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NATURAL FOOD COLORS

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Abstract

Color is the main feature of any food item as it enhances the appeal and acceptability of food. During processing, substantial amount of color is lost. To make any food commodity attractive to the consumers, synthetic or natural colors are added. Several types of dyes are available in the market as coloring agents to food commodities but natural colorants are now gaining popularity and considerable significance due to consumer awareness as synthetic colors cause severe health problems. Natural colorants are prepared from renewable sources and majority are of plant origin like carotenoids, lutein, anthocyanidins, chlorophyll, betalain etc which are extracted from several horticultural plants. In addition to food coloring, natural colorants also act as antimicrobials, antioxygens and thereby prevent several diseases and disorders in human beings.

Introduction

The main factors to evaluate food quality are color, flavor, and texture, but color is the most important. Colors are the visual palette and first impression that "sets the table" for other sensory experiences. It is the main feature of food, which determines its appeal to the consumers. Natural colors are those coloring agents, which are obtained from the natural sources. These colorants are mainly derived from pigments like anthocyanidin, carotenoids etc., however, there are natural colorants, which are not pigments in any state like structural color and light emitting luciferin (Chattopadhyay *et al*., 2008). Color is added to food for one or more of the following reasons: to replace color in the food, which is lost during processing, to enhance color of the food already present, to minimize batch-to-batch variations, to color otherwise uncolored food, and to supplement food with nutrients (Mortensen, 2006). The chemistry of natural colours cannot fail to fascinate and intrigue and has become the most important part of any commodity (Clydesdale, 1993). In the past few years, the availability and use of natural colorants has greatly increased as a consequence of perceived consumer preference as well as legislative action, which has continued the delisting of approved artificial dyes. The current consumer preference for naturally derived colorants is mainly because these are healthy and have good quality. Moreover, synthetic colorants tend to impart undesirable taste and are harmful to human beings, as these are responsible for allergenic and intolerance reactions (Chaitanya Lakshmi G, 2014). As a result, there has been a worldwide interest in the development of food colorants from natural sources. The use of food colorants as additives in the food industry is highly useful for both food manufacturers and consumers in determining the acceptability of processed food.

Following reasons have increased the use and demand of natural colors in market:

- Health-promoting properties of natural colorant food
- It has become the consumer priority
- Low-fat content is the objective for many new or improved food formulations, replacing fats with thickeners or other food additives
- Increased consumer preferences for organic food
- Variety of food colour and flavours.
- Universal use of colours for health benefits.

NATURAL COLORANTS

Sources of natural colorants

Pigments are found widespread in nature from the simplest procaryotic organisms like cyanobacteria, and throughout the kingdoms of fungi, plants, and animals. Most natural food colorants come from the division

Magnoliophyta (flowering plants) of the plant kingdom. However, natural colorants from other sources such as scale insects (cochineal and lac), fungi (*Blakeslea trispora* and *Monascus* spp.), and cyanobacteria (*Arthrospira* spp.) are used today for coloring food.

Extraction of pigments

One way of coloring a food would be to add a strongly colored food (e.g., elderberry or black currant) to the food item (e.g., raspberry jam) that is to be colored. This is the approach used in home-cooking where spices, besides flavor, may impart color: turmeric and paprika are examples of this. However, for industrial food production this approach presents a series of problems: (1) low concentration of pigments in most foods means that a large amount would have to be added to give the desired shade, (2) unwanted flavor (elderberry flavor in a raspberry jam), and (3) insoluble matter (e.g., peel and seeds), which may not be a problem in some applications (jam) but is unacceptable in others (e.g., beverages). Therefore, pigments are extracted to overcome the problems of low concentration, flavor, and insoluble material. Lipid-soluble pigments like chlorophyll and carotenoids are usually extracted with organic solvents, which are subsequently removed, yielding an oleoresin rich in pigments, but also containing other material such as triglycerides, sterols, wax, and other lipid-soluble compounds. Water-soluble pigments such as carminic acid and anthocyanins are in general extracted with water or lower alcohols.

Carotenoids

These are one of the most important groups of natural pigments. These are lipid-soluble, yellow–orange–red pigments found in all higher plants and some animals (Britton *et al*., 2004). Animals cannot synthesize carotenoids, so their presence is due to dietary intake. The most important carotenoids are carotenes which including (alpha carotene, beta-carotene, betacryptoxanthin, lutein, and lycopene) and xanthophylls including violaxanthin, neoxanthin, zeaxanthin and canthxanthin (Zeb and Mehmood, 2004).

ß-Carotene is orange-yellow in color, oil soluble but can be made into a water dispersible emulsion. Carrot (*Daucus carota*) is a good source of ß-carotene. But most ß-carotene for commercial use is now derived from algae. Oil palm, orange, apricot, mango, and peach and pepper contributed significantly in increasing ß-cryptoxanthin and ß-carotene concentrations of foods (Rymbai *et al*., 2011). Besides being used as colorants, carotenes are also used for nutritional purposes as provitamin A agents as in margarine where they also provide color or as dietary supplements (Mortensen, 2006).

Lycopene, being a precursor in the biosynthesis of carotene, it is found in plants containing carotene, usually at a very low (sometimes undetectable) concentration. Lycopene is an expensive pigment and is very prone to oxidative degradation (Mortensen, 2006), but highly stable under a wide range of temperature and pH, hence used as common food colorant. It is available in liquid form or as coldwater dispersible powder. The best-known sources of lycopene are tomatoes, watermelon, guava, and pink grapefruit. The only allowed source is tomatoes (*Lycopersicon esculentum*, lycopersicon meaning wolf peach). In solution, lycopene is orange (as anyone making a dish with tomatoes and oil would have noticed) and not bright red as in the tomato (Rymbai *et al*., 2011).

Lutein is also a very common carotenoid. The name is derived from the Latin word for yellow (compare xanthophyll, vide supra)**.** Marigold, (*Tagetes erecta*) flowers are by far the most abundant natural source for commercial lutein (Jothi, 2008). Although lutein is oil soluble it is also available in specially formulated water dispersible forms and thus finds application in a wide range of food and drinks. It is also important in the poultry industry where its inclusion in the feed can enhance skin colour and the depth and shade of the egg yolk. In common with other carotenoids, it is stable to heat and acid but is susceptible to oxidation. The addition of antioxidants such as Vitamin C and tocopherols can overcome this problem.

Annatto

The seeds of the annatto bush have long been recognised by some cultures to bring colour and flavour to the diet. Annatto seeds provide two pigments: bixin, which is oil soluble and norbixin, which is soluble in water. Both pigments are cartenoids and may, therefore, be adversely affected by light and oxygen. In extreme cases, it is helpful to protect sensitive products using ascorbic acid (Hawkinswatts). Annatto is a rich source of tocotrienols, antioxidants that are similar in structure and function to vitamin E. The tocotrienols from annatto is the subject of current nutritional and medical research since this compound is thought to prevent cancer due to its antiangiogenic effect (Sharma, 2013).

Norbixin is sensitive to sulphur dioxide at levels in excess of 100ppm, whereas hard water or low pH conditions can lead to pigment precipitation unless specially formulated products are used. These pigments are heat stable and provide an orange hue. They are frequently offered as blends with other pigments,

especially curcumin, to ensure that precise yellow/orange shades are achieved. Traditionally, the main use of norbixin has been in cheese colourations, but it is used in a much wider variety of applications including breadcrumbs, flour confectionery, dairy products and ice cream. Available in both liquid and powder forms; it is a colouring with wide application.

Bixin is used in cream fillings for biscuits, snack foods, margarines, low-fat spreads and other fat-based systems (Hawkinswatts).

Paprika

It is obtained from sweet red peppers using a solvent extraction process to prepare an oleoresin. Paprika is well recognised as a spice and it is a popular ingredient in many recipes. The extract principally contains two carotenoid pigments: capsanthin and capsorubin. Both pigments are oil soluble and provide a rich orange/red hue depending upon the concentration used (Mortensen, 2006). When used for colouring purposes, paprika extracts invariably contribute a spicy flavour character and they are generally more suited to either savoury or lightly coloured products. Although sensitive to oxidation, these pigments are stable to heat and are unaffected by changes of pH. Its range consists of both oil-soluble and water-dispersible products.

Saffron

The saffron coloring matter is crocin which is extracted from the dried stigmas and styles of the saffron plant**,** *Crocus sativa*. It is water soluble and considered as the most expensive colorant as well as spice. The flower is light purple with thread-like red stigma, is the valued material. The color appears as a powerful yellow (Raina *et al*., 1996). The associated saffron flavor and the high cost of saffron limit its use as colorant to special applications (Rymbai *et al*., 2011).

Chlorophyll

Chlorophylls, a group of fat soluble natural pigments, are obtained by solvent extraction of grass material, grass, lucerne and nettle. The principal colouring matters are the phaeophytins and magnesium chlorophylls, which are highly unstable to light. The green colour is due to the pigments chlorophyll a (blue–green) and chlorophyll b (yellow–green) that occur together in a ratio of about 3:1 (Hendry, 1992). Chlorophyll is converted to chlorophyllins in presence of alkali, which renders it water soluble. It is used in jam, jelly, candy, ice cream and in several other products, but chlorophyll finds limited use as a colorant because of the lability of the coordinated magnesium and the associated color change (Mortensen, 2006) .

Curcumin

Curcumin is the principle pigment of turmeric. Turmeric is the yellow component of curry powder. It is the dried, ground rhizomes of *Curcuma longa*. Turmeric contains three pigments; the major one is called curcumin and the two others are derivatives of this. Curcumin provides a bright, strong yellow shade in solution. It is an oil soluble pigment that is available in convenient, water-dispersible forms that are used in a wide range of foods. It is available in liquid or powder preparations, singly and in combination with other pigments, expanding the range of shades available. Mainly used in dairy products, beverages, cereal, pickels, sausages, confectionaries, ice cream, bakery and savory products. Apart from coloring, it is also used in skin care and hair care cosmetic products as it is antibacterial in nature. It is also used in Ayurvedic medicine as analgesic, antiinflammatory, antitumor, antiallergic, antioxidant, antiseptic, in treating anemia, diabetis, indigestion, gallstones, food poisoning, poor blood circulation (Delgado-Vargas *et al.,* 2000).

Anthocyanins

Anthocyanins (also anthocyans; from Greek: ?íèüò (anthos) = flower + êõáíüò (kyanos) = blue) are water-soluble vacuolar pigments that may appear red, purple, or blue depending on the pH. They belong to a parent class of molecules called flavonoids synthesized via the phenylpropanoid pathway; they are odorless and nearly flavorless, contributing to taste as a moderately astringent sensation. These are mainly red pigments that are responsible for the colours of many edible fruits and berries. Anthocyanins are particularly recommended for the colouring of soft drinks, jams, most types of sugar confectionery and other acidic products such as fruit toppings and sauces. They also contribute to the colours of some vegetables and flowers (Anderson and Francis, 2004).

Betacyanins (betalains)

These are obtained from the red beet (*Beta vulgaris*) extract that are mainly used as a food colouring agents. Betanin is the major component (95%) of the pigments in the extract and have a good flavor. The beet root extract contains red, yellow and also a bluish-red color pigments depending on their content produced by a compound known as betanin which is stable at higher pH range than red cabbage extract (Im *et al*., 1990). It has wide application in different food commodity from beverages to candy and from dairy to cattle products (Counsell *et al*., 1979).

Caramel

Caramel colour (also known as burnt sugar) is the

world's most widely consumed (by weight) food colouring ingredient. Caramel colour results from the controlled heat treatment of carbohydrates (sugars, malt syrup, molasses, and/or starch hydrolysates), in the presence of food-grade acids, alkalis, and/or salts, in a process called caramelisation**.** Caramels come in many shades, from yellow shade brown to dark brown.

Conclusion

Natural colors are not only having dyeing property but also having the wide range of medicinal properties. Nowadays, fortunately, there is increasing awareness among people towards natural colors and dye yielding plants. Due to their non-toxic properties, less side effects, more medicinal values, natural dyes are used in day to-day food products and in pharmaceutical industry. Although worldwide possesses large plant resources, only little has exploited so far. More detailed studies and scientific investigations are needed to assess the real potential and availability of natural dye yielding resources in great demand on the therapeutic formulations of natural drugs commercially.

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