FOOD CHEMISTY

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Food colours

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Food colours

- food colours → added to food or drink to change its colour → acceptability.
- Colour is one of those important ingredients upon which → flavour and quality of food can be judged.
- Today's consumers are proactively seeking food products → contain **'safe'** ingredients in them.
- Absence of → adverse reaction → regular & prolonged consumption.

WHY FOOD colours ?

- improve appearance, taste and texture of the product
- maintain / improve safety and freshness
- maintain / improve nutritional value
- influence consumer to buy a product through visual perception

HISTORY OF FOOD colours

- Around 1500 BC, candy makers (Egyptian cities) → natural extracts and wine to improve → products appearance.
- In 1856, William Henry Perkin discovered → first artificial organic dye (**"mauve"**) by oxidizing aniline while trying to form an anti-malaria drug (quinine).
- By 1900, many foods and drugs (U.S.) → artificial colour with many blatantly poisonous materials → arsenic, lead, and mercury → hide defective or inferior foods.

- In 1906, Congress passed the Food and Drugs Act → prohibited use of poisonous or deleterious colours in food industries.

- In1962, The first EU directive, focusing on the use of colorants in foods was published → 36 colours (20 natural and 16 artificial) were considered safe for human consumption.

- In 2009, Barry Callebaut's IBC brand (specialized in colour and printing technology in food applications) has launched **Power Flowers** by tempering cocoa butter and 40% coloring agents.

WHY FOOD PRODUCTS NEED TO BE COLOURED?

- impart attractive and natural colour to food → first characteristic → noticed
- affects identification of flavor → plays a key role → defining its quality
- overcome the damage to appearance caused by processing → visual indication
- preserve the product identity
- ensure colour uniformity of food products
- intensify the colours of certain manufactured foods
- protect flavour and light sensitive vitamins during storage → sunscreen effect
- give colour to foods → sugar confectionery, soft drinks, sauces, ice lollies and soft drinks → would otherwise be virtually **colourless**.

AVAILIBILITY

- Food colours are available as

- Liquids
- Liquid gel
- Powders
- Gels
- Pastes

CLASSIFICATION OF FOOD COLOURS

Natural colours: Pigments made by living organisms.

- Examples: **Anthocyanins, Carotenoids, Annatto**.

Nature-identical colours: Man-made pigments which are also found in nature.

- Example: **Betacarotene and canthaxanthin**.

Artificial colours: purely man-made colours.

- Example: **Indigocarmine, Alura red, Brilliant blue etc**.

1. NATURAL COLOURS:

- extracted from animals, vegetables, fruits, minerals and spices e.g., carotenoids (from annatto, anthocyanins, chlorophyll and turmeric) followed by the red pigment and brown coloured caramels.

Permitted Natural Colours

- **Anthocyanins,**
- **Carotenoids,**
- **β-carotene,**
- **β -apo-8'- carotenal,**
- **Canthaxanthin,**
- **Annatto,**
- **Betalain**

a. Anthocyanins

- use of anthocyanins dates back to antiquity as Romans used highly coloured berries to augment the colours of wine.
- water soluble compounds → red to blue colour of variety of fruits and vegetables.
- sources → apples, blackcurrants, bringle, cherries, grapes, red cabbages, strawberries, red currants and raspberries.
- provide orange, red, blue, violet and magenta colours.

b. Carotenoids

- widely spread (over 600 different carotenoids) in plants and animals.
- estimated → nature produces some 3.5 tonnes of carotenoids every second.
- provide natural yellow, orange or red colours of many food as well as being used extensively **non-toxic** natural or nature-identical colorants.
- Chemically the carotenoids are aliphatic or alicyclic members of **terpene** group -- eight isoprene units joined in a tail-to-tail manner at the center of the molecule.
- carotenoids can be divided into → hydrocarbon carotenes and their oxygenated derivatives → xanthophylls (violaxanthin, neoxanthin etc.).

c. β-carotene

- first isolated from carrots and hence the name carotene.
- occurs in nature → usually associated with a number of **chemically closely related pigments and extracts.**
- other **sourses** → banana, jack fruit, maize, mango, papaya, pumpkin, watermelon, red pepper, spinach, peaches, apricots, oranges, broccoli, etc.
- imparts **yellow-to- orange** colour.
- used at a concentration of **0.13% to 2%.**
- **oil soluble** form of β-carotene → colouring butter and margarine.
- **water soluble** nor-bixin products → water-based products (ice-cream, yoghurts).

d. β -apo-8’-carotenal

- first synthesized in the year 1962.
- source → pulp and skin of citrus fruits, various fodder plants including oranges, spinach, grass and marigold.
- used in food products like cheese, imitation dairy products, pastry, whipped margarine, non-standardized salad dressings and fresh dressing.

e. Canthaxanthin

- first synthesized chemically in the year 1964.
- a diketo carotenoid pigment with an orange-red colour.
- widely occurs in water birds that feed on crustacean → a major pigment of several **flamingo** species → in their feathers, leg, skin, egg yolk, blood plasma and liver.
- **source** → pink edible mushroom, chanterelle (Cantharellus cinnabarinus), the scarlet ibis (Guara rubra), and roseate spoonbill (Ajaja ajaja), and in various crustacea and fish (trout, salmon) **also** from algae, hydra and the brine shrimp.
- **used** at **5 to 60 ppm** levels → impart **red** colour.
- **blends** well with β-carotene to produce **orange** shades.
- enhance and standardize the colour → **tomato products**- juice, sauce, soup and dehydrated pd.
- other food applications → Russian & French dressings, fruit drinks & ice cream.

f. Annatto

- derived from **pericarp of annatto** (Bixa orellana L.) **seeds**.
- **use → 0.5 to 30 ppm →** resulting in hue ranging from **light yellow to dark orange.**
- Oil-soluble annatto → fat-based products like butter, margarine, creams, spreads, desserts.
- Water soluble annatto → in cheese and cheese products.

(Annatto is fast growing shrub → produces cluster of pods containing 10 to 50 seeds → covered with thin pulpy, bright orange resinous coating which serves as a **source of colour**.)

g. Betalain

- water soluble → **red, violate, orange and yellow** colours.
- **Source→** fruits, vegetables, leaves of some plants, underground part of beet-root.
- phenolic compounds (indigoids and indol derivatives) in plant foods.
- **Use →** beverages, jams, jellies, ice cream, yoghurt, gelatin desserts, canned fruits, toppings, confections etc.
- relatively **safe**, various health benefits and no impact on environment.
- a developing concept in recent years → used as colourant in **organic foods**
- Since very low level of colour is used in food product → imparts very **less technical defects** to product.

LIMITATIONS OF USING NATURAL FOOD COLOUR

- **costlier** than artificial colourings (Saffron)
- Can cause **allergic reactions** (Cochineal extract, Annatto)
- Some sources → their own **flavour** → may affect the taste of the finished product. (Turmeric)
- Actual **colour** may not retain as such when subjected to high temp. (Grape juice extract)
- At times raw ingredients remains **scarce**. (Marigold extract)
- Require in **large quantities** when compared to Artificial dyes (Cochineal extract)

2. Nature identical synthetic colours:

❖synthesized in the laboratories and a very limited range is available.

3. Artificial colours:

❖ Synthetic colourants also known as **certified colour additives.**

❖ **two types :** FD and C dyes and FD and C lakes.

❖ **Dyes → water-soluble** compounds that produce colour in **solution**.

❖ **Lakes →** made by combining dyes with alumina to form **insoluble** colourants.

❖ Coal tar is available in wide range of colours.

❖ Indigocarmine is an example of synthetic colour.

Synthetic food colours which may be used

S. No.	Colour	Common Name (1956)	Colour index	Chemical Glass
(1)	(2)	(3)	(4)	(5)
1.	Red	Ponceu 4R	16255	Azo
		Carmoisine	14720	Azo
		Erythrosine	45430	Xanthene
2.	Yellow	Tartrazine	19140	Pyrazolone
		Sunset yellow FCF	15985	Azo
3.	Blue	Indigo Carmine	73015	Indigoid
		Brilliant Blue FCF	42090	Triarylmethane
4.	Green	Fast green FCF	42053	Triarylmethane

❖ Use of Lake colours as colourant in foods :

- **Aluminium Lake** of Sunset yellow FCF → in **powdered dry beverages mix** (max limit of **0.04%** wt/wt) and → **label** → clear instruction for reconstitution of product → making final beverage.

- **maximum limit** of colour content → final beverage sd **not exceed 8.3 ppm** and aluminium content sd not exceed **4.4ppm**.

NATURAL COLOURS ARE BEST OVER ARTIFICIAL COLOURS

Artificial food colourings cause :

- Food allergies
- Behavioural problems
- Headaches and migraines
- Depression
- Attention Deficit Hyperactivity Disorder

Case study

A study conducted at University of North Carolina(2015) found that more than 80 percent of child oriented candies, cakes, fruit-flavoured snacks, drink mixes and powders are artificially coloured with **Brilliant Blue→** excess consumption lead to **Attention deficit hyperactivity disorder .**

4. Inorganic colours:

❖ Addition of inorganic matter and pigments **prohibited** by PFA

❖ Inorganic colouring matters and pigments shall not be added to any article of food

❖ Provided that chewing gum may contain **Titanium dioxide** – (food grade) up to a maximum limit of **1 per cent**.

FOOD COLOURS PERMITED BY FSSA

Following natural colouring principles whether isolated from natural colours or produced synthetically may be used in or upon any article of food :

- Carotenoids,
- Chlorophyll,
- Riboflavin (Lactoflavin),
- Caramel,
- Annatto,
- Saffron,
- Curcumin or
- Turmeric

THANKS