Original Research Article

The Status and Trends of Food Fraud in Tamale, Ghana

ABSTRACT

Despite its seriousness, food fraud has not received the necessary attention in Ghana's discourse on food safety. Food fraud is generally considered as the intentional misrepresentation of the contents or identity of food for economic gain. The study was aimed at assessing the food fraud awareness level of participants as well as the foods most likely to be implicated in food fraud cases in Tamale, Ghana. Data was collected from 385 participants, including food business operators and consumers, via a simple random sampling technique using a structured questionnaire. Most participants (54%) were not aware of food fraud and its related activities before the study. Beverages and juices, fruits and vegetables, spices, oils, meat and fish, baked foods, honey, milk, and semi-processed local foods such as groundnut paste, "dawadawa," "kulikuli zim," and "agushi powder" were all revealed to be implicated in food fraud by respondents. Adulteration was the most common food fraud action, but tampering, substitution, and mislabeling were also identified as ongoing in the study area. "Moora" (Bixa Orellana seeds) was revealed as the key adulterant used in most foods. Food fraud, which is a threat to consumer health and well-being, is active in the region and is predicted to increase without strict regulation and increased sensitization about its dangers. The fight against food fraud should be refocused on making food defense systems like vulnerability analysis and critical control points (VACCP) a key aspect of food safety systems to tackle food fraud.

Keywords: adulteration; consumer protection; food adulterant; food fraud; good health; substitution

1. INTRODUCTION

Food fraud is a collective term that represents intentional tampering, addition, substitution or misrepresentation of food, food ingredients or food packaging and labelling to gain an undue advantage for those selling the food [1]. Unlike other food safety challenges, food fraud is intentional and motivated by a food business operator's desire to make more profit and prevent loss [2]. Adulteration is the commonest type of food fraud, however different food fraudulent activities such as food theft, overrun, substitution, diversion, simulation, counterfeiting, tampering, and mislabeling of food exist in the food supply chain [3]. Purchase and consumption of fake or substandard food products by consumers may be the main problem posed by food fraud motivated activities; however, food fraud may result in serious public health consequences such as in the case of food adulteration when the adulterant is toxic [4]. In China only, 53, 000 infants fell sick after drinking formula milk adulterated with melamine while 4 babies died and 104 were hospitalized because they were in critical condition suffering from kidney stones [5]. Also, adulterated olive oil resulted in a disease called the toxic olive oil syndrome which caused 300 deaths and a chunk of people

developing other chronic diseases [6]. According to literature, food adulteration techniques normally used by food fraudsters include mixing powdered chalk with sugar, the addition of water to honey to increase its volume and mixing powdered red pepper with coloured sawdust [7-9].

Sulley and Amankwaa [10] suggest that several food products on the Ghanaian market happen to be predisposed to food fraud activities. The Ghana Food and Drugs Authority (FDA) also reports that palm oil sold on the Ghanaian market constitutes Sudan IV dye which certain palm oil producers add as an enhancer to meet certain consumers' strict demand for only 'red' palm oil. Sudan IV dye is however banned and not approved for use in food products after classification by the International Agency for Research on Cancer (IARC) as a group 2 carcinogen [11]. Other food products like groundnut paste, honey, powdered pepper, sugar and salt are all predisposed to economically motivated adulteration and other food fraud activities in the country as well [10]. Most Ghanaians, unfortunately, may not be aware of such food fraudulent activities and will be predisposed to these fake and substandard products which can pose a direct health threat after consumption. Ghana like other developing countries struggling to achieve food safety need to improve education and awareness on all that affects food safety. Less research has been done on food fraud as a food safety concern in the country despite its seriousness hence this study aims to assess the food fraud awareness level of food business operators and consumers in Tamale Metropolis and to investigate the common foods highly likely to be implicated in food fraud cases on the Ghanaian market.

2. MATERIAL AND METHODS

2.1 Study area and population

This study was conducted in the Tamale Metropolis. Tamale is the capital city of the Northern region of Ghana with the coordinates 9.4N and 0.8W. Areas and locations of high or moderate population density such as markets, lorry stations and schools were specifically selected because these areas are much busier in terms of commerciality of which food business operations and patronage are common. The study population constituted both food business operators and food consumers.

2.2 Sample size

Slovin's formula was employed in determining the sample size for the study. At the end of the survey, data were collected from 385 participants of which 131 were food business operators whiles 254 were consumers.

2.3 Data collection and survey instrument

Questionnaires were used as the primary research instrument for data collection. Data were collected with both a paper-printed questionnaire and a google form where the link was shared personally with the participant via email or WhatsApp. After clicking the link, it redirected the participant to the questionnaire. The questionnaire consisted of three sections. Section I focused on capturing the demographics of the participant while sections II and III focused on questions that could help achieve the objectives of the research such as participant's awareness of food fraud, the foods they know are implicated in food fraud cases in the markets, shops, canteens and street food joints they purchase food and food products or ingredients from, the types of food fraud performed with these foods and the dangers of food fraud.

During data collection, participants were educated and briefed on food fraud after assessing their awareness. There was a section that gave food fraud education in the google form as well after participants answered questions on their awareness of food fraud before the study. Participants were encouraged to read that information before proceeding.

2.4 Data analysis
The data generated from participants were analyzed with Microsoft Excel 2019.

2.5 Ethical considerations
The informed consent of respondents was sought before participants took part in the study. Respondents were educated about their right to withdraw at any stage of the process and were also assured that the information gathered will be protected. Respondents were further assured of their anonymity during the publication or presentation of the research finding.

3. RESULTS AND DISCUSSION

3.1 Results
3.1.1 Demographic characteristics of respondents
The demographic characteristics of the 385 respondents are presented in Table 1. Males were 169(44%) and females were 216(56%). Most of the respondents 177(46%) were between the age range of 20 – 29. A majority of the respondents, 160 (42%) had a tertiary education background and 131 (34%) were food business operators.

Table 1: Demographic characteristics of respondents

Variables	Frequency(%)
Gender	
Male	169(44)
Female	216(56)
Age in years	
≤ 19	38(10)
20 – 29	177(46)
30 – 39	71(18)
40 – 49	56(15)
50 – 59	33(9)
≥ 60	10(2)
Level of education	
No formal education	93(24)
Basic education	87(22)
Senior high education	45(12)
Tertiary education	160(42)
Occupation	
Food business operators	131(34)
Others	254(66)

3.1.2 Food fraud awareness
Respondents were asked if they have ever heard of food fraud (Table 2). Out of the 385 respondents, 176 (46%) indicated they have heard of food fraud before whiles 209 (54%) said they had never heard of food fraud before this study. The school and social media were found to be some of the commonest places to get food fraud information as shown in Table 2.

Table 2: Respondent's food fraud awareness

Food fraud awareness	Frequency (%)
Have you ever heard of food fraud?	
Yes	176(46)
No	209(54)
If yes, what is food fraud?	
Could explain	107(61)
Could not explain	69(39)
If yes, where did you first hear of food fraud??	
School	66(38)
Social media	59(33)
Television/Radio	10(6)
Home	9(5)
Graphic	7(4)
Seminar	25(14)

3.1.3 Identification of fake foods from original

When respondents were asked if they could identify fake foods from the original, 178 (46%) said they could differentiate fake or adulterated foods from the original while 207 (54%) said they couldn't. Respondents further indicated they could use taste, appearance or familiarity to distinguish between fake foods from original as shown in Table 3.

Table 3: Identification of fake foods from original

Food fraud awareness	Frequency (%)
Can you distinguish between fake and original foods?	
Yes	178(46)
No	207(54)
If yes, how do you distinguish them?	
Taste	143(67)
Appearance	61(29)
Familiarity	9(4)

3.1.4 Common foods that are easily implicated in food fraud

Foods mentioned by respondents were grouped and categorized under various food groups like semi-processed local foods, spices, oils, milk and dairy products and baked foods as presented in Figure 1.

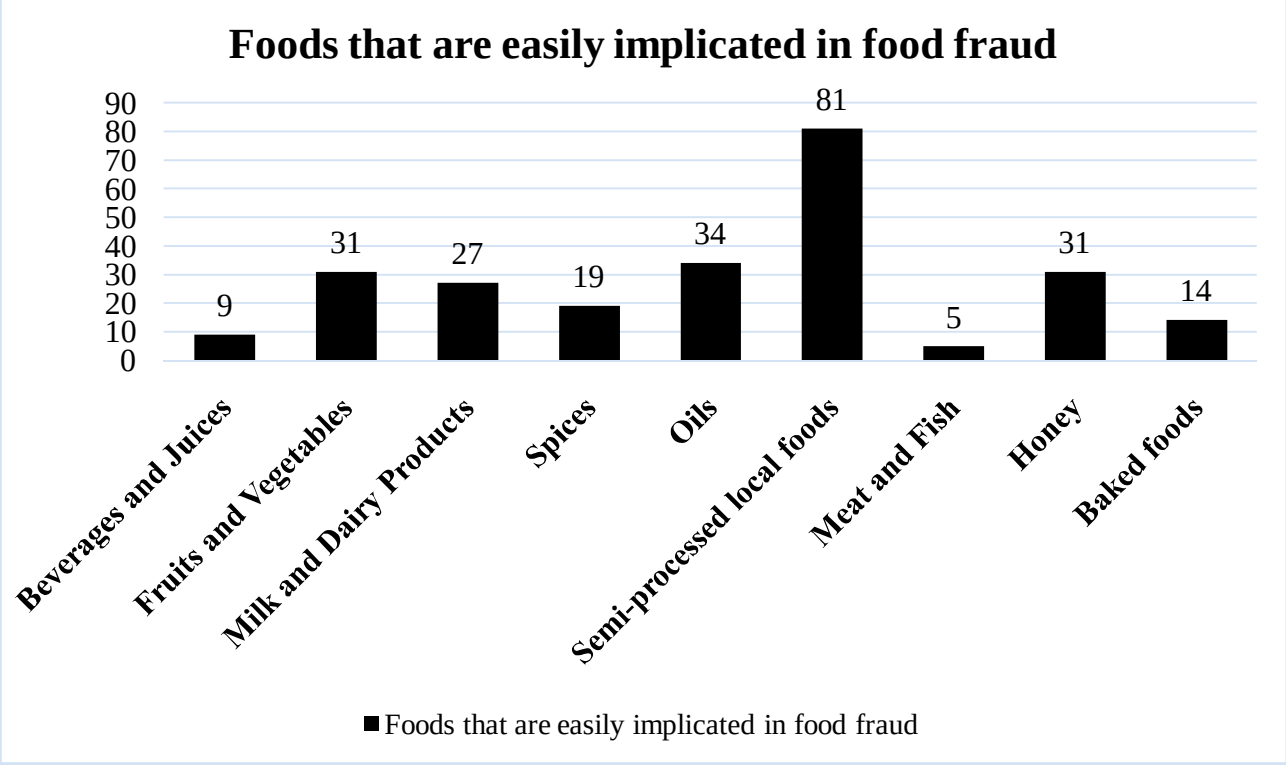

Figure 1: Foods implicated in food fraud cases

3.1.5 Types of food fraud

Types of food fraud activities witnessed by respondents were grouped according to the classification of food fraud actions by Spink *et al.* [1]. Food adulteration was recorded to be the highest food fraud action with 149(59%) responses followed by mislabeling of food. The details are shown in Table 4.

Table 4: Types of food fraud activities

Type of food fraud	Frequency(%)
Adulteration	149(59)
Tampering	29(11)
Mislabeling	43(17)
Simulation	5(2)
Substitution	14(6)
Counterfeiting	13(5)

3.1.6 Consequences of food fraud

Out of the 385 respondents, 277 (72%) indicated that food fraud is dangerous while 108 (28%) said food fraud was not dangerous. Out of the respondents that indicated food fraud is dangerous, 153(60%) cited health issues as a possible danger whiles 38(15%) also mentioned that food fraud can affect trade and export and hence has an economic implication (Table 5). More respondents 239(62%) also indicated that they were willing to pay more for zero food fraud products as shown in Table 5.

Table 5: Consequences of food fraud

Consequences of food fraud	Frequency(%)
Is food fraud dangerous?	
Yes	277(72)
No	108(28)
If yes, what are the dangers?	
Affects trust and confidence in the food supply	41(16)
Health implications	153(60)
Affects trade and has economic implications	38(14)
Gives food a negative brand	25(10
Are you willing to pay more for a zero-food fraud product?	
Yes	243(63)
No	142(37)

3.2 Discussion

The survey revealed that 54% of the respondents had not heard of food fraud before this study. Some respondents (39%) who also indicated they had heard of food fraud before could not explain what food fraud meant. These two findings at least prove the inadequate sensitization and inclusion of food fraud in food safety discourses in the country by bodies involved in enforcing and promoting food safety in Ghana. Respondents who could explain further what food fraud meant stressed food adulteration more than other forms of food fraud identified in published literature.

Most of the respondents confirmed that the identification of fake or tampered food is a difficult task and hence they could not distinguish between these fake foods from the original as indicated in a study by Singh et al. [12]. The FAO manual on food fraud mentioned that one of the reasons that make food fraud detection difficult is that food fraudsters actively escape detection and once a food fraud method is identified, they change the method and move to a different method [13].

The views of respondents were explored regarding the identification of these fake foods from the original to get more insight. A respondent said, “I sometimes purchase food and do not realize it has been adulterated or tampered with. I only realize when I get home. I usually assume it is the same everywhere so I go ahead and eat.”

Another respondent who sold raw milk also said, “I add water to increase the volume but I make sure it is small so that the appearance will not change. I don’t think my customers notice it and even if they do, no one has complained before.”

Although difficult to identify as the above comments from some respondents show, 46% of the respondents also indicated that they could distinguish between these foods by using the taste after consumption or the appearance of the food. One respondent who mentioned appearance as a means of distinguishing fake foods from the original said, “Sometimes you know the food is not original when you look at the colour. It appears too light. Honey for instance should be thick and dark but when I notice it is too light, I know water has been added to it.”

Semi-processed foods like groundnut paste, a local food called “Kulikuli Zim” [powdered and spiced groundnut), “agushi powder” (powdered melon seeds) and “dawadawa” (fermented *Parkia biglobosa)* also were mentioned to be highly predisposed to food fraud in the supply chain by respondents. These foods are easily implicated because they are produced locally with no or less supervision or regulation by Ghanaian food safety regulators hence the producers and retailers tend to do whatever they deem fit to the food and sell it to others.

A grocery vendor explained what was done to groundnut paste and said; “The groundnut paste is normally mixed with ground “Moora” (*Bixa orellana* seed) by most of us here. When you use it to prepare the groundnut soup, it looks a bit reddish as if you used palm oil.”

Similarly, a grocery vendor who mentioned “dawadawa” (fermented *Parkia biglobosa)* and “agushi powder” (powdered melon seeds) said; “You know locust beans are used to produce the “dawadawa”. Some of us use soya beans instead to produce it and the melon seeds too, some of us add soya beans to the melon seeds and grind them together and sell it as powdered melon seeds to the buyers.”

Oils such as palm and olive oil were mentioned 34 different times by respondents. This finding is supported by the study of Amoako-Mensah [14] where it was revealed that palm oil vendors in the Greater Accra Region of Ghana often add Sudan IV dye and other artificial colours to the palm oil they sell. It was further revealed that palm oil is often adulterated to meet the demand of certain customers who only want “very red palm oil”.

One of the respondents who mentioned palm oil as one of the implicated foods said, “I know a palm oil vendor who adds red food colour to her palm oil. She said if the palm oil is not red enough, her customers won’t buy it so she has to add it to attract them.”

Another respondent who sells palm oil said, “My customers prefer red palm oil. I sometimes have to add red food colour or “Moora” (*Bixa orellana* seed) to the palm oil so they buy and then get my money so I don’t run at a loss. It is not harmful like the dye.”

Honey, although a natural sweet substance produced by bees was one of the top three foods implicated in food fraud cases in the study area. This corroborates the finding of Oti [15] where market women in the Northern part of Ghana revealed that some honey sellers buy original honey and then add caramel or melted foam to the honey to gain more profit. An economic advantage to the seller at the expense of the buyer is one of the basic defining principles of food fraud.

During the interactive session, a respondent who sold honey revealed that “Oh! my honey is the pure one. I know how some mix it because I have been selling honey for a very long time now. Some add water to it because they want to increase the quantity. Some even melt sugar and add it so yes as for the honey, you need to be sure you are buying from a trusted source else you will buy fake honey.”

Another respondent also said, “Once I went to buy honey and asked if it is original because I have heard they normally mix it with other things. The vendor said he doesn’t sell fake honey because he might lose customers. He took a match stick, dipped it in a honey sample and told me if I have mixed it with water, it cannot light a fire and burn. The match was able to ignite the fire and burn so I bought the honey.”

Fruits and vegetables like banana, mango, onion, pepper and tomatoes were mentioned also by respondents as one of the foods implicated in food fraud. Mislabeling is employed by vendors to cheat customers and consumers when it comes to fruits and vegetables. Mislabeling is a food fraud act where there is a false advertisement of the product being sold [16].

A mango vendor revealed during the interaction that, “The farmers and middlemen I buy from sometimes deceive me and other buyers. They sometimes cover bad fruits with fresh and healthy ones. Because of the way it is packaged in a crate, you will realize when removing them from the crate after you are back to your destination. If you complain to them, they will say they gave you the correct mangoes and you didn’t handle it well.”

A tomato vendor shared similar remarks saying, “Yes! The people we buy from sometimes pack the nice tomatoes above the bad ones. They do it sometimes. If you are not lucky you might get that crate. The painful thing is you will know when you come and reach home because you can’t inspect the tomato one after the other when purchasing.”

Adulteration was revealed as the commonest food fraud action in the study area. Adulteration activities revealed by respondents during interaction included dilution of raw milk with water, melting of sugar into honey and mixing groundnut oil with vegetable oil. It was further observed from further probe questions that adulteration was done for different reasons such as to gain profit, shortage of a particular food and the desire to make the food attractive and appealing. This finding is supported by Oti [15] as market women in that study

indicated improved food colour and appearance, increased profit and volume or weight addition as part of the factors that influence their use of food adulterants.

Bixa orellana seed known as “Moora’ in the study area was revealed as a key adulterant used in several food products according to food business operators in the study area. A grocery vendor said, “For “Moora”, it is used in a lot of foods here oo. It is used in colouring “wagashi” (local cheese), it is used in colouring redfish, it is ground with powdered pepper, it is added to tomato during milling and even mixed with spices for meat”.

Aside from adulteration and mislabeling, other types of food fraud such as tampering, substitution, counterfeiting and simulation were revealed to be ongoing in the Tamale metropolis among food business operators. This is a worrisome revelation because these actions are done with common foods eaten by most people daily. Consumers will not only miss out on consuming original and nutritional quality foods but they are also at risk of consuming potentially harmful adulterants. Unfortunately, most of these actions revealed by this survey are committed by offenders knowing very well the unavailability or insufficient systems to detect their actions and also to gain economic benefit in their business.

As shown in the results, 72% of the respondents believed food fraud is dangerous and cited reasons such as danger to health, affects the export of Ghanaian foods if the foods are known to be fake and as well makes customers lose confidence in the food system of the country. Research by Rahman e*t al.* [17] mentioned similar reasons why food fraud should be a major food safety concern. Also, Alauddin [18] reported that some food adulterants that are added as additives lead to mental retardation, cardiac arrest and chronic effects like cancers. Research by Oti [15] also corroborates the finding of this study as participants agreed that food adulterants could shorten the life span of consumers, pose a health threat, cause liver damage, delay conception and childbirth in women and interfere with the ability of men to impregnate their wives. *Bixa orellana* seed which is often used in Tamale as a food adulterant has traditionally been used for different things like body paints, lipsticks and in the cosmetic industry [19]. Research shows that though safe for some consumers, others experience allergic reactions to it. These reactions result in symptoms like low blood pressure, swelling, itchiness and stomach pain [20]. *Bixa orellana* seeds also have the potential to trigger bowel syndrome [21]. Vulnerable persons like pregnant, breastfeeding women and children are advised to reduce consumption of this colourant or better still avoid its consumption. The issue then is how such persons will avoid this when it is been used as an adulterant in almost every food they consume on daily basis.

Also tampering with “dawadawa”, thus usage of soya bean instead of locust bean is dangerous because a consumer allergic to soya bean and not locust bean will be at risk if it triggers an allergic reaction after consumption of “dawadawa” made from soya bean. Sudan IV dye often used in palm oil is a category 2 carcinogen that has the potential of causing cancer over time when consumed frequently [22]. Due to the knowledge of these indirect dangers associated with food fraud by respondents, most consumers prioritize their health and safety and are willing to pay more for a zero-food fraud product as indicated in the results of the survey.

4. CONCLUSION

The study concludes that food fraud activities are active in the study area. There is however a relatively low food fraud awareness which is enhancing the practices among food business operators in the region. Food business operators who admitted to performing food fraud and its related activities in their food service delivery highlighted meeting customer demand for specific characteristics of foods, profit-making and prevention of loss as their main motivations. Low surveillance and regulation have led to honey, oils and semi-processed foods like groundnut paste, “dawadawa”, and “agushi powder” to be among the foods highly

implicated in food fraud activities in the study area. Food adulteration is the commonest food fraud activity although others like mislabeling, tampering and simulation are ongoing in the study area. *Bixa Orellana* seeds are used as an adulterant in several foods like groundnut paste, powdered pepper, local cheese, ground tomato and spices to give colour.
Food fraud affects food safety and hence should be tackled along with other food safety challenges affecting the region. The study, therefore, recommends that food fraud should be made a public health issue in the country to enable it to receive the necessary attention it deserves. Second, food defense approaches like the Vulnerability Analysis and Critical Control Point (VACCP) suggested by the FAO should be introduced in food safety systems to tackle food fraud. Also, education and sensitization on the dangers of food fraud activities especially should be maximized to increase awareness of the general population so food safety can be improved. Customers should learn the habit of whistleblowing whenever they suspect fraud in foods, they purchase to draw the attention of authorities in charge of food safety in the region and country. Again, the foods revealed as easily implicated should be individually investigated in subsequent research by using scientifically driven and laboratory techniques to give more insight into what is done to them and their potential risks.

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