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NATURAL EDIBLE COLOUR AND FLAVOURS USED AS HUMAN HEALTH

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ABSTRACT: Colour is a molecule that absorbs certain wavelengths of visible light and transmits or reflects others whereas colourant is the activity of that molecule. Natural food colour is any dye, pigment or any other substance obtained from vegetable, animal, mineral, or source capable of colouring food drug, cosmetic or any part of human body, colours come from variety of sources such as seeds, fruits, vegetables, algae, and insect. Natural colour exists in their normal habitat at extremely low concentrations and as a result their extraction is expensive and highly sensitive to change.. Colour as a way to identify a food and a way to judge the quality of a food. Food colours come in many forms consisting of liquids, powders, gels and pastes. Food colouring is used both in commercial food production and in domestic cooking. Due to its safety and general availability, food colouring is also used in a variety of non-food applications including cosmetics, pharmaceuticals, home craft projects and medical devices.

INTRODUCTION: Natural colours are extract from fruits, vegetables, seeds, roots and also from microorganisms which are sometimes called biocolours. Plant pigment, by virtue of their natural occurrence in edible plant are generally considered to be harmless. Nature produces a variety of brilliant coloured pigments *viz*., water soluble anthocynanins, betanins and fat soluble pigments carotenoids and chlorophylls used for colouring foods [1, 2].

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Anthocyanins, a group of water soluble pigments are responsible for the attractive red to blue colours in many fruits and vegetables including cherries, grapes, black berries and have high colour intensity at pH values less than 4.0 (Griffiths, 2005) [3]. Anthocyanins absorb UV and visible light in a range 250-650 nm. They are used worldwide as a source of edible colours in beverages and desserts which have an acidic pH.

Why colours are used in food (Patil, 2006) [4]:

Offset colour loss due to exposure to light, air, temperature extremes, moisture and storage conditions.

1. Correct natural variations in colour.
2. Enhance colours that occur naturally.
3. Provide colour to colourless and "fun" food.

4. To Maintain or Improve Safety and Freshness:

5. To Improve or Maintain Nutritional Value:

6. To Improve Taste, Texture, and Appearance.

The anthocyanin and betalain groups are mutually exclusive in the plant kingdom. Betalain, found in red beet, is a water soluble pigment similar to anthocyanin. Betalains are a group of red and yellow pigments, betacyanin and betaxanthin respectively.

Carotenoid group of pigments are responsible for the yellow, orange and red colours of many plants and are used extensively as natural and nature identical colours in foods. The major representative of carotenoids is β-carotene. Carotenoids are hydrocarbons with 40 carbon atoms formed by linkage of C_5 isoprenoid units in a series of conjugated diene bonds and their oxygenated analogues are called xanthophylls. Carotenes tend to be soluble in non polar solvents such as hexane, while xanthophylls are more freely soluble in polar solvents such as methanol and ethanol. A significant advance has been made by the food industry to use carotenoids as food colour as a replacement for artificial colours, which also has an extra advantage of their associated health benefits. As a result, a large number of published articles are available on the extraction and analysis of carotenoids and on identification of new carotenoids from new sources. Information on nutritional profile of foods including cis and trans-isomers of carotenoids, health consequences of carotenoid consumption and use of carotenoids as food colourants are reported.

Caramel, another natural colour, is obtained by heating carbohydrates, alone or in the presence of food-grade acids, alkalis and/or salts, produced from commercially available, food-grade nutritive sweeteners consisting of fructose, dextrose (glucose), invert sugar, sucrose, malt syrup, molasses and/or starch hydrolysates and fractions thereof. The acids used are food grade sulfuric, sulfurous, phosphoric, acetic and citric acids; the alkalis are ammonium, sodium, potassium and calcium hydroxides; and the salts are ammonium, sodium and potassium carbonate, bicarbonate, phosphate (including mono- and dibasic), sulfate and bisulfite. Caramel, a dark brown to black liquid, is a complex mixture of compounds. Caramel is soluble in water and is used to impart a range of brown colours to foods. Caramel colour preparations can also be converted to powder form and are suitable for application in a wide range of foods and beverages.

Animals can also be a source of food colourings. Cochineal, or carminic acid, is a red, purple colour that is obtained from the bodies of certain scale insects. These feed off cactus leaves and their bodies are commercially harvested in Africa, Spain and Central America. Their bodies are dried and crushed to red colouring.

Mineral dyes:

Ocher mixture of varying proportions of iron oxide and clay, used as a pigment. It occurs naturally as yellow ocher (yellow or yellow-brown in colour), the iron oxide being limonite, or as red ocher, the iron oxide being hematite [5].

TABLE 1: SOURCES OF MINERAL COLOUR

Colour	Sources
White	Titanium Oxide, Limestone
Black	Carbon, Sooth
Green	Malachite
Blue	Azurite, Turquoise
Red	Zinober, Iron Oxides and Hydroxides

Nature Indentical Colours:

Obtaining colours from natural sources can be costly and their quality can vary. To overcome this, chemists have found ways to make identical colours in the laboratory. This improves their purity and may also cost less.[1, 4] Nature identical colours are exactly the same molecules found in natural sources but they are made synthetically.

- Flavonoids, found in many flowers, fruits and vegetables indigoid, found in beetroot.

- Carotenoids, found in carrots, tomatoes, oranges and most plants.

Carrots contain an orange molecule called beta-carotene which is part of this group.

Most natural and nature identical colours can dissolve in oil but do not dissolve in water. They are usually processed to form their sodium or potassium salt. This makes them soluble in water and suitable for use in foods. They may also be dissolved in oil and incorporated into water soluble beadlets.

Some sources of natural colours [4, 6]; Food colouring [7]:

- Orange β-carotene from carrots.
- Blue azulene from chamomile.
- Vitamin C or Ascorbic acid (fruits and vegetables).
- Vitamin E or tocopherols (grains, edible oils).
- Catechins (tea).
- Marigold meal" and "aztec marigold" for the dried, powdered flowers; and "marigold extract" for the solvent extract of the flowers.
- "Sweet peppers", paprika are a mixture of carotenoids, in which capsanthin.
- Zeaxanthin from corn (maize) *zea mays.*
- Rubixanthin from hips (fruits) of dog rose *rosa canina.*
- Cryptoxanthin from eggyolk, corn or strawberries.
- Orange β-carotene from carrots *Daucus carota.*
- Orange-yellow rhodoxanthin from autumn leaves and in the seeds of the poisonous yew tree (*Taxus baccata*) or feathers of the downy legged pigeon.
- Red lycopene from tomato *lycopersicon.*
- Annatto is a red to orange natural (golden yellow) pigment derived from the seed of the tropical bush *Bixa orellana*.
- Crocin extract is the trade term for the yellow, water soluble food colourant obtained from Cape jasmine (*Gardenia jasminoides* L.) and from red stigmas of saffron (*Crocus sativus* L.). However, the extracts are not used interchangeably in all applications since saffron is valued as much for its aroma and flavor as for its colouring properties and, moreover, it is the world's most expensive spice/colourant.
- β-Citraurin from *Citrus sinensis* sweet orange, navel orange carotenoid pigment found only in orange peel.
- Curcumin is the principal colour present in the rhizome of the turmeric plant (*Curcuma longa*). This imparts both flavour and colour to a food product.
- Safflower (*Carthamus tinctorius* L.) Formerly as a red dyestuff for textiles; and currently as a minor colourant by the food industry.
- Alizarin red from madder, *Rubia tinctorum* occurs in nature as (glycoside) called ruberythrinic or ruberythric acid.
- Naphtoquinone: *Juglans cinerea*, *J. regia*, *J. nigra* (Butternut, P. walnut, Black walnut), hulls of the nut contain dark colourant which is used as pink, brown to dark brown Naphthoquinones, including juglone, juglandin.
- Yellow apigenin from parsley *Petroselinum crispum*, celery *Apium graveolens* and chamomile, lat. *Matricaria recutila* (*M. chamomilla*).
- Yellow hesperidin from citruses.

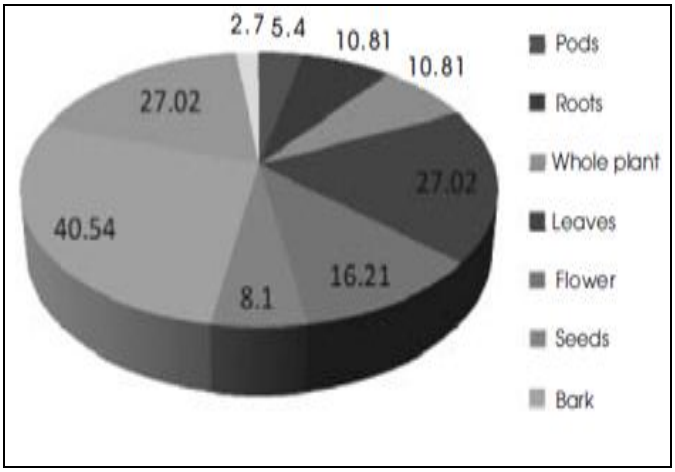

FIG.1: REPRESENTATION OF PLANT PARTS USED IN PREPARATION OF NATURAL COLOURS (IN %) [1]

Criticism and health implications:

Some synthetic colours are permitted in one country but banned in others. For example, Tartrazine is banned in Norway and Austria; Sunset Yellow FCF is banned in Norway; Erythrosine is banned in Norway; Brilliant Blue is banned in Belgium, France, Germany, Switzerland, Sweden, Austria and Norway; Indigotine-Indigo carmine is banned in Norway; and many other countries except U.K.; Vegetable carbon is banned in USA, Brown HT (Chocolate) is banned in Denmark, Belgium, France, Germany, Switzerland, Sweden, Austria, USA and Norway [7, 8].

Reasons to Hate Artificial Food Dyes:

- They are made in a lab with chemicals derived from petroleum, a crude oil product, which also happens to be used in gasoline, diesel fuel, asphalt, and tar.

- They have been linked to long-term health problems such as cancer. Synthetic food dyes have been shown to cause an increase in hyperactivity in children as well as a negative impact on their ability to learn.

- They add absolutely no value to the foods we are eating, but does in-fact pose quite a few serious risks.

They are contributing to the obesity epidemic by attracting children (and adults) to highly processed food, which in many cases is being eaten instead of fresh whole foods [10].

Information concerning the negative effects of synthetic food colourants on human health, particularly children's health, continues to be a major concern with respect to food chemistry. Though past research showed no correlation between attention-deficit hyperactivity disorder (ADHD) and food dyes, new studies now point to synthetic preservatives and artificial colouring agents as aggravating ADD and ADHD symptoms, both in those affected by these disorders and in the general population.

- Norway banned all products containing coal tar and coal tar derivatives in 1978. New legislation lifted this ban in 2001 after EU regulations.

- Tartrazine causes hives in less than 0.01% of those exposed to it [11].

- Erythrosine is linked to thyroid tumors in rats[12].

- Cochineal, also known as carmine, is derived from insects and therefore is not vegetarian or kosher.

Furthermore, allergic reactions to food additives are usually mild- skin irritation, intestinal upset, some breathing problems, so they may be greatly under-reported. A 2009 study published in "Current Opinion in Allergy and Clinical Immunology" reported that allergic reactions to food additives seem to be much more common up-to 7 per cent in chemically sensitive people prone to eczema, a type of skin rash. Chemicals associated with triggering allergies or asthma includes monosodium glutamate, or MSG, sulfites, food colourings and artificial sweeteners.

Research has also associated food dyes with problems in children including allergies, hyperactivity, learning impairment, irritability and aggressiveness. A U.S. study published in Science found that when children who scored high on a scale measuring hyperactivity consumed a food dye blend they performed worse on tests that measured their ability to recall images than when they drank a placebo. In July 2010, the European Parliament's mandate that foods and beverages containing food

dyes must be labeled as such went into effect for the entire European Union [13].

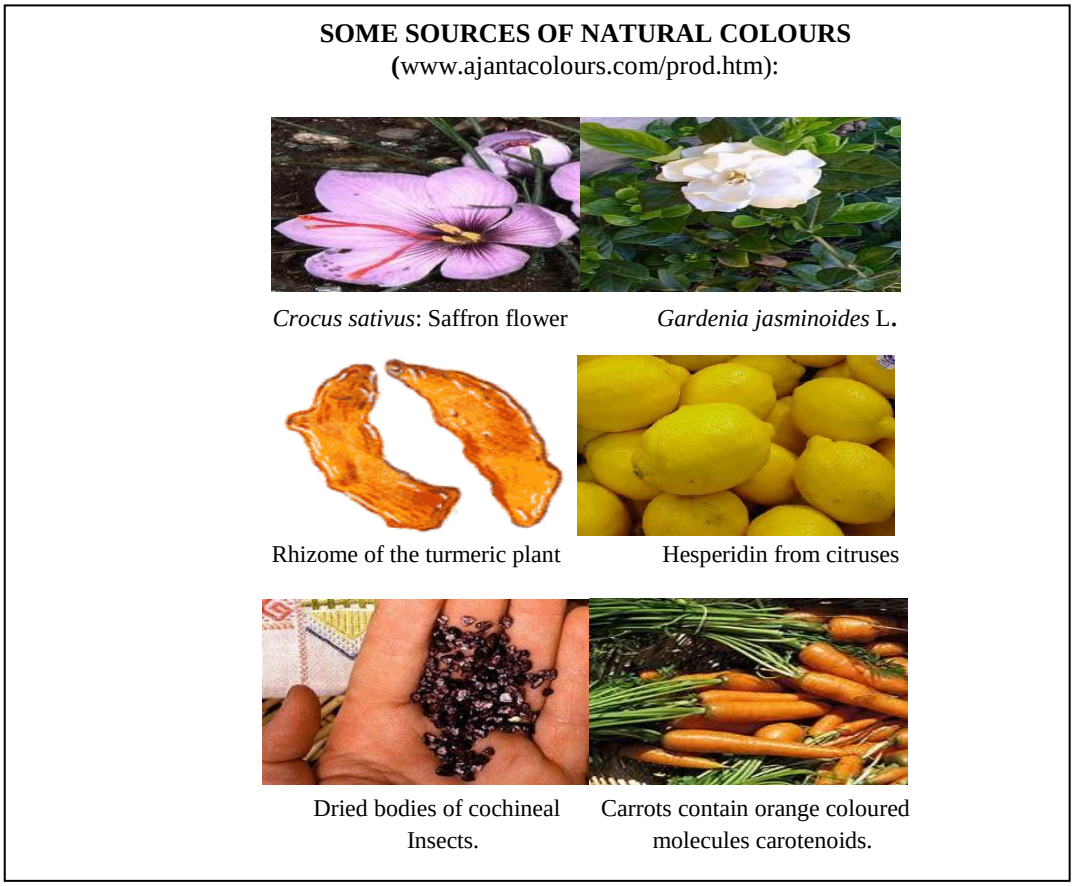

FIG.2: NATURAL SOURCES OF FOOD COLOURS

Required Colour in Food:

The law in Europe allows 43 colours with E-numbers to be used in foods. It also lists the foods which may be coloured and maximum levels of colour added to those foods. The variety of colours allows many different shades to be obtained [14].

Natural colours are less intense than synthetic colours and so need to be used in higher concentrations. Natural colours are used in concentrations in the range of 0.05-10 grams (10-10,000 mg) per kilogram of food.

Nature identical colours vary in usage levels but can be very efficient. For example, beta-carotene is used at levels of 1 to 30 mg per kilogram of food.

Natural Colours as Health Cure:

Besides colouring food, several natural dyes possess bioactive properties and have been used as therapeutic agents and as diagnostic tools. Some of the dyes have been reported for following curative effects; analgesics, antibacterial, antifungal, antileprotic, antiviral and anti-inflammatory [15].

Turmeric contains phytochemical compounds (curcuminoids), which give bright yellow-orange colour. These curcuminoids have been the focus of numerous clinical studies investigating their long term safety, antimicrobial and anti-inflammatory activities. Turmeric's most active curcuminoid is curcumin [16]. Preliminary studies have examined the possible role of turmeric (specifically curcumin) in reducing the risk or severity of several types of cancer [17]. Recent research has examined curcumin's ability to block the effects of homocysteine on the vascular system. This could potentially benefit those with HIV as well as protect the cardiovascular system [18].

Turmeric is also used as a dye in textile industry, in cosmetics, preparation of medicinal oils and textile industry, in cosmetics, preparation of medicinal oils and ointments. It is a Stomachic, a carminative, a

tonic, a blood purifier and an antiseptic [19]. Presently, there has been much interest in carotenoids, especially betacarotene (carrots, mango, papaya etc.) which besides natural orange pigment is converted in body to vitamin A and has antioxidant powers. Similarly, there is trend towards the use of anthocyanins (red grapes, red cabbage, elderberries, sweet potatoes etc.) and betacyanins (red potatoes, beet, amaranth etc.), which contribute positive health effect [4, 5].

Flavours and Flavour Enhancers:

Flavouring additives are the ingredients, both naturally occurring and added, which give the characteristic flavor to almost all the foods in our diet. "Flavour enhancers are not flavours themselves but they amplify the flavours of other substance through a synergistic effect." A flavour enhancer is a substance that added in a food to suppliment and enhance its taste or aroma [4, 8].

Flavourings are used in food products at very low concentrations. They are normally made from a mixture of substances which provide a flavouring of suitable strength that can be stored and then used in the food production process [20].

FIG.3: THE FLAVOUR IN RASPBERRIES IS BECAUSE OF AN AMAZING NUMBER OF FLAVOUR MOLECULES.

Natural flavours: include Spices, roots, essences, and essential oils, herbs, fruit juices and certain plant extracts like menthol from mint and citral from lemon grass. The most natural form of flavor additives available in the food industry are Whole fruit, crushed fruit, purees and concentrates. Another group of natural flavourings obtained by extraction from certain plant products vanilla beans, Licorice root, lemon peel, coffee, cherry etc., which are generally extracted in the form of alcoholic infusion.

Different classes of flavours:

Essential oils:

They are volatile. They are concentrated hydrophobic liquids containing volatile aromatic compounds extracted from plants. Hydro distillations are used to extract the materials [21].

Absolutes:

They are non-volatile. They are concentrated aromatic oily mixture extracted from plants through solvent extractors. They are obtained from wax like masses called concretes (high mol wt) from plant tissue. Absolutes are low molecular weight compounds.

Fruit Flavours with other natural flavours:

Fruit concentrates or extracts fortified with naturally occurring plants for wines and cordials

True fruit flavours:

They are composed of fruit juices and their concentrates.

Common Flavourings in Food:

TABLE 2: REASONS FOR ADDING FLAVOUR IN FOOD PRODUCTS

Food	Reason for adding flavor
Ice cream	Taste is unacceptable without the addition of flabourings.
Margarine	Taste is unacceptable without the addition of flavouring.
Meat substitutes such as soya protein and mycoprotein	These are low fat and extremely nutritious however, without the addition of a flavour, they have a bland and uninteresting taste.
Wine gums / table jelly	No flavour at all without the addition of flavourings
Yoghurt	May have a natural flavour present but possibly at a low intensity. Flavourings may be added to enhance the natural flavor

Many natural foods are acidic. For example, oranges, lemons, apples, tomatoes, cheese and yoghurt contain natural acids, such as citric acid, that give them their characteristically sharp taste [22].

TABLE 3: TYPICAL SYNTHETICS

Isoamyl Acetate	Banana	Beverages
Cinnamaldehyde	Cinnamon	Candies
Citral	Lemon	Beverages
Menthol	Mint	Gums and Candies
Allyl Caproate	Pineapple	Gums and Candies
Diacetyl	Butter	Margarine
Methyl Anthranilate	Grapes	Soft Drinks, Candies, Jams

FIG.4: MANY FRUITS CONTAIN NATURAL ACIDS THAT GIVE THEM A SHARP TASTE.

CONCLUSION: Food colours flavours and flavor enhancers are used for a number of purposes, mainly to extend the life of processed foods so they can be transported, stored or kept on the shop shelf for longer, maintain a standard quality**,** and make the products more attractive to the consumer. Additive groups include antioxidants, colourings, flavourings and preservatives. They have played an important role in reducing serious nutritional deficiencies among consumers. These ingredients also help ensure the availability of flavorful, nutritious, safe, convenient, colourful and affordable foods.

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