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Proliferation of Illegal and Potentially Hazardous Food Additives in Processed and Packaged Foods in Africa: A Case Study and Hazard Identification in Ghana

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ABSTRACT

In the developed countries, a lot of researches have been carried out on the effects of food additives on consumers but few studies have been reported in Africa and particularly Ghana. The objective of the study was to survey labels of processed and packaged foods in Ghana and document all the potentially harmful food additives in processed and packaged foods in some Ghanaian food products. We purchased 63 processed and packaged food products from the Ghanaian market and documented food additives on their labels as well as trade name, type of food, company name, country of origin and whether the Ghana Food and Drugs Authority (GFDA) certified them. Thirty seven percent of all the products sampled on the market were not registered with the GFDA. Seventy one percent of all the products sampled contained one or more additives that are likely to cause adverse reactions when consumed. The general public is at risk of consuming potentially hazardous food additives. There is the need for a research to determine whether the levels of additives are above the recommended acceptable daily intake proposed by the Joint FAO/WHO Expert Committee on Food Additives (JECFA).

Key words: Food additives, food safety, chemical hazards, Ghana, Africa

INTRODUCTION

Food additives are normally added to food or feed to enhance their palatability, shelf life and attractiveness. There are several categories of food additives: acids, acidity regulators, antioxidants, anticaking agents, antifoaming agents, bulking agents, food colouring, preservative sweeteners, etc. The Joint FAO/WHO Expert Committee on Food Additives (JECFA) regulates food additives globally but individual countries have specific regulations, which are enforced by their food regulating bodies. There are several controversies surrounding the use of certain food additives and the acceptable daily intake (McCann *et al.,* 2007; Bosetti *et al.,* 2009; El-Wahab and Moram, 2013; Ceyhan *et al*., 2013; Abhilash *et al.,* 2014; Masone and Chanforan, 2015).

In most African countries, regulations and enforcement of the recommended food additives is weak due to inadequate experts, inadequate equipment for testing and lack of knowledge on the part of most consumers to read labels on especially processed and packaged foods (Van der Merwe *et al*., 2013). This situation is worsened by the proliferation of the African markets with products from especially countries that are noted to be food violators: India, China, Mexico, France, USA, Vietnam, Brazil etc. (Scott and Zak, 2014). There is little information about food additives especially illegal ones in Africa as well Ghana. Most people do not know about the designated numbers for the various food additives. This makes it easier for other countries to dump processed

and packaged foods with illegal food additives in African countries. The objective of this study was to survey processed and packaged foods in Ghana and document all the illegal or potentially harmful food additives that are used to prepare them and their possible adverse effects on Ghanaians.

MATERIALS AND METHODS

Sample collection and documentation: Wide ranges of samples were randomly purchased on the Ghanaian Market from September 2013 to June 2014. In all, 63 items were purchased and include: Fruit juices, soft drinks, milks, ice creams, energy drinks, spices, noodles and margarine. Information documented on labels or packaging materials include: trade name, type of food, company name, country of origin, additives/preservatives and whether they were certified by the GFDA.

Verification of the products for Food and Drugs Authority Certification: All the products sampled were checked for certification from the Ghana Food and Drugs Authority's registered products site (http://www.fdaghana.gov.gh/index.php?option=com_fdasearch&Itemid=36) to verify whether they were duly registered in the country.

Determination of food additives that are likely to cause adverse effects: The food additives in the various products purchased were first checked in the food intolerance network website (http://fedup.com.au/information/information/complete-lists-of-additives-6#code) to determine whether they were listed among the food additives that may cause adverse effects. Based on this list, we calculated in percentages the products that had the highest and lowest number of food additives likely to cause adverse effects. We did not, however, perform any chemical analysis on the products to check the levels of those potentially harmful additives.

Data analysis: The results were calculated using Microsoft excel and presented with graphs and tables with descriptive statistics.

RESULTS

Countries of origin of products sampled: Figure 1 shows the country of origin of all the processed or packaged food sampled in this research. Majority of the products were manufactured here in Africa (46%) followed by Europe (30%), Asia (21%) and USA (3%). Out of the percentage manufactured in Africa (46%), 62% was manufactured in Ghana by either foreign or local companies followed by Nigeria (15%), Algeria (10%), Togo (7%), Ivory Coast (3%) and South Africa (3%). Among the European countries, UK recorded the highest number of products (26%) followed by Bulgaria (21%), Germany (17%), Netherlands, Austria (11%) and Romania, Spain (7%). Among the Asian countries the highest number of products was from China (24%), followed by Dubai (19%), Lebanon (17%) while Bangladesh, Turkey, Thailand, Taiwan and Vietnam had 8%.

Categories of foods sampled: The highest category of food sampled was soft drinks (38%), followed by energy drinks (18%), fruit juice (13%), ice cream (11%), milk (5%), noodles (6%), spices (3%) and biscuit and margarine (1.6%) each. Among the soft drinks, 46% originated from Europe (Bulgaria, Germany, Netherlands, Northern Ireland and UK), 38% were produced in Africa (Algeria, Ghana Nigeria and Togo) and 17% originated from Asia (China, Turkey and Dubai). Only

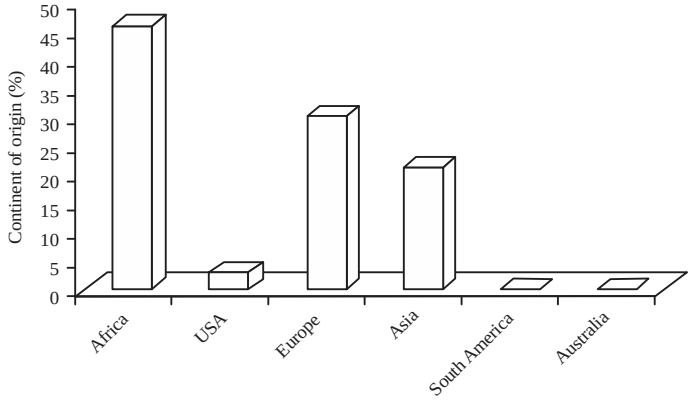

Fig. 1: Percentage of countries of origin represented by the various continents from which the sampled products originated

8% of the soft drinks sampled originated from Ghana. Most of the energy drinks originated from Europe (46%) followed by Asia (27%), USA (18%) with only 9% coming from Africa. The only energy drink produced from Africa in this study was from Ghana. Most of the fruit juices were produced in Africa (50%) followed by Europe (25%) and Asia (25%). All the ice creams sampled originated from Ghana (100%). Forty percent (40%) of the milk originated from Africa (all from Ghana), 40% from Europe and 20% from Asia. Most of the noodles were from Asia (75%) and Africa 25%. All the spices sampled originated from Africa (Ghana and Cote de Ivoire) while the biscuit and margarine originated from Ghana.

Verification of the products for Food and Drugs Authority Certification: Upon verification from the Ghana Food and Drugs Authority's product register, 37% of all the products sampled on the market were not registered with the GFDA at the time of collecting samples for this research. The Ghana Food and Drugs Authority certified only 63% of the products. Of all the uncertified products, majority of the products originated from Europe (52%), of which Bulgaria represented 34%, followed by UK (17%), Germany (17%), Austria, Netherlands, Northern Ireland and Romania represented 8% each. Twenty six percent of the non-certified products originated from Asia, of which China represented 50% followed by Thailand, Turkey and Bangladesh that represented 17% each. The uncertified products from Africa represented 17% and originated from Algeria, Ghana, Nigeria and Togo representing 25% each. Only 5% of the illegal products came from USA. The results show that most of the illegal products sampled came from European countries followed by Asia, Africa and USA. Only 1 Ghanaian product out of the total of 17 from all the 63 products sampled was not registered. Majority of the uncertified products were soft drink (50%), noodles (18%), energy drinks (14%), Fruit juice and Milk represented 9% each. Of all the uncertified products, 82% of them contained 1 or more food additives that are potentially hazardous.

Food additives in products sampled: Out of the total number of 63 products sampled, 6 (10%) indicated there were no additives added on their labels. Majority (50%) of products with "No additives" labels were fruit juices followed by milk (33%) and a soft drink (17%). Ninety percent (90%) of all products sampled contained 1 or more food additives. All the food additives found in this survey are presented in Table 1. Seventy-one percent of all the products sampled contained one or more additives that are likely to cause adverse reactions when consumed.

Table 1: Categories of potential harmful food additives in sampled products

Category	Food additive
Artificial colours	*Tartrazine (E102)*, *sunset yellow (E110)*, *Amaranth (E123)*, *brilliant scarlet or Ponceau (E124)* and *Allura red (E129)*
Natural colours	*Annatto extracts (E160b)*
Preservatives	*Sodium benzoate (E211)*, *potassiumsorbate (E202)*, *tert-Butylhydroquinone, tBHQ (E319)*, *butylated hydroxytoluene*, *BHT (E321)*, *butylated hydroxyanisole*, *BHA (E320)* and *sodium metabisulphite (E223)*
Flavour enhancers	*Monosodium L-glutamate (E621)*, *disodium guanylate (E627)* and *disodium inosinate (E631)*
Artificial sweeteners	*Aspartame (E951)*, *sucralose (E955)*, *cyclamates (E952)*, *saccharin (E954)* and *acesulphame-K (E950)*
Miscellaneous (1)	*Carrageenan (E407)*, *anthocyanins (E163)*, *paprika oleoresins*, *(E160c)*, *cochineal* or *carmines red (E120)* and *disodium 5'-ribonucleotides (E635)*
Miscellaneous (2)	Sodium phosphates (E339), potassium phosphates (E501), lecithin (E322), guar gum (E412), sodium alginate (E401), locust bean gum (E410), Mono and di-glycerides of fatty acids (E471), sodium carboxymethylcellulose (E466), glycerin (E422), starch sodium octenylsuccinate (E1450), sucrose acetate isobutyrate (E444), phosphoric acid (E338), citric acid (E330), malic acid (E296), caramel i (E150a), caramel iii (E150c), caramel iv (E150d), magnesium carbonates (E504), acetylated distarch adipate (E1422), calcium disodium EDTA (E385) and gum arabic (E414)

Italicized words are food additives that are likely to cause adverse reactions

Potentially harmful artificial and natural colours found in the products sampled: With the artificial colours: Tartrazine (E102) was found in 43% of the ice creams, 13% of soft drinks, 25% of fruit juice, 25% of noodles sampled, sunset yellow (E110) was found in 43% of ice creams, 18% of energy drinks and 13% of soft drinks sampled, amaranth (E123) was found in only 29% of the ice creams sampled, brilliant scarlet (E124) was found in 14% of the ice creams, 9% of the energy drinks and 50% of the spices sampled and allura red (E129) was found in only 9% of the energy drinks.

Potentially harmful preservatives in products sampled: Sodium benzoate (E211) was found in 46% of the soft drinks, 27% of the energy drinks and 38% of the fruit juices. Potassium sorbate (E202) was found in 29% of the soft drinks, 36% of the energy drinks, 25% of the fruit juices and 50% of the spices. Sodium metabisulphite (E223) was found in only 1 of the fruit juices (13%). tert-butylhydroquinone, tBHQ (E319) was found in both spices (50%) and noodle (25%) only. Butylated hydroxytoluene, BHT (E321) was found in only one noodle (25%) while Butylated hydroxyanisole, BHA (E320) was also found in only one noodle (25%).

Potentially harmful artificial sweeteners in products sampled: Aspartame (E951) was found in 21% of the soft drinks, sucralose (E955) was found in 8% of the soft drinks, cyclamates (E952) was found in 21% of the soft drinks, saccharin (E954) was found in 13% of the soft drinks, acesulphame potassium (E950) was found in 17% of the soft drinks while saccharin was found in 4% of the energy drink.

Potentially harmful flavour enhancers in products sampled: Monosodium L-glutamate (E621) was found in 50% of the spices and 100% in the noodles, disodium guanylate (E627) was found in 75% of the noodles while disodium inosinate (E631) was also found in 75% of the noodles.

DISCUSSION

Countries of origin of products sampled: Most of the products sampled originated from Africa (46%) and most of the products from Africa originated from Ghana (62%). However, 54% of the products came from outside Africa. This results shows that what is happening in other countries in terms of regulation of food additives must be of concern to us in Ghana and Africa since we import most of our products from outside. What this study designed but was constrained by

funding, was to verify whether these additives with potentially adverse effects are consumed in the countries of origin. This is to ascertain whether some of the products that contain potentially hazardous food additives were intentionally dumped into Africa. There is a tendency of dumping of products that contained illegal or banned additives in Africa because most of the people in our countries in Africa are either ignorant of the E numbers or do not know the adverse effects of some food additives.

Categories of foods sampled: Out of the top 4 most common categories of products sampled, 3 categories of products (soft drink, fruit juice and ice cream) are mostly consumed by children and women. This means any illegal or adverse food additives found in those products are likely to have a deleterious effects on children and women.

Verification of the products for Food and Drugs Authority Certification: It was clear that, some products entered the Ghanaian market without the approval of the Food and Drugs Authority. The number of potentially hazardous food additives (82%) that is present in the uncertified products is really a cause for concern. The influx of these products in the country may pose potentially hazardous adverse effect to our people if not properly regulated. The situation is more alarming considering the fact that 50% of the uncertified product was soft drinks, which are mostly consumed by the vulnerable (children and women) in the population. This clearly shows the loophole in our food regulatory body and the risk of contracting any disease if all trust is put in our regulatory bodies alone. The government must, therefore, encourage other researcher especially in our universities to carry out research to compliment the efforts of the regulatory bodies.

Food additives in products sampled: The result of this study is really a course for concern. Some of these products especially the soft drinks, fruit juice and ice creams are taken daily. With the little knowledge that exists in the population about the Acceptable Daily Intake (ADI) of these additives, most people are likely to take them above the acceptable limit. This may lead to toxic effect in consumers and may lead to severe complications. The worrying aspect of this study is that artificial colours or a sodium benzoate preservative (Table 1), either mixed or individuals are known to increase hyperactivity in 3-year-old children in the general population (McCann *et al.,* 2007; Turner and Kemp, 2012). The additive, sodium benzoate (E211) was found in 46% of the soft drinks, 27% of the fruit juice and 27% of the energy drinks sampled. Some of these products are given to children in Ghana and this may lead to hyperactivity in Ghanaian children. It is worth mentioning that 2 energy drinks from Europe (Germany and UK) provided cautions on the labels of their products that sunset yellow (E110) and ponceau 4 R (E124) may have an adverse effect on the activity and attention in children. It was therefore, surprising and scary that most of the products sampled on the Ghanaian market are not having such labels warning consumers about the health effect of consuming such additives.

Potentially harmful artificial and natural colours found in the products sampled: Patients with allergic disorders have been found to have high leukocyte hypersensitivity to tartrazine in 10.8%, sunset yellow in 4.8% and ponceau or brilliant scarlet in 13.2%, (Titova, 2011). In a similar study, some of these food colorants (amaranth and tartrazine) had a toxic potential to human lymphocytes and have been found to bind directly to DNA (Mpountoukas *et al*., 2010). This means that either children or adults who take these products regularly or in excess are at risk of

allergic disorders and possible DNA damage, which may result in cancer (Axon *et al*., 2012). The alarming revelation in this study is that, tartrazine and other artificial colours are prohibited in several countries including Iran (Hajimahmoodi *et al*., 2013) and strictly regulated in the UK by the Food and Standard Agency because of their possible effects on children (http://www. food. gov.uk/science/additives/foodcolours/). Tartrazine (E102) has been reported to produce several harmful effects in humans and mice of which hyperactivity, asthma and urticaria are most common (El-Wahab and Moram, 2013; Saxena and Sharma, 2014). However, some studies have also debunked the claim that there are no adverse effects of these additives (Pestana *et al*., 2010; Shimada *et al*., 2010). Sunset yellow (E110) has also been reported to produce adverse effects in people especially children (Yadav *et al*., 2013) and has been regulated in most countries. The other artificial colours Allura red (129), amaranth (E123) and ponceau (E124) have also been reported to have adverse effects in several studies (Ceyhan *et al*., 2013). The only natural colour found to be potentially harmful among the sampled products was annatto extracts (E160 b), which was found in one of the spices. Annatto extracts (E160 b) has been implicated to cause allergy reactions in certain products (Ebo *et al*., 2009). Even though annatto extracts (E160 b) causes allergy reactions, the risk of its allergenicity in Ghana is very low since it was found in one out of the 63 products sampled. But it effect cannot be overemphasized since there is proliferation of spices in the Ghanaian market. In order to be on the safer side in the light of these findings and counter findings, consumers need to be careful when consuming these additives.

Potentially harmful preservatives in products sampled: Sodium benzoate has been found to cause allergic reactions and other medical conditions when included in food and drugs (Schnuch *et al*., 2011; Mori *et al*., 2012). The cytotoxicity and genotoxicity of tert-butylhydroquinone (E319) has been demonstrated (Eskandani *et al*., 2014). Butylated hydroxyanisole, BHA (E320) has also been reported to have carcinogenic effects on epithelial cells (Schilderman *et al*., 1995). Liver toxicity has been linked to the over consumption of butylated hydroxytoluene, BHT (E321) (Engin *et al*., 2011). Even though there seem to be very low amount of these food additives in the products sampled, they are present in one of the spices that is widely used in the Ghanaian homes and restaurants, so it is a cause for concern in the general public. It worth to note that one of the spices (popular known in Ghana as cube) in our research contained the highest number of additives that are likely to cause adverse effect. It contains 8 potentially harmful additives [Potassium sorbate, (E202), ponceau 4R (124), monosodium L-glutamate (E621), disodium 5'-ribonucleotides (E635), potassium metabisulphite (E224) butylated hydroxytoluene (E321) butylated hydroxyanisole (E320) and tert-butylhydroquinone, (E319)] out of the 11 additives used in its preparation.

Potentially harmful artificial sweeteners in products sampled: Artificial sweeteners have generated a lot of controversies. Long-term aspartame exposure could alter the brain antioxidant status and can induce apoptotic changes in brain (Ashok and Sheeladevi, 2014). Aspartame has also been reported to have a possible effect on cognitive functions (Abhilash *et al*., 2014). Artificial sweeteners are also implicated in certain types of cancers (Soffritti *et al*., 2010). Studies have also reported that there is no adverse effect for the consumption of artificial sweeteners with regards to its carcinogenic potentials (Bosetti *et al*., 2009). Long term use of artificial sweeteners have also been linked with significant increase in body weight (Polyak *et al*., 2010). Acesulphame potassium has also been reported to trigger allergy reactions (Stohs and Miller, 2014) as well as affect

cognitive functions (Cong *et al*., 2013). There are several controversies on the consumption of artificial sweeteners. Considering the long-term exposure to artificial sweeteners, consumers must be educated in Ghana to know the possible side effects of products that contain them. There is more cause for concern especially in children who take soft drinks in Ghana indiscriminately.

Potentially harmful flavour enhancers in products sampled: A study has reported that high doses of monosodium L-glutamate (E621) may lead to partial infertility in male (Iamsaard *et al*., 2014). Monosodium L-glutamate treated rats have also been reported to be more susceptible to develop anxiogenic and depressive like behaviour (Quines *et al*., 2014). Oral consumption Monosodium L-glutamate appears to cause alkaline urine and may increase the risks of kidney stones with hydronephrosis in rats (Sharma *et al.,* 2013). With the percentage of monosodium L-glutamate that is found in noodles products sampled (100%), there is a serious cause for concern due to the high craze for noodles especially by children in Ghana. In recent times these noodles have flooded the Ghanaian markets. This means that consumers in Ghana are at risks of all the harmful effects of these products.

CONCLUSION

This study is to survey processed and packaged foods in Ghana and document all the illegal or potentially harmful food additives that are used to prepare them. The study shows that most of the products sampled (71%) contain one or more food additives that could potentially cause adverse effects in the Ghanaian populations. The potentially adverse effects that these food additives could trigger in the Ghanaian populace range from allergy, hyperactivity, hypersensitivity, asthma, urticaria and several types of cancer effect on cognitive functions to partial infertility in male. Most of the products that contained the potentially harmful additives (soft drinks, fruit juice and ice creams) are mostly consumed by children, who have been reported in several studies to be the most vulnerable to the consumption of potentially harmful additives. The serious concerns is the long-term effects these additives have on it consumers. The long-term effect of these additives, if not properly monitored will have a serious repercussion on the future generations in our country and Africa. In the course of this study, most people seem to have little knowledge about food additives and cared less about the labels to look for any potentially hazardous additives. This means that there is generally low public knowledge about food additives in Ghana. The Food and Drugs Authority must be resourced very well to carry out extensive test on products for some of these harmful additives whether they are local or foreign. There is the need for a research into the levels of inclusion of these additives to establish if they meet the acceptable daily intake recommended by JECFA.

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