S. SRIVASTAVA & BANGALI BABOO

Biocolours

Safe Food Colours

BIOCOLOURS or natural dyes are derived from plants, insects and minerals. The use of such colouring matter is rooted in antiquity. Relics from the excavations of Harrapan Culture have yielded evidence of ropes and fabrics dyed with natural colours. The caves of Ajanta (the earliest dating back to the first century B.C.) still preserve the beauty of biocolours in their fullest splendour. In short, use of biocolours through the art of dyeing and printing is one of our richest heritages.

Biocolours had to pay a very heavy price due to the development of the synthetic genre of dyestuff. Synthetic dyes made their advent in India in the 18th century and gradually pushed natural dyes into oblivion due to their superiority in the speed of dyeing or printing and the fastness of colours.

But synthetic dyes are based on toxic raw materials and intermediaries. The effluents from the industry are one of the major causes of environment pollution. The continuous use of synthetic colours in textile and food industry has been found to be detrimental to human health, also leading to environmental degradation.

Biocolours, on the other hand, are not only free from this handicap but could also assist the regeneration of the environment if plant varieties were cultivated on a commercial scale. Moreover, biocolours represent an apparently more sustainable source of colourants than their synthetic counterparts, which are derived from non-renewable resources.

Biocolours are extracted from natural herbs, plant parts, as leaves, fruits (rind or seeds), flowers (petals, stamens),

Synthetic colours in food and their possible health hazards

Typical foods in which artificial colours are added	Chemicals used as colour additives	Potential Health hazards
Sweets, jams, cereals, snack canned fish, packaged soups	Tartrazine aka FD&C Yellow No:5; CI Acid Yellow 23, CI Food Yellow 4. Coal tar dye. Polycyclic Aromatic Hydrocarbon	Known to provoke asthma attacks (though not foods, recognized by the US FDA) and urticaria (nettle rash) in children (the US FDA estimates 1:10 000). May cause altered states of perception and behaviour, uncontrolled hyper agitation and confusion, wakefulness in young children. Is also known to inhibit zinc metabolism and interfere with digestive enzymes.
Soft drinks	Yellow 2G, Acid yellow 17, CI Food yellow 5, Coal tar dye	May cause asthma rashes and hyperactivity.
Cereals, bakery, sweets, snack foods, ice cream/lollies, and canned fish, orange jelly, jam, cakes, soups, desert mixes, yoghurt, sauces	Sunset Yellow FCF, Orange Yellow S, FD&C Yellow No:6, CI Food yellow 3	Can provoke allergic reactions such as abdominal pain, hyperactivity, hives, nasal congestion, drinks broncho -constriction, kidney tumours, squash, chromosomal damage, and distaste for food. Produces urticaria, swelling of the blood vessels, gastric upset. Potentially dangerous to asthmatics.
Sweets, cakes, biscuits, drinks, condiments, medications	FD&C Red No: 40	It has been connected with cancer.
Milk deserts, sweets, biscuits, ice creams, baked goods, confectionary	Indigotine, Indigo carmine, FD&C Blue No: 2, synthetic coal tar dye.	May cause nausea, vomiting, high blood pressure, skin rashes, breathing problems, brain tumours and other allergic reactions.
Dairy products, sweets and drinks	Brilliant blue FCF, FD&C Blue Dye No:1, CI Acid blue 9, CI Food blue 2, CI Pigment blue 24	May cause hyperactivity, skin rashes, bronchoconstriction.

From left: Orange colour extracted from *palas* (*Butea monosperma*) flowers; Red colour isolated from lac; Use of red biocolour in textile

bark or roots, minerals such as prussian blue, red ochre and ultramarine blue, and are also of insect origin such as lac, cochineal and kermes. Every food is associated with a certain type of colour. The addition of colour gives food an attractive and appetizing appearance, and enhances the acceptability. Hence, biocolours have tremendous potential of application in food products, for example as a colouring material in soft drinks and other food products like hams/sausages, jam, noodles, soft drinks etc.

Among different colouring materials, red dye is used for more than a third of the modern world's food, either fresh or processed and also in pharmaceuticals. Because of a ban of the potentially carcinogenic red dyes Sudan IV and Sudan I, there is a great demand for red coloured dyes in the food industry because of high meat intake.

Similar demand also exists in the pharmaceutical industries because of the ban on red coloured dye amaranth. Violet Dye No. 1 is also banned as a proven carcinogen. Red Dye No. 3 has long been defended by the food and pharmaceutical industries. Food processors around the world are working hard to meet new laws of the US, EU, Japanese and other countries to avoid use of illegal red dye contaminates. Here red biocolour could be a good substitute for the synthetic food colours.

The Indian Institute of Natural Resins and Gums (IINRG) at Ranchi has already transferred the technology of technical-grade lac dye to several entrepreneurs. Recently the institute has developed a plant for pilot scale production of food grade lac dye. It is believed that success will not only expand the scope of export of this value-added product, but will also increase export earning of the country. It will reduce import of edible dye/colour additives from foreign countries, hence, saving foreign exchange of the country.

There has been an alarming outbreak of a number of diseases and disorders due to the over use of synthetic dyes in food production, drugs, medicines etc. This has led to synthetic colours in food products being looked down upon with certain amount of apprehension with regard to their safety and consequent shift to biocolours or herbal dyes in the world market. Many countries have restricted the use of synthetic colours in food products. This has provided impetus and need for development of alternate colours and natural colours are now being considered as better alternative.

The total size of the world market for dyes, pigments and intermediates as estimated in 1999 was around US $23 billion. Dyes and pigments constitute the largest segment with a market size of 1.3 million tonnes and a market value of US $ 16 billion. Vegetable dyes constitute US $0.03 billion and are expected to grow in the coming years. In 1998, Europe imported US $53 million worth of "biocolours of animal or natural origin". The major importing countries were Germany (32%), France (17%), Italy (14%) and the U.K. (10%). The largest suppliers were Mexico and Peru each with about US $15 million exports to Europe. Imports from India were less than US $3 million (approx 5%). The US imports of biocolours are worth over US $4 million (Rs. 180 crores).

Biocolours represent an apparently more sustainable source of colourants than their synthetic counterparts.

According to a report of the German Ministry of Food, Agriculture & Forestry, about 90000 tonnes of natural dyes can be produced every year. At present USA is one of the major importers of natural dyes. The total imports of these dyes, which is about 3500 tonnes per year, works out to 0.4% of synthetic dyes. The imports of natural dyes of EU countries were 5300 tonnes per year, which is about 0.53% of synthetic dyes. From the above figures it is clear that the requirement for natural dyes is about 10000 to 12000 tonnes, which is equivalent to 1% of the worlds' total dye consumption.

India has a great opportunity for export of natural dyes due to its vast plant wealth and rich traditional knowledge of using natural colourants as dye. However, although biocolours used in food are screened for safety, toxicological information for most of these natural colours used as colouring material in soft drinks and other food products is sparse. There is a tendency to assume that natural products are safer and better than synthetic products because they are natural. However, the safety of biocolours needs to be proved if they are to be used more widely in food products and in commercial processes.

Dr. S. Srivastava is Senior Scientist (Organic Chem.) and Dr. B. Baboo is Director, Indian Institute of Natural Resins and Gums (IINRG), ICAR, Namkum, Ranchi-834010, Jharkhand; Email: sanjay_60. 2009@rediffmail.com