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Full Length Research Article

ANALYSIS OF NON-PERMITTED DYES IN BAKERY AND DAIRY PRODUCTS FOR FORENSIC CONSIDERATION

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ABSTRACT

Synthetic dyes and pigments are used in a wide range of industries. The present study was carried out to detect the non-permitted dyes added to bakery and dairy products. Different types of products were collected from local areas of Allahabad like 8 samples of cake, 8 samples of pastry were analysed for identification of the added synthetic food colours and it was found that 2 out of 8 samples of cake and 1 out of 8 samples of pastry adulterated with metanil yellow and 2 out of 8 samples of cake and 3 out of 8 samples of pastry adulterated with malachite green. The colour changes and Rf values of standard samples were compared with suspected samples for further confirmation of presence these dyes with the help of chemical tests and thin layer chromatographic method.

INTRODUCTION

Food colours are added to edibles to make them look more attractive and tempting. Food colours are pigments, dyes or any other compound which when added to any food article imparts colour. The term pigment and dye are often used interchangeably. Strictly speaking a pigment is insoluble in the given medium whereas a dye is insoluble. Colour is added to food for various reason.

To replace the colour lost during processing. Food colours are generally divided into four categories:

- Natural colour,
- Nature- identical colour,
- Synthetic colour,
- Inorganic colour.

The colouring matter in food may be natural or synthetic. They may also be classified as water soluble and oil soluble.

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The trend of consumption of foods coloured with synthetic dyes has been increasing over the years. Natural colours consist of chlorophyll, carotenes, curcumin, caramel, annatto, capsainthin etc. Synthetic colours are widely used in different foods. Synthetic colours are further classified as acidic and basic dyes. Only eight coal-tar food colours are permitted in certain food products under the provision of Food Adulteration Act (1954). Adulterant usage was first investigated by German chemist Fredrick Accum (1820), who identified many toxic metal colouring in food and drinks.

MATERIALS AND METHODS

22 different samples of dairy and bakery products like cake, pastries, and ice-cream were collected from local areas of Allahabad like Civil Lines, Bairehana, Kydganj Mutthiganj, Chowk, Allapur, Rambagh, Shahganj, Teliyarganj, Colonelganj, Katra etc. were collected. To determine the presence of various non-permitted food colours in edibles like dairy and bakery products using comparison of chemical test and TLC. The samples of Cake were mentioned as S1, S2, S3, S4, S5, S6, S7 and S8, Samples of Pastry were mentioned as S9, S10, S11, S12, S13, S14, S15 and S16 and Samples of Ice-Cream were mentioned as S17, S18, S19, S20, S21 and S22.

Standard coloured samples of metanil yellow, malachite green, erythrosine, sunset yellow, and were purchased from CDH.

Extraction of colours from samples

Taken 5 gm. of each sample and soaked in 10 ml of petroleum ether with occasional shaking followed by filtration using Whatman no. 1 filter paper. After filtration, the residue was dried at room temperature and scraped out from filter paper and shaken with 5 ml of ethanol with occasional heating on water bath, after which the solvent was decanted. The extracted samples were used for detection of non-permitted dyes with different chemical methods.

Colour test for malachite green;

Taken 1 ml of extracted sample was taken in a test tube and then about 1 ml of propanol was added to dissolve the sample. 2 ml of freshly prepared neutral sulphite solution was added to the test tube. Disappearance of green colouration indicates the presence of malachite green.

Colour test for metanil yellow

Taken 1 ml of extracted sample was taken in test tube and then about 1 ml of propanol was added to dissolve the sample. After that 10 drops of conc. HCl was added to the sample and then the colour was observed. Presence of pink colouration indicates the presence of metanil yellow.

Chromatographic Analysis:

The advantages to the use of TLC for the analysis of dyes compared with other chromatographic techniques. The most obvious is that dyes are easily visualized on a chromatographic layer by their colour. To detect the presence of non-permitted food colors in edibles using preliminary color test and thin layer chromatography as suggested by Purba *et al.* (2015) were used. For separation and qualitative determination of non-permitted colours, TLC was performed using appropriate solvent system.

For malachite green: The solvent system used for malachite green was, Carbon tetra chloride: methanol in the ratio of (4:1).

For metanil yellow: The solvent system used for metanil yellow was, Ethyl acetate: methanol: ammonia: water in the ratio of (35:11:5:5).

RESULTS

According to the observations based on colour tests, peculiar change was observed which was compared with the standard sample of metanil yellow dye in which Cake samples S1, S2, S3, S4, S5, S6, S7 and S8, Pastry samples S9, S10, S11, S12, S13, S14, S15 and S16 and Ice-Cream samples S17, S18, S19, S20, S21 and S22 were taken for test of Metanil Yellow dye in which 2 samples of Cake as S3 and S7 and 1 sample of ice-cream as S17 were found to be presence of Metanil Yellow dye. According to the observations based on colour tests, peculiar change was observed which was compared with the standard sample of malachite green dye in which Cake samples S1, S2, S3, S4, S5, S6, S7 and S8, Pastry samples S9, S10, S11, S12, S13, S14, S15 and S16 and Ice-Cream samples S17, S18, S19, S20, S21 and S22 were taken for test of Malachite Green dye in which 2 samples of Cake as S1 and S6 and 2 samples of Pastry as S9 and S15 were found to be presence of Malachite Green dye. The data collected from the chromatogram were recorded and the Rf values were calculated through distance travelled by solute / distance travelled by solvent. The chromatogram of samples of Cake as S1 and S6 and Pastry as S9, S13 and S15 in figures (7) and (8), shown the similarities between suspected and standard samples of Malachite Green dye and according to table (4.5), the Rf values of suspected samples were matched with Rf value of standard sample of Malachite Green dye.

Fig. 1. Standard test sample of Metanil Yellow shown pink colour

Fig. 2. Suspected sample shown pink colour during colour test of Metanil Yellow

Fig. 3. No colour change

Metanil Yellow dye

The data collected from the chromatogram were recorded and the Rf values were calculated through distance travelled by solute / distance travelled by solvent. The chromatogram of samples of Cake as S3 and S7, samples of Pastry as S12 and samples of Ice-Cream as S17 and S21 in figures (9) and (10), shown the similarities between suspected and standard samples of Metanil Yellow dye and according to table (4.6), the Rf values of suspected samples were matched with Rf value of standard sample of Metanil Yellow dye.

Fig. 4. Standard test sample of Malachite Green

Fig. 5. Suspected sample shown disappearance of green colour

Fig. 6. No Colour change

Fig.7. Developed TLC for standard

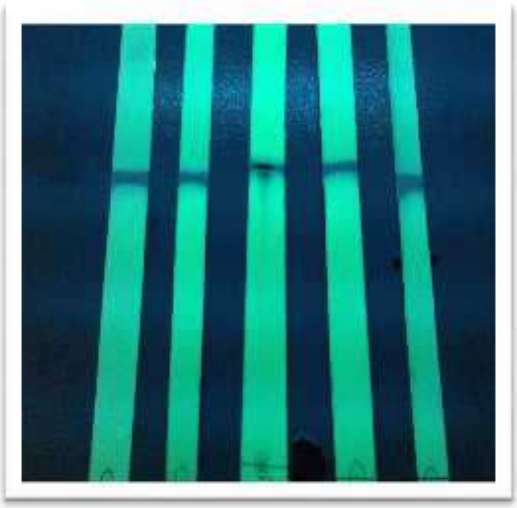

Fig. 8. TLC for suspected sample

Fig. 9. Developed TLC for standard

Table 4.5. Thin layer chromatography analysis for standard and suspected samples of Malachite Green dye

Sr. no.	Sample	Sample no.	Distance travelled by solvent	Distance travelled by sample	Rf value
A	Cake				
		Standard sample (Malachite Green)	8 cm	5.9 cm	0.74
		S1	8 cm	5.9 cm	0.74
		S6	8 cm	5.8 cm	0.73
B	Pastry				
		S9	8 cm	5.9 cm	0.74
		S13	8 cm	5.8 cm	0.73
		S15	8 cm	5.9 cm	0.74

Table 4.6 Thin layer chromatography analysis for standard and suspected samples of Metanil Yellow dye

Sr.no.	Sample	Sample no.	Distance travelled by solvent	Distance travelled by sample	Rf value
A	Cake				
		Standard sample (Metanil Yellow)	8 cm	6.2	0.77
		S3	8 cm	6.1	0.76
		S7	8 cm	6.2	0.77
B	Pastry				
		S12	8 cm	6.2	0.77
C	Ice- cream				
		S17	8 cm	6.2	0.77
		S21	8 cm	6.1	0.76

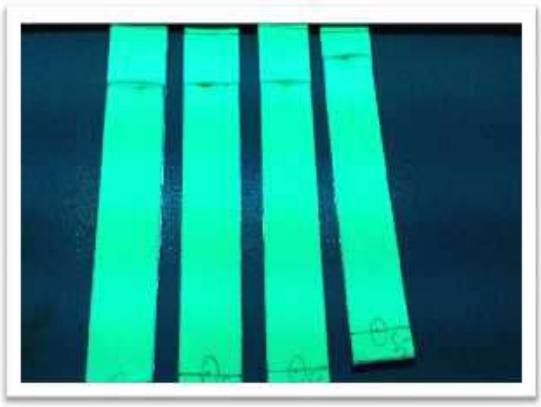

Fig. 10 TLC for suspected samples

DISCUSSION

The study has been carried out for the products manufactured by organized and unorganized sectors and the samples were collected randomly from the different shops of Allahabad. The samples included food items that is cakes, pastries, ice-creams. According to this study, observations based on colour tests mentioned in tables (4.1) and (4.2) for non-permitted dyes of metanil yellow and malachite green and tables (4.3), (4.4), (4.5) and (4.6) shown the comparison of Rf values between different non-permitted dyes like erythrosine, sunset yellow, malachite green and metanil yellow of suspected samples with their respective standard samples.

According to table (4.1), the non-permitted dye metanil yellow was present in 2 samples of cake out of 8 samples, 1 sample of pastry out of 8 samples and 2 samples of ice-cream out of 6 samples. In table (4.2), the non-permitted dye malachite green was present in 2 samples of cake out of 8 samples and in 3 samples of pastry out of 8 samples.

The data collected from the chromatogram were recorded and the Rf values were calculated using distance travelled by solvent/distance travelled by sample. The chromatogram of samples as shown in figure (7) and (8) shown the similarities between standard and suspected samples of malachite green and in figure (9) and (10) shown the similarities between standard and suspected samples of metanil yellow.

Summary

In this thesis colour tests and TLC analysis of different samples was done and it provides awareness between consumers. In the present study the bakery and dairy products were purchased from local areas of Allahabad. After collection of samples, the colour tests performed for metanil yellow and malachite green in which 2 samples of cake and 1 sample of ice-cream were adulterated with metanil yellow and 2 samples of cake and 2 samples of pastry were adulterated with malachite green, then TLC was performed. For different dyes samples, different solvent systems were used. Rf value of standard sample and Rf value of controlled samples were compared. In India, there is lack of awareness among the people about health hazards of food colours. Using synthetic dyes may not be a problem if certain control measures are taken to keep and maintain proper regulation over the use and consumption of these dyes in food items and to discourage the use of non-edible dyes in food as they are life threatening when consumed.

Conclusion

There is a great need to create awareness in the society at different levels about the toxic effects of non-permitted dyes used in food items. From this study it was concluded that non-permitted dyes which are banned for food items are frequently used by different shopkeeper in preparing various food items to get intense and attractive colours like cake,

pastry and ice-cream etc. which are carcinogenic for human beings.

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