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Papori Bora
Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Pranati Das
Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Ruma Bhattacharyya
Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India.

Mridula Saikia Barooah
Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Correspondence
Papori Bora
Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University, Jorhat, Assam, India

Biocolour: The natural way of colouring food

Papori Bora, Pranati Das, Ruma Bhattacharyya and Mridula Saikia Barooah

Abstract
The colour of food is an integral part of our culture and enjoyment of life. Colour is an important attribute as well as selection criterion when it comes to food choices; it enhances the appeal towards foods, thus influencing preference, pleasantness and acceptability of food products. Colour is the most outstanding parameter by which the quality of food and flavour are judged. The characteristic colour of raw food is due to the natural pigments present in the plant and animal materials. During processing, substantial amount of colour is lost and make any food commodity attractive to the consumers, synthetic and natural colourants are added. The use of food colourants to make food more attractive and appetizing has been in practice for centuries. These days the demand for natural colour is increasing worldwide due to the increased awareness on therapeutic and medicinal properties and their benefits among public and also because of the recognized profound toxicity of synthetic colours. Natural colours for food are derived from naturally occurring sources such as plants, insects, animals and minerals. Development of cost-effective, viable technology for the preparation of a natural food colour and its application in foods is a challenge and the need of the day. This review article covers recent developments in technological advances of food colours with respect to natural colour application and stability in foods compared to synthetic colours and the detail heath benefits about of the major pigments.

Keywords: Food colour, natural colour, synthetic colour, pigments, health benefits

Introduction
Today's consumers are proactively seeking food products that contain 'safe' ingredients in them. Colour is one of those important ingredients upon which the quality of food and flavour can be judged (Altinoz S, Toptan S, 2003) [3]. These food colours are any substance that is added to food or drink to change its colour for acceptability (Solymosi *et al*., 2015) [13]. These are derived from both artificial and natural sources in varied intensities. The objective of the addition of colour in food is to make the food more appealing and recognizable (Lawrence *et al*., 2000) [8]. Everyone is sensitive to the colour of the food as it can stimulate or suppress one's appetite. Artificial colours when added to food products possesses very bright and tempting effect, but very often are responsible for specific teratogenic and carcinogenic affects. Potential sources of artificial food colours are mineral compounds, petrochemicals, petroleum, and coal tar which leads to many harmful diseases like Attention Deficit Hyperactivity Disorder (ADHD), brain tumours etc. Thus, the natural colour market is currently going twice as fast as that of artificial colours. It has been observed that within last 10 - 15 years, there has been a distinct move towards naturals, especially within flavours and colours. Natural food colours not only give an appealing and appetizing look but also possesses varied nutritional and health benefits.

Why we colour foods?
- To restore the original food appearance even after processing and during storage.
- To assure the colour uniformity to avoid variations in tone colour by seasonal variations.
- To intensify colours that are normally found in food and thus to maintain its quality.
- To protect the flavour and light susceptible vitamins making a light screen support.
- To maintain or improve safety and freshness
- To maintain or improve nutritional value
- To improve taste, texture and appearance of the product
- To influence the consumer to buy a product through visual perception.

Table 1: Categories of food colours

Sl. No.	Categories	Description	Examples
1.	Natural colours	Pigments made by living organisms	Beetroot extract, Luetin, Annatto
2.	Nature-identical colours	Man-made pigments which are also found in nature	Betacarotene and Canthaxanthin
3.	Artificial colours	Artificial colours are purely man-made colours	Alura red, Brilliant blue etc.

Source: Solymosi *et al.*, (2015) [13]

What is Biocolour?

- A natural food colour (Biocolour) is any dye or pigment which when added to food products enhances therapeutic and medicinal properties in it (Chaitanya *et al.,* 2014) [4].
- Biocolourword consists of two words *bio* means *natural* and *colour* means *anything which is used for colouring purpose.*
- Biocolouants are those coloring agents, which are obtained from the biological sources such as plants, algae, insects, fungi, and animals and those are capable of colouring food (Rymbai *et al.,* 2011) [14].
- Biocolourants are prepared from renewable sources and majority of plant origin (Rymbai *et al.,* 2011) [14].
- Besides colouring food, biocolourants possess bioactive properties and have been used as therapeutic agents.
- Natural colours are best over artificial colours because artificial food colourings cause: Attention Deficit Hyperactivity Disorder (ADHD), behavioural problem, depression, food allergies, headaches and migraines.

History of Biocolour

- Colour is vital constituent of our food. Colour irrespective the form has been added to our foods from centuries. The colouring of candy by the Egyptians and colouring of wine dates bake to as long ago as 400 BC.
- Saffron, turmeric and paprika were used as traditional food colourants. Butter has been coloured yellow as far back as the 1300 BC.
- Ancient Romans used saffron and other spices to put a rich yellow colour into various foods. Other natural foods, such as carrots, pomegranates, grapes, mulberries, spinach, beets, parsley and flowers, were also used as food colouring agents.
- Henna was used even before 2500 BC, while saffron is mentioned in the Bible.
- Use of natural biocolourants in food is known from Japan in the text of the Nara period (8th century), which contains references regarding colouring soybean and adzuki-bean cakes. Thus, it appears that coloured processed foods had been taken by the people of some sections during that period.
  Source: Adam Burrows (2009) [2]

The need for biocolour

- Subsequent toxicological evidences and adverse physiological effects of many synthetic food colours (eg-Azo dyes) has resulted in their removal from the permitted colour list for food uses and even more are likely to be banned in near future. Some of them were found to be carcinogenic.
- Synthetic colourants tend to impart undesirable taste and are harmful to human beings, as these are responsible for allergenic and intolerance reactions. As a result, there has been a worldwide interest in the development of food colorants from natural sources because these are healthy and have good quality.
- Colours derived from minerals (lead chromate, copper sulphate) may cause serious health problems and environment hazardous effects. Thus, in the last few decades, synthetic additives have been severely criticized, and consumers show reluctance towards these products, consequently they prefer to use the natural colorants.
- Lead chromate and copper sulfate were used to pigment candies and sauerkraut, but in the pigmentation process arsenic and other venomous impurities were added frequently.
- Synthetic colourants have been used for many years. In 1938 there were about 200, and nowadays only seven can be used in food pigmentation.
- At present, most people interpret the content of chemical products as a contaminant and the tendency has been reinforced.
- With the advent of strict legislative regulations and growing awareness among the consumers about food safety, bicolourants have become the choice in the foods as they are extracted from sources of biological origin and are much safer than their synthetic counterparts in many foods.

Therefore, the demand for natural food colours is increasing worldwide due to the increased awareness on therapeutic and medicinal properties and their benefits among public and also because of the recognized profound toxicity of synthetic colours (Chaitanya *et al.*, 2014) [4].

Table 2: Replacing artificial colours with natural colours in food industries

Colours	Artificial colours	Natural colours
Yellow	Sunset yellow	Turmeric, Beta carotene
Orange	Sunset yellow	Annatto, Beta carotene, Apo Carotenal, Paprika
Red	Allura red,Erithrosine	Beet, Anthocyanins, Carmine/ Cochineal
Purple	Allura red and brilliant blue	Anthocyanins/ Beet+ Acid Stable Blue
Blue	Indigotine blue	Acid Stable Blue
Green	Tartrazine and Fast green	Turmeric, Beta carotene + Acid Stable Blue
Black	Brilliant blue, Tartrazine, Allura red	Turmeric, Beta carotene + Acid Stable Blue + Anthocyanins/ Beet

Source: Aberoumand (2011) [1]

Table 3: Sources of biocolours

Biocolours	Sources
Vegetable Juice	Black carrot, red cabbage, red beet juice etc.
Fruit Juice	Elderberry, grapejuice etc.
Grape Skin Extract	Grape skin
Annatto Extract	Yellow or orange coloured extract with bixin as the main colouring pigment, extracted from the seeds of *Bixaorellana* tree
Turmeric oleoresin	Yellow coloured, extracted from the rhizome of *Curcuma longa* with curcumin as the main colouring pigment
Paprika	Yellow coloured paprika powders and paprika oleoresins are extracted from red chilli pods with capsanthin and capsorubin as the principal colouring components
β-carotene	A yellow or orange colourant found in many fruits, vegetables, and certain algae
Beet root powder	Red and yellow coloured beet powders are extracted from red table beets with betalain as the main coloring component

Source: Chattopadhyay *et al.*, (2008) [5]

Table 4: Types and uses of natural colours

Natural colourants	Colour	Uses
Carmine	Bluish red	Soft drinks, sugar & flavor confectionary, pickles, sousages
Sandal wood	Orange-orange red	Fish processing, alcoholic drinks, sea food dressings, meat product
Chlorophyll	Olive green	Soups, fruit products, jams
Beet powder	Bluish red	Frozen ice creams & flavored milk
Turmeric	Bright yellow	Yogurt, frozen products, pickles
Riboflavin	Yellow	Cereal products, sherbet, ice cream
Safflower	Yellow	Soft drinks, alcoholic drinks
Anthocyanin	Blue-reddish shades	Soft drinks, alcoholic drinks, pickles
Annatto	Orange shades	Dairy & fat products & desserts
Beta-carotene	Yellow-orange	Butter, fats, oils, soft drinks, fruit juices, ice creams
Canthoxanthin	Orange red-red	Soups, meat & fish dishes
Paprika	Orange-red	Meat products, snacks, soups, salad
Saffron	Yellow	Baked goods, rice dishes, meat dishes, soups
Leutin	Yellow	ice creams,dairy products, sugar, flour

Source: Parmar M, Gupta PU, (2015) [11]

Permitted Biocolours

In India, Rule 26 of The Prevention of Food Adulteration Act, 1954 (PFA) and The Prevention of Food Adulteration Rules, 1955 & 1999 permitted following colours which are isolated from natural sources.

- Beet root concentrates
- Annatto
- Beta-carotene
- Cochineal Extract
- Grape extract
- Paprika oleoresin
- Turmeric oleoresin
- Luetin
- Phycocyanin
- Saffron

Available biocolours and their applications in food industry

1. **Beet root concentrate:** Betacyanins (betalains) are obtained from the red beet (*Beta vulgaris*) extract. These red dyes andthe related group, betaxanthins (yellows) were initially thought to be flavonoids but now it is estimated they differ from flavonoids as they contain nitrogen and do not change colour reversibly as the anthocyanins do to pH. Betanin is the major component (95%) of the pigments in the extract and have a good flavour. The beet root extract contains red, yellow and also a bluish-red colour pigments depending on their betanin content. They are largely used as food colorants in food products like yogurts, ice cream, ice bar, hard candy, dry beverage mixes (in powder form), noodle/pasta etc. Recent studies have shown that betanines have antioxidant, antimicrobial and antiviral activity besides betanine, another pigment which is extracted from beetroot is vulgaxanthine (Delgado-Vargas *et al.*, 2000) [6].
2. **Annato:** A yellow to orange colour has been used for over two centuries mainly for colouring dairy products especially cheese and is derived from the outer layer of seeds of the tropical tree *Bixaorellana*. The chief colouring principle is the carotenoid, bixin and norbixin.The pH and solubility affect the color hue; the greater the solubility in oil, the brighter is the colour. Water soluble, oil soluble, and oil/water dispersible forms of annatto are available. Annatto may be extracted using either of three methods: (i) extraction with (hot) vegetable oil, (ii) extraction with organic solvents, or (iii) extraction with alkali. Extraction with vegetable oil or organic solvents gives a colourant containing bixin as the main colouring principle, whereas extraction with alkali leads to saponification of bixin yielding the water-soluble (at neutral and high pH) norbixin, which may be precipitated by acid to give a powder. Norbixin is used to colour cheese (e.g., cheddar) because it binds to the proteins. It may also be used to colour beverages with neutral pH, e.g., flavored milk drinks, but not with low pH because of precipitation and it is slightly more reddish in application than β- carotene. Since it precipitates at low pH, it is also available as emulsion, an acid proof state.
3. **Beta carotene:** Beta caroteneis orange-yellow in colour, 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 *(Dunaliellasalina)*. Oil palm, orange, apricot, mango, and peach and pepper contributed significantly in increasing ß-cryptoxanthin and ß-carotene concentrations of foods. Besides being used as colourants, carotenes are also used for nutritional purposes as pro-vitamin A agents as in margarine where they also provide colour or as dietary supplements (Delgado-Vargas *et al.*, 2000) [6].

4. **Cochineal extract**: Cochineal extract is obtained from Cochineal insect *(Dactylopius coccus)* and its eggs. It is a native insect of South America and Mexico. It is a parasite which lives on cacti of genus Opuntia, feeding on moisture and nutrients. The dye stuff extracted from this insect and its eggs is known as Carminic acid (Carmine), which is red in colour. They are water-soluble, so they can be extracted with water or lower alcohols. Carmine is used as a food colourant in sausages, alcoholic drinks, juices, beverages, ice cream, yogurt, candy, bakery and dairy products-desserts and sweets. But as afood dye it has been known to cause severe allergic reactions and an aphylactic shock in some people. Its stability in light and heat is excellent whereas in pH; stability is poor. It gives orange in acidic pH, purple in neutral pH and blue in alkaline pH.
5. **Paprika oleoresin**: Paprika (*Capsicum annuum)* is the pioneer and widely used carotenoid as food colorant. In paprika, the red carotenoids are dominated by canthaxanthin and capsorubin whereas yellow xanthophylls includes cryptoxanthin, zeaxanthin, antheraxanthin and carotene. Paprika oleoresin is mainly extracted from the pods. It contains three main naturally occurring pigments: capsanthin, capsorubin and carotene. This combination produces a bright orange to red-orange in food products. The oleoresin is oil soluble, when emulsified becomes water dispersible. It is used in seasoning, snack, salad dressing, popcorn, beverage and confectionaries.
6. **Turmeric oleoresin (Curcumin):** It is extracted from the ground powder of the rhizomes of turmeric (*Curcuma longa* Linn.) plant - a member of ginger family. It has been considered as the poor man's saffron because it offers a bright yellow colouring cost effectively. It is used as an alternative to saffron. Curcumin is the primary pigment of colour. Turmeric contains 3-5% volatile oils and 2.5-6% yellow pigments, the curcuminoids, of which curcumin predominates. Solubility of turmeric compound depends on the processing medium. Turmeric oleoresin is water soluble; but oil extract can be added to fat based foods and at high pH, the extract turns orange. It is used in dairy products, pudding, yogurt, beverages, cereal, pickles, sausages, snacks, confectionaries, gummy bear, gelatin, popcorn, ice cream, bakery and savory products. Apart from coloring, it is also used in skin care and *Ayurvedic* medicine as analgesic, anti-inflammatory, antitumor, anti-allergic, antioxidant, antiseptic, in treating anaemia, diabetis, indigestion, gallstones, food poisoning, poor blood circulation. It is antibacterial in nature.
7. **Lutein:** Lutein is a naturally occurring yellow coloured carotenoid found in marigold flower (*Tageteserecta)*. Lutein from *Tageteserecta* L. is a purified extract obtained from marigoldoleoresin. Lutein is extracted from the petals of marigold flowers with organic solvents which impart yellow to orange colour. It is oil soluble. It acts as a free radical scavenger (antioxidant). It is used as a food colouring agent and nutrient supplement (food additive) in a wide range of baked goods, beverages, breakfast cereals, chewing gum, dairy product analogs, egg products, fats and oils, sauces, infant and toddler foods, in levels ranging from 2 to 330 mg/kg.
8. **Phycocyanin:** Among all microalgae, genus spirulina are the most inexpensive source of pigment- phycocyanin. It has many commercial applications like in food as colourants, cosmetics and in biomedical research. It is also a potential pharmaceutical in oxidative stress-induced diseases as it has antioxidant and anti-inflammatory properties**.** Source is blue green algae or spirulina. Colour varied from light greenish blue to intensely dark blue. Colour pigment is phycocyanin and cyanobacteria. Used in dairy industry (ice cream, yogurt, frozen desserts, cheese), beverages industry (fruit drinks, soup mix), confectionery (coated soft candy) and bakery (baked goods, baking mix).
9. **Saffron:** Saffron (means "yellow" in Arabic) is the dried stigma of *Crocus sativus*. The major pigment is the water-soluble crocin, a digentiobioside of crocetin. In contrast to the other carotenoids, the pigment is not extracted from the raw material rather the whole stigma (possibly finely divided) is added to the food. The high antioxidant activity of safranal compound in saffron possesses bioactive properties and free radicals scavenging ability at cellular level, thereby alleviating various metabolic syndromes (Naidu M, Sowbhagya HB, 2012) [9]. Mostly used in seasonings, desserts, sweets, health drinks and in traditional food items.
10. **Vegetable juice:** Vegetable juice is fermentable liquid product, obtained from the edible part of one or more vegetables (red cabbage, red radish, black carrot, purple yam, tomato) for direct consumption and preserved exclusively by physical means.The juice shall be free from skins, seeds and other coarse parts of the source vegetables. Tomato juice and blends based on tomato have long been popular and account for over 90% of the non-fruit juice trade. Lycopene is the principal compound derived from tomato. It is highly stable under a wide range of temperature and pH. It is available in liquid form or as cold-water dispersible powder. Carrot has long been a component of tomato blends. Red-cabbage juice produces a bright pink to red color to a product with a pH less than 4.0 and is soluble in water, but not in oil.
11. **Fruit juice:** Mature, edible fruits of elderberry**,** black currant, blackberry and Indian black plum (jamu) are the sources of fruit juice. Anthocyanin is the major pigment. It is soluble in water and possesses good stability to light while fairly stable to heat. Colour changes heavily as pH changes: acidic-red, neutral – purple and in alkaline pH - blue**.** Lower the pH, the darker the colour**.** Mostly used in beverages, tomato paste and fruit preparation (Delgado-Vargas *et al.*, 2000) [6].
12. **Grape colour extract:** is extracted and concentrated using either water or lower alcohols. Sources are cherry, raspberry, and strawberry. Anthocyanin is the major pigment. It is soluble in water and possesses good stability to light while fairly stable to heat. Colour changes heavily as pH changes: acidic-red to purple, neutral – purple and in alkaline pH - blue**.** Mostly used in non-beverage foods, fruit filling- pie, fruit preparation, gelatin desserts and confectionaries.
13. **Grape skin extract (Enochianina):** Sources are extracts of deseeded marc, remaining after grapes have been pressed for juice or wine. It is soluble in water. Pigment present in grape skin extract is anthocyanin that imparts a reddish purple colour to beverages. Stability to light is good while fairly stabe to heat. Colour changes heavily as pH changes: acidic-red to purple, neutral - purple and in alkaline pH - blue. Applications are beverages (alcoholic, carbonated) – Wine.

Table 5: Authorized Biocolourants with their European E- Codes

Colourants	E number	Design feature
Anthocyanin	E 163	Red to blue pigment found in mature fruits
Betanin	E 162	Major pigment in red beet
Caramel colour	E 150	Obtained by careful heating of food grade carbohydrates
Carminic acid	E 120	Extract of the female cochineal insect
Carotinoids	E 160	Extracted mainly from plants (carrots, tomatoes)
Beta- carotene	E 160 a	Carrot
Bixin, norbixin, or annato extract	E 160 b	Extract from a seed *(Bixaorellana)*
Lycopene	E 160 d	Tomatoes, pink grapefruit, watermelons
Lutein	E 161 b	Marigold flowers
Canthaxanthin	E 161 g	Salmon, shrimp
Chlorophyll	E 140	Natural green pigment participating in the photosynthesis process
Chlorophyllin	E 141	Natural green pigment
Curcumin	E 100	Major pigment of turmeric extracted from a plant rhizome *(Curcuma longa)*

Source: Mortensen A, (2006) [10]

Implications of biocolours in food and pharmaceutical industry

1. **Food preservatives:** Most of the natural biocolourants possess antagonistic activity to certain bacteria, viruses and fungi for protecting the food from microbial spoilage. Some are also active against protozoa and insects. Carotenoids act as sun screen for maintaining the quality of food by protecting them from intense light (Mortensen A, 2006) [10].
2. **Quality control markers:** Level of anthocyanin is used as an indicator to evaluate the quality of coloured food for maintenance of good manufacturing practices. Anthocyanin profiles have been used to determine the quality of fruit jams. From anthocyanin profile, it can be easily detected that labeled blackcherry jam which is prepared from common red cherries is real or not (Delgado -Vargas *et al.*, 2000) [6].
3. **Nutritional supplements:** Carotenoids are used as vitamin supplements, since β-carotene is the precursor of vitamin A. Riboflavin is another example of natural food grade biocolourant which is an essential vitamin source and available in milk and in several leafy vegetables, meat, and fish. Yellow β- xanthins, in addition to their potential role as food colourant, may be used as a means of introducing essential dietary amino acids into food stuffs (Downham A, Collins P, 2000) [7].
4. **Therapeutic properties:** Biocolourants may also play an important role in human health as they contain some biologically active compounds, which possess a number of pharmacological properties like strong antioxidant, anti-mutagenic, anti-inflammatory and anti- arthritic effect (Rhodia I, Madison WI, 2000) [12].

- ✓ **Carotenoids** act as biological antioxidants, protecting cells and tissues from the damaging effects of free radicals and singlet oxygenand also as a good source of anti-tumor agent (Mortensen A, 2006) [10].
- ✓ **Lycopene** is effective at quenching the destructive potential of singlet oxygen (Rhodia I, Madison WI, 2000) [12]. It prevents oxidation of low-density lipoprotein (LDL) cholesterol and reduces the risk of developing atherosclerosis and coronary heart disease.
- ✓ **Lutein**, **zeaxanthin** and **xanthophylls** function as protective antioxidants in the macular region of the human retina. These compounds also act against aging, muscular degeneration, and senile cataracts (Chaitanya *et al.*, 2014) [4].
- ✓ **Betacyanin** also contain antioxidant and radical scavenging properties. Since betanin exerts a good bioavailability, red beet products may provide protection against certain stress related disorders (Parmar M, Gupta PU, 2015) [11].
- ✓ **Flavonoids** present in different plant products show good antioxidant activity (Parmar M, Gupta PU, 2015) [11].
- ✓ **Anthocyanins** have been named 'Vitamins of the 21'st Century' due to their impressive medical and health benefits. It Possess strong antioxidant abilities (Delgado - Vargas *et al.*, 2000) [6].
- ✓ Epidemiological studies indicated that there is a correlation between the consumption of chlorophylls and decreased risk of colon cancer.

Benefits of biocolours

- ✓ Less toxic, less polluting, less health hazardous, non-carcinogenic and non-poisonous.
- ✓ They are harmonizing colours, gentle, soft and subtle, and create a restful effect.
- ✓ Most of them are water-soluble (anthocyanins), which facilitates their incorporation into aqueous food systems. These qualities make natural food colorants attractive.
- ✓ They are environment friendly and can be recycled after use.
- ✓ They attribute to food-both for aesthetic value and for quality judgement and also they tend to yield potential positive health effects, as they possess potent antioxidant and improve visual acuity properties.
- ✓ They inhibit mutagenesis.
- ✓ Use of biocolour may enhance immune systems.
- ✓ They may also lead to inhibition of tumour developments.

Limitations of using biocolours

- ✓ Some sources of natural colours have their own flavour which may affect the taste of the finished product (Turmeric)
- ✓ Actual colour may not retain as such when subjected to high temperatures (Grape juice extract)
- ✓ Biocolour can cause allergic reactions (Cochineal extract, Annatto)
- ✓ Natural food colours are costlier than artificial colourings (Saffron)
- ✓ At times raw ingredients remain scarce (Marigold extract)
- ✓ Require in large quantities when compared to artificial dyes (Cochineal extract)
- ✓ Anthocyanin degradation and brown pigment formation cause colour loss in food products
- ✓ Curcumin is very prone to photo bleaching and beetroot colour has low heat stability.

Conclusion

Colour is one of the main features of food, which determines it appeal to the consumers. Biocolourants are those colouring agents, which are obtained from the biological sources**.** Several types of colourants are available in the market as colouring agents to food commodities but biocolorants are now gaining popularity and considerable significance due to consumer awareness because synthetic colours cause severe health problems. Biocolourants are prepared from renewable sources and majority are of plant origin. In addition to food colouring, biocolourants also act as antimicrobials, antioxidants and thereby prevent several diseases and disorders in human beings. Therefore in today's progressive world a shift from synthetic to biocolour is observed. Hence, more detailed studies and scientific investigations are needed to assess the real potential and availability of biocolourants to meet the need and demand of growing population.

References

1. Aberoumand A. A Review Article on Edible Pigments Properties and Sources as Natural Biocolorants in Food stuff and Food Industry. World Journal of Dairy & Food Sciences. 2011; 6(1):71-78.
2. Adam Burrows JD. Palette of Our Palates: A Brief History of Food Coloring and Its Regulation. Comprehensive Reviews in Food science and Food Safety, 2009, 394-408.
3. Altinoz S, Toptan S. Simultaneous determination of Indigotin and Ponceau-4R in food samples by using Vierordt's method, ratio spectra first order derivative and derivative UV spectrophotometry. Journal of Food Composition and Analysis. 2003; 16(4):517-530.
4. Chaitanya LG. Food Coloring: The Natural Way. Research Journal of Chemical Sciences. 2014; 4(2):87-96.
5. Chattopadhyay P, Chatterjee S, Sen SK. Biotechnological potential of natural food grade biocolorants, African Journal of Biotechnology. 2008; 7(17):2972-2985.
6. Delgado-Vargas F, Jiménez AR, Paredes- Lopez O. Natural pigments: carotenoids, anthocyanins and betalins-characteristics, biosynthesis, processing and stability. Critical Reviews in Food Science and Nutrition. 2000; 40(3):173-289.
7. Downham A, Collins P. Coloring of our foods in last and next millennium. International Journal of Food Science & Technology. 2000; 35(1):5-22.
8. Lawrence LG, Eva MH, Richard GS. The effects of food color on perceived flavor. Journal of Marketing Theory and Practice. 2000; 8(4):59-72.
9. Naidu M, Sowbhagya HB. Technological Advances in Food Colours. Chemical Industry Digest. 2012, 79-88
10. Mortensen A. Carotenoids and other pigments as natural colorants. Pure and Applied Chemistry. 2006; 78(8):1477-1491.
11. Parmar M, Gupta PU. Biocolours: The New Generation Additives. International Journal of Current Microbiology and Applied Sciences. 2015; 4(7):688-694.
12. Rhodia I, Madison WI. Natural colors as functional ingredients in healthy foods. Cereal Foods World. 2000; 45(5):221-222.
13. Solymosi K, Latruffe N, Morant-Manceau A, Schoefs B. Food colour additives of natural origin, In book: Colour additives for foods and beverages, Edition: Elsevier, Chapter: Food colour additives of natural origin, Publisher: Woodhead Publishing, Editors: M. J Scotter. 2015, 3-34.
14. Rymbai H, Sharma RR, Srivastav M. Biocolorants and its Implications in Health and Food Industry - A Review. International Journal of Pharmtech Research. 2011; 3(4):2228-2244.