Original Research Article

Food colouring additives in selected confectioneries in Khartoum state, Sudan

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ABSTRACT

Background: The natural food colours extracted from plants are used to dye different foods do not change their properties when they are used. Therefore, most synthetic coloured additives are carcinogenic, teratogenic and cause impairment of vision, tooth decay. The aim of the study was to determine food colouring additives in confectioneries.

Methods: A descriptive cross-sectional study was designed and confectioneries samples include Cane, Ice-cream and Lollipop was randomly collected from venders around schools, transport stations and other places in Khartoum state through (May - June / 2014). E-number and types of colouring agents was carried by using planar chromatography technique and questionnaire data were analyzed using (SPSS) software.

Results: The majority of participants 80.8% know that food colouring additives are harmful. The food colouring additives can cause cancer 32.6%, intestinal pain 9.8%, allergy 9.1% and hyperactivity 3.3%. Most food colouring agents were bought from local source 65.7% while 34.3% was imported. About 69.5% of the participants determined the quantity of food colouring agents according to the degree of the colour they required while 30.5% determined according to the weight of food stuff, and 76.2% mentioned that they usually do not abide to written dates on the pack of the food colouring additive and 60% of the samples contain the permitted synthetic food colouring additives.

Conclusions: The majority of participants knew that food colouring additives are harmful, all confectioneries samples contained synthetic food colouring additives that have adverse effect on human health, strict preventive measures and health education are highly recommended.

Keywords: Food additives, Confectioneries, Sudan

INTRODUCTION

In industrialized nations, the last 50 years have shown a huge number of food chemicals additives introduced to food before they go to consumer. It has been estimated that today about 75% of the diet especially western food is made up of various processed foods and each person is now consuming on average 3.6-4.5Kg of food additives per year.¹ Sudan, like most developing countries, both the industrial and non-industrial sectors is engaged in food processing activities. The industrial sector is subjected to quality checks where the non-industrial sector is outside of this realm, resulting in increased production of sub-

standard food products compromising human health to serious diseases, leading to an indirect financial burden on the national economy.

The natural food colours extracted from plants are used to dye different foods do not change their properties when they are used.² Synthetic colours are classified into synthetic colours dyes and mineral pigments and more use compared to natural ones.³ Synthetic colors show various preferences such as high consistency to light, oxygen and pH, color monotony, low pollution, relatively lower production costs, etc.⁴ Therefore, synthetic food colors are used instead of natural colors in many foods

such as drinks, candies, and sweets.⁵ In addition, synthetic dyes, like amaranth, erythrosine, carmoisine, ponceau 4R, indigo carmine, tartrazine, and sunset yellow FCF are used in pediatric formulations.⁶ However, the use of permitted colours has raised concerns that they might be used in excess of the statutory limit (100 mgk⁻¹) or in foods in which they were not permitted.⁷ Permitted colours like ponceau 4R, tartrazine and sunset yellow have provoked allergic reactions in several individuals, even at low levels of intake.^{8,9} Therefore, most synthetic coloured additives are carcinogenic, teratogenic and cause impairment of vision, tooth decay and adverse thyroid changes.^{10,11} The synthetic azo dyes and their degraded (sulphanilic acid and naphthenic acid) products inhibit both human true and pseudo-cholinesterases activities *in vitro*.¹² The most popular illicit synthetic colourants Sudan I-IV and Para Red are classified as carcinogenic.¹³ Curcumin have anti allergic properties that it inhibits certain signaling mechanisms in mast cell.¹⁴ Sunset yellow (yellow no.6) was used in food and drinks as colour additives earlier but due to its adverse effects on human health, yellow 6 has been banned in many countries.¹⁵ Kus and Eroglu, indicated that Sunset Yellow and Brilliant Blue can have cytotoxic and genotoxic potential.¹⁶

In most countries, the regulatory bodies which control food, drugs, and cosmetics are responsible for regulating all the color additives to ensure that they are safe with those products, ensuring that they contain only approved ingredients, and that they are accurately labeled.¹⁷ The E-number system for food additives was introduced in the 1960s and the E-number was intended to reassure consumers that permitted additives were safe. In the 1980s full ingredient declarations had to be provided on food products for the first time and manufacturers were permitted to use either the name or the number of the additive on the ingredient list.¹⁸ There is very scanty documented information about food colouring additives in Sudan. Previous study show that the traditionally prepared Halwa molid was contain 2.67% natural colour, 66% synthetic permitted colour and 31.33% unpermitted colour.¹⁹ The objective of the present study was to understand community knowledge about food colouring agent used in Sudan and to specify the type of food colouring additives used in confectioneries.

METHODS

Study design

This was a descriptive cross-sectional study, the sample size was determined using the following formula.

$$n = \frac{z^2 * p * q}{d^2}$$

Where z is the value of the standard normal variable corresponding to 95% level of significance (z =1.96); p=q=0.5 since there is no prior information; d is a margin of error (d =0.04).²⁰

Base on the formula the sample sizes were 600 respondents, divided equally between the three towns (Khartoum, Omdurman, and Khartoum North) and selection within each town was followed simple random process. Basic information was collected by questionnaire such as level of education, age and basic knowledge of food colour additives and their impact on human health.

Confectioneries

Forty samples of confectioneries includes sixteen samples of cane sweet, fifteen samples of Lollipop sweet and nine samples were randomly collected from venders around some schools, main transportation stations and other random places in Khartoum state. Samples were categorized as branded i.e. having some labels and trade names and unbranded having no labels either unpacked or packed by the vendors. Each sample was carried to the National Public Health Laboratory in hygienically clean polyethylene bags on which the number, type and date of sampling were recorded. All collected samples were analyzed using planar chromatography which has two types: A- Paper Chromatography, and B-Thin Layer Chromatography (TLC).

RESULTS

Most of the participants are older than 25 years (Figure 1), 44.7% had primary education (Figure 2). More than half of the participants 57.2% knew the type of food colour additives while 42.8% did not know. The vast majority of participants 80.8% knew that food colouring additives are harmful and 19.2% did not know. The food colouring additives causes cancer 32.6%, intestinal pain 9.8%, allergy 9.1% and hyperactivity 3.3%. About 17.5% of the participants work in confectionery. The most food colouring agents were bought from local source either grocery or perfumer 65.7%, while 34.3% was imported. About 69.5% of the participants determined the quantity of food colouring agents according to the degree of the colour they required while 30.5% determined according to the weight of food stuff. The majority of participants 76.2% mentioned that the production and expiratory dates are written on the pack of food colouring additives (Table 1).

Colour agents

All Cane confectionery (Halawa hali) samples contained synthetic colouring materials which are not permitted for used in food (Table 2). However, all Ice cream (*shoula*) confectionery samples contained synthetic food colouring additives which are permitted for use in food, the colours found were Ponceau 4R, Ponceau 4R + Tartrazine, Carmoisine + Sunset Yellow FCF, Sunset yellow FCF, Ponceau4R + Tartrazine and Carmoisine + Tartrazine Table 3. All Lollipop confectionery samples contained synthetic food colouring additives which are permitted for use in food (Table 4). The colours found were Carmoisine 20%, Tartrazine + Brilliant blue FCF 13.3%, Tartrazine 20%, Sunset Yellow FCF 26.7% and Sunset

Yellow FCF + Brilliant blue FCF + Tartrazine + Allura Red AC 20% Table 5. Therefore, it was concluded that among the 40 samples of confectioneries analyzed, 24 of

the samples contained permitted food colouring additives but the quantities were added without specifications. While 16 were not permitted for used in food.

Table 1: Participants knowledge about the type of food colouring additives.

Parameters	N (%)
Do you know the colorful food additives	
Yes	343 (57.2)
No	257 (42.8)
Safety and harmfulness of food colouring additives	
Safe	66 (19.2)
Harmful	277 (80.8)
What harmful food colouring it causes?	
Allergy	25 (9.1)
Hyperactivity	9 (3.3)
Cancer	90 (32.6)
Intestinal pains	27 (9.8)
All the above mentioned is correct	110 (39.9)
Other	15 (5.3)
Do you work in confectionery industry?	
Yes	105 (17.5)
No	495 (82.5)
Source for food colouring additives	
Imports	36 (34.3)
Locally	69 (65.7)
How do you determine the added quantity of food colouring additives?	
According to the degree of the color they required	73 (69.5)
According to the weight of colored food stuff	32 (30.5)
According to the amount specified by SSMO	0
Is the production and expiry date were written on the pack of food colouring additives?	
Yes	80 (76.2)
No	25 (23.8)

Table 2: Synthetic food colouring additives in cane confectionery

No. Sample	Type of colour			
	Cane confectionery (Halawa hali)			
	Red	Green	Yellow	Orange
1	+			
2		+		
3	+			
4	+			
5			+	
6	+			
7				+
8	+			
9			+	
10			+	
11			+	
12	+			
13				+
14	+			
15				+
16				+
Total	43.7%	6.3%	25%	25%

Table 3: Synthetic food colouring additives in Ice-cream confectionery.

Sample ID	Type of colour								
	A	B	C	D	E	F	G	H	I
Ice cream shoulda confectionery									
1	+								
2		+							
3			+						
4				+					
5					+				
6						+			
7							+		
8								+	
9									+

A, Red (Ponceau4R); B, Yellow pink (Ponceau 4R + Tartrazine); C, Red orange (Carmoisine+Sunset Yellow FCF); D, Orange pink (Ponceau4R+ Sunset Yellow FCF); E, Orange Sunset Yellow FCF); F, Orange yellow (Sunset Yellow FCF+Tartrazine); G, Pink Red (Ponceau4R+Tartrazine); H, Yellow red (Ponceau4R +Tartrazine); I, Red yellow (Carmoisine +Tartrazine).

Table 4: Synthetic food colouring additives in lollipop confectionery.

Sample ID	Type of colour				
	Lollipop confectionery				
	A	B	C	D	E
1			+		
2	+				
3				+	
4		+			
5					
6					+
7	+				
8			+		
9			+		
10				+	
11	+				
12				+	
13				+	
14					+
15		+			+
Total	20%	13.3%	20%	26.7%	20%

A, Red (Carmoisine); B, Green (Tartrazine+Brilliant blue FCF); C, Yellow (Tartrazine); D, Orange (Sunset Yellow FCF); E, Brown (SunsetYellowFCF+BrilliantblueFCF+ Tartrazine+AlluraRedAC).

Figure 1: Age of the study participants. **Figure 2: Level of education of the participants.**

Table 5: Synthetic food colouring additives in cane, ice cream and lollipop confectionery.

Type of sample	Artificial colour (synthetic)	Without artificial colour (natural)	Permitted	Un permitted
Cane (Halawa)	16 (100%)	0 (00%)	0 (00%)	16 (100%)
Ice Cream	9 (100%)	0 (00%)	9 (100%)	0 (0%)
Lollipop	15 (100%)	0(00%)	15(100%)	0 (0%)
Total	40 (100%)	0 (00%)	24 (60%)	16 (40%)

DISCUSSION

Color is one of the three main attributes of the food products along with flavor and texture that affects our taste in the food and provides us with visual clues about the identity of the food.²¹ The study proved that 69.5% of the participant working in the confectionery industry determines the added quantity of the food colouring additives according to the colour degree they required and not to any standards. Saleem et al, mention that there was no quality control in such products and the quantity of the colours additives is generally higher than the toxic levels, even permitted colouring additives, compromising human health to serious diseases, resulting in direct financial burden over national economy.²² It is approved that the misuse or overuse of permitted food colouring additives has adverse and an accumulative effects and can leads to many diseases and the use of non-permitted colours is also known to cause adverse effects in humans and in experimental animals. Samples of confectioneries that were manufactured in industrial sector contain permitted food colouring additives, while the samples of confectioneries that were manufactured in traditional industrial sectors contained unpermitted food colouring additives. There was not enough control in developing countries where food colouring additives are used without specifying the type or quantity, and some workers in the field of food industry are using textile colours.²³ Timbrell was indicated that traditional industrial sector is un subjected to quality checks, resulting in an increased production of sub-standard food products with misuse and overuse in these food colouring additives, compromising human health to serious diseases like kidney failure, damage of liver, hyperactivity disorders in children, allergic reactions, carcinogenicity and teratogenicity.²⁴

The current study found that 40% of the samples contain unpermitted colouring materials for use in food. Morshide was stated that no enough control in developing countries where food colouring additives are used without specifying the type or quantity, and some workers in the field of food industry are using textile colours.²³ Similarly Elmustafa was indicated that 31.33% contain unpermitted food colour. The study showed that 60% of the confectionery samples contain permitted food colouring additives, and this was agreed with Elmustafa.¹⁹ 66% of traditionally prepared Halwa molid contain permitted food colouring additives. The study showed that 13 samples contained the artificial colour

tartrazine and this colour has an adverse effect on human health. Kulkarni was indicated that Tartrazine agent causes itching and asthma in sensitive people.¹⁰ Patients with allergic and non-allergic rhinitis observed that rhinitis symptoms were aggravated when ingesting diets containing tartrazine.¹¹ Ten to forty percent of aspirin sensitive patients were also susceptible to bad health affected by tartrazine.²⁴ The reactions include asthma, urticaria, rhinitis, and childhood hyperactivity. The most extreme reaction to tartrazine was reported as anaphylactic shock which occurred in a person who was known to be allergic to tartrazine. The study showed that food samples contained the artificial colours carmoisone, sunset yellow and tartrazine mentioned which has adverse effect on human health. Previous study show that food colours like amaranth, carmoisone, sunset yellow and tartrazine may cause behavioral changes in children, potential toxicity and adverse thyroid changes.^{10,15} Similarly Wroblewska was stated that Sunset Yellow FCF/E110 is capable to cause allergic reactions such as abdominal pain, hives nasal congestion and bronchoconstriction as well as kidney tumors, chromosomal damage and distaste for food when fed to laboratory rats. It has been found to be carcinogenic when fed to animals.¹ Statistics confirmed that 90% of cancer patients in the United States where consumed foods containing food colouring additives for periods exceeding twenty years.²³ Excessive uses of food coloring additives cause deformities and mental retardation especially in children.²⁵ Using synthetic colours in various foods for long periods of time has adverse effects on some of the consumers like changes in liver and kidney histopathological structure and increased white blood cell count. Singh was indicated that synthetic colours are in more use compared to natural ones due to the fact the yield of natural colours from plant sources is low as compared to the yield from modern synthetic processes.²⁶ Natural colours are invariable expensive, their fastness properties are not good and they fade in light.¹⁹

CONCLUSION

The study concludes that all confectioneries samples contained synthetic food colouring additives that have adverse effect on human health. Sixty percentages of confectioneries samples were contained permitted food colouring additives but the quantities added were not according to specifications. While forty percentages of confectioneries samples were contained unpermitted colouring agents. The quantity of colour agents was

added to the confectioneries according to the degree of the colour. The majority of participants knew that food colouring additives are harmful. Therefore, our study recommended the encouragement of food safety training and health education to manufacturers of confectioneries in industrial and non-industrial sectors. Activate laws and legislations related to food colouring additives.

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