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SYNTHETIC COLOURS IN SOME LOCALLY AVAILABLE FOODS

B.T. LIM*

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RINGKASAN

Bahan pewarna tiruan dalam gula-gula, jem dan jeli, jeruk dan makanan ringan telah dikenalpasti. Brilliant Blue FCF, Fast Green FCF, Amaranth dan Rhodamine B yang tidak dibenarkan mengikut Ordinan Jualan Makanan dan Dadah 1952, adalah di antara bahan-bahan pewarna tiruan yang dikesan. Bahan pewarna tiruan yang dapat dikesan tetapi tidak dibenarkan mengikut Peraturan-peraturan Makanan 1985 ialah Green S, Amaranth, Orange RN, Yellow 2G, Red 2G dan Rhodamine B.

INTRODUCTION

Generally, two classes of food colours are available i.e., natural colours (vegetable, animal and mineral products) and synthetic colours (products of chemical synthesis). The synthetic colours are preferred by the food industry because of the variety of shades, intensity, uniformity, excellent solubility and stability. Generally, synthetic colours are also much cheaper than natural colours.

The two main types of synthetic colours are FD & C dyes and FD & C lakes (FURIA, 1968). FD & C dyes are water-soluble but insoluble in nearly all organic solvents, fats and oils. Dyes are available in the forms of powders, granules, liquids, blends, pastes and dispersions. They are used in a variety of food products, such as beverages, dairy products, confections, baked products, dry mixes and pet foods. FD & C lakes are insoluble pigments and colour by dispersion. Lakes are the aluminium salts of dyes formed by chemically extending the dye onto an insoluble alumina hydrate substratum. Lakes are suitable for colouring oil-based products and products which do not contain sufficient water for dye solubilization.

As food regulations became more strict, many synthetic food colours that were formerly allowed in food are now banned. Different countries permit different synthetic food colours due to differences of opinion on these colours. Food products containing colours may be imported into a country which forbids the use of colouring matters. Therefore, there is a need to monitor and control the use of synthetic colours in foods.

In United States, under the Federal Food, Drug and Cosmetic Act (1938), certification of synthetic food colours became mandatory (ANON., 1986). Certification involves submission to the government samples of each colour batch produced by the manufacturers for evaluation of chemical purity specifications. According to United States legislation (ANON., 1977), all synthetic and natural colours for use in food are required to undergo premarketing safety clearance by the manufacturer using modern toxicological testing techniques.

Some synthetic colours that are not permitted but found to be present in local foods are Amaranth, Metanil Yellow, Blue VRS, Rhodamine B, Yellow 2G, Red 10B, Orange RN, Green S and Patent Blue V (MAT ISA and LIM, 1984; LIM, PATIMAH and CHAN, 1986). As many as 23 food colours were permitted in Malaysia under The Sale of Food and Drug Ordinance and Regulations 1952. The new Food Regulations 1985 came into effect on 1 October 1985 and only ten synthetic colours are now permitted in Malaysia.

*Food Technology Division, MARDI, Serdang, Selangor, Malaysia.

MATERIALS AND METHODS

Materials

A total of 40 samples of sweets, 40 samples of jams and jellies, 39 samples of pickles and 38 samples of snack food were collected from the states of Johore, Selangor, Kelantan and Kedah.

Methods

Synthetic colours were separated and identified according to the scheme and methods described by the Association of Public Analysts (ANON., 1960). The scheme generally involves:

a) preliminary treatment of the food,

b) extraction of colour from the prepared solution of the food by wool-dyeing,

c) separation of mixed colours by paper chromatography on Whatman No. 1 paper, and

d) identification of the separated colours by paper chromatography and by comparing the absorption spectra with that of standards.

Preliminary treatment of foods

The procedures involve the removal of interfering substances and obtaining the colours in acidic solution ready for wool-dyeing.

Sweets. 25 g of the sample was dissolved in hot water. Filtered and then acidified with acetic acid.

Jams and jellies. 25 g of the sample was thoroughly mixed with 100 ml of hot water. The mixture was then centrifuged and the supernatant acidified with acetic acid.

Pickles. 25 g of the sample was thoroughly mixed with 100 ml of 70% ethanol. It was then filtered and evaporated to dryness using a rotary evaporator. The colour residue was taken up in 100 ml of water and then acidified with acetic acid.

Snack foods. The colours were extracted as described for pickles. When fat was suspected to be present, the sample was first defatted by extracting with petroleum ether before colour extraction.

The procedures described are suitable for the detection of acidic colours. When basic colours such as Rhodamine B were suspected, the final colour extract was rendered alkaline with ammonia (35%) before proceeding with the wool-dyeing.

Wool-dyeing process

Extraction of acidic colours. Pure white knitting wool was added to about 50 ml of the acidified colour extract and boiled for at least 10 minutes. The coloured wool was removed and washed well with cold tap water. The washed wool was then transferred to a beaker containing 1% (v/v) ammonia solution and boiled gently until the colours were stripped. The coloured solution obtained was then filtered and concentrated to give a fairly pure colour residue which can be used for paper chromatography.

Extraction of basic colours. Basically the same procedure for the extraction of acidic colour was used except that the coloured solution was rendered alkaline with ammonia solution (35%) before wool-dyeing process. In this case, the colours absorbed by the wool were stripped by boiling gently with 1% (v/v) acetic acid.

Colour separation

Colour extracts were examined by paper chromatography using the seven solvent systems shown in *Table 1* (ANON., 1960). Mixed colours were separated by

Table 1. The composition of solvent systems used for paper chromatographic separation and identification of synthetic food colours (ANON., 1960)

Solvent no.	Composition
1	1 ml ammonia (s.g. 0.88) + 99 ml water
2	2.5% (w/v) aqueous sodium chloride
3	2% (w/v) sodium chloride in 50% ethanol
4	iso-butanol : ethanol : water (1 : 2 : 1)
5	n-butanol : water : glacial acetic acid (20 : 12 : 5)
6	iso-butanol : ethanol : water (3 : 2 : 2) (to 99 ml of the mixed solvent add 1 ml of ammonia s.g. 0.88).
7	80 g phenol + 20 ml water

large-scale paper chromatography (Whatman No. 1) using the most effective solvent system. The separated colour bands were cut out, eluted with 50% ethanol or 20% (v/v) aqueous acetone, evaporated to dryness and then dissolved in a few drops of water.

Colour identification

The Rf values of the unknown colour on paper chromatography were compared with that of colour standards. At least three to five solvent systems were used for the identification of each unknown colour. The identity of the unknown colour was further confirmed by comparing the absorption spectra with that of colour standards. The absorption curves were plotted on a Unicam Sp 800 spectrophotometer in the region of 200–600 nanometres. In each instance, the absorption spectrum was examined in 0.1 M hydrochloric acid, 0.1 M sodium hydroxide and in neutral aqueous solution containing 0.02% ammonium acetate (ANON. 1960).

RESULTS AND DISCUSSION

The majority of food samples were found to contain only one synthetic colour *(Table 2)*. The various types of synthetic colours detected in the samples are shown in *Table 3*. The most frequently used synthetic colours in sweets and snack food were Tartrazine and Sunset Yellow FCF. In pickles, the most frequently used colours were Tartrazine and Ponceau 4R. In jams and jellies, Tartrazine, Ponceau 4R and Carmoisine were found to be most frequently used.

Synthetic food colours detected that are banned under The Sale of Food and Drug Ordinance and Regulations 1952 are shown in *Table 4*. However, Brilliant Blue FCF and Fast Green FCF are now permitted by the new Food Regulations 1985. Brilliant Blue FCF is also permitted in United States, Canada and the countries of the EEC. In Japan and United Kingdom, Brilliant Blue FCF is permitted in a limited number of foods (BERDICK, 1982). As of January 1986, Fast Green FCF is permitted for use in foods in the United States (ANON., 1986). In Japan and Canada, Fast Green FCF is permitted only in certain foods (BERDICK, 1982).

Table 5 shows the various synthetic colours detected that are not permitted for use under the new Food Regulations 1985. Green S, Orange RN, Yellow 2G and Red 2G which were permitted under The Sale of Food and Drug Ordinance and Regulations 1952 are now banned in Malaysia. All these four colours are banned from use in foods in the United States (ANON., 1986). Green S is permitted in all EEC countries. In the EEC,

Table 2. The types of food examined and the number containing synthetic colours

Food	No. of samples	No. of samples containing synthetic colours			Total
		1	2	3	
Sweets	40	22	11	3	36
Jams and jellies	40	20	5	1	26
Pickles	39	17	9	4	30
Snack food	38	16	10	2	28

Table 3. Frequency of occurrence of various synthetic colours identified in the foods examined

Synthetic colour	Frequency of occurrence			Total
	Singly	With one other	With two others	
Sweets				
Tartrazine	9	7	2	18
Sunset Yellow FCF	5	6	2	13
Ponceau 4R	4	3	1	8
Carmoisine	3	2	2	7
Brilliant Blue FCF	0	3	0	3
Fast Green FCF	0	1	0	1
Green S	0	0	1	1
Erythrosine	0	0	1	1
Amaranth	1	0	0	1
Jams and Jellies				
Tartrazine	5	4	1	10
Ponceau 4R	5	1	1	7
Carmoisine	6	1	0	7
Sunset Yellow FCF	2	2	1	5
Brilliant Blue FCF	0	2	0	2
Red 2G	1	0	0	1
Amaranth	1	0	0	1
Pickles				
Tartrazine	12	3	1	16
Ponceau 4R	5	5	4	14
Sunset Yellow FCF	0	3	3	6
Orange RN	0	3	1	4
Carmoisine	0	1	2	3
Yellow 2G	0	2	1	3
Brilliant Blue FCF	0	1	0	1
Snack food				
Tartrazine	8	10	2	20
Sunset Yellow FCF	3	10	2	15
Ponceau 4R	1	0	2	3
Carmoisine	2	0	0	2
Indigo Carmine	1	0	0	1
Rhodamine B	1	0	0	1

Table 4. Synthetic colours detected that are not permitted in Malaysia under The Sale of Food and Drug Ordinance and Regulations 1952

Food	Colour	Total occurrence
Sweets	Brilliant Blue FCF	3
	Fast Green FCF	1
	Amaranth	1
Jams and jellies	Brilliant Blue FCF	2
	Amaranth	1
Pickles	Brilliant Blue FCF	1
Snack food	Rhodamine B	1

Table 5. Synthetic colours detected that are not permitted in Malaysia under The Food Regulations 1985

Food	Colour	Total occurrence
Sweets	**Green S**	1
	Amaranth	1
Jams and jellies	**Red 2G**	1
	Amaranth	1
Pickles	**Orange RN**	4
	Yellow 2G	3
Snack food	**Rhodamine B**	1

both Red 2G and Yellow 2G have been used only in the United kingdom (BERDICK, 1982).

Amaranth was detected in both sweets and jellies. As of January 1986, Amaranth is not permitted in foods in the United States. The FDA of United States terminated the provisional listing of Amaranth in 1976 based on insufficient evidence demonstrating that the colour is safe. However, Amaranth is permitted in foods in Canada, Sweden, Denmark, West Germany, Japan and all the countries of the EEC (ANON., 1986). Rhodamine B which is a basic red colour was detected in a sample of cheap snack. Rhodamine B is also not permitted for use in foods in the United States and United Kingdom. Toxicological study has shown that Rhodamine B caused tumours in the lymph nodes of rats (SIHOMBING, 1984).

There has been a continuing trend over the last few years to replace synthetic colours for food with natural colours. A massive shift towards the use of natural colours is not likely in the near future. The reasons include technical inadequacy, high cost of natural colour production and difficulties associated with financing the toxicological work required.

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ABSTRACT

Synthetic food colours present in samples of sweets, jams and jellies, pickles and snack food were identified. Brilliant Blue FCF, Fast Green FCF, Amaranth and Rhodamine B which are not permitted under The Sale of Food and Drug Ordinance and Regulations 1952, were among the food colours detected. Detected food colours which are not permitted under the new Food Regulations 1985 are Green S, Amaranth, Orange RN, Yellow 2G, Red 2G and Rhodamine B.

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