DYES (incl. Food colorants)

NPARR 3(4), 2012-0352 Isolation, identification and dyeing studies of betanin on modified acrylic fabrics

Mature red fruits of *Opuntia ficus-indica* contain two soluble pigments, betanin and indicaxanthin. The optimal conditions for dye extraction were to mix 50 g of juice from cactus pears with 100 mL of acidified water as solvent for dye extraction. Two main dyes were purified from the pigment extract by chromatography and identified by UV–vis, HPLC and LC–MS techniques as indicaxanthin (15 mg per 100 g) and betanin (280 mg per 100 g). The effect of dye bath pH, salt concentration, dyeing time and temperature was studied. The optimal conditions for dyeing modified acrylic fabrics with betanin dye were carried out at 50°C for 45 min at pH 5. Un-mordanted samples have good properties of water and washing fastness. Mordant CoSO₄ was found to give good light fastness (rating 5) [A. Guesmi*, N. Ladhari, N. Ben Hamadi and F. Sakli (Textile Research Unit, Higher Institute of Technological Studies of Ksar Hellal, Tunisia), *Industrial Crops and Products*, 2012, 37(1), 342-346]

NPARR 3(4), 2012-0353 Response surface optimization and artificial neural network modeling of microwave assisted natural dye extraction from pomegranate rind

The extracted dye from brown dry rind of the pomegranate has been used as natural colorant for textiles from ancient times. In this study, microwave assisted extraction (MAE) has been used for extraction for dye from dried pomegranate rind. The effect of three independent parameters namely extraction time (25-90 s), pH of solution (3.5-8) and amount of pomegranate rind (0.5-1.5 g) was considered. Response surface methodology (RSM) is applied to optimize the effects of processing parameters of extraction on the yield of dye and a computer-stimulated artificial neural network (ANN) model is developed to get a good correlation between the input variables responsible for extraction and the output parameter (concentration of dye) of extraction from pomegranate rind. Considering the yield of dye extraction and the feasibility of the experiment, the optimum conditions of dye extraction are extraction time 90 s, pH 3.5, amount of sample 1.48. Application of microwave irradiation method proved to be a rapid and improved technique for dye extraction and significantly reduced the extraction time. The optimization procedure shows a close interaction between the experimental and simulated values for dye extraction [Keka Sinha, Papita Das Saha* and Siddhartha Datta (Department of Biotechnology, National Institute of Technology Durgapur, Durgapur, West Bengal, India), *Industrial Crops and Products*, 2012, 37(1), 408-414].

NPARR 3(4), 2012-0354 Anthraquinones dye production using root cultures of *Oldenlandia umbellata* Linn.

The presence of anthraquinones gives many plants of the Rubiaceae commercial importance. The root of *Oldenlandia umbellata* Linn. (Indian madder) is a source of natural dyes. In the present study, successful protocols have been developed for rapid root development and dye production from *in vitro* raised normal roots. For rapid root development, organogenic calli were subcultured onto MS medium supplemented with various concentrations of NAA (1-naphthaleneacetic acid) (0.15–1.0 mg/l) with CM (coconut milk) (0.2–0.6%). The best root development (47.3 per calli) as well as response (100%) was obtained in the MS medium supplemented with 0.7 mg/l NAA and 0.4%CM. The dye obtained from *in vitro* raised normal roots was analyzed by thin-layer chromatography (TLC), high performance thin-layer chromatography (HPTLC), spectrophotometric quantification followed by high performance liquid chromatography (HPLC). The *in vitro*
roots represented 338.84 μg/ml AE (alizarin equivalence) of anthraquinones, whereas the in vivo roots were found to possess 361 μg/ml AE. To the best of our knowledge, this is the first report on anthraquinone dye production from *O. umbellata* which enhances the production of fresh pigment and through in vitro culture allows harvest throughout the year [Ramamoorthy Siva*, Sean Mayes, Shuvra Kanta Behera and C. Rajasekaran (School of Bio Sciences and Technology, VIT University, Vellore, Tamil Nadu- 632 014, India), *Industrial Crops and Products*, 2012, 37(1), 415-419].

**NPARR 3(4), 2012-0355 Dyeing properties and colour fastness of wool dyed with indicaxanthin natural dye**

This research work involves the dyeing of wool with indicaxanthin, a natural dye extracted from fruits of *Opuntia ficus-indica*. The optimal conditions for dye extraction were to mix 50g of Juice from cactus pears with 100mL of 80% aqueous ethanol as solvent for dye extraction. Liquid chromatography was applied for the separation. Two main dyes were obtained, which were identified as indicaxanthin (75mg per 50g) and betanin (5mg per 50g). The effect of dye bath pH, salt concentration, dyeing time and temperature were studied. The optimal conditions for wool dyeing with indicaxanthin dye were carried out at 70°C for 90min with the pre-treatment of various metal salts as mordant. The colour yields of the dye on the wool were found to be highly dependent of the pH, optimum results being obtained at pH 4. The K/S of wool increased in the order of the dyeing using KAl (SO₄)₂>MnSO₄>CoSO₄>FeSO₄>none>ZnSO₄>C uSO₄. Un-mordanted samples have good properties of water and washing fastness. Mordants KAl (SO₄)₂ and CoSO₄ were found to give light fastness (rating 5) [A. Guesmi*, N. Ben Hamadi, N. Ladhari and F. Sakli (Textile Research Unit, Higher Institute of Technological Studies of Ksar Hellal, Tunisia), *Industrial Crops and Products*, 2012, 37(1), 493-499].

**NPARR 3(4), 2012-0356 Au–Ag nanoparticles as red pigment in ceramic inks for digital decoration**

Novel pigments, consisting of Au–Ag mixed nanoparticles, were developed for digital decoration by ink-jet printing of ceramic wares. Special attention was paid to set up a microwave assisted synthesis route, with a low environmental impact, easily transferable to large-scale production. Several suspensions, based on Au, Ag and Au–Ag mixed nanoparticles were prepared, trying to get a core-shell assemblage, and the synthesis parameters like metal concentration, Ag/Au ratio, time, temperature and chelating agent amount were optimized. The suspensions are stable over many months and a total reaction yield, assessed by ICP-AES analysis, was achieved. Particle size, shape, composition and optical properties were measured by DLS, TEM-EDS, XRD and UV–VIS spectroscopy. The so-prepared inks were applied on ceramic tiles simulating the ceramic process and the colour performance, assessed by colourimetry, were expressed in the CIELab parameters [M. Blosi*, S. Albonetti, F. Gatti, G. Baldi and M. Dondi (Institute of Science and Technology for Ceramics (ISTEC-CNR), Via Granarolo 64, 48018 Faenza, Italy), *Dyes and Pigments*, 2012, 94(2), 355-362].

**NPARR 3(4), 2012-0357 Extraction of natural dye from petals of Flame of Forest (*Butea monosperma*) flower: Process optimization using response surface methodology (RSM)**

The uncontrolled discharge of synthetic dyes into the aquatic ecosystem is a global environmental concern due to their negative ecotoxicological effects. Dyes obtained from different natural sources have emerged as an important alternative to synthetic dyes. In this study, natural colorant from the petals of the Flame of forest (*Butea monosperma*) flower was extracted under different operating conditions such as extraction time (45-120 min), temperature (60-90°C) and mass of the petals.
(0.5-2 g) by conventional extraction technique. Response surface methodology (RSM) with the help of Design Expert Version 7.1.6 (STAT-EASE Inc., USA) was used for optimization of the extraction process and evaluation of interaction effects of different operating parameters. The optimum conditions for dye extraction were found to be 153.65 min, 73.53°C and 1.47g for extraction time, temperature, and mass of the flower, respectively. The efficiency of extraction under these optimum conditions was found to be 8813.67mgL⁻¹. Further, Fourier Transform Infrared Spectroscopy was used to identify the major chemical groups in the extracted dye [Keka Sinha, Papita Das Saha* and Siddhartha Datta (Department of Biotechnology, National Institute of Technology Durgapur, Mahatma Gandhi Avenue, Durgapur (West Bengal) 713209, India), Dyes and Pigments, 2012, 94(2), 212-216].