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Approval Sheet

QUANTITATIVE ANALYSIS OF FOOD SAFETY RISKS ASSOCIATED WITH VENDOR PRACTICES IN GHANA

By

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Degree to be awarded: Master of Public Health

Executive Master of Public Health

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Abstract Cover Page

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Abstract

QUANTITATIVE ANALYSIS OF FOOD SAFETY RISKS ASSOCIATED WITH VENDOR PRACTICES IN GHANA

By WALTER K. AMOAH

It is scientifically well-established that foodborne illnesses are associated with unsafe food processing, storage, handling, and preparation (fsis.usda.gov, 2022). Globally, the food industry recognizes that food safety management practices comprise HACCP [Hazard Analysis Critical Control Points], safe product design, prerequisite programs [PRPs] (Wallace, 2014), and SSOP [Sanitation Standards Operating Procedures]. The aim of our pilot study was to analyze food safety hazards associated with traditional food vendor practices. We hypothesized that most food vendors did not practice food safety management, resulting in food safety hazards. Out of 20 volunteers recruited by word of mouth at the Kajetia New Market in Kumasi, Ghana, 12 vendors were randomly chosen to respond to a set of quantitative questionnaires, crafted to cover aspects of food safety management practices by food vendors. Ten participants inside the market, in Kumasi and two other vendors for palm wine and cocoa beans, responded to our survey questionnaires on handling fermented products [n1=4], sun-dried products [n2=2], smoked products [n3=3], roasted and salted products [n4=1], salted fresh meat [n5=1], and salted and sun-dried fish [n6=1]. Survey responses were organized into tables [refer to appendix] for quantitative analysis of food safety hazards. Most vendors received fresh stock every two weeks. Smoked, salted, and sundried products usually had a shelf-life of six to twelve months. Unwholesome products were identified by organoleptic means, mastered through years of traditional practices. All meat items were exposed to the environment, but maize and cassava products were protected by plastic coverings. We noticed several food handling practices that fell short of modern and universally acceptable good food safety management practices. These setbacks were mainly because most of these vendors lacked the knowledge and skills needed to identify and be proactive in preventing potential food safety hazards. A gradual introduction of the rudiments of modern food safety management systems to the vendors in these economies could improve food safety. Evaluating food safety practices at the level of food vendors in Ghana will help improve food handling practices and provide some guidelines for local health authorities and policymakers to enhance food safety and ultimately reduce foodborne illnesses.

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KEYWORDS

Hazard analysis, Critical Control Points, Unwholesome, Food Safety, Good Food Management Principles, and Foodborne illnesses.

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Chapter 1: INTRODUCTION

BACKGROUND

According to the World Health Organization, about 600 million people each year become sick after eating contaminated food (Ahmad et al., 2021). Unsafe foods pose serious concerns to public health in Africa, particularly among children, pregnant women, and older adults (afro.who.org, 2015). There are several factors like poor sanitation, non-potable water, personal hygiene, improper storage ambient temperatures, and unhygienic practices in the food supply chain that contribute to foodborne illnesses. These foodborne illnesses occur due to food infected with bacteria, larvae, or eggs of parasites or consuming food contaminated with toxins produced by germs (FAO/PAHO, 2017). Food processing, handling, packaging, and storage must be done safely to prevent foodborne illness (fsis.usda.gov, 2022). Food preservation is the means of controlling spoilage for a longer shelf life, whether by traditional or modern methods (Ahmad et al., 2021). Unfortunately, modern food safety and preservation techniques or knowledge of HACCP (Hazard Analysis Critical Control Points) to reduce contamination and foodborne illnesses are lacking in rural West African communities (Agyei-Baffour et al., 2013). Rural Ashanti people traditionally have several methods of food preservation such as fermentation, salting, ageing, sun drying, and smoking (smartsense.co, 2018). A recent report by the Ghana Food and Drugs Authority (FDA) shows that between the years 2013 and 2021, a total of 1,914 Ghanaians endured foodborne illness, and out of 60 cases of foodborne outbreaks 36 deaths were recorded (GBN, 2022). The purpose of this pilot research was to explore and assess the food safety risks associated with food vendor practices in developing countries. Considering the lack of knowledge on food safety practices by vendors among such

populations, we hypothesized that most shelf-stable food products sold traditionally were potential health hazards. Unlike some of the food vending practices in developing countries, food safety in industrial economies like the United States is regulated by governmental agencies and food safety polices are well embraced and practiced throughout the food supply chain.

SOME CURRENT KNOWLEDGE ON SAFE FOOD HANDLING

Dried food products are normally regarded as shelf stable and can be stored and distributed unrefrigerated because they have a very low water activity (A_W) of 0.85 or below (FDA, 2022). According to the U.S. Food and Drug Administration's (FDA) guidance, for example, pathogenic bacteria such as *Staphylococcus aureus* (*S. aureus*) and *Clostridium botulinum* (*C. botulinum*) growth and toxin formation can occur in finished fishery products due to improper drying during processing which can result in consumer illness (FDA, 2022). Packaging material must not cause rehydration under storage and distribution conditions. Also, dry food products must not be exposed to moisture during storage and distribution (FDA, 2022) otherwise pathogens can be introduced into foods from the environment, unsanitary hands, unclean utensils, and equipment. The amount of time and temperature under which finished food products are exposed must be controlled, and properly managed to prevent the introduction of pathogens.

The history of food fermentation dates as far back to 6000 B.C. when early civilizations produced beer, wine, bread, and dairy products. Since then, almost all global cultures have incorporated at least one fermented food in their cuisine (Foroutan R., 2012). The initial purpose was to extend food shelf-life to enable long storage times at room temperature and to improve food microbial stability (Galimberti et al., 2021). Societies later realized the nutritional and

health benefits of fermented food, such as probiotic effects, improved digestibility, allelopathic activity against bacteria or fungi hazards, and an appeal to organoleptic characteristics like aromas, textures, and taste (Galimberti et al., 2021). Advances in biotechnology and industrialization have preserved traditional fermentation and exploited the benefits to produce an array of impressive food types and organoleptic variants in a predictable food safety environment, especially in developed countries (Galimberti et al., 2021).

Most foodborne illnesses are due to bacteria origin, which is implicated in several outbreaks. The most dangerous pathogens associated with meat, poultry, and fish products are *Salmonella spp., Campylobacter spp., verotoxigenic Escherichia coli, Listeria monocytogenes, and Toxoplasma gondii*. In addition to pH and heat monitoring, food manufacturers in industrialized countries like the United States and Canada use salt and nitrates or nitrites to inhibit pathogen growth in cured and smoked meats. Consumers' health concerns regarding nitrates have been on the rise in recent years because nitrates have been associated with cancer (Parada et al., 2017; Niklas et al., 2022). Consumers' increased demand for lower salt, lower nitrate, or highly moist food products creates conditions for microbes like *Staphylococcus*, which is very salt-tolerant to grow and produce poisonous toxins in food. Bacteria are naturally present on human skin and therefore handling food products with uncleaned hands at warm temperatures (over 40^{o}F) leads to microbial growth and toxin formation. It is not recommended to freeze salt-cured meats because of oxidative rancidity that affects the quality and flavor of the product (Nummer et al., 2002).

FOOD SAFETY MANAGEMENT PRINCIPLES

One key factor that enhances safe food handling is the various packaging methods used in the United States to protect shelf-stable food products from contaminants. Most of the food

industries in advanced economies in Europe, Japan, and the United States have adopted food management systems like SQF [Safe Quality Food] (FMI, 2020) and HACCP [Hazard Analysis Critical Control Points] (Chiba, 2022) to promote food safety.

The SQF is challenging but a genuine food safety and quality program recognized globally in the food industry. SQF has developed coding systems as standards to meet food industry, consumer, and federal regulatory requirements throughout the food supply chain (SQF, 2023). The coding system is used for a certification program that lays emphasis on the use of HACCP to control food hazards to ensure food safety (SQF, 2023). Food manufacturers and retailers must meet coding requirements during rigorous audits to remain certified for recognition (SQF, 2023).

Achieving retail food safety encompasses the principles of HACCP at the retail level of the food supply chain with collaboration between regulators and the food industry (FDA.gov, 2022). The International Life Sciences Institute defined significant hazard as any risk eliminated or reduced to tolerable levels necessary for a safe food supply chain. It is essential to understand and assess the possibility of hazard occurrence and the associated harm to consumers. Understanding and assessing the significant hazards are based on experience and judgment, using risk evaluation methods developed by the International Organization for Standardization 22 000 audit standard, food safety systems (Wallace, 2014).

HACCP is a preventive system that has been well-established worldwide as a major player in food safety management throughout the food supply chain (Wallace, 2014). For a successful food safety system, HACCP must be practiced alongside other food safety elements such as safe product design, and prerequisite programs (Wallace, 2014). To practice HACCP, the potential hazards whether biological, chemical, or physical associated with food product

handling must be identified, analyzed, and controlled at the critical points in the food supply chain to prevent hazards from occurring (fda.gov, 2022). The HACCP approach involves risk assessments beyond food production (Kleter et al., 2009). Prerequisite programs are environmental conditions conducive to the production and handling of safe food (Wallace, 2014). Control measures include ambient temperature monitoring for storage or holding facilities. Sanitation- clean and hygienic practices prevent contamination and adulteration. Validation – gathering evidence that the food safety practices are working and Verification – evaluations and monitoring to determine the effectiveness of food safety measures (Wallace, 2014). Listed in Table 1.1 are some of the food safety measures enumerated above that were used to create the survey questionnaires.

Table 1.1

SELECTED FOOD SAFETY PRINCIPLES

HACCP	PREREQUISITES	SANITATION STANDARD OPERATING PROCEDURES	HYGIENE
Monitoring	Pest control	Building maintenance	Product handling
Observation	Product protection	Facility sanitation	Personal hygiene
Recordkeeping	Environmental control	Operational sanitation	Product Showcase
Verification	Product id & Label	Ventilation	Hand washing basin
Validation		Lighting	Use of gloves
Packaging			Product utensils
Employee training			

Note: List of food safety management principles used to assess vendor food handling practices.

Chapter 2: METHODOLOGY

Assessment of the vendors' food safety risks was done in three parts: (1) responses to the survey questions, (2) direct observation of vendor food handling practices and (3) evaluation of vendor work environment. Quantitative survey questionnaires were formulated to cover aspects of Food Safety Management practices, published by the Codex Alimentarius Commission [a joint commission created between the United Nations Food and Agriculture Organization and the World Health Organization Food Standards Program] (Vojir et al., 2012). This research protocol (IRB ID STUDY00005417) was approved by IRB at Emory University, Atlanta, GA. We proceeded with research by traveling to Kumasi, Ghana to recruit and survey volunteers at their most convenient place, the New Kajetia Market located in the center of the city, Kumasi, Ghana.

RECRUITMENT OF VENDORS

Recruitment was by word of mouth, in the local dialect "Twi" with the help of a local field guide. The purpose and benefits of this study were explained to potential volunteers. The market food vendors, both women and men were provided with informed consent and given a small token of appreciation. Survey candidates were chosen randomly by selecting a number, using an online number generator. Counting from left to right of a row of volunteer vendors who sold the same items, the third person was chosen. Thus, out of about five volunteers for a particular food item, one vendor was randomly selected to respond to the questionnaires. The chart in Figure 2.1 shows the various categories of vendor representation according to food preservation or processing methods. All participants, 10 women and 2 men completed the survey (100% completion). Each selected vendor was also observed as they continued transactions with customers without interruption.

Figure 2.1

Vendor selection is based on the traditional preservation method.

Note: The above chart shows various shelf-stable food products selected according to mode of preservation; fermentation, sun-dried, smoked, roasted, salt-cured, and salt-dried.

The first vendor sold a variety of smoked whole fish, the second vendor sold sun-dried and salted whole tilapia, known locally as “Koobi”. The fourth participant sold salt-cured fresh raw meats [goat, pork, mutton, and beef]. The fifth participant sold sun-dried baby herrings [anchovies] locally known as “Abobi”, “Keta school boys” or “One-man thousand”. The sixth vendor sold corn dough, made by mixing water and corn or maize flour, which is then fermented for some days. The seventh vendor participant sold sun-dried yuca or cassava flour and the eighth participant sold salt-roasted peanut butter. The ninth vendor participant was the public administrator representing a cocoa merchant company that purchases directly from local farmers and exports the cocoa to Europe and Japan. Our tenth vendor sold fermented and salted fish [stock fish] known locally as “Momoni” used as a bouillon flavor enhancer. Vendor number eleven sold smoked game meats such as antelopes, boars, grasscutters, and deer, hunted in the wild. The last participant sold sweet and fermented palm wine and local liquor [homebrewed alcohol] called “Akpeteshie” or “Apio”.

ANALYZING SURVEY RESPONSES

The survey questionnaire which is based on HACCP principles was structured to mirror food safety assessment guidelines used by the US Food Safety Agency (FSIS.USDA.gov, 2022). The questions were categorized to cover most of food handling or associated practices at the level of food vendors. The first group of questions was to identify types of products sold by individual vendors; the second group of questions was to study the condition of products as they are transferred to vendors; The third group of questions focused on how the products are cared for by the vendor. A sample of the questionnaire is presented in “Appendix A”.

Many food companies assess food safety hazards based on sensible knowledge and experience which often includes the use of risk assessment tables to depict the severity of

hazards as demonstrated by the Hazard Significance Assessment Model designed by Mortimore SE and Wallace CA (Wallace C.A., 2014). The categorized assessment of hazard severity as low, medium, or high considering the likelihood of food practices causing harm to consumers. Based on excerpts of the Wallace Model's scoring system, Excel software will be used to graph and show the comparative analysis of food handling practices among our vendor participants. Counts of potential food safety hazards will be categorized as follows; 0 to 3 counts as Low, 4 to 6 counts as Medium, and 7 counts and above as High.

Chapter 3: RESULTS

SURVEY RESPONSES

All survey participants were presented with the same questionnaires and responses collected have been organized into tables listed in the "Appendix B" section. The following were responses to the question on when new stock was received:

Daily	*Palm wine vendor and cocoa merchant*
Weekly	*Corn dough, smoked game meats and peanut butter vendors*
About two weeks	*Vendors of fresh meat and fish products*
Monthly	*Cassava dough vendor*
About three months	*Skewed snails' vendor*

To the question on temperature monitoring on incoming stock, all participants said they did not monitor product temperature. Even though vendor number four received uncooked meats at refrigerated conditions, product temperature was not taken or recorded. Only the cocoa merchant who mainly exports products, monitored humidity and pH to meet customer specifications. All

vendor participants practiced daily organoleptic monitoring to identify and remove unwholesome products. To the question pertaining to stock differentiation or segregation, all vendors practiced the first in first out principle. Response to the question on product storage length varied from a week to a year as listed below:

One week	*Fresh palm wine beverage and corn dough*
Three weeks	*Cassava dough*
Six months	*Cocoa beans, skewed snails, and peanut butter*
Year	*All fish and meat products and distilled palm wine [hard liquor]*

Handwashing and the use of protective gloves was not common practice among all the vendors. Meat and fish products were not packaged or protected in any material but corn dough, cassava dough, cassava flour, and cocoa beans were stored in jute sacks [biodegradable and durable sacks woven from natural plant fibers]. Peanut butter and palm wine were all protected in plastic containers. Vendor #1 who sold smoked fish reported that products found in poor condition are reworked by heating in the oven, so no product is discarded. Just like vendor #1, vendor #2 who sold salt-cured and sun-dried Tilapia said the practice of identifying bad products is by organoleptic methods and the first in first out principle is used to sell her products. The fourth vendor participant reported that she received her imported, uncooked, and unsalted meat products refrigerated but after using salt brine to cure the products she does not refrigerate them anymore.

Vendor #6 for fermented corn dough reported that she did not monitor the temperature of her product, but she keeps an eye on off-white coloration which signifies unwanted conditions. Her product is always protected with clear plastic that is changed every three days to prevent

moisture buildups, due to high humidity. Unwholesome products are discarded. Vendor #7 sold sun-dried cassava flour which she received monthly and sold within three weeks during which cassava products found to be in a bad condition are sold to pig farmers as feed. Vendor participant number eight sold peanut butter which is received every week in blue gallon-size plastic containers. She used a metal utensil to apportion the product into smaller plastic sachets. Vendor #9 was a representative of a merchant company that bought cocoa beans from farmers and exported them to countries in Europe, Japan, and Canada. Environmental conditions he said were well monitored to prevent any natural absorption from the air that could affect the flavor profile of the product. This vendor or merchant has well-trained quality control professionals who routinely practiced recordkeeping, checked on product humidity, monitored air pollutants, and ensured products met purchase specifications.

OBSERVATIONS

- All vendors received their products in protective containers or sacks from manufacturers.
- Only fresh meat products were received as refrigerated items, the other selected products were delivered to vendors with no temperature controls.
- Fish and meat products were displayed in the open, most of which were unprotected as exhibited in figures 3.1, 3.2 and 3.3 below.
- Some vendors did not display products on a table but showcased in containers placed directly on the floor, close to walkways.
- The traditional way of choosing a quality product is by touching to have a feel of food products therefore both vendors and some customers touched smoked fish products during purchase.

- Vendor storage stalls were cluttered, which created potential harborage for pests or vermin, especially at night when the market closed.
- There were no handwashing facilities close to the vendors, but restrooms were positioned far back from food vendors.
- No cooling units were installed, but the ambient temperature in the roofed market building felt very comfortable despite the heat and high humidity outside.
- The market walkways and surroundings were in sanitary and dry condition with no standing water or wet floors.

Figure 3.1

Smoked Fish displayed in the open market.

Note: Smoked whole fish displayed in front of market stalls, closer to shoppers' walkways. The products are not individually packaged or protected from environmental conditions.

Figure 3.2

Salted and Sun-Dried Tilapia: “Kobi”

Note: This fish product is heavily salted and sun-dried to eliminate any water activity, a way of preventing microbial growth but vendors expose product to the market environment as long as it takes to sell them while both vendors and potential buyers are allowed to touch with bare hands.

Figure 3.3

Cured Meat [Lamb, Goat, Beef & Pork]: “Tolo beef.”

Note: Variety of Cured fresh meat products, unpackaged and displayed in the open market environment for sale. At the end of the day, these products go back into salt brine until sold.

Figure 3.4

Maize/Corn Mill and Yuca Flour Products

Note: Corn/Maize and Cassava/Yuca products are covered with clear plastics to protect the product from dust, pests, and other potential contaminants.

Figure 3.5

Jute bags of Corn and Yuca products in storage

Table 3.1

IDENTIFYING FOOD SAFETY HAZARDS

Food safety assessment based on survey responses [Appendix A] and investigator observations.

	Vendor #1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	Vendor #12
Sanitation	**1**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**0**	**1**	**2**	**3**
Building maintenance.	G	G	G	G	G	G	G	G	G	G	G	H
Vendor area sanitary.	G	G	H	G	H	G	G	H	G	G	H	H
Vendor next to clutter.	H	H	H	H	H	H	H	H	G	H	H	H
Vendor area ventilation.	G	G	G	G	G	G	G	G	G	G	G	G
Prerequisites	**3**	**3**	**3**	**2**	**4**	**2**	**1**	**4**	**1**	**3**	**3**	**1**
Vendor pest control [flies]	H	H	H	G	H	H	H	H	G	H	H	H
Product exposure.	H	H	H	H	H	G	G	H	G	H	H	G
Container on or off the floor.	G	G	G	G	H	G	G	H	G	G	G	G
Sink for handwashing.	H	H	H	H	H	H	G	H	H	H	H	G
HACCP	**2**	**2**	**2**	**1**	**4**	**2**	**2**	**2**	**0**	**2**	**2**	**0**
Daily product verifications.	G	G	G	G	H	G	G	G	G	G	G	G
Daily visual monitoring.	G	G	G	G	H	G	G	G	G	G	G	G
Daily product recordkeeping.	H	H	H	G	H	H	H	H	G	H	H	G
Individual packaging.	H	H	H	H	H	H	H	H	G	H	H	G
Hygiene	**2**	**2**	**4**	**1**	**4**	**0**	**0**	**2**	**0**	**3**	**3**	**2**
Unhygienic handling.	H	H	H	G	H	G	G	H	G	H	H	H
Personal hygiene.	G	G	H	G	H	G	G	G	G	G	G	G
Display table conditions.	G	G	H	G	H	G	G	H	G	H	H	H
Utensils to handle product.	H	H	H	H	H	G	G	G	G	H	H	G
Column total H	**8**	**8**	**11**	**5**	**14**	**5**	**4**	**10**	**1**	**9**	**10**	**6**
Column total G	**8**	**8**	**5**	**11**	**2**	**11**	**12**	**6**	**15**	**7**	**6**	**10**

Note: [H] represents food hazards and **[G]** for good management practices. Numbers in each row represent counts of practices that are potential hazards in the sub-section column cells. The last two bottom rows are total counts of hazard or good manufacturing practices in each column.

Gathered survey responses from each individual participant [presented in the tables under the Appendix section] and food safety practices observed by investigators were compiled into table 3.1 above. The first column from the left are various food handling practices at the level of vending, grouped into four categories: hygiene, HACCP, prerequisites, and sanitation. The tabulated results were then tallied and used to generate graphs shown below [Figures 3.6 and 3.7]

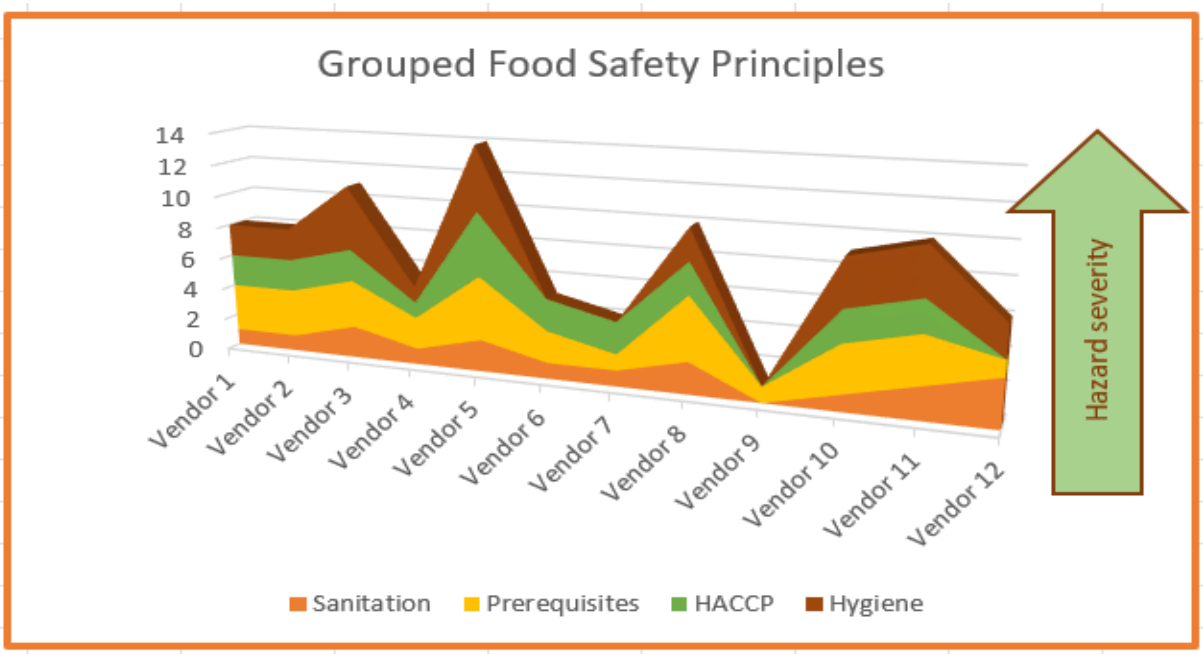
Figure 3.6

Food Safety Practices:

Figure 3.6 above shows the frequency of unsafe individual food handling practices compared to safer practices. The statistical mean for food safety hazards identified was 7.6 and the median was 6.0. Seven of the participants (58.3%) scored above the average hazard severity. Vendor #5 who sold small herrings met the least principles of good food safety management. Vendor #9, the cocoa bean merchant scored highest for good food safety management practices and was an outlier.

Figure 3.7

Universal Food Safety Principles:



Note: Bars represent the major components of food safety management practices; Sanitation, Prerequisites, HACCP, and Hygiene. The heights of the bars represent several lacking food safety management principles, hence the hazard severity. Hazard severity score ranges: 0 to 3 as Low, 4 to 6 as Medium, and from 7 and above as High severity.

Vendors #3 and #5 sold smoked-sundried snails, and sun-dried anchovies (baby herrings) respectively, and vendor #12 had very high counts of unsafe food practices, about 50%. Vendor #9, for fermented and sun-dried cocoa beans, had the least unsafe food practices (1.0%) which shows that food safety was not a factor in vendor practices. Comparatively, institutional food handlers in Ghana are more informed regarding food safety than market or street vendors but still, these institutional cafeteria staff do not conform to strict hygienic systems (Akabanda et al., 2017). The higher the number of unsafe food handling counts the greater the chances of potential food safety hazards.

Chapter 4: DISCUSSION

Overall, most of the survey participants were not meeting good food safety standards. Apart from vendor number nine, who was a well-organized merchant, the rest of the participants were individuals who practiced very minimal good food safety management principles. Most of their products were not covered or protected from potential hazards and products were subjected to practices that lacked modern food safety principles.

There is no worldwide food industry standard to assess or evaluate food safety risks. A group of food safety regulators in Africa started a collaborative initiative in 2015 to come up with food safety principles or standards that will be recognized and adopted in member states to improve food safety systems in Africa by the year 2024 (AFSI, 2021). The African Food Safety Initiative members include the University of Missouri, USA, Texas A&M University, United States Food and Agricultural Service, UMAP-Ghana, and other partners from the regions of Africa (AFSI, 2021)

Analysis of our survey responses showed that almost all vendors of smoked fish and meat products hardly threw out or discarded products when they started going bad. Their normal practice is to recondition the item, by sun drying or baking it repeatedly in the oven, hot enough to kill bacteria. According to the Centers for Disease Control and Prevention (CDC) in the United States, reheating or boiling food kept at room temperature for a long period is not always safe (CDC.org, 2022).

The survey results indicate that because of high humidity in the tropics, some vendors did not package or protect their products in plastics, to prevent moisture buildup in the plastic, which can lead to microbial growth. Water vapor permeability of food packaging materials also have effects on food texture, nutrient, flavor, and shelf-life (Sand, 2021). The practice by the

corn/maize dough vendor to replace the plastic covering on her product every three days to prevent moisture build-up demonstrated a correlation with good food safety practices. According to the World Food Program, proper packaging protects food from damage and preserves quality even under extreme weather conditions like high humidity, dust, and hot temperatures, prolonging shelf life (Beltrami, 2019).

Data collected showed all the vendors did not practice product temperature monitoring which was inconsistent with modern food safety management practices. One of the principles under HACCP implementation is product temperature monitoring to ensure that product is well controlled at critical points in the food chain where hazards could occur (fda.gov, 2022).

There were no visible handwashing sinks near the food vendors in the market and so food contamination was very likely, considering the common traditional practices of touching food products with bare hands before purchase. The Food Safety and Inspection Service of the U. S. Department of Agriculture pinpoints cleanliness as a key factor in preventing foodborne illness through cross-contamination and therefore suggests that food handlers wash their hands before and after handling food (fsis.usda.org, 2023). Data shows most food vendors in Ghana have very little or no formal education which leads to low food hygiene practices (Cudjoe et al., 2022).

The smoked fish and meat vendors rarely discard products that are found to be off condition. Unlike the United States where unwholesome product is discarded, these smoked fish and meat vendors recondition unwholesome products with oven heat.

There were some limitations to the study. Survey responses were self-reported and therefore could have been influenced by some response biases or social desirability biases such as exaggeration of product shelf life because vendors wanted to impress the research team by reporting a lengthy shelf-life of a product (Johns et al., 2015). Also, this was a pilot study and

therefore using a very small could affect the use of the study to generalize (Tipton et al., 2017) food vendor practices in developing countries like Ghana.

Chapter 5: RECOMMENDATIONS

PACKAGING:

The local industries or manufacturers of the surveyed food products must be educated, guided, and encouraged to package food products to improve food safety by preventing product exposure to hazards.

TOUCHING PRODUCTS:

Traditionally, customers or potential buyers will want to have the feel and weight of a product before purchase. This practice must be discouraged by local health authorities. Vendors must adopt basic hygienic practices such as the use of clean utensils or wearing gloves to grab food items. They must practice handwashing before and after handling a product. We suggest that vendors post notices to inform customers not to touch unpackaged or exposed products.

LOT TRACKING:

The majority (75%) of the survey respondents stated that they did not practice recordkeeping when products were received from producers or middlemen. These vendors mixed old and new stock together. It would be better to have a system where they can at least put a receiving date or mark on containers to help identify old stock from new ones. That will also enhance the practice of first in first out system of controlling or monitoring product shelf-life.

PRODUCT TEMPERATURE MONITORING:

Considering high humidity and hot weather in the tropics, educating the vendors on proper product temperature monitoring practices when they receive, store, and sell their products will prevent food products from a "food safety temperature danger zone" [Between 40^{O}F and 140^{O}F] that leads to spoilage and foodborne illnesses. Cured food items that can be stored at room temperature might get a long shelf-life, but in an ideal situation, heat-treated and fully cooked must be refrigerated to avoid the danger zone.

Chapter 6: CONCLUSION

Efforts to improve food safety management practices in developing countries like Ghana is a mission that is ongoing (afro.who.int, 2021) but lagging due to difficulties in achieving food safety (Omari et al., 2016) (Ababio et al., 2015). Comparatively, food preservation as we discovered in this study was not too far from the traditional practices still used in developed countries like the United States. Food handling on the other hand is way behind compared to practices in the developed world. The setbacks in food safety management practices are the result of a lack of knowledge pertaining to food safety principles like HACCP, proper hygiene, sanitation, and prerequisites for good management practices. The study results confirmed our hypothesis that most of the food vendors practiced fewer good food management principles and therefore potential Hazard Severity was high. All it takes is a gradual introduction of these food safety principles to food vendors, to acquire skills to identify food safety hazards and practice a new food culture that will minimize or eliminate physical, chemical, and biological hazards during food handling practices. Achieving that goal will curtail foodborne illnesses, improve food security, and promote international food trade.

REFERENCES

Ababio P.F., Lovatt P. (2015) Food Control: A review on food safety and food hygiene studies in Ghana. *ScienceDirect* Volume 47, Pages 92-97. Accessed from: A review on food safety and food hygiene studies in Ghana - ScienceDirect

AFSI. (2021). Project On Strengthening Food Safety Systems in West Africa. *Africa Food Safety Initiative*. Retrieved from: https://africafoodsafety.org/2021/11/09/food-safety-in-africa-2021-2023.

Agyei-Baffour, P., Sekyere, K. B., & Addy, E. A. (2013). Policy on Hazard Analysis and Critical Control Point (HACCP) and adherence to food preparation guidelines: a cross-sectional survey of stakeholders in food service in Kumasi, Ghana. *BMC research notes*, *6*, 442. https://doi.org/10.1186/1756-0500-6-442

Akabanda, F., Hlortsi, E. H., & Owusu-Kwarteng, J. (2017). Food safety knowledge, attitudes, and practices of institutional food handlers in Ghana. *BMC Public Health*, *17*(1), 40. https://doi.org/10.1186/s12889-016-3986-9

Beltrami S. (2019). To protect and preserve: How packaging can help prevent food loss and waste. *World Food Programme*. Retrieved from: To protect and preserve: How packaging can help prevent food loss and waste | World Food Program (wfp.org)

CDC.org (2022). Food Safety: How Food Gets Contaminated – The Food production Chain: Mishandling at Multiple Points. *Centers for Disease Control and Prevention.* Retrieved from: How Food Gets Contaminated - The Food Production Chain | Food Safety | CDC

Christiana Cudjoe, D., Balali, G. I., Titus, O. O., Osafo, R., & Taufiq, M. (2022). Food Safety in Sub-Sahara Africa, An insight into Ghana and Nigeria. *Environmental health insights*, *16*, 11786302221142484. https://doi.org/10.1177/11786302221142484

Chiba T. (2022). Yakugaku Zasshi: Journal of the Pharmaceutical Society of Japan, 142(1), 27–31. https://doi.org/10.1248/yakushi.21-00161-3

FAO/PAHO (2017) Food Handlers Manual, Student. *Food and Agriculture Organization of the United Nations and Pan American Health Organization/World Health Organization*, Washington DC. Retrieved from: http://iris.paho.org/handle/10665.2/34130

FDA (2022). HACCP Principles & Application Guidelines: HACCP Principles. *U.S. Food & Drug Administration*. Accessed from: HACCP Principles & Application Guidelines | FDA

FDA (2022). Fish and Fishery Products Hazards and Controls Guidance: Understanding The Potential Hazard. *Health and Human Services*. Pages 239 - 307. Retrieved from Fish and Fishery Products Hazards and Controls Guidance (fda.gov)

FMI (2020) The Food Industry Association: The Safe Quality Food Institute Releases New Food Safety Code Architecture. *Food Marketing Institute*. Retrieved from: https://www.fmi.org/newsroom/news-archive/view/2020/10/26/sqfi-releases-new-food-safety-audit-code-architecture

Foroutan, R. (2012). The History and Health Benefits of fermented Food: Global Cultures. *Food & Nutrition.* Retrieved from: The History and Health Benefits of Fermented Food - Food & Nutrition Magazine (foodandnutrition.org)

FSIS (2022). Food Safety Assessment (FSA) Tools: Inspection: General FSA Tool. Retrieved from: Food Safety Assessments Tools | Food Safety and Inspection Service (usda.gov)

Galimberti, A., Bruno, A., Agostinetto, G., Casiraghi, M., Guzzetti, L., & Labra, M. (2021). Fermented food products in the era of globalization: tradition meets biotechnology innovations. *Current opinion in biotechnology*, *70*, 36–41. https://doi.org/10.1016/j.copbio.2020.10.006

GBN (2022) In Ghana 36 people dead, over 1,900 affected by food-borne diseases – FDA. *Ghana Business News*. Retrieved from: In Ghana 36 people dead, over 1,900 affected by food-borne diseases - FDA - Ghana Business News

Johns, G., & Miraglia, M. (2015). The reliability, validity, and accuracy of self-reported absenteeism from work: a meta-analysis. *Journal of Occupational Health Psychology*, *20*(1), 1–14. https://doi.org/10.1037/a0037754

Junaid, A., Muhammad, A., Rehan, A. M., Sumaria, I., Iqra, R., Mohsin, H., Shahzeb, J., Sahibzada, A., Hazrat, B., & Shubana, H. (2021). Traditional and Modern Techniques for Food Preservation. *International Journal of Modern Agriculture* ISSN: 2305-7246 Volume 10 Issue 3. Retrieved from https://www.researchgate.net/publication/357335464_Review_Article_on_Traditional_and_Modern_Techniques_For_Food_Preservation

Kleter G.A., Marvin H.J.P. (2009) Indicators of emerging hazards and risks to food safety. *Food and Toxicology*. Vol. 47. Pages 1022-1039. Retrieved from: Indicators of emerging hazards and risks to food safety | Elsevier Enhanced Reader

Makhunga, S., Mashamba-Thompson, T., & Hlongwana, K. (2019). Mapping evidence on charitable food assistance system's compliance with safety and general hygiene requirements in

Africa and the rest of the world: a systematic scoping review protocol. *Systematic reviews*, 8(1), 10. https://doi.org/10.1186/s13643-018-0907-2

Niklas, A. A., Herrmann, S. S., Pedersen, M., Jakobsen, M., & Duedahl-Olesen, L. (2022). The occurrence of volatile and non-volatile N-nitrosamines in cured meat products from the Danish market. Food chemistry, 378, 132046. https://doi.org/10.1016/j.foodchem.2022.132046

Nummer B. A., Andress E. L. (2002). Curing and Smoking Meats for Home Food Preservation Literature Review and Critical Preservation Points. *National Center for Home Food Preservation.* Retrieved from: Curing and Smoking Meats for Home Food Preservation (uga.edu)

Omari, R., & Frempong, G. (2016). Food safety concerns of fast-food consumers in urban Ghana. *Appetite*, *98*, 49–54. Retrieved from: https://doi.org/10.1016/j.appet.2015.12.007

Parada, H., Jr, Steck, S. E., Bradshaw, P. T., Engel, L. S., Conway, K., Teitelbaum, S. L., Neugut, A. I., Santella, R. M., & Gammon, M. D. (2017). Grilled, Barbecued, and Smoked Meat Intake and Survival Following Breast Cancer. *Journal of the National Cancer Institute*, *109*(6), djw299. https://doi.org/10.1093/jnci/djw299

Sand, C. K. (2021). Controlling Moisture in Foods Using Packaging: Packaging. *Food Technology Magazine*. Volume 75: No. 8. Retrieved from: Controlling Moisture in Foods Using Packaging - IFT.org

SmartSense (2018). Food Safety Milestones Part 1: A Short History of Food Preservation. Retrieved from Food Safety Milestones Part 1: A Short History of Food Preservation (smartsense.co)

SQFI (2023). SQFI Food Service Program: From Gate to Plate. *SQFInstitute*. Retrieved from: SQFI Food Service Program - Safe Quality Food Institute

Tenssay, Z. W., & Mengistu, A. (1997). Bacterial isolates from indigenous weaning foods in rural Ethiopian setting, Jimma Zone, southwest Ethiopia. *Ethiopian medical journal*, *35*(2), 93–102.

Tipton, E., Hallberg, K., Hedges, L. V., & Chan, W. (2017). Implications of Small Samples for Generalization: Adjustments and Rules of Thumb. *Evaluation review*, *41*(5), 472–505. https://doi.org/10.1177/0193841X16655665

USDA.gov (2022). Food Safety basics: 2022 Summer Food Safety Toolkit. *U.S. Department of Agriculture*. Retrieved from https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics

U.S. FDA (2022) Retail & Food Service HACCP: HACCP & Managerial Control of Risk Factors. *U. S. Food & Drug Administration*. Retrieved from: Retail & Food Service HACCP | FDA

Vojir, F., Schübl, E., & Elmadfa, I. (2012). The origins of a global standard for food quality and safety: Codex Alimentarius Austriacus and FAO/WHO Codex Alimentarius. *International journal for vitamin and nutrition research. Internationale Zeitschrift fur Vitamin- und Ernahrungsforschung. Journal international de vitaminologie et de nutrition*, *82*(3), 223–227. https://doi.org/10.1024/0300-9831/a000115

Wagacha, J. M., & Muthomi, J. W. (2008). Mycotoxin problem in Africa: current implications to food safety and health and possible management strategies. *International journal of food microbiology*, 124(1), 1–12. https://doi.org/10.1016/j.ijfoodmicro.2008.01.008

Wallace C.A. (2014). Food Safety Assurance Systems: Hazard Analysis and Critical Control Point System (HACCP): Principles and Practice. *Encyclopedia of Food Safety*. Volume 4, pages 226-239. Accessed From: https://www.sciencedirect.com/science/article/pii/B9780123786128003589?via%3Dihub#s0010

WHO (2022) Food Safety: Key Facts. *World Health Organization*. Retrieved from: http://www.who.int/newsroom/fact.sheets/detail/food-safety

WHO (2015). Unsafe food: a major health threat in the African region. World health Organization, Regional Office for Africa Bulletin. Retrieved from: https://www.afro.who.int/news/unsafe-food-major-health-threat-african-region

WHO Africa (2021). Ghana launches 2021 World Food Safety Day. World Health Organization Regional Office for Africa Bulletin. Retrieved from: Ghana launches 2021 World Food Safety Day | WHO | Regional Office for Africa

APPENDIX A

Quantitative Survey Questionnaires

Product Category/ID

1. What is the selected product type?
   - ☐Fish ☐Meat ☐Cocoa Beans

   ☐Corn ☐Wine ☐Snail ☐Other_____
2. What is the mode of preservation?
   ☐Smoked
   ☐Salted
   ☐Sun Dried
   ☐Air Dried
   ☐Fermented
3. What is the physical state of products?
   ☐Intact
   ☐Non-intact
   ☐Granular/Coarse/Grains
   ☐Flour
   ☐Other_____

Receiving Stage [transferring from Producer to Vendor]:

4. How often do you receive new stock from manufacturer(s)/producer(s)
   ☐Daily
   ☐Less than a week
   ☐Weekly
   ☐More than a week
   ☐Monthly or more
5. Do you check product condition when you receive them? If **yes** continue with #6, if **no** go to #12
   ☐Yes ☐No
6. What is temperature of product at Receiving? [“Danger Zone” = 40^{O}F to 140^{O}F]
   ☐Hot [150^{O}F to 250^{O}F]
   ☐Warm [at/above 140^{O}F]
   ☐Room Temperature [70^{O}F to 90^{O}F]
   ☐Refrigerated [at/below 40^{O}F]

☐Frozen [O^{O}F and below]

7. Do you have written records of temperatures at Receiving?
   ☐Yes ☐No
8. How do you identify unwholesome/inedible products? [organoleptic]
   ☐Smell/Odor
   ☐Physical touch/Texture
   ☐Discoloration
   ☐Visual inspection
   ☐Temperature
   ☐Other_____
9. If yes for #5, who checks on condition of product?
   ☐Owner
   ☐Supervisor
   ☐Quality Control Staff
   ☐Other_____
10. What corrective action is taken when product is unwholesome/inedible?
   ☐Sell it discounted.
   ☐Discard
   ☐Return to producer for credit/refund.
   ☐Return to producer for replacement.
   ☐Other _____
11. Do you have written records of received stock?
   ☐Yes ☐No
12. What kind of shipping containers are used for products?
   ☐Cardboard containers
   ☐Plastic containers
   ☐Wooden containers
   ☐Fabric containers
   ☐No containers
13. What conditions are the packaging/containers?
   ☐Reusable clean
   ☐Reusable unclean
   ☐New containers/packages
   ☐Unsanitary containers
   ☐Other

Vendor Storage:

14. Do you monitor the temperature of products in storage?
    ☐Yes ☐No
15. If yes for #14, how do you monitor storage ambient conditions/product temperature?
    ☐Digital Thermometer
    ☐Mercury Thermometer
    ☐Infrared Sensor Thermometer
16. How long do products stay in storage?
    ☐One day [24 hours]
    ☐2-3 days
    ☐One week
    ☐2-3 weeks
    ☐ One month or more
17. Are the products multi-ingredient or single ingredient?
    ☐Multi☐Single
18. If multi-ingredients, which of these are included?
    ☐Spices
    ☐Salt
    ☐Pepper
    ☐Nuts (peanut/tree nuts)
    ☐Other _____
19. How do you differentiate Old Stock from New Stock?
    ☐First in, first out method
    ☐Marked containers.
    ☐Color coding
    ☐Lot system
    ☐Shelf segregation
    ☐No differentiation
    ☐Other_____

Customer Complaints:

20. How often do customers/retailers/consumers complain or return inedible products after purchase?
    ☐Never
    ☐Sometimes
    ☐Frequently
    ☐Always

Investigator's Observations:

21. Are products exposed to the storage environment (covered to protect from flies, dust)?
    ☐Yes ☐No
22. Is there evidence of pets/vermin/pest activities in immediate storage area?
    ☐Yes ☐No
23. Is there any signage in the storage environment that addresses employee hygiene?
    ☐Yes ☐No
24. How often did employees demonstrate hygienic awareness/practices?
    ☐Never
    ☐Sometimes
    ☐Frequently
    ☐Always

25. Are there any food Allergen concerns addressed? Are food allergens labeled or disclosed?
    ☐Yes ☐No

26. Are products segregated to prevent co-mingling or cross-contamination of common allergens?
    ☐Yes ☐No

APPENDIX B: SUPPLIMENTAL TABLES

Table 3.2: Vendor #1. SMOKED WHOLE FISH

Product Elements	**Survey Response**	**Storage Elements**	**Survey Response**	**Selling to Consumer**	**Survey Response**
New Stock Frequency	2 weeks	Ambient Temp.	No Monitoring	Product Package	No Individual Packaging
Product Temp.	No Temp.	Storage Length	Month or more	Handling Utensils	No use of Utensils
Receiving Records	No Records	Added Ingredient	Nothing Added	Gloved Hands	No use of Gloves
Organoleptic Method	Smell Texture Visual	New/Old Stock Differentiation	No Differentiation	Serving customer	Product grabbed with bare hands
Action when Product found Unwholesome	Rework to eliminate worms			Hand Washing Facility	No hand washing Sink/Basin
Container Type	Plastic			Consumer Complaints	Sometimes
Container Condition	Clean Reusables			Hygiene Signage	No Employee Signage

Table 3.3: Vendor #2. SUN-DRIED SALTED WHOLE FISH [“Kobi”]

Product Elements	**Survey Response**	**Storage Elements**	**Survey Response**	**Selling to Consumer**	**Survey Response**
New Stock Frequency	Weekly	Ambient Temp.	No Monitoring	Product Package	No Individual Packaging
Product Temp.	No Temp.	Storage Length	Month or more	Handling Utensils	No use of Utensils
Receiving Records	No Records	Added Ingredient	Nothing Added	Gloved Hands	No use of Gloves
Organoleptic Method	Smell Texture Visual	New/Old Stock Differentiation	First In, First Out [FIFO] Principle	Serving customer	Product grabbed with bare hands
Action when Product found Unwholesome	Returned and replaced			Hand Washing Facility	No handwashing Sink/Basin
Container Type	Wooden Baskets			Consumer Complaints	Never
Container Condition	Clean Reusables			Hygiene Signage	No Employee Signage

Table 3.4: Vendor #3. SUN-DRIED SMOKED SNAILS

Product Elements	Survey Response	Storage Elements	Survey Response	Selling to Consumer	Survey Response
New Stock Frequency	Seasonal More than a Month	Ambient Temp.	No Monitoring	Product Package	No Individual packaging
Product Temp.	No Temp	Storage Length	A Month or more	Handling Utensils	No use of Utensils
Receiving Records	No Records	Added Ingredient	Nothing is added	Gloved Hands	No use of Gloves
Organoleptic Method	Smell Texture Visual	New/Old Stock Differentiation	FIFO Method	Serving customer	Skewed so grabbed by end of stick
Action when Product found Unwholesome	Returned and replaced			Hand Washing Facility	No Handwashing Sink/Basin
Container Type	Fabric/ Jute Sac			Consumer Complaints	Never
Container Condition	New or Clean Reusables			Hygiene Signage	No Employee Signage

Table 3.5: Vendor #4. SALTED FRESH MEAT [Goat/Beef/Pork]: [“Tolo beef”]

Product Elements	Survey Response	Storage Elements	Survey Response	Selling to Consumer	Survey Response
New Stock Frequency	Weekly	Ambient Temp.	No Monitoring	Product Package	No Individual Packaging
Product Temp.	Refrigerated = or < 41^{o}F	Storage Length	Yearly- One month or more	Handling Utensils	No use of Utensils
Receiving Records	No Record-keeping	Added Ingredient	Salt brine	Gloved Hands	No use of Gloves
Organoleptic Method	Smell Texture Discoloration	New/Old Stock Differentiation	FIFO Methods Shelf-Segregation	Serving customer	Use of clear plastic bag
Action when Product found Unwholesome	Returned for replacement			Hand Washing Facility	No Handwashing Sink/Basin
Container Type	Plastic Barrels/Tubs			Consumer Complaints	Never
Container Condition	New/Clean Reusables			Hygiene Signage	No Employee Signage

Table 3.6: Vendor #5. SUN-DRIED FISH [BABY HERRINGS: "Keta School Boys"]

Product Elements	**Survey Response**	**Storage Elements**	**Survey Response**	**Selling to Consumer**	**Survey Response**
New Stock Frequency	Weekly	Ambient Temp.	No Monitoring	Product Package	No Packaging
Product Temp.	No Temp.	Storage Length	A Month or more	Handling Utensils	No use of Utensils
Receiving Records	No Record - keeping	Added Ingredient	Nothing is Added	Gloved Hands	No use of gloves
Organoleptic Method	Visual Texture	New/Old Stock Differentiation	FIFO Method	Serving customer	Uses bare hands to grab product
Action when Product found Unwholesome	Discard			Hand Washing Facility	No Handwashing Sink/Basin
Container Type	Wooden Basket			Consumer Complaints	Never
Container Condition	Clean Reusables			Hygiene Signage	No Employee Signage

Table 3.7: Vendor # 6. FERMENTED CORN/MAIZE DOUGH ["Mori"]

Product Elements	**Survey Response**	**Storage Elements**	**Survey Response**	**Selling to Consumer**	**Survey Response**
New Stock Frequency	Weekly	Ambient Temp.	No Monitoring	Product Package	Protected with plastic wrap
Product Temp.	No Temp.	Storage Length	3 Days or a Week	Handling Utensils	No use of Utensils
Receiving Records	No Recordkeeping	Added Ingredient	Nothing is Added	Gloved Hands	No use of gloves
Organoleptic Method	Discoloration Visual Smell	New/Old Stock Differentiation	FIFO Method Taste Test	Serving customer	Use plastic sachets
Action when Product found Unwholesome	Discard			Hand Washing Facility	No Handwashing Sink/Basin
Container Type	Plastic tubs			Consumer Complaints	Never
Container Condition	Clean Reusables			Hygiene Signage	No Employee Signage

Table 3.8: Vendor #7. SUN-DRIED CASSAVA/MANIOC/YUCA FLOUR

Product Elements	Survey Response	Storage Elements	Survey Response	Selling to Consumer	Survey Response
New Stock Frequency	Monthly	Ambient Temp.	No Monitoring	Product Package	Measured into plastic bags
Product Temp.	No Temperature	Storage Length	2 to 3 Weeks	Handling Utensils	Vendors use Scoop
Receiving Records	No Recordkeeping	Added Ingredient	Nothing is Added	Gloved Hands	No Gloves
Organoleptic Method	Visual Inspection	New/Old Stock Differentiation	FIFO Method Visual	Serving customer	Touched only scoop handle
Action when Product found Unwholesome	Sold as feed to pig farmers			Hand Washing Facility	No Handwashing sink/basin
Container Type	Jute sacks/bags			Consumer Complaints	Never
Container Condition	New Jute bags/sacks			Hygiene Signage	No Employee Signage

Table 3.9: Vendor #8. ROASTED & SALTED PEANUT BUTTER

Product Elements	Survey Response	Storage Elements	Survey Response	Selling to Consumer	Survey Response
New Stock Frequency	Weekly	Ambient Temp.	No Monitoring	Product Package	Packaged in Plastic gallons
Product Temp.	No Temperature	Storage Length	Month or more	Handling Utensils	Metal Scoops
Receiving Records	No Recordkeeping	Added Ingredient	Nothing added after production	Gloved Hands	No gloves
Organoleptic Method	Discoloration Visual	New/Old Stock Differentiation	Marked receiving dates. FIFO	Serving customer	No Direct product touch
Action when Product found Unwholesome	Return for replacement			Hand Washing Facility	No Handwashing Sink/Basin
Container Type	Plastic tubs			Consumer Complaints	Never
Container Condition	New containers			Hygiene Signage	No Employee Signage

Table 3.10: Vendor #9. SUN-DRIED FERMENTED COCOA BEANS

Product Elements	Survey Response	Storage Elements	Survey Response	Selling to Consumer	Survey Response
New Stock Frequency	Daily	Ambient Temp.	Monitor Air Pollutants but Not Temp	Product Package	Jute Bags
Product Temp.	No Temperature	Storage Length	6 Months	Handling Utensils	Steel Scoops
Receiving Records	Practices Recordkeeping	Added Ingredient	Nothing added	Gloved Hands	No
Organoleptic Methods	Visual Inspection Humidity Check	New/Old Stock Differentiation	FIFO Marked Dates	Serving customer	Yes, but touched product is discarded
Action when Product found Unwholesome	Discard or recondition			Hand Washing Facility	Washing Sinks not available
Container Type	Jute Sacks			Consumer Complaints	Occasionally
Container Condition	New bags			Hygiene Signage	Employee Signage? Yes

Table 3.11: Vendor #10. FERMENTED & SALTED FISH [“Momoni”]

Product Elements	Survey Response	Storage Elements	Survey Response	Selling to Consumer	Survey Response
New Stock Frequency	More than a Week	Ambient Temp.	No Monitoring	Product Package	No packaging
Product Temp.	No Monitoring	Storage Length	Month or more	Handling Utensils	No
Receiving Records	No recordkeeping	Added Ingredient	Nothing added	Gloved Hands	No
Organoleptic Method	Texture Discoloration Visual	New/Old Stock Differentiation	No Differentiation	Serving customer	Product touched with bare hands
Action when Product found Unwholesome	Discard			Hand Washing Facility	No Handwashing Sink/Basin
Container Type	Wooden Baskets			Consumer Complaints	Never
Container Condition	Clean reusables			Hygiene Signage	No Employee Signages

Table 3.12: Vendor #11. SMOKED GAME/BUSH/WILD/HUNTED MEAT

Product Elements	**Survey Response**	**Storage Elements**	**Survey Response**	**Selling to Consumer**	**Survey Response**
New Stock Frequency	Weekly	Ambient Temp.	No Monitoring	Product Package	No packaging
Product Temp.	No Temperature	Storage Length	Month to one year	Handling Utensils	None
Receiving Records	No Recordkeeping	Added Ingredient	Nothing added	Gloved Hands	No
Organoleptic Method	Smell Texture Visual	New/Old Stock Differentiation	No differentiation	Serving customer	Product touched
Action when Product found Unwholesome	Reconditioning By Heating in Oven			Hand Washing Facility	No Handwashing Sink/Basin
Container Type	Jute sacks Wooden basket			Consumer Complaints	Sometimes
Container Condition	Clean reusables			Hygiene Signage	No Employee Signage

Table 3.13: Vendor # 12. FERMENTED & DISTILLED PALMWINE

Product Elements	**Survey Response**	**Storage Elements**	**Survey Response**	**Selling to Consumer**	**Survey Response**
New Stock Frequency	Daily	Ambient Temp.	No monitoring	Product Package	Bottled or Plastic gallon
Product Temp.	No Temperature	Storage Length	One Week	Handling Utensils	Funnel
Receiving Records	No recordkeeping	Added Ingredient	Nothing added	Gloved Hands	No
Organoleptic Method	Smell Taste	New/Old Stock Differentiation	FIFO Method	Serving customer	Product not touched
Action when Product found Unwholesome	Not Applicable			Hand Washing Facility	No Handwashing Sink/Basin
Container Type	Plastic gallons Glass bottles			Consumer Complaints	Never
Container Condition				Hygiene Signage	No Employee Signage