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RESEARCH ARTICLE

Synthetic Colours in Commonly Consumed Food Products

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Abstract

Colour is an important property of the food that adds to the enjoyment of eating. Originally, the colours added to the food were of natural origin, such as caramel, saffron, curcumin, etc., however, nowadays their use has largely been suppressed by the synthetic coal tar dyes, which are cheaper and provide better colouration. These colours are widely present in a variety of eatables in both, urban and rural markets, and are used in the form of blends of one or more colours. According to the Food Adulteration Act, 1955, synthetic colours and their permissible limits have been specified, which if not used in proper amount, may have toxic effect on the body, manifested in the form of hypersensitivity, change in behaviour, food toxicity, food poisoning, etc. Monitoring of the type of colour and amount, in high consumption products, such as beverages and ice-creams, become therefore of paramount importance. The present study includes a market survey to find out the information, related to type and quantity of food colours, available on the labels of packed products, as well as identification and estimation of the synthetic colour/s present in commonly consumed beverages and ice creams. The findings of the study revealed - incomplete information on the food labels with reference to type, name and quantity of the colours used in various packed food products. Further, identification of the colour in the selective branded and non-branded beverages and ice creams, revealed discrepancy between the colours mentioned on the labels and actually identified in the laboratory, using thin layer chromatography technique. The quantitative estimation of the colours, however, showed their levels to be within permissible limits.

Keywords

Food Colour, Market Survey, Pigment, Quantitative Estimation, Synthetic Colour

Introduction

Food colour is a dye, pigment, or other substance, whether synthetic or derived from a vegetable, animal, mineral, or other source, which imparts a colour when added to any food/drink during commercial food production or at the time of domestic cooking. Food and Drug Administration (FDA), US has certified certain man-made colours, which are being widely used to provide an alternative to create a range of hues without imparting an unpleasant flavour to the food product. There are currently nine certified colour additives that are approved by the FDA. The other category of colours is that which is exempted from certification. These include pigments that are derived from natural sources, such as vegetables, minerals or animals. Some of these are chlorophyll, curcumin, saffron, caramel, anthocyanin, betacyanins, carotenoids, etc. Despite coming from natural sources, they are still artificial colour additives and must comply with regulatory requirements. These colours are typically more expensive than certified colour additives and may add undesirable flavours to the foods, however, do not cause much harm to the body.

Synthetic Food Colours

Today synthetic colours have widely replaced natural colours and are artificially prepared to supplement and enhance the natural colours that are destroyed during processing or storage and substantially increase the appeal and acceptability of food stuffs where no natural colours exist. According to the Prevention of Food Adulteration Act (PFA), 1954 eight synthetic colours namely-indigotine, carmoisine, erythrosine, brilliant blue, tartrazine, fast green, sunset yellow and ponceau 4R are permitted to be added in the food items. These colours are widely encountered in a variety of eatables in both urban and rural markets (Khanna, *et al*., 1973) and are used in the form of blends of one or more colours. Studies conducted by the Industrial Toxicology Research Centre (ITRC) in the state of Uttar Pradesh have revealed that nearly 62 per cent of the artificially coloured eatables, in the rural markets have non-permitted colours that are hazardous to health (Dixit, *et al*., 1995). These colours usually carry chemicals that have harmful effect on

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human body. Few other studies have revealed that people have suffered from hypersensitivity, asthma, multiple types of cancers, kidney failure, liver failure and reactive intolerances due to harmful ingredients present in the artificial food colours. Because of these possible effects, synthetic food colourings are restricted in some of the countries. The quantity of these compounds in food quality control is becoming more important. In addition to the colours prescribed by the PFA, there are a number of other colours, which are banned, but are being indiscriminately used in sweets, beverages, condiments and spices. It is possible that synthetic colours added to these food products may exceed the authorised levels. Monitoring of the levels of colours in high consumption products such as beverages and sweets become therefore of paramount importance. In India, usage of synthetic food colours (permitted) is around 90%. Besides this, there is also extensive use of non-permitted or non-food grade colours. These colours are incorporated in the food articles consumed on routine basis by the consumers. Small-time food manufacturers or processors like that of sweet (*mithai*)/ice cream/squash/syrup/candies, etc., mostly use colours which are not legally approved. Moreover, local food manufacturers are unaware of the colour that they are using the source. Further, the labels on the food products do not indicate chemical names of the food colours, which are mandated by the law.

Thus, in the present study an attempt was made to carry out a market survey and find out about the information available on the food labels of commonly consumed packed products. This included information with regard to type and quantity of the food colour/s used. Further, an effort was made to identify and quantitatively estimate the synthetic colour used in the selected food products.

Materials and Method

The methodology followed to carry out the present study was divided in three steps -

Step I - Market survey of the coloured food products

A market survey was carried out to collect information available on the labels of the packed food products about the type and quantity of colour used. For this, local bakery, departmental stores, local provision shops and ice creams parlours of Mansarovar area, Jaipur were visited. The selected packed products included candies, ice creams, squashes, syrups, wafers, fruit juices and fruit crushes. Selection of these samples was based on their availability and preference of food products by young children. Also, care was taken, that each product had a proper food label, was seal packed, and was of about the same manufacturing date and within expiry period.

Step II - Identification of the synthetic colours in syrups/ squashes and ice-creams

Identification of the synthetic food colour/s, present in the selected food products, was carried out using standard techniques. The products selected were syrups/squashes and ice creams and the technique used was Thin Layer Chromatography. The general scheme for identifying synthetic food colors in foods, normally involve preliminary treatment of the food, extraction of the colour from the prepared solution of the food, separation of colours in case of mixtures and identification of the separated colours using Thin layer chromatography method (PFA Act 1995). The colours to be identified were permitted synthetic colours- Brilliant Blue, Indigotine, Fast Green, Allura Red, Erythrosine, Tartrazine, Sunset Yellow and Ponceau 4R

A total of eight samples of squashes/syrups and 8 samples of ice creams were collected, out of which 4 were branded samples and 4 were local made.

Step III- Quantitative estimation of the identified synthetic food colour/s

Quantitative estimation of the identified synthetic colours, present in the selected food products, was carried out using spectrophotometry method. The estimated values were then compared with the permissible limits given by Prevention of Food Adulteration Rules, 1955 *(INS by Notification .No. GSR 304 (E), dated 4.6.1997).

Results

Synthetic food colours are added to food to improve their appearance and acceptability, but if these colours are not added in specified or permissible amounts then they may be harmful to the human body.

Market Survey

Market survey of the selected food products - candies, ice creams, squashes, syrups, fruit juices and fruit crushes revealed information about type of colour (permitted/ synthetic/natural) to be present on the labels of all the food products; however name of the colour was not specified. Further, it was found that the Colour Index (Code No.) was mentioned on the labels of all the fruit juices and crushes selected for the study, whereas, labels of only few of the candies, squashes, syrups and ice-creams showed Colour Index. The quantity of the colour used was missing on the food labels of all the selected food products completely.

Identification of synthetic colour/s used

Two products out of the survey were selected for identification of the colours present in them. The

identification of the colours was done in the laboratory using standardized technique, i.e., Thin Layer Chromatography. The selection of the products was based on their higher consumption and popularity among consumers. The two food products selected were syrups/ squashes and ice creams. Further, the samples of these products included - branded as well as locally available non branded varieties. The details of the findings are given below-

Ice creams

Eight samples of coloured ice cream were procured from the market, which included four branded varieties and four locally available non branded varieties. Care was taken to include ice creams having same flavour and colour, in both the categories.

Table 1. Food colour/s identified in the branded Ice creams

Branded Samples	Flavour	Synthetic colour/s mentioned on food label	Synthetic colour/s identified in the laboratory
A	Orange	Sunset Yellow	Sunset Yellow, Carmosine
B	Strawberry	Erythrosine	Sunset Yellow, Erythrosine
C	Mango	Tartrazine	Sunset Yellow, Carmosine
D	Chocolate	Tartrazine, Carmosine, Allura Red	Tartrazine

The information available on the food labels of the branded ice cream, revealed presence of Sunset Yellow colour (synthetic) in brand A ice cream (orange flavour). However, the laboratory identification of colour, using Thin Layer Chromatography technique, showed presence of two colours, i. e. Sunset Yellow and Carmosine in the ice cream of brand A (Table1). In the second sample of branded ice cream B (strawberry), information available on food label revealed synthetic colour as Erythrosine, while identified colours were found to be Sunset Yellow and Tartrazine. Label of ice cream brand C revealed presence of Tartrazine colour in mango flavoured ice cream. The laboratory data indicated presence of Sunset Yellow and Carmosine colour. The brand D ice cream (chocolate) label showed name of colours Tartrazine, Carmosine and Allura Red whereas, identified colour was found to be only Tartrazine. Thus, it can be concluded that the colours mentioned on the labels of B and C were not the same as identified in the laboratory, indicating false and insufficient information on the labels (Table1). Moreover, labels of brand A and D ice creams provided incomplete information.

Table 2. Food colour/s identified in the non-branded Ice creams

Non-Branded Samples	Flavour	Synthetic colour/s mentioned on food label	Synthetic colour/s identified in the laboratory
A1	Orange	-	Carmosine
B1	Strawberry	-	Erythrosine
C1	Mango	-	Sunset Yellow
D1	Chocolate	-	Tartrazine, Allura Red

The selection of the non-branded ice creams was done keeping in mind similarity in the colour and flavours with that of branded ice creams. In the non-branded sample of ice cream A1 (orange), the identified synthetic colour was Carmosine. The second sample of non-branded ice cream, i.e. B1 (strawberry) contained synthetic colour Tartrazine. The identified colour in sample C1 of non-branded ice cream (mango) was Sunset Yellow and that in sample D1 (chocolate) were Tartrazine and Allura Red. None of the labels, of the non-branded ice cream, had information about the type as well as the quantity of the colours used (Table 2).

Squash/Syrups

All the eight samples of coloured syrups/squashes were procured from the market which included two branded varieties and two non-branded varieties (locally available) of each, syrup and squash for comparison purpose. Care was taken to include same flavour and colour of syrups/ squashes in both the categories. The identification of the food colours was done using Thin Layer chromatography method.

Table 3. Food colour/s identified in the selected branded Syrups

Branded samples	Flavour	Synthetic colour/s mentioned on food label	Synthetic colour/s identified in the laboratory
A	Rose syrup	Tartrazine, Carmosine	Carmosine
B	KhusKhus syrup	Brilliant Blue	Tartrazine, Brilliant Blue

Information available on the food label of branded rose syrup of sample A revealed names of two synthetic colours - Tartrazine and Carmosine, whereas, the identified colour, using T.L.C technique, was found to be only Carmosine. In the sample B (khuskhus), food label showed name of synthetic colour Brilliant Blue, while laboratory findings revealed presence of Brilliant Blue and Tartrazine colours (Table 3). Thus it can be concluded that the information about the colours present in the syrups was insufficiently mentioned on the labels.

Table 4. Food colour/s identified in the selected non-branded Syrups

Non-Branded Samples	Flavour	Synthetic colour/s mentioned on food label	Synthetic colour/s identified in the laboratory
A1	Rose syrup	-	Carmosine
B1	KhusKhus syrup	-	Tartrazine, Brilliant Blue

The selection of the non-branded syrups was done keeping in mind the similarity of colour and flavor as that of branded syrups. These syrup samples were procured from the local vendors. The labels on the bottles showed no information about the type and quantity of colours present. The laboratory investigation revealed presence of Carmosine colour in the sample A1 of non-branded rose syrup. Further, in the second sample (B1) of non-branded syrup (khuskhus), two synthetic colours were identified, which were Tartrazine and Brilliant Blue (Table 4).

Table 5. Food colour/s identified in the selected branded Squashes

Branded Samples	Flavour	Synthetic colour/s mentioned on food label	Synthetic colour/s identified in the laboratory
A	Orange	Tartrazine, Yellow	Carmosine, Sunset Yellow
B	Mango	Yellow-6	Sunset Yellow

The information available on the food label of sample A of branded squash (orange) revealed it to be of synthetic type, i.e.Tartrazine and Yellow, whereas, the identified colours were Sunset Yellow and Carmosine. In the second sample of branded squash, i.e. B (mango), food label showed presence of synthetic colour Yellow 6, whereas, identified colour in the laboratory was Sunset Yellow (Table 5). Thus, the name of colours mentioned on the labels of samples A and B were not same as identified, indicating false and insufficient information on the labels.

Table 6. Food colour/s identified in the selected non-branded Squashes

Non-Branded Samples	Flavour	Name of synthetic colour on food label	Name of synthetic colour identified in laboratory
A1	Orange	-	Tartrazine
B1	Lemon	-	Colour was not present

In the sample A1 (orange) of non-branded squash, synthetic colour identified was Tartrazine. In the second sample i.e. sample B1 (lemon), no synthetic colour was found (Table 6). On the labels of both the non-branded squash samples, no information about the type and quantity of colours used was present.

Estimation of synthetic colour/s used

The samples of branded and non-branded ice creams, syrups and squashes selected for identifying colour/s present in them were further used for estimating the amount of identified colour/s. The spectrophotometry technique was used for quantitative estimation of colours. The estimated amount of all the synthetic colours was then compared with the specified permissible limit (standard) given by PFA, 1955.

Table 7. Quantitative estimation of identified synthetic food colours present in various food products

1. Branded Ice-creams		
Brands	**Colour**	**Quantity (g/kg)**
A	Sunset Yellow	0.005
	Carmosine	0.004
B	Sunset Yellow	0.002
	Erythrosine	0.002
C	Sunset Yellow	0.008
	Carmosine	0.007
D	Tartrazine	0.038
2. **Non-Branded Ice-creams**		
A1	Carmosine	0.008
B1	Erythrosine	0.007
C1	Sunset Yellow	0.006
D1	Allura Red	0.007
	Tartrazine	0.038
3. Branded Syrups (g/l)		
A	Carmosine	0.005
B	Brilliant Blue	0.002
	Tartrazine	0.003
4. Non-Branded Syrups (g/l)		
A1	Carmosine	0.030
B1	Brilliant Blue	0.002
	Tartrazine	0.031
5. Branded Squashes (g/l)		
A	Carmosine	0.034
	Sunset Yellow	0.040
B	Sunset Yellow	0.007
6. Non-Branded Squashes (g/l)		
A1	Tartrazine	0.002
B1	No colour was present	-

The quantitative estimation of colours, present in the selected food products, revealed their amount to be within the permissible limits (Table 7). Contrary to the findings, Biswas, *et al*., 1994 in one of the studies showed that the statutory limit of 200 ppm exceeded in 6.6 per cent of the food samplesin which permitted colours were used, with some eatables containing as much as 730 ppm of colour.

Conclusion

The findings of the market survey revealed that the food labels did not provide complete information with regard to food colours used. The colours mentioned on the labels of many branded products were not same as identified in the laboratory. The labels on the non branded products had no information about the type and quantity of colours. Quantitative estimation of the identified food colours however revealed amount of colours to be within permissible limits, in both, branded and non- branded products.

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