Chapter- 1

Detection of synthetic colours in sweet confectioneries by UV-Visible spectroscopy

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Abstract

Food adulteration, particularly through the addition of synthetic colours or any other harmful substances, causes significant health risks globally. Synthetic colours, used to enhance the visual appearance of food products, can be potentially harmful if consumed above permissible limits. This study investigates the prevalence of synthetic colours in sweet confectioneries through UV-visible spectroscopy. Samples collected from rural areas were analyzed to detect both permitted and non-permitted colours including tartrazine, amaranth, malachite green, orange G, and rhodamine B. Results revealed that out of 30 samples tested, 7 contained synthetic colours, with 5 samples showing non-permitted colours and two samples were permitted colours. The study underscores the importance of rigorous monitoring and regulation by authorities such as the Food Safety and Standards Authority of India (FSSAI) to safeguard public health against the adverse effects of food adulteration. Understanding the composition of synthetic colours in confectioneries is crucial for ensuring food safety and consumer protection.

Key words: Sweet confectioneries, UV-Visible spectroscopy, Tartrazine, Amaranth, Rhodamine B, FSSAI

1.Introduction

Food additive are the substances which are added to the food by the manufactures to improve appearance, texture, flavour and keeping quality. Food adulteration is defined as addition of undesirable

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substances. Which may be added naturally, accidentally or deliberately for the removal of certain constituents. Over time, various food additives have been created for the demands of large-scale food production. These additives are crucial for ensuring the safety and freshness of processed food as it travels from factories to consumers [1]. Even if the adulterant is not harmful, it reduces the nutritional value of food. Some of the adulterants are also identified as carcinogenic or lethal when exposed to them for a longer period.

A dye is pigment or a substance which is added to food to get colour. Also, we can call it a colour additive. The colours that are added to the food can be natural colours or synthetic colours (permitted and non-permitted). Natural food colours come from sources such as vegetables and fruits. These colours are permitted, and they do not impart any toxic effects to the body. Synthetic food colours are regulated and authorized for use in food additives in many countries. Permitted colours are defined as colours that are permitted under The Prevention of Food Adulteration Act. And the permitted colours, according to FSSAI, are tartrazine, sunset yellow FCF, brilliant blue colours such as metanil yellow, rhodamine B, orange green, amaranth, malachite green, and orange II, And the maximum amount of permitted synthetic colours doesn't exceed 100 parts per million, according to FSSAI regulation [2]. The Food Safety and Standards Authority of India (FSSAI) was established in 2006 to consolidate various food safety acts and create standards for food articles. Its primary goal is to ensure the availability of safe food for human consumption through regulations on manufacture, storage, distribution, sale, and import [3].

Recently some states on India to ban the use of certain colouring agents in cotton candy and even in Gopi Manchurian. The ban is on the state like Goa, Tamil Nadu and Karnataka. Recently Himachal Pradesh has instituted one year ban for the production, sale of cotton candy after the detection of Rhodamine B. The survey by the Public Health Department that showed the presence harmful chemicals in food samples, which is unsafe for consumption and may lead to acute toxicity. And it is carcinogenic in nature. Exposure to this chemical causes damage to the dye and cause irritation in respiratory tract. Rhodamine B is the chemical that present in popular street items such as cotton candy& Gopi

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Manchurian. FSSAI specially banned the Rhodamine B in food products, any use of this chemical in the processing, preparation and distribution is punishable. Penalties include the cancellation of commercial licence and fine note less than ₹ 10 lakh and minimum 7 years jail term, extending jail imprisonment. The negative effects include attention deficit hyperactivity disorder, along with potential carcinogenic properties, immune-related issues, respiratory problems, and gastrointestinal disturbances [4].

2. Materials And Methods

2.1 Reagents And Chemicals

- Distilled water
- Acetone And 5 standard synthetic colours
- Tartrazine(85% Pure), Amaranth(85% Pure), Malachite green(90%Pure),OrangeG(88% Pure), Rhodamine B (80% Pure), have been purchased from Vidya Lab equipment and Chemicals, Kozhikode.

2.2 Laboratory Equipments

- Beaker
- Glass rod

2.3 Instrumentation

Uv-visible spectrophotometer is used for the detection of synthetic colours. A uv-visible spectrophotometer uses Beer-Lambert's law to measure the absorption of UV light by a sample, allowing for the determination of concentration and the identification of substances based on their distinctive absorption patterns. Here, it compares the sample with a blank sample to measure the

2.4 Sample Collection

In this present study, all 30 samples (consisting candies, cotton candy, chalk candy and pudding candies) were collected from the different shops including both rural and urban area. Collection of samples were chosen from different locations, to check the adulteration in sweet confectioneries by synthetic colours, mainly focusing on non-permitted colours.

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And standard was also used and test were performed for comparison. The standard colours collected are, Rhodamine B, Amaranth, Malachite green, Orange G and Tartrazine. The study mainly focused on the coloured ones suspected on synthetic colours.

2.5 Method

First step is the dilution of the sample. A small portion of the candy is dissolved in 25 ml of distilled water within a beaker. This dilution process ensures that the candy's components are dispersed evenly in the solution, facilitating uniform absorption measurements later on. Stirring the mixture using glass rod, until a consistent colour appears in the solution ensures that the sample is adequately prepared for spectroscopic analysis. Also, take a pinch of each colour, such as, tartrazine, rhodamine B, amaranth, malachite green and orange G. And makeup to 100 ml in a distilled water.

After sample solution prepared, attention turns to the UV-visible spectrophotometer, a sophisticated instrument designed to measure how substances absorb light in the UV and visible spectra. The setup process begins with powering on the spectrophotometer and allowing it to initialize, indicated by a reassuring green tick mark. Next, the wavelength of light used for analysis is meticulously chosen using the instrument's monochromator, typically within the range of 200 to 800 nm. This selection is crucial as different substances absorb light at specific wavelengths, allowing researchers to target and quantify particular components present in the candy. To ensure accuracy in measurement, baseline measurements are conducted using cuvettes filled with distilled water. This initial measurement establishes a reference point against which subsequent samples are compared. Once the baseline is confirmed, a cuvette containing the candy sample solution is inserted into the spectrophotometer's sample compartment. Initiating the measurement captures the absorbance spectrum of the candy sample, recording how much light is absorbed at the chosen wavelength. This data is critical for understanding the concentration of substances present in the candy.

After completing the measurement, the spectrophotometer's software generates a calibration curve, between absorbance and wave

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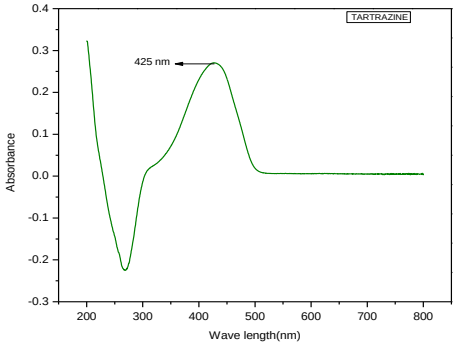
length. The data, typically exported in spreadsheet format (export > file location > file name >. Xls format > save). And clean the cuvette with acetone, for the preparation of next samples.

3. Results And Discussion

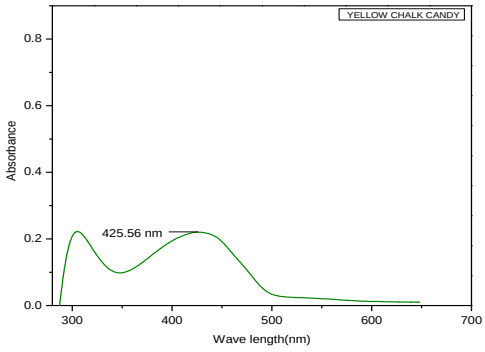
Out of the 30 samples analysed, 6 contained synthetic colours, one contained permitted colour and the remaining 5 containing non-permitted colours.

Tartrazine

Only one sample was found to contain tartrazine when tested using a UV-visible spectrophotometer.



Tartrazine standard



Yellow chalk candy

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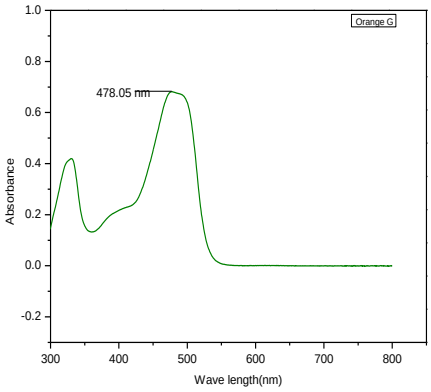
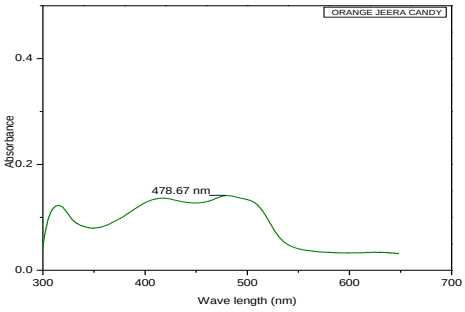
Orange G

5 samples which containing orange colour are collected. Some are branded while others are local products with no labelling. Out of which only one sample showed the presence of synthetic colour.



Orange G standard



Orange jeera candy

Rhodamine B

11 samples, which have the combinations of red, rose, and purple colours, were suspected to contain rhodamine B. Out of which, only 2 samples were detected to have its presence when run on the UV-visible spectrophotometer.

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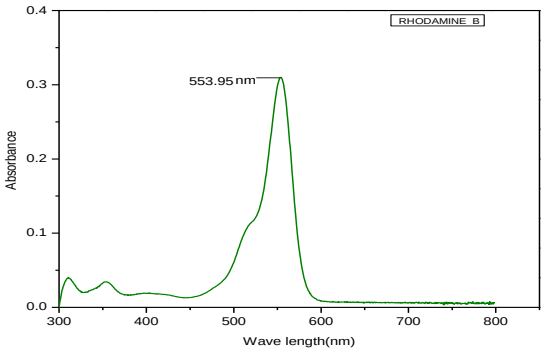
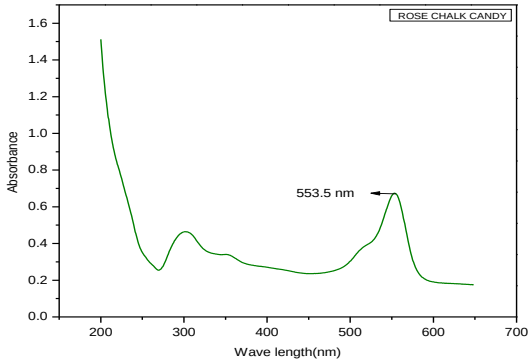
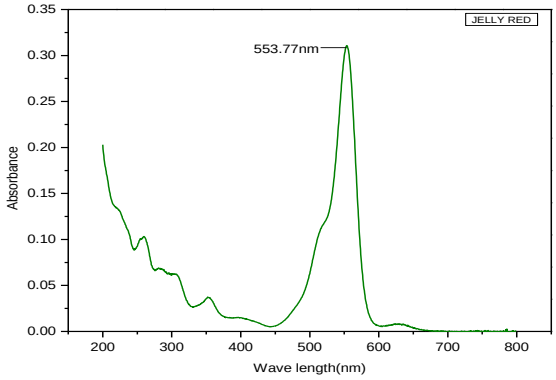


Rhodamine B standard



Rose chalk candy



Jelly red

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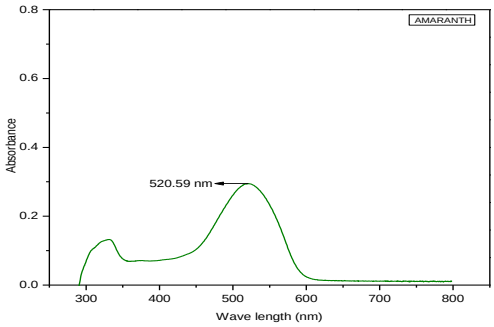
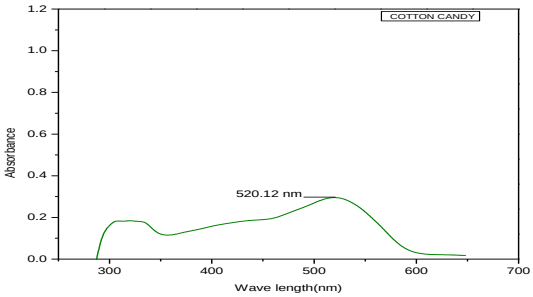
Amaranth

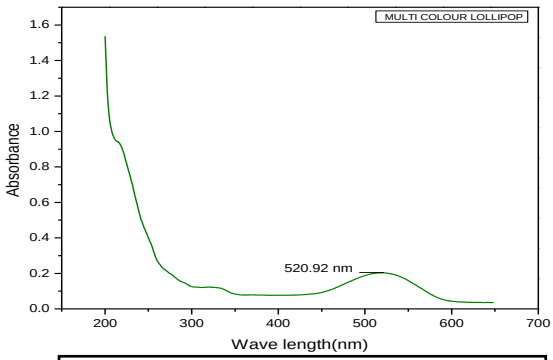
11 samples, which have combinations of red, rose, and purple colours, were suspected to contain amaranth. Only 2 samples were detected the presence of amaranth.



Amaranth standard



Cotton candy



Multicolour lollipop

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The study was focused on a simple method of detecting the synthetic colours only by dissolving the sample using distilled water as the solvent. And the prepared solution is run on a UV-visible spectrophotometer. All standard colours are run on a UV-visible spectrophotometer, and get a calibration curve. Save the data after measurement. Different peaks are identified in each sample. The standard peaks are,

- Tartrazine - 425 nm
- Orange B - 478.05 nm
- Rhodamine B- 553.95 nm
- Amaranth - 520.59 nm

Synthetic colours were found in 6 samples. Out of which 5 contained non-permitted colours and the remaining one detected the presence of permitted colours. It was noted that tartrazine is a permitted colour, could have adverse effects on the body with repeated use. Interestingly, non-permitted colours were mostly found in non-branded samples, some of which lacked proper labelling. Orange G was detected on jeera candy and amaranth was detected in a multi colour candy, and it doesn't contain any label on outside of the sample. Recently, the sale and manufacturing of rose chalk candy was banned in Kerala. Chalk candy is one of the traditional candies in south India. Mainly, the sale of this chalk candy was found during the traditional festivals. This rose-coloured candy was detected the presence of rhodamine B. Rhodamine was also detected in non-branded jelly sample. The yellow chalk candy was also found to contain tartrazine.

For instance, a branded cotton candy was found to contain the non-permitted colour amaranth without any mention on the label, despite listing only sugar and flavour extract as ingredients. Although labelled as allergen-free, amaranth can be carcinogenic and trigger allergic responses. Experiment, focused on samples primarily from rural areas rather than urban areas. The range of areas from which samples were collected was limited. Therefore, collecting samples from a wider range of areas, including both rural and urban, would provide more insight into the presence of synthetic colours, particularly non-permitted colours.

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4. Conclusion

Numerous artificial food colours are utilized in processed foods. These synthetic colours are preferred over natural ones due to their consistency and suitability for a wide range of processed foods. This study was an attempt to identify the presence of synthetic colours, mainly non-permitted colours by using a simple method. The samples are diluted in distilled water and run on a UV-visible spectrophotometer. The summary of the above analysis shows that, overall, 30 samples were analysed. The outcome showed that 6 samples indicated the presence of artificial colours, out of which only one sample contained permitted colour and the remaining are non-permitted colours. So, it is essential l to systematically monitor the presence of harmful and unauthorized colours within the country. While also being cautious of potential adulteration in locally sourced foods that could pose serious health risks, which include irritation, allergies, and carcinogenic properties. Implementing and enforcing strict regulations is crucial to mitigating the risks associated with the use of unauthorized colours and exceeding permissible levels of approved colours.

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