Practical 4

IDENTIFICATION OF FOOD COLOURS

EXERCISE

4.1. Identification of food colours used in food industry

OBJECTIVES

- To learn about identification of colour additives used in food industry

Delivery lectures: 01 period

Student expectations/learning objectives

- To know different synthetic colours used in the food industry
- To identify synthetic and natural colours available in the market
- Importance of colour additives in processed fruit products

Pre-learning required: Acquaintance with different kinds of fruit products available in the market and their colour requirements

Handouts/material/equipment's & tools required: Paper sheet and pen to note down the attributes and shades of different food colour and material for collection of different colours.

INTRODUCTION

Any product, which has eye appeal is liked by the consumers. For example, we prefer attractive red coloured apples and are ready to pay any price for them. Similarly, a processed product with attractive colur fetches a good price in the market. Hence, food processing industries use different shades of colours to make their products more attractive to the consumers.

Some permitted synthetic colours extensively used by processing industries

Colour additives have been used for many of thousands of years. The coloring matter in food may be (a) natural and (b) synthetic colours. They may also be classified as (a) water soluble, and (b) fat soluble. They have to be separated from food before identification can be done. Natural colours consists of chlorophyll, carotenes, canthaxanthin, riboflavin, annatto, saffron, turmeric and caramel etc. Synthetic colours are of importance as they are widely used in different foods. They are again classified as acidic and basic dyes. Only eight coal-tar dyes are permitted to be used in certain food products under the provisions of Prevention of Food Adulteration (PFA) Act. They include three red shades (Carmoisine, Ponceau 4 R, Erythrosine), two yellow shades (Sunset Yellow FCF and Tartrazine), two blue shades (Brilliant Blue FCF and Indigo Carmine) and one green shade (Fast Green FCF). However, certain unpermitted colours such as Metanil Yellow, Rhodamne B, Orange G, Blue VRS, Auramine and certain unidentified water and fat soluble colours often appears as adulterants in foods.

Candy having shades of different colours

Some colours being used for colouring processed products

Identification of natural colours

Juices with different shades of caramel natural colour

Caramel: Caramel is detected by Fiehe's reaction. Extract the sample solution with 50 ml ether and evaporate it in a porcelain dish. To the residue add 3 drops of 1% solution of resorcinol in HCl. The presence of caramel is indicated by appearance of rose color.

Cochineal: Shake an amyl alcohol solution of the material with dilute ammonia. A purple color is produced is produced in the presence of cochineal.

Turmeric (Curcumin): Evaporate an alcoholic extract of the material almost to dryness on the water bath with a piece of filter paper. Moisten the dried paper with a few drops of weak solution of boric acid to which some drops of HCl have been added. Dry the paper again. If turmeric is present, the dry paper 'll be cherry red in color which changes to bluish green by a drop of NaOH or NH_4OH.

Curcumin prepared from turmeric

Annatto: Shake the melted fat or oil with 2 % NaOH solution and pour the aqueous extract on moistened filter paper. The filter paper will show a straw color which will remain with a gentle wash with water. Dry the paper and add a drop of 40 % stannous chloride solution and dry carefully. If the color turns purple, the presence of annatto is confirmed.

Annatto, a natural colour

Chlorophyll: Extract the sample with ether and treat the ether extract with 10 % KOH in methanol. Color becomes brown, quickly returning to green, confirms the presence of chlorophyll.

Betanin: Extract the aqueous suspension with amyl alcohol. It remains in aqueous phase. Dye t with a piece of tannin mordanted cotton; a terracotta shade is produced in presence of betanin.

Betanin, a natural colour extracted from beet root

Isolation, identification and estimation of synthetic colours

Originally, food colours came from nature and their first purpose was to mask poor quality or spoiled food. During the 1800s, scientists began searching for ways in which to colour food by chemical means and the result was the so called synthetic colours.

Unfortunately, in the beginning, arsenic and similar poisons were used to colour pickles and hard candies leading to many injuries and deaths. These incidents sparked action to be taken by the government, which in 1906, formed the F.D.A. or Food and Drug Administration. Now colours used in food and drugs had to be regulated by the government. Many foods, drugs and cosmetics are artificially coloured with federally approved food dyes (FD & C dyes). These dyes include Carmoisine, Ponceau 4 R, Erythrosine, Sunset Yellow FCF, Tartrazine, Brilliant Blue FCF, Indigo Carmine, Fast Green FCF. Since each dye has an identifiable absorption spectrum and peak, a spectrophotometer may be used to identify the types of FD & C dye used in a product. The following table gives the wavelength of peak absorbance for each of these dyes.

Wavelength of maximum absorbance of commonly used FD & C Dyes

Food, Drug and Cosmetic dye	Wavelength (nm) of maximum absorbance
Carmoisine	516
Ponceau 4 R	507
Erythrosine	527
Green FCF	624
Indigo Carmine	609
Brilliant Blue FCF	630
Tartrazine	427
Sunset Yellow FCF	482

Pigments may be extracted from foods and drinks that contain one or more of these dyes. An absorption spectrum of that extract can then determine what dyes are in that food or drink by comparing the peaks of maximum absorbance with information in the table above. If the absorption spectrum of a food extract has a peak at 630 nm and one at 427 nm, you can assume the food contains both Brilliant Blue FCF and Tartrazine. FD&C dyes contained in foods and drinks must be listed on the ingredients label of the package. The Kool-Aid® package shown below lists Red 40 and Blue 1 on the ingredients label. If you did an absorption spectrum on this Kool-Aid® where would you expect the peaks? What colour would you expect this Kool-Aid® to be?

A. Preparation of Solutions - Choose one of the following.

1. Extract the dye from a piece of candy, such as an M&M or skittle, by placing the candy in a test tube with water and gently shaking. Quickly pour off the liquid into a cuvette. If you leave the candy in too long other components of the candy start to dissolve and your solution will become too cloudy to read in the spectrophotometer. You may need to filter the solution if this happens.

2. Make a solution of Kool-aid® by dissolving 0.3 g of unsweetened powder in 100 ml of water.

3. Gatorade, vitamin waters, mouthwashes, and other colored liquids may be used straight.

Some foods available in the market with different shades of colour

B. Procedure

- Set the spectrophotometer to read absorbance
- Set the wavelength to 400 nm
- Fill a cuvette with water. This is your blank.
- Fill a cuvette with the solution to be tested.
- Place the cuvette containing the water blank into the sample compartment of the spectrophotometer and set the absorbance to zero. Remove the blank.
- Place into the solution to be tested into the sample compartment
- Record absorbance reading
- Remove cuvette
- Set the wavelength to 425 nm, repeat steps 5-8
- Repeat above at 25 nm increments until 700 nm
- Graph your absorbance spectrum. Where were the peaks of maximum absorbance?
- What dye(s) were present in your food or drink?

For teachers

- Collect some food colours available in the market. Identify them and ask the students to collect some different types.
- Narrate the differences between synthetic and natural colours and also ask the students to collect some.
- Ask students to bring some coloured foods (e.g, kurkure, puffs, pasta, some drink, fruit juice, toffees, candies, jam or jelly, biscuits, wafers etc., from the market and get the colour of food item identified.

Other methods for identification and estimation of synthetic food colours include :

- Paper chromatography
- Column chromatography
- Thin Layer Chromatography
- HPLC-High Pressure Liquid Chromatography

STUDENT'S ACTIVITIES/EXERCISES

1. Collect different coloured foods from market, keep sample of each and try to identify the color additives used to enhance their appearance.

2. Differentiate the natural and synthetic colors used in foods.

3. Collects some items from the market. From the packet, read the colour, which has been used for its colouration, and then note it down.

RESOURCE MATERIAL

- Sharma, S.K. and Nautiyal, M.C. (2009). Postharvest technology of horticultural crops. New India Publishing Agency, New Delhi.

- Siddappa, G. and Tandon, D.K. (1998). Preservation of fruits and vegetables. ICAR, New Delhi.

- Srivastava, R.P. and Kumar, S. (2001). Fruit and vegetable preservation: Principles and practices. International Book Distributing Co., Lucknow, India.

- Verma, L.R. and Joshi, V.K. (2000). Post harvest technology of fruits and vegetables. Volume 1 and 2. Indus Publishing House, New Delhi.