

shelf-life (time taken to reach 10^7 CFU/ml). Little inactivation of *Pseudomonas* was achieved at 15 or 40°C compared with 50 or 55°C. The greatest inactivation (>5 logs) was achieved by processing at 55°C with 31kV/cm (139.4kJ/l). Heat treatment at the application temperature without PEF treatment caused minimal inactivation of *Pseudomonas* (only 0.2 logs), demonstrating that the inactivation of the *Pseudomonas* was due to the PEF treatment rather than the heat applied to the milk. At added *Pseudomonas* levels of 10^3 and 10^5 CFU/ml, the microbial shelf-life of PEF-treated milk was extended by at least 8 days at 4°C compared with untreated milk. The total microbial shelf-life of the PEF-treated milk was 13 and 11 days for inoculation levels of 10^3 and 10^5 CFU/ml, respectively. The results indicated that PEF treatment is useful for the reduction of pseudomonads, the major spoilage bacteria of milk [Craven HM, Swiergon P, Ng S, Midgely J, Versteeg C, Coventry MJ and Wan J, Evaluation of pulsed electric field and minimal heat treatments for inactivation of pseudomonads and enhancement of milk shelf-life, *Innov Food Sci Emerg Technol*, 2008, 9(2), 211-216].



Production of concentrated cherry and apricot juices by cryoconcentration technology

The scientists at Department of Food Engineering, Laval University, Québec, Qc, Canada prepared apricot and cherry juices successfully by cryoconcentration technology. Two freezing temperatures $-10\pm 1^\circ\text{C}$, $-20\pm 1^\circ\text{C}$ and three cryoconcentration stages were studied. Freezing temperature did not show any affect on total



dry matter content of the concentrated juices, as well as on their physico-chemical properties. At the same time, the cryoconcentration stage effect was highly significant on total dry matter content and juice qualities. Total dry matter of the apricot juice increased from $14.50\pm 1.12\text{g}/100\text{g}$ up to $35.50\pm 2.09\text{g}/100\text{g}$ in three cryoconcentration stages. Cherry juice total dry matter increased from $15.50\pm 1.26\text{g}/100\text{g}$ up to $45.50\pm 2.47\text{g}/100\text{g}$. Concentrated juices had high aroma numbers and high content of ascorbic acid compared to the same juices obtained by the conventional method. The present study demonstrated that cryoconcentration as an environmentally friendly technology is a promising and highly effective food processing technique in the juice industry. Aroma number increased from 3.55 up to 8.38 and from 5.23 up to 15.75 for apricot and cherry juices, respectively. The juices obtained by cryoconcentration technology were compared to the same juices obtained by the conventional method of evaporation [Aider Mohammed and Halleux Damien de, Production of concentrated cherry and apricot juices by cryoconcentration technology, *LWT-Food Sci Technol*, 2008, 41(10),1768-1775].

Dye

HPLC quantification of dye flavonoids in *Reseda luteola* Linn.

The scientists at Portugal developed a HPLC method for the simultaneous identification of *Reseda luteola* Linn. (Weld) flavonoids and quantification of the main compounds responsible for the yellow colour. This method was applied to a large number of wild Portuguese Weld to evaluate its

potential application as dyestuff for textile factories, as a substitute for the synthetic dyes currently used. Portuguese Weld dyestuff content ranged between 1.04 and 5.87%, corresponding to a wide variation of the flavonoids amount (1.39-9.04%). Luteolin 4'-O-glucoside was found for the first time in *R. luteola*, but kaempferol,

isorhamnetin and their glycosides were not detected in the Portuguese specimens [Moiteiro Cristina, Gaspar Helena, Rodrigues Ana I, Lopes João F and Carnide Valdemar, HPLC quantification of dye flavonoids in *Reseda luteola* Linn. from Portugal, *J Separ Sci*, 2008, 31(21), 3683-3687].

Effect of UV radiation on dyeing of cotton fabric with extracts of henna leaves

Recently the concern for the environment has created an increasing demand for natural dyes. The treatment of fibres with UV radiations are reported to affect the coloration, therefore researchers at Department of Chemistry, University of Agriculture, Faisalabad, Pakistan studied effect of UV radiation on dyeing of cotton fabric with extracts of henna (*Lawsonia inermis* Linn.) leaves. Natural dye containing Lawsone that imparts yellowish-green colour on to the cotton fabric has been extracted using water, alum and methanol from non-irradiated and irradiated henna powder

through UV source. The effect of treatment time, temperature and salt concentration on the dyeing of cotton fabric has been studied using CIELab system for the optimization of dyeing conditions. Different mordants, such as copper



Henna leaves

sulphate and ferrous sulphate, have been employed for the improvement in colour fastness properties of the irradiated dyed cotton fabrics. It was observed that the UV radiation not only enhances the colour strength of dye on cotton fabric but also improves the fastness properties of pre-irradiated cotton fabrics. The technique used in the study not only improves the colour strength but also enhances the colour fastness properties of the irradiated powder [Iqbal Javed, Bhatti Ijaz A and Adeel Shahid, Effect of UV radiation on dyeing of cotton fabric with extracts of henna leaves, *Indian J Fibre Text Res*, 2008, **33**(2), 157-162].

Red Sicilian orange and purple eggplant fruits as natural sensitizers for dye-sensitized solar cells

Dye-sensitized solar cells (DSSCs) were assembled by scientists at Italy using red Sicilian orange juice [*Citrus sinensis* (Linn.) Osbeck] and the purple extract of eggplant peel (*Solanum melongena* Linn.) as natural sensitizers of TiO_2 films. Conversion of solar light into electricity was successfully accomplished with both fruit-based solar cells. The best solar energy conversion efficiency ($\eta=0.66\%$) was obtained by red orange juice dye that, under AM 1.5 illumination, achieved up to $J_{sc}=3.84\text{mA}/\text{cm}^2$, $V_{oc}=0.340\text{V}$ and fill factor= 0.50 . In the case of the extract of

eggplant peels, the values determined were up to $J_{sc}=3.40\text{mA}/\text{cm}^2$, $V_{oc}=0.350\text{V}$ and fill factor= 0.40 . Cyanidine-3-glucoside (cyanine) and delphinidin 3-[4-(*p*-coumaroyl)-l-rhamnosyl(1-6)-glucopyranoside]-5-glucopyranoside (nasunin) are the main pigments of cocktail dyes for red orange and eggplant, respectively [Calogero Giuseppe



Orange juice



Egg plant fruits

and Marco Gaetano Di, Red Sicilian orange and purple eggplant fruits as natural sensitizers for dye-sensitized solar cells, *Solar Energy Mat Solar Cells*, 2008, **92**(11), 1341-1346].

Thermodynamic and kinetic studies of adsorption of berberine on silk

Berberin is a widely distributed berberidacean alkaloids that has been employed in traditional medicine as an antiprotozoal and antidiarrhoeal agent. It is found mostly in roots of *Rhizoma coptidis* and stems of *Phellodendron*. As the only cationic natural plant dye, berberine is yellow crystal and soluble in water and organic solvents such as ethanol. It can be used for dyeing natural fibre such as silk and wool. Scientists at Wuhan University of Science and Engineering, Wuhan, P R China studied dyeing properties of silk fabric with berberine in terms of the thermodynamic and kinetic factors, including standard affinity, enthalpy change, entropy change, dyeing rate, diffusion coefficient and activation energy of the diffusion. The results showed that the adsorption isotherm of berberine on silk fabric belongs to Langmuir type. The analysis of dyeing thermodynamics shows that the adsorption of berberine on silk fabric is an exothermic process. When the fabric is dyed at higher temperature, the lower affinity and less dye uptake are obtained; however, the higher temperature increases the initial dyeing rate and diffusion coefficient.

The study helps in improving the quality of the berberine-dyed silk products and motivates natural dyes in dyeing application [Ke Gui-zhen, Xu Wei-lin and Yu Weidong, Thermodynamic and kinetic studies of adsorption of berberine on silk, *Indian J Fibre Text Res*, 2008, **33** (2), 185-188].

Dyeing of jute with binary mixtures of jackfruit wood and other natural dyes

Varying proportion of binary mixtures of aqueous extracts of Jackfruit wood (JFW) or *Kanthal* (*Artocarpus heterophyllus* Lam.) with other natural dyes, like *Manjistha* (MJ) or Madder (*Rubia cordifolia* Linn.), Red sandal wood (RSW) or *Raktachandan* (*Pterocarpus santalinus* Linn. f.), Marigold (MG) or *Genda* (*Tagetes patula* Linn./*Tagetes erecta* Linn.), Sappan wood (SW) or Red wood (*Caesalpinia sappan* Linn.) and *Babool* (BL) or *Babla* (*Acacia arabica* Willd.), have been used by researchers at Institute of Jute Technology, Kolkata and Department of Chemical Engineering, Jadavpur University, Kolkata, West Bengal, India to dye bleached jute fabric pre-mordanted with 20% myrobalan followed by 20% aluminium sulphate. Binary combinations of JFW with each of the five natural dye extracts have been evaluated for colour strength (*K/S* value) and its coefficient of variation, brightness index (BI), changes in hue (ΔH), metamerism index (MI), total colour differences (ΔE) and colour fastness to washing, light and rubbing. Dyed fabric samples have been further treated with the cationic dye fixing agents *n*-cetyl-N-trimethyl ammonium bromide, cetrimide and Sandofix-HCF to improve wash fastness. Treatment with 1% benzotriazole is also given to improve light fastness. The compatibility of these binary pairs has been assessed by the analysis of ΔC vs ΔL and *K/S* vs ΔL plots for the progressive depth of shade produced by varying time and temperature profile as well as by varying total concentrations of the binary pairs of dyes taken in equal proportion. A simple method of assessing relative compatibility rating of pairs of dyes has been proposed, where a new index called colour difference index [$(\Delta E \times \Delta H) / (\Delta C \times MI)$] has been postulated and the compatibility ratings determined. The results of this proposed system of compatibility rating are found to be in well agreement with the results of conventional methods of plots analysis. The order of relative degree of compatibility of these binary pairs of natural dyes applied on pre-mordanted jute is found to be JFW : RSW \geq JFW : BL \geq JFW : MJ $\gg \gg$ JFW : MG $\gg \gg$ JFW : SW.

Thus, this proposed method of the relative compatibility rating system may be useful to identify compatible binary pairs of natural dyes for dyeing jute with binary mixture of natural dyes in various proportions, providing the dyer an option for selecting correct and compatible mixture of natural dyes to match a target compound shade [Samanta Ashis Kumar, Agarwal Priti and Datta Siddhartha, Dyeing of jute with binary mixtures of jackfruit wood and other natural dyes — Study on colour performance and dye compatibility, *Indian J Fibre Text Res*, 2008, **33**(2), 171-180].

Optimization of reactive textile dyes degradation by laccase-mediator system

In the textile industry, large quantities of intensely coloured and toxic effluents are released, causing serious environmental pollution. Several biotechnological approaches have been suggested to eliminate this pollution source in an eco-efficient manner. Laccase can be used to decolourise dyes and its substrate range can be extended by inclusion of a mediator.

The scientists at Laboratory of Separation and Reaction, Porto, Portugal performed a screening using several laccase mediators (2,2-azinobis(3-ethylbenzothiazoline-6-sulfonate) (ABTS), 1-hydroxybenzotriazole (HBT), *N*-

hydroxyacetanilide (NHA), polioxo-metalates, violuric acid (VA) and (2,2,6,6-tetramethylpiperidin-1-yloxy) (TEMPO) on the degradation of six reactive textile dyes. ABTS was the most effective mediator leading to higher decolourisation. The efficiency of ABTS depends on the type of dye, *pH*, temperature and dye concentration. The optimum temperature and *pH* values were 35°C and 5.0, respectively, for maximum decolourisation (above 70%) of reactive black 5, reactive blue 114 and reactive yellow 15. For reactive red 239 the optimum conditions were found to be a temperature of 40°C and *pH* of 4.5 (above

56% decolourisation). ABTS has no effect at low concentrations, except for reactive blue 114, where it resulted in the best decolourisation (93%). A comparison of decolourisation based on the percentage absorbance reduction at the maximum absorbance wavelength of each dye and throughout the visible spectrum was made. These results suggest that the laccase mediator system could be used to treat textile dyeing wastewaters [Tavares Ana PM, Cristóvão Raquel O, Loureiro José M, Boaventura Rui AR and Macedo Eugénia A, Optimisation of reactive textile dyes degradation by laccase-mediator system, *J Chem Technol Biotechnol*, 2008, **83**(12), 1609-1615].

Dyeing of wool with an oil-in-water microemulsion system

The scientists at Barcelona, Spain investigated the influence of oil-in-water (o/w) microemulsions, used as media for both dye solubilization and dye baths, on the dye uptake on fibre surfaces. An acetic acid solution/Synperonic L7/benzyl alcohol microemulsion system was used to solubilize a water-insoluble antimicrobial natural dye (C.I. Natural Orange 2) and to dye wool fabric at an acidic *pH*. The results clearly show that the dye exhaustion on the fabric took place mainly when the temperature of the dye

bath promoted a change in the molecular organization of the microemulsions with the liberation of the dye solubilized in the oil droplets of the microemulsions. Although uniformly and evenly dyed fabrics were obtained, they showed very low wash fastness. To confirm the mechanism involved and to achieve dyed fabrics with good wash-fastness properties, two different dyeing methods were also studied. The first method was dyeing at a constant low temperature, at which the o/w microemulsion remained a

monophase system; the second one was dyeing at a high temperature, at which it was transformed into a multiphase system. Both the dye exhaustion and wash fastness improved considerably for the fabrics dyed at a high temperature and uniform and even dyeing was achieved [Paul Roshan, Solans Conxita and Erra Pilar, Mechanism involved in the dyeing of wool with an oil-in-water microemulsion system, *J Appl Polym Sci*, 2008, **110**(1), 156-162].

Dyes from the leaves of deciduous plants with a high tannin content for wool

The scientists at Department of Textile Technology, PSG College of

Technology, Coimbatore, Tamil Nadu, India investigated the possible use of the

aqueous leaf extracts of five different deciduous plants, namely, silver oak,

flame of the forest, tanner's senna, wattle and serviceberry for dyeing wool. The extracts were used on their own and in combination with aluminium sulphate, stannous chloride and ferrous sulphate to dye wool by a simultaneous mordanting technique. The washing and light fastness properties of the developed shades were moderate to good. Based on the CIE 2000

spectral colour coordinate values (K/S, ΔL , Δa , Δb and ΔE), the developed shades were classified into four groups: yellow/brown, yellow, orange and dark grey. The use of aluminium sulphate gave medium shades (K/S=8.24), while the stannous chloride and ferrous sulphate mordants provided deep shades (K/S=30.5). Statistical analyses have shown that only

the type of mordant and not the dye source significantly influenced the development of colour on wool. Hence, it was theoretically possible to use five selected leaves as a single mixture to produce four different colours on wool [Raja ASM and Thilagavathi G, Dyes from the leaves of deciduous plants with a high tannin content for wool, *Color Technol*, 2008, **24**(5), 285-289].

Coloration of wool and silk with *Rheum emodi* Wall. ex Meissn.

Silk and wool fabrics have been dyed with colorant extracted from *Rheum emodi* Wall. ex Meissn. (commonly known as *Dolu*) by researchers at Institute of Jute Technology, Kolkata, Visva Bharti University, Srinikatan and Department of Chemistry, Jadavpur University, Kolkata, West Bengal, India in the absence and presence of magnesium sulphate, aluminium sulphate and ferrous sulphate mordants for producing shades of different colours, ranging from yellow to olive green. The researchers aimed their study at applying colouring component of *R. emodi* on wool and silk and evaluated some fundamental parameters of dyeing,

and assessed different colour fastness properties. Coloring component of *R. emodi* has close resemblance with a typical anthraquinonoid type disperse dye; the uptake of such colouring component by the protein fibres remains unaffected within a wide pH range of 4-8. Colour uptake, rate of dyeing and affinity of colour are found to be more for silk than that for wool under all the conditions studied. The dyeing mechanism corresponds to the partition mechanism, confirming that this anthraquinonoid-based colorant is adsorbed by silk and wool fibres as a disperse dye and the dyeing process is endothermic. The use

of ferrous sulphate and aluminium sulphate produces significant improvement in depth of shade, when both the substrates are treated with such salts prior to application of the colorant. Coloured protein fibres, in general, show a common light fastness and wash fastness ratings of 4 and 3, respectively. Ferrous sulphate, however, improves the colour fastness properties and colour retention on washing of both wool and silk fabrics further [Das Debasish, Maulik Ray Sankar and Bhattacharya Subhash Chandra, Colouration of wool and silk with *Rheum emodi*, *Indian J Fibre Text Res*, 2008, **33**(2), 163-170].

Feed/Fodder

Comparative effect of biofertilizers on fodder production and quality in Guinea grass

Guinea grass, *Panicum maximum* Jacq. is one of the most important fodder grasses of the tropics. For good production and growth it requires high amounts of N fertilizer. Chemical fertilizers have a deleterious effect on soil fertility and are not economical for

resource-poor farmers. Utilization of plant growth-promoting bacteria and fungi proved to be beneficial for improving crop production as well as the soil fertility. The scientists at Centre for Rural Development and Technology, Indian Institute of Technology, Hauz Khas, New Delhi studied

the effect of inoculation of N fixer (*Azospirillum brasilense*) and P solubilizers [arbuscular mycorrhizal (AM) fungi consortia and inoculum of *Glomus intraradiaces*] in single as well as mixed inoculation on forage yield and quality in Guinea grass at different cuttings under