

Colour-strength-related parameters and compatibility for dyeing of cotton fabric

Varying proportions of binary mixtures of aqueous extracts of jackfruit wood (JFW) with other natural dyes like manjistha (MJ), red sandalwood (RSW), marigold (MG), sappan wood (SW) and babool (BL) were used by the scientists at Institute of Jute Technology, Kolkata and Department of Chemical Engineering, Jadavpur University, Kolkata, India to dye bleached cotton fabric premordanted with 20% myrobolan and then 20% aluminium sulphate applied in sequence. Binary combinations of JFW with each of the other five extracts named above have been evaluated for colour strength (K/S value), coefficient of variation for colour strength, and other related colour parameters, such

as brightness index (BI), changes in hue (ΔH), metamerism index (MI) and total colour differences (ΔE). The compatibility of these binary mixtures was assessed by a conventional method of analysis of ΔC versus ΔL plots and K/S versus ΔL plots for progressive depth of shade produced by varying time and temperature profile, as well as by varying total concentrations of the binary mixture of dyes taken in equal proportion. A simple method of assessing relative compatibility rating (RCR) of pairs of dyes has been proposed, where a new empirical index called colour difference index $[(\Delta E \times \Delta H)/(\Delta C \times MI)]$ has been postulated and corresponding relative compatibility ratings (5=excellent,

4=good, 3=average, 2=poor, 1=worst and 0= noncompatible) have been determined. The results of this newer system of compatibility rating are in agreement with the results of the conventional methods of ΔC versus ΔL or K/S versus ΔL plots. The order of the relative degree of compatibility of these binary mixtures of natural dyes applied on premordanted cotton is JFW: MJ > JFW: RSW \geq JFW: BL \geq JFW: MG >>> JFW: SW [Samanta Ashis Kumar, Agarwal Priti and Datta Siddhartha, Studies on Colour-Strength-Related Parameters and Compatibility for Dyeing of Cotton Fabric with Binary Mixtures of Jackfruit Wood and Other Natural Dyes, *J Nat Fibers*, 2009, 6(1), 27-45].

Extraction and formulation of anthocyanin-concentrates from grape residues

The interest in natural food colorants shows an increasing tendency due to the strictening rules and consumers' concerns over synthetic additives. One of natural pigments with high potential are anthocyanins, which are providing colours from yellow to blue in berries, flowers and vegetables. However, the use of anthocyanins as food colorants is still limited because of their relatively low stability during processing, formulation and storage. In a study done by researchers at Slovenia and Germany extraction of anthocyanins from grape marc was investigated with different concentrations of acetone (50, 70 and 100wt%) at 20 and 60°C temperatures.

Pilot-scale extraction of grape marc was performed upon the results obtained from laboratory scale experiments. High-pressure concentrated powder form (CPF) technique was applied in order to formulate the obtained extracts in powderous form. Carrier materials, such as starch and silica were tested. Colorimetric properties (lightness, chroma and hue angle) of powderous products were measured and compared with synthetic colorants. Colour stability was monitored during storage at different conditions (light/dark and ambient temperature/refrigerator). The results were compared with the non-formulated extracts, which were stored at same

conditions. Product formulation with CPF improved the colour stability of anthocyanin extracts, while for the non-formulated extracts degradation of colour rapidly occurred. The results shown that formulated anthocyanin extracts have potential use as natural colorants. However, the major difference compared to synthetic colorants is still in the saturation of the colour [Vatai Tünde, Škerget Mojca, Knez Zeljko, Kareth Sabine, Wehowski Manuel and Weidner Eckhard, Extraction and formulation of anthocyanin-concentrates from grape residues, *The J Supercrit Fluids*, 2008, 45 (1), 32-36].

Extraction of betanine by pulsed electric fields

The scientists at University of Zaragoza, Food Technology, Zaragoza, Spain carried out a systematic study about the influence of pulsed electric fields (PEF) and other operating parameters on betanine extraction from red beetroots. Thin disks of red beetroots were subjected to PEF at different intensities (number of pulses and field strengths) and the release of betanine into media of different pH and at different temperatures was determined. The influence of mechanical pressing after PEF treatments on betanine

extraction was also investigated. The use of extracting media having pH 3.5 and temperatures of 30°C gave the highest yields and rates for betanine extraction from PEF treated samples. When subjected to 5 pulses of 2µs at 7kV/cm, the samples released about 90% of total betanine in 300min, a rate that is fivefold quicker than the non-PEF-treated samples. Pressing the samples during the extraction process at all pressures investigated further reduced the extracting time. A general mathematical expression was developed

to determine the percentage of betanine extracted from red beetroots treated at different electric field strengths (1-9kV/cm) and then pressed (0-14kg/cm²). Based on this equation, a treatment of 5 pulses at 7kV/cm (2.5kJ/kg) and 10kg/cm² at room temperature permitted the extraction of 90% of the total red colouring in 35 min [Noelia López, Eduardo Puértolas, Santiago Condón, Javier Raso and Ignacio Alvarez, Enhancement of the extraction of betanine from red beetroot by pulsed electric fields, *J Food Eng*, 2009, **90**(1), 60-66].

Serratula tinctoria Linn., a source of natural dye

In the context of new alternative crop development in Europe (France) the scientists investigated flavonoids in saw-wort, *Serratula tinctoria* Linn., a perennial 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-4'-*O*-glucoside and 3-methylquercetin were isolated for the first time in *S. tinctoria* leaves and identified by NMR spectroscopy. 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 [Guinot P, Gargadennec A, Fisca P La, Fruchier A, Andary C and Mondolot L, *Serratula tinctoria*, a source of natural dye: Flavonoid pattern and histolocalization, *Ind Crops Prod*, 2009, **29**(2-3), 320-325].

The synergistic effect of two photosynthetic pigments in dye-sensitized mesoporous TiO₂ solar cells

Chlorophyll and xanthophyll were extracted from different plants for use as sensitizer colorants by researchers at PR China; cells were sensitized using chlorophyll, xanthophyll and a mixture of the two pigments. It was found that energy conversion efficiency (η) and maximum output power (P_{\max}) were 15.16% and 8.31% higher than that achieved by the linear superposition of the cells sensitized by individual pigments. This indicates that the mixed pigment co-sensitization entails a synergistic effect in the energy transfer of the pigment-sensitized mesoporous TiO₂ solar cells. Fluorescence analysis revealed that the electron transfer between chlorophyll and xanthophyll in the mixed pigment co-sensitized mesoporous TiO₂ solar cells was similar to that in 'zigzag chains' of photosynthesis [Liu Bao-Qi, Zhao Xiao-Peng and Luo Wei, The synergistic effect of two photosynthetic pigments in dye-sensitized mesoporous TiO₂ solar cells, *Dyes Pigments*, 2008, **76** (2), 327-331].

Extraction, dealcoholization and concentration of anthocyanin from red radish

The extraction procedure is of great importance for the extraction of natural colorants. In a study conducted by researchers at Department of Food Engineering, Central Food Technological Research Institute, Council of Scientific and Industrial Research, Mysore, India, an alternate process is reported for anthocyanin from the peels of red radish

(*Raphanus sativus* Linn.). Different extracting mediums are used and the mixture of 50% ethanol and acidified water resulted in maximum anthocyanin content (37.26mg/100ml) with better chroma (69.03) and hue angle (44.54). Membrane pertraction is used for the first time to dealcoholize and concentrate the anthocyanin extract (from 37.26mg/

100ml to 62.58mg/100ml). The extract is further concentrated using osmotic membrane distillation (485mg/100ml) at ambient temperature and atmospheric pressure [Patil Ganapathi, Madhusudhan MC, Babu B Ravindra and Raghavarao KSMS, Extraction, dealcoholization and concentration of anthocyanin from red radish, *Chem Eng Process: Process Intensif*, 2009, **48** (1), 364-369].

Induction of kidney and liver cancers by the natural food additive madder colour

Madder colour (MC) extracted from the roots of *Rubia tinctorum* Linn. (Madder root) has been used as a food colouring in Japan. Previous studies revealed MC to have obvious subchronic and chronic toxicity and potent carcinogenicity targeting rat liver and kidney. In a two-year carcinogenicity study, conducted by researchers at Japan to further elucidate the long-term effects of MC and its target organs, male and female F344 rats were fed diet containing 0%, 2.5%, and 5.0% MC for 104 weeks. Body weights were significantly decreased in treated groups of both sexes throughout the feeding period. However, survival rates at week 104 were higher in treated groups of both sexes than in controls. Relative weights of the kidneys and liver were significantly increased in treated groups of both sexes. Histopathologically, karyomegaly and atypical tubules/hyperplasias, as well as



Madder roots

renal cell adenomas and carcinomas were significantly increased in treated groups of both sexes with dose-dependence. Moreover, the incidence of hepatocellular adenomas and/or carcinomas was increased significantly with a dose-relation in treated groups of both sexes. These data provide clear evidence that MC exerts unequivocal carcinogenicity against renal tubule cells and hepatocytes in rats.

The results clearly indicate that MC exerts carcinogenic potential in the kidney and liver, even with the lower dose

of the study. The data obtained is sufficient to evaluate carcinogenicity of MC from the food safety perspective, and support data in the previous 750 days study for madder root. MC contains anthraquinones, and MC used in the study was in fact largely composed of three anthraquinones, alizarin, lucidin-3-*O*-primeveroside and ruberythric acid. Lucidin and rubiadin are metabolites of lucidin-3-*O*-primeveroside with genotoxic potential. These anthraquinones are also contained in some food stuffs, dyeing baths for textiles and wool treated with madder root. Therefore, further studies on these individual components should be performed to clarify which anthraquinone is responsible for carcinogenicity [Inoue Kaoru, Yoshida Midori, Takahashi Miwa, Shibutani Makoto, Takagi Hironori, Hirose Masao and Nishikawa Akiyoshi, Induction of kidney and liver cancers by the natural food additive madder color in a two-year rat carcinogenicity study, *Food Chem Toxicol*, 2009, **47** (1), 184-191].

Extraction of colouring matter from *Sargentodoxa cuneata* (Oliv.) Rehder & E.H. Wilson by ultrasonic technique

The ultrasonic extraction technique has been used to extract colouring matter from *Sargentodoxa cuneata* (Oliv.) Rehder & E. H. Wilson and the application of colouring matter on wool fabric were studied by researchers of P. R. China. The effects of temperature, ultrasonic power, extracting time and bath ratio on the extraction of colouring matter from *S. cuneata* have been studied. From the orthogonal experiment, the optimum extraction

conditions are found to be 50°C temperature, 90 min extracting time, 200 W ultrasonic power, and 1:50 bath ratio. It is also observed that the efficiency of the ultrasonic extraction at 50°C is higher than the normal extraction at 100°C, and this optimum extraction condition is stable, feasible and has good repeatability. Ultrasonic extraction offers a promising alternative for efficient extraction of colouring matter from *S. cuneata*. As compared to normal

extraction method, ultrasonic extraction has many merits, like low temperature, shorter time, and high efficiency. It has bright prospective in industrialization. Colour of the fabrics dyed by ultrasonic extracting solution is found to be deeper [Xie Xincheng, Wang Lu, Jia Shunhua, Zhou Qicheng, Zhang Xinlong and Hu Xiaofeng, Extraction of colouring matter from *Sargentodoxa cuneata* by ultrasonic technique and its application on wool fabric, *Indian J Fibre Text Res*, 2008, **33** (4), 426-430].

Feed/Fodder

Evaluation of castor seed cake in the total mixed ration for sheep

Castor (*Ricinus communis* Linn.) seed cake (CSC), a byproduct of the vegetable-oil industry, contains fairly good amounts of protein (crude protein, 290-390g/kg) which could be a suitable substitute of conventional oil cakes like soybean meal (SBM) in livestock diets but for the presence of a toxic glycoprotein, ricin, it is not used for the purpose of animal feed. The scientists at National Institute of Animal Nutrition and Physiology and Department of Pathology, Veterinary College, Bangalore made efforts to determine the feasibility of feeding CSC as such or after detoxification with lime (4%, wt/wt) by incorporating it into a total mixed ration (TMR) containing 65 and 35 parts ragi (*Eleusine coracana* Gaertn.) straw and concentrate mixture,



respectively, with 11g/kg crude protein and 50g/kg total digestive nutrient (TDN) in which the SBM of a control diet was isonitrogenously replaced with either raw or lime-treated CSC in test diets. The control and two test TMRs were fed to 24 sheep, respectively, divided at



random into three dietary groups having equal number of animals for 150 days.

Although lime treatment had a positive effect in reducing ricin by 58%, no adverse effect could be noticed by feeding raw or lime-treated CSC in terms of body weight changes, macro- and micro-nutrient utilisation, blood biochemical and mineral profile, rumen fermentation pattern, carcass traits, except the level of plasma immunoglobulins which was significantly ($P < 0.05$) higher in sheep fed CSC diets. No pathological lesions could be noticed in the tissues of visceral organs due to feeding the raw or treated CSC. The results suggest no adverse effect in the nutritional performance of adult sheep due to feeding the raw or treated CSC when incorporated