordant-dye systems studied.

However, the negative ΔG values of all the systems studied indicate that the potentiality of chemical interaction / reaction of these fibre-mordant-dye systems in some otherwise favourable conditions of dyeing need to be further studied [Samanta Ashis Kumar, Agarwal Priti and Datta Siddhartha, Dyeing of jute and cotton fabrics using jackfruit wood extract: Part I - Effects of mordanting and dyeing process variables on colour yield and colour fastness properties, *Indian J Fibre Text Res*, 2007, **32**(4), 466-476; Samanta Ashis Kumar, Agarwal Priti and Datta Siddhartha, Physico-chemical studies on dyeing of jute and cotton fabrics using jackfruit wood extract: Part II dyeing kinetics and thermodynamic studies, *ibid*, 2008, **33**(1), 66-72].

Effect of screening and subculture on the production of betaxanthins in *Beta vulgaris* Linn. cv. 'Dark Detroit' callus culture

Plant cell culture is an innovative technology to produce a variety of substances including natural dyes. Betaxanthins are considered food-safe nutraceuticals pigments because they exhibit antiradical and antioxidant activity. An important obstacle for developing large-scale production systems based in plant cells has been the instability of metabolite accumulation. In a study by researchers at Mexico, a protocol was established to obtain yellow callus of *Beta vulgaris* Linn. cv. 'Dark Detroit'. Homogeneous and heterogeneous pigmented callus were obtained with yellow, red, orange and colourless



phenotype. Particular attention was done to isolate and establish a yellow line. After continuous screening of the more intense yellow callus it was possible to increase the betaxanthins production 1.8-fold after

48 subcultures. Spectrophotometric and chromatographic analysis of the pigments, confirmed the presence of betaxanthins. HPLC analysis indicated two mainly distinct betaxanthins, vulgaxanthin I and II. *B. vulgaris* yellow callus line did not lose pigment production ability as a result of long-term subculture. The stable *B. vulgaris* cell culture technology developed could be an alternative process to obtain betaxanthins as nutraceutical pigments [Trejo-Tapia G, Balcazar-Aguilar JB, artinez-Bonfil B, Salcedo-Morales G, Jaramillo-Flores M, Arenas-Ocampo ML and Jiménez-Aparicio A, Effect of screening and subculture on the production of betaxanthins in *Beta vulgaris* L. var. 'Dark Detroit' callus culture, *Innov Food Sci Emerg Technol*, 2008, **9**(1), 32-36].

Improving the colour fastness of poly(ethylene terephthalate) fabrics with the natural dye

The effect of a low-temperature plasma and/or chitosan pretreatment as a mordant on the dyeing of poly(ethylene terephthalate) fabrics with an aqueous extract of *Caesalpinia sappan* Linn. wood, which showed a remarkably high colouring property in a natural dyeing system, was investigated by the scientists of Yonsei University, Korea. After dyeing, scanning electron microscopy, add-on, colour measurements and fastness to washing tests were performed. Dyeing with the *C. sappan* extract led to fair-to-good fastness properties in conventional natural dyeing. The results clearly showed that the pretreatment with chitosan and/or plasma is better than a metal mordant in terms of the dye uptake and reduction in the dyeing time, that the proposed pretreatment coloration reaction could be carried out without the need for repetitive dye steps and that it prevents the excessive use of dye chemicals, thereby resulting in a more ecofriendly process [Park Youngmi, Koo Kang, Kim Samsu and Choe Jongdeok, Improving the colourfastness of poly(ethylene terephthalate) fabrics with the natural dye of *Caesalpinia sappan* L. Wood extract and the effect of chitosan and low-temperature plasma, *J Appl Polym Sci*, 2008, **109**(1), 160-166].

Colour analysis of natural colorant-dyed fabrics

Colours from naturally dyed fabrics recently have attracted both consumers and manufacturers in fashion markets. Even though colour attributes of the fabrics have been partially observed in some literature, a data base of colours for natural colorants in fabrics needs to be established and the colours to be characterized according to systematic colour notations and tones in order to relate the traditional natural colours to contemporary colour communication systems. Therefore, a study was performed by the scientists of Cheju National University, Jeju, Korea and the Human Ecology Research Institute, Yonsei University, Seoul, Korea to investigate colour characteristics for a given large set of natural colorant-dyed fabrics based on the Munsell colour notations, to analyze their tones with relation to the notation such as hue, value and chroma, and finally to identify the effects of mordanting, an important colouring auxiliary, on the colorimetric properties of the fabrics. As a result, the dominant hue for a total of 350 naturally dyed fabrics was yellowish families followed by reddish and purplish ones in the Munsell notation owing to the use of leaves and plant as usual natural dyestuff, which confirms the limit of colour hues of the fabrics. Colour value for most of naturally dyed fabrics was generally higher whereas the chroma was lower, which means that most of colours for naturally dyed fabrics tended to be bright and weak shaded. Grayish, light grayish and soft tones were the main tones of natural colorant-dyed fabrics. All of hue, value and chroma were found as being influenced by mordanting in that more particularly, iron mordanting was likely to cause the decrease of both value and chroma for most of naturally dyed fabrics. These results could provide a systematic colour data for naturally dyed fashion fabrics and suggest a future direction of colour development for them [Yi Eunjou and Cho Ju-Yeon, Color analysis of natural colorant-dyed fabrics, *Col Res Appl*, 2008, **33**(2), 148-157].

Eco-friendly sonicator dyeing of cotton with *Rubia cordifolia* Linn.

Rubia cordifolia Linn. produces anthraquinone reddish orange dyes in roots, stem and leaves, which has been used for dyeing textiles since ancient times. Studies conducted by researchers in India showed that commercial sonicator dyeing with *Rubia* showed that pretreatment with biomordant, *Eurya acuminata* DC. var. *euprista* Karth. of family Theaceae (2%) shows very good fastness properties for dyed cotton using dry powder as 10% of the weight of the fabric is optimum. Use of biomordant may replace metal mordants and making natural dyeing eco-friendly [Vankar Padma S, Shanker Rakhi, Mahanta Debajit and Tiwari SC, Eco-friendly sonicator dyeing of cotton with *Rubia cordifolia* Linn. using biomordant, *Dyes Pigments*, 2008, **76**(1), 207-212].

Benzylated modification and dyeing of Ramie fibre in supercritical carbon dioxide

The effects of pretreatment conditions, including the addition of a phase-transfer catalyst, on the benzylation of ramie fibre were investigated by the researchers of Shaanxi Normal University, and Chinese Academy of Agricultural Sciences, China. Raw and benzylated ramie fibres were dyed in supercritical carbon dioxide and the colour strength (K/S) of the ramie fibre was measured by ultraviolet-visible spectroscopy. An obviously improved dyeing capability of the benzylated ramie fibre, that is, a better level-dyeing property and a higher K/S, was achieved. Moreover, the colour strength of the ramie fibre, indexed as the value of K/S, increased significantly with the degree of substitution of the benzylated ramie fibre. The raw and modified ramie fibres were characterized with Fourier transform infrared spectroscopy, X-ray diffraction, scanning electron microscopy, thermogravimetric analysis and differential scanning calorimetry [Liu Zhao-Tie, Sun Zhifeng, Liu Zhong-Wen, Lu Jian and Xiong Heping, Benzylated modification and dyeing of ramie fibre in supercritical carbon dioxide, *J Appl Polym Sci*, 2008, **107**(3), 1872-1878].

Primary flavonoids of Marigold dye

The researchers in France investigated flavonoids extracted from marigold flowers for their dyeing potential. Patulitrin (1) and patuletin (2) were isolated and their structures established using NMR and HPLC-MS. These compounds were identified as the main flavonoids present in the dyeing bath. Following the dyeing process, it was demonstrated that aglycone 2 bound more strongly to wool fibres than its glucoside 1. Moreover, analysis focused on 1 and 2 dynamics during plant growth revealed that these components were only found in flowers during and after flowering. The influence of growing location was also investigated and it appeared that cultivation under Mediterranean conditions enhanced biosynthesis of 1 and 2. Finally, several solvents were tested for their potential to extract the flavonoids: the use of a water-ethanol mixture gave a high extraction efficiency and allowed selective extraction of 1 and 2. The implications of these results have been discussed in relation to the development of marigold as a potential dyeing plant [Guinot Pauline, Gargadennec Annick, Valette Gilles, Fruchier Alain and Andary Claude, Primary flavonoids in marigold dye: extraction, structure and involvement in the dyeing process, *Phytochem Anal*, 2007, **19**(1), 46-51].

Synthesis of anthraquinone derivatives in *Rubia tinctorum* Linn. cell suspension cultures

Researchers at Hungary carried out investigations and showed that an elicitation method increased the synthesis of anthraquinone derivatives occurring in cell suspension cultures of *Rubia tinctorum* Linn. High performance liquid chromatography coupled with diode array detection and mass spectrometry (HPLC-DAD-MS) was used for the detection and quantification of the two glycosides, lucidin primeveroside and ruberithric acid and eight aglycones, namely pseudopurpurin, lucidin, alizarin, purpurin, alizarin-2-methylether, lucidin- ω -ethylether, nordamnacanthal and munjistin ethyl ester. The improved elicitor treatment of the suspension cultures increased the amounts of the natural dyes; the different elicitors, such as fungal polysaccharides and endogenous signal molecules (salicylic and jasmonic acid) provided specific yields of anthraquinone derivatives. After 7 days of elicitation, the total yield of anthraquinones increased from ≈ 70 mg/g to ≈ 262 mg/g while the amounts of lucidin primeveroside and ruberithric acid grew three-fold and the quantity of pseudopurpurin increased by a factor of 28 [Orbán Norbert, Boldizsár Imre, Szücs Zoltán and Dános Béla, Influence of different elicitors on the synthesis of anthraquinone derivatives in *Rubia tinctorum* L. cell suspension cultures, *Dyes Pigments*, 2008, **77**(1), 249-257].

Extraction of anthocyanins from grape by-products

Extracts from grape by-products contain bioactive substances such as anthocyanins which could be used as natural antioxidants or colorants. Researchers at Germany conducted studies to examine the feasibility of different emerging technologies such as high hydrostatic pressure (HHP), pulsed electric fields (PEF) and ultrasonics as potential extraction methods for bioactive substances from grape by-products. The effect of heat treatment at 70°C combined with the effect of different emerging novel

technologies such as ultrasonics (35 KHz), high hydrostatic pressure (600 MPa) and pulsed electric fields (3 kV/cm) showed a great feasibility and selectivity for extraction purposes. After 1 h extraction, the total phenolic content of samples subjected to novel technologies was 50% higher than in the control samples. Therefore, the application of novel technologies increased the antioxidant activity of the extracts being the extractions carried out with PEF four-fold, with HHP three-fold and with

ultrasonics two-fold higher than the control extraction. In addition, the extraction of individual anthocyanins was studied showing a selective extraction based on the glucose moieties linked to the anthocyanidins; anthocyanin monoglucosides were better extracted by PEF, whereas the acylated ones were extracted by HHP [Corrales M, Toepfl S, Butz P, Knorr D and Tauscher B, Extraction of anthocyanins from grape by-products assisted by ultrasonics, high hydrostatic pressure or pulsed electric fields: A comparison, *Innov Food Sci Emerg Technol*, 2008, **9**(1), 85-91].

Feed/Fodder

Limiting amino acids for growing goats fed a Corn grain, Soybean meal and maize stover based diet

Two experiments were conducted by researchers at P. R. China and Nigeria to determine limiting amino acids (AA) for growing goats fed a corn grain, soybean meal and maize stover based diet. In experiment 1, three 4-month-old Liuyang Black growing wether goats (10.0 ± 0.1 kg), fitted with ruminal, proximal duodenal and terminal ileal cannulae, were used to determine flows of AA into the duodenum and apparent intestinal AA digestibilities. These data were used to calculate amounts of essential amino acids (EAA) that should be infused into the duodenum to match the ideal AA pattern of muscle protein according to calculations, which suggested that 0.91, 0.77, 0.58, 0.52 and 0.44 g/d of lysine, methionine, leucine,



Corn grains

arginine and threonine were required, respectively to be supplemented to the duodenum. In experiment 2, four Liuyang Black growing wether goats (10.0 ± 0.5 kg and 4-month-old) fitted with duodenal cannulae were used in a 4×4 Latin square design experiment, and the four treatments were continuous duodenal infusion of a mixture of methionine, lysine and leucine at 0.77, 0.91 and 0.58 g/d, respectively (3EAA, from experiment 1), or replacement of 0.21 of methionine (-0.19 g methionine), lysine (-0.52 g lysine) or leucine (-0.56 g leucine), respectively with isonitrogenous

glutamate infusion from the 3EAA mixture. Replacement of methionine, lysine or leucine reduced methionine concentrations in plasma. The magnitude of the change was greatest for methionine, followed by lysine and leucine. A general lack of statistical significance between AA replacement and 3EAA group on almost all measurements, except for plasma methionine concentration, was probably due to the small number of goats used. Nevertheless, for growing goats fed a corn grain/soybean meal/maize stover diet, methionine was likely the first limiting amino acid, followed by lysine and leucine [Shan JG, Tan ZL, Sun ZH, Hu JP, Tang SX, Jiang HL, Zhou CS, Wang M and Tayo GO, Limiting amino acids for growing goats fed a corn grain, soybean meal and maize stover based diet, *Anim Feed Sci Technol*, 2007, **139** (3-4), 159-169].