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(RESEARCH ARTICLE)

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Synthetic food color estimation in local market sweets, vegetables, chocolates by UV visible spectrophotometry

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Abstract

Colors are added to food to enhance its flavor and texture. They are important food additives as they are concerned with the taste and perception of food.

According to FSSAI, food colors should be added within permissible limits. Hence, various analytical techniques should identify, isolate, and quantify it. UV- Visible spectrophotometer is a simple and accurate method to determine the colors in food products and compare the results by plotting a calibration curve obtained by the different concentrations of standard food colors.

Keywords: Food additives; Calibration curve; UV- Visible spectrophotometer; Synthetic colours; Natural colours; Quantification.

1. Introduction

Colour is the first sensory quality by which foods are judged; food quality and flavor are closely associated with color. Colour far outweighs flavor in the impression it makes on the consumer even when the flavorare pleasant. Colour powerfully influences the consumer's ability to identify the flavor and quality. Colour is the general name of all sensations arising from the activity of the retina of the eye. Colour is important to many foods, both that are unprocessed and manufactured. Together with flavor and texture, color plays an important role in food acceptability. The colors of foods are the result of natural pigments or added colours. Color compounds are a unique class considering their structural diversity and extremely complex chemical and physical properties.

1.1. Importance of Food Colours

As food should also be attractive to the eye, color plays a key role in defining its quality. Colour is the first characteristic of the food that is noticed and it determines our expectation of both flavor and quality. Colorants affect the identification of flavor as well as sensing the actual sweetness level in the food [1, 2].

- To overcome the damage to the appearance caused by processing and to preserve product identity
- To ensure color uniformity of food products that naturally vary in color
- To intensify the colors of certain manufactured foods
- To help protect flavor and light sensitive vitamins during storage by a sunscreen effect
- To serve as a visual indication of quality
- This would otherwise be virtually colorless to give color to certain foods such as sugar confectionery, soft drinks, sauces, ice lollies, and soft drinks.

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1.2. Classification of Food Colours

1.2.1. Natural colors

Natural colorants are those that are extracted from animals, vegetables, fruits, minerals, and spices used to color foods. E.g. carotenoids from annatto, paprika, saffron, anthocyanins, caramel, chlorophyll, and curcumin.

Natural colours	**Applications**	**Description**
Carotenoids	Beverages, Dairy Products, Bakery Products, Fruit Preparation.	Beta-Carotene is extracted from a variety of sources, including algae, fruits, orange carrots, and oil palm fruits. Beta Carotene, a powerful antioxidant, is a Carotenoid that is responsible for giving fruits and vegetables their orange pigment [2]. Beta carotene is a fat-soluble vitamin, so eating the following foods with a fat like olive oil or nuts may help absorption.
Curcumin	It can be used in condiments such as butter, bakery products, sauces, canned food, pickles, mustard, seasonings, relish, hot peppers, snacks, baked goods, salad dressing, oils, margarine, frozen desserts, cheeses, pies, cakes, candies, beverages, frosting, cereal, fruit preparation, convenient food, meat, seafood, and soups.	Curcumin is the principal pigment of turmeric, a spice that is obtained from the rhizomes of Curcuma longa. The pigment is obtained by solvent extraction of turmeric and purification of the extract by crystallization [7,8]. Curcuminoids are natural phenols that provide a bright, strong yellow color shade and antioxidant effect. Curcumin is extremely heat stable and may generally be used in products throughout the acid pH range.
Caramel	Caramel color is mostly used in soft drinks and alcoholic beverages [14]. It can also be added to drugs, cosmetics, and food including confectionery, bakery products, dairy products, desserts, meat, seafood, vinegar, sauces, gravies, soups, snack food, and fruit preparations, and convenient food.	Caramel is prepared by the controlled heating of food-grade carbohydrates with or without added chemical catalysts. Caramel is water-soluble in powder as well as in liquid form.
Anthocyanins	Deserts, Ice-Creams, Beverages, confectionary, fruit preparations, baker's jam, and non-standard jellies and preserves, sherbets, ices, pops, raspberry, yogurt, gelatin desserts, candy, and bakery fillings and toppings.	Anthocyanins are water-soluble compounds which are derived from the plants of Grapes, Berries Black Carrots, blueberry, etc. [15] Anthocyanin pigments change their color with the change in pH. So based on the pH, anthocyanin can be red, blue, or purple.
Chlorophyll	confectionery, instant food, soft drinks, soups, beverages, soaps, cosmetics, ice cream, jellies, desserts, beverages, dairy products, fruit preparation, bakery products, sauces, snack food, seasonings, and convenience food.	Chlorophyll is the most widely distributed natural plant pigment, present in all green leafy vegetables & widely used as coloring matter for various food items. Chlorophyll is an oil-soluble color. Chlorophyllin is obtained by the coppering of chlorophyll following its alkaline hydrolysis. This is a water-soluble color and provides a green/blue to yellowish-green color. The improved stability and brightness of copper chlorophyllin lead to its much wider use than chlorophyll as a food color.
Annatto	For coloring dairy products such as cheese, and butter.	Annatto Colour is made from the Annatto Seeds found inside the fruit of the Bixa Orellana plant. Annatto is antibacterial, antifungal, anti-inflammatory, and high in antioxidants.

Paprika	Paprika is used to color meat products, confectionery, vegetable oils, snacks, surimi, seasonings, sauces, meat product, soups, bakery products, salad dressings, marinades, processed cheese, fruit preparations, convenient foods, and canned goods	Paprika oil soluble is a natural red color obtained through extraction, separation, and filtration processes. It is a dark red color oil liquid. It is dissolved in grease and mineral oil. Paprika water-soluble is a fine powder ground from Capsicum annum.

1.2.2. Synthetic colors

Synthetic colors arechemicals divided into two categories as permitted and non-permitted dyes. Synthetic colors are important and widely used in foods. They are widely used in bakery products, jellies, confectioners, and beverages available on market. Synthetic food colors are a major source of food intoxication [5, 12] and lead to severe health problems such as low hemoglobin, effect on kidneys, liver, intestine, asthma, etc.

They have to be separated from the food before identification is done. They are classified as acidic and basic dyes [12]. Only 8 coal tar food colors are permitted to be used in certain food products under the provision of FSSAI regulations, 2011[10,4]. It includes carmoisine, ponceau 4R, erythrosine, sunset yellow FCF, tartrazine, brilliant blue FCF, indigo carmine, and fast green FCF. Unpermitted colors [13, 15] are metanil yellow, rhodamine B, orange G, Blue VRS, auramine, and certain unidentified water and oil soluble colors that appears as adulterants in foods.

In this study, the Determination of synthetic food colors in motichoorladdoo, tuty fruity, gems, peas, and jelly sweet is done by UV visible spectrophotometer and comparing the results with standard orange, yellow and green colorants.

2. Material and methods

2.1. Apparatus

Volumetric flask, pipette, measuring cylinder, mortar and pestle, beaker, water bath, centrifuge.

2.2. Chemicals

Glacial acetic acid, petroleum ether, 2% ammonia in 70% alcohol, distilled water, standard orange, red and green colors.

2.3. Instrument

UV- Visible spectrophotometer.

2.4. Sample collection

A total of 100g of each sample of motichoorladoo, jellies, gems, tuty fruity, and peas were randomly collected from the market.

Figure 1 Jellies, Peas, Tuty Fruity

Figure 2 Gems, Motichoor Ladoo

2.5. Preliminary Treatment

In the case of beverages, liquid samples are directly used for color extraction.

In the case of confectioneries like sweets, jellies, candies, laddo, Bondi they are used for preliminary treatment.

Take samples collected (motichoorladoo, jellies, gems, tuty fruity, peas) ground them, weigh 5g and transfer it in a beaker.

Add petroleum ether to remove oil. Then add 10ml of 2% ammonia in 70% alcohol to the oil removed sample.

Heat the mixture ina water bath for 2-3 minutes for starch to settle down.

After heating the liquid is centrifuged for 15 minutes at 30,000 rpm. The separated liquid was evaporated ina water bath.

2.6. Colour Extraction

The pretreated sample was slightly acidified by 2ml of 2M glacial acetic acid and2ml of distilled water was added.

Keep it ina water bath for a few minutes to concentrate the color intensity and then dilute it with water.

Transfer it toa glass cuvette and check the absorbance of the color at maximum wavelength.

2.7. Standard Preparation

2.7.1. Preparation of standard red color

In a clean and dry volumetric flask, add 10mg of the standard red and dissolve in distilled water.

Now add distilled water to make up the volume to a 10ml volumetric flask.

From this stocksolution, prepare serial dilutions of red color 10, 15, 20, 25, 30, 35 ppm and check the absorbance at wavelength 482.2nm, and note the readings.

2.7.2. Preparation of standard yellow color

In a clean and dry volumetric flask, add 10mg of the standard yellow and dissolve in distilled water.

Now add distilled water to make up the volume to a 10ml volumetric flask.

From this stock, solution prepare serial dilutions of yellow color 10, 15, 20, 25, 30, 35 ppm and check the absorbance at wavelength 443.5nm, and note the readings.

2.7.3. Preparation of standard green color

In a clean and dry volumetric flask, add 10mg of the standard green dye and dissolve in distilled water.

Now add distilled water to make up the volume to a 10ml volumetric flask.

From this stock, solution prepare serial dilutions of green color 25, 50, 75, 100, 200, 250, 300, and 350 ppm and check the absorbance at wavelength 422nm and note the readings.

3. Results and discussion

3.1. Red colour

The absorbance of standard solutions of different concentration was measured at 482.2nm. The results are tabulated for standard and sample.

Table 1 linearity data of standard Red Food color

ANALYSIS OF STANDARD RED FOOD COLOR

Concentration	Absorbance
10	0.1156
15	0.1348
20	0.1549
25	0.1789
30	0.2015
35	0.2205
Jelly sample	2.234
Concentration	504.8973477

By calibration curve method, a graph was plotted by taking concentration on the x-axis and absorbance on y-axis. A straight line was obtained which shows linearity i.e. by an increase in the concentration of the solution, the absorbance also increases linearly. The concentration of the sample can be determined by extrapolating the standard graph.

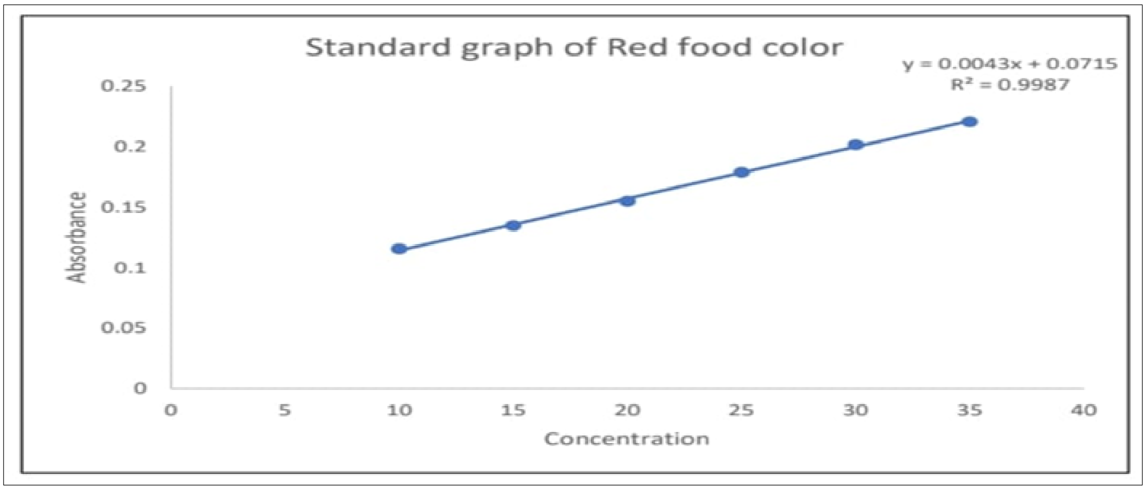

Figure 3 Calibration curve of Red food colour

3.2. Yellow Colour

The absorbance of standard solutions of different concentrations was measured at 443.5 nm. The results are tabulated for standard and sample.

Table 2 linearity data standard of Yellow food color

ANALYSIS OF STANDARD YELLOW FOOD COLOR	
Concentration	**Absorbance**
10	0.0828
15	0.125
20	0.1745
25	0.2231
30	0.2632
35	0.3121
Motichoor Laddoo Sample	1.217
Concentration	133.3327398

By calibration curve method, a graph was plotted by taking concentration on the x-axis and absorbance on y-axis. A straight line was obtained which shows linearity i.e. by an increase in the concentration of the solution, the absorbance also increases linearly. The concentration of the sample can be determined by extrapolating the standard graph.

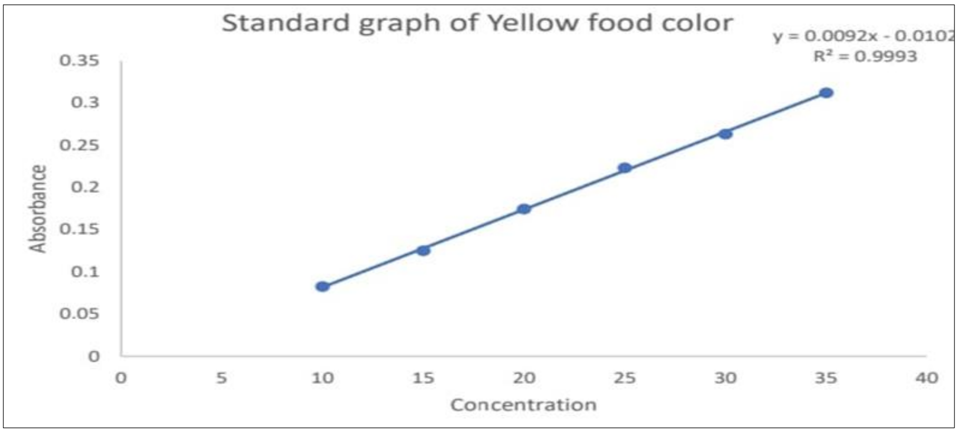

Figure 4 Calibration curve of Yellow food color

3.3. Green colour

The absorbance of standard solutions of different concentration was measured at 423 nm. The results are tabulated for standard and sample.

Table 3 linearity data of Green food color

ANALYSIS OF STANDARD GREEN FOOD COLOR	
Concentration	**Absorbance**
25	0.1466
50	0.263
75	0.3742
100	0.4953
200	0.8948
250	1.1214
300	1.3657
350	1.5362
Gems sample	1.3242
Concentration	296.5058343
Tuty fruity sample	1.1311
Concentration	251.6151936
Green peas sample	0.5887
Concentration	125.5215451

By calibration curve method, a graph was plotted by taking concentration on x-axis and absorbance on y- axis. A straight line was obtained which shows linearity i.e. by increase in the concentration of solution, the absorbance also increases linearly. The concentration of sample can be determined by extrapolating the standard graph.

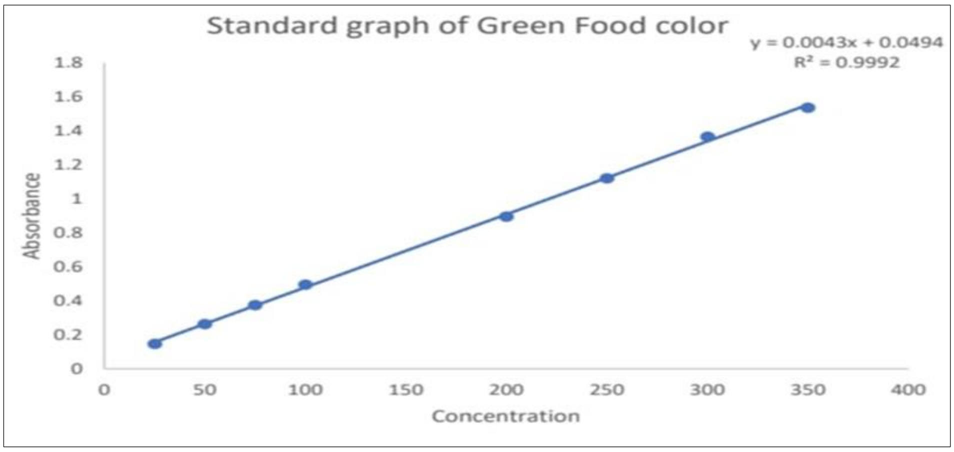

Figure 5 Calibration curve of Green food colour

4. Conclusion

A method was developed for the estimation of food colors that is simple, accurate and effective. The regression coefficient was found to be within the specified range. Hence this method is linear.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to disclosed.

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