**UNIVERSITY OF EDUCATION, WINNEBA**

**COLLEGE OF TECHNOLOGY EDUCATION, KUMASI**

# AN ASSESSMENT OF PRODUCTION PRACTICES OF *HIBISCUSSABDARIFFA* DRINK 'SOBOLO' IN THE SEKONDI TAKORADI METROPOLIS, GHANA.

**GEORGINA DADSON**

**200028256**

**JANUARY, 2020**

## DECLARATION

I hereby declare that this submission is my own work towards the Master of Philosophy (MPHIL), and that, to the best of my knowledge, it contains no material previously published by another person, nor materials which has been accepted for the award of the university, except where due acknowledgement has been made in the text.

…… Date: ……

Georgina Dadson
(Student)

…… Date: ……

Dr. Gilbert Owiah Sampson
(Supervisor)

## ACKNOWLEDGEMENT

I give my utmost gratitude to the Almighty God for his strength and grace throughout my studies. I am most grateful to my dearest mother, Mrs Elizabeth Jackson, my twin sisters Sylvia and Sylvestina Dadson, my brothers George and Francis Dadson and my husband Mr. Augustine Sarkwah for their financial support, encouragements and prayers.

To my supervisor, Dr Gilbert Owiah Sampson, (Dean, faculty of Vocational Education, UEW-kumasi campus), you were such an inspirer, a great mentor, rich in wisdom and therefore I am very grateful for your consistent guidance and immense input for the successful completion of this thesis.

My gratitude also goes to the Food and Drugs Authority (FDA) Takoradi branch and the Environmental Protection Authority, ( EPA ) Takoradi branch for their assistance during the visits to the production sites.

I thank my friends Joycelyn Armo-Ampomah and Johnson Yeboah for their contribution in diverse ways to the success of this work.

God bless you all.

## TABLE OF CONTENT

## LIST OF TABLES

**CONTENT** **PAGE**

## LIST OF FIGURES

**CONTENT** **PAGE**

## ABSTRACT

The main purpose of the study was to assess the production process, handling/serving practices and the personal and environmental hygiene producers observed in 'Sobolo' production. Specifically, the study sought to establish the production and handling practices, identify possible lapses in the production and handling practices, and develop a standardized production and handling model, guided by the HACCP to ensure a healthy 'Sobolo'. The study adopted both observational and explanatory descriptive survey design, gathered data through interview and an observation check list. A sample size of fifteen (20) 'Sobolo' producers were sampled through the snowball sampling technique. The microbial load of 'sobolo' samples were investigated with respect to total viable count (TVC). All tested samples revealed loads of Bacillus spp, Listeria monocytogens and Escherichia coli with TVC between $10^5$ and $10^6$ which is very unacceptable according to food safety standards of International Commission for Microbiological Specification of Foods (ICMSF). Data was analyzed qualitatively following thematic analysis approach using Nvivo as the analytical software. Key among the study findings: 'Sobolo' leaves (calyx) were not properly stored, sun-dried or sorted. Most producers used cold extraction and bottles for packaging were not properly washed. Overall, it could be concluded that 'Sobolo' producers do not adopt HACCP to ensure a hazard-free drink. It was therefore recommended that 'sobolo' producers must ensure high standards of personal hygiene and food safety practices. Environmental agencies, FDA and NGOs should take up projects to educate 'sobolo' producers in the adoption of HACCP in their production practices to ensure food safety. It was further recommended for a future study into composition of locally prepared 'sobolo' in Secondi -Takoradi Municipality in Ghana.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background to the Study

The street food industry plays an important role in the economic life of most people from producers to sellers as a source of business venture and food security, especially in the cities and towns. The industry also serves as a reliable source of affordable ready-to-eat foods and beverages for the mass population in public places such as the market, lorry terminals, ceremonial grounds and the like (Guardiola& Mach, 2014). In this regard, the significant impact street food industry has on national economy cannot be overemphasized. In the observation ofAllison, Marnie, &Lamm(2014), street-vended foods are mostly meat, fish, vegetables, cereals, frozen products and beverages.

Food safety is now a major public health concern and cases of outbreaks have recently been recorded, both in Ghana and Africa at large (Alfers & Abban, 2011). Diarrheal diseases due to the consumption of contaminated and unhygienic food are among the leading causes of illness and deaths in low-income countries, and several outbreaks of disease have been attributed to consumption of street food. In Ghana, diarrhea has been recognized as one of the major causes of hospitalization, resulting in 16% deaths among African children younger than five years (Sarkodie, Bempong, Tetteh, Saaka, & Moses, 2014). Food-borne illness or food poisoning is any illness associated with consumption of food contaminated by disease-causing bacteria, viruses, or parasites; natural toxins in plants or animals. Food is said to be hygienic when it contains no hazardous substance that could be harmful to human or animal health (Sarkodie et al., 2014).

Recent reports also highlighted the danger of high levels of heavy metals including lead, cadmium, arsenic, mercury and copper from utensils, raw materials or transport methods used (Nurudeen, Lawal&Ajayi, 2014) Other studies have taken a look at consumer behavior for possible answers to questions such as: *why, what, when, where and how* vendors purchase raw materials for processing (Alfers&Abban, 2011). Ensuring food hygiene and safety practice among vendors is one challenge that has existed for decades, and therefore the need for vendors to adhere to high standard food safety regulations and hygienic practices cannot be overemphasized (Alfers&Abban, 2011). However, a preventive strategy based on thorough analysis of prevailing conditions to ensure the achievement of quality assurance programme objectives is also recommended (Chukuezi, 2012).

The growing popularity of*Hibiscus Sabdariffa* drink sold by street vendors in most African markets has been great in recent times. The drink made from *Hibiscus Sabdariffa* plant serves as traditional non-alcoholic beverage with nutritional and medicinal purposes (Van Tonder, Lues Jan, & Theron, 2007). The product is termed differently in different nations and communities because of variations in languages and dialects. In Nigeria, the beverage from *Hibiscus Sabdariffa* is called 'Zibo' drink, and it is normally used to serve as refreshment in many occasions such as entertainments, funerals and parties or as appetizer at homes before meals (Ross, 2003; Donkor, Kayang, Quaye&Akyeh, 2009). In the Caribbean, the term 'Sorrell' is used to call the drink prepared from *Hibiscus Sabdariffa*whilst the Egyptians call it 'Karkarde' and serves as both non-alcoholic food beverage and for medicinal purposes (Clarence, Nwinyi&Chinedu, 2009).

Ghana is no exception in the business and consumption of the beverage made from *Hibiscus Sabdariffa* as popularly called ‘Sobolo’. Guardiola and Mach (2014) reiterate that plants such as *Hibiscus sabdariffa*have served as a good source of therapeutic agents for many years because consumption of herbs and vegetables is noted for their improvement in human health.Generally, food gets contaminated by pathogenic microorganisms and thus transmits food borne diseases such as cholera and dysentery among others. According to Mensah, Yeboah, Owusu and Ablordey (2002), this unfortunate situation often results from improper washing and handling of the *Hibiscus* leaves, unclean water used for preparation, packaging with dirty containers and unhygienic environment (amidst dust and flies) within which the product is prepared, in the case of‘Sobolo’.

‘Sobolo’is extracted from the dried reddish purple calyces of the *Hibiscus sabdariffa*plant.Itis prepared by boiling the dry calyces in water for at least 15 minutes to extract the pigment or the embedded flavour. The raw extract has a sharp and sour taste and is usually sweetened with granulated sugar and fruits depending on choice(Gilbert, Louvois, De& Donovan, 2000). In addition, ‘Sobolo’ is mostly spiced up with ginger. At present, much is not seen about mechanization and standardization of the production processes of ‘Sobolo’ in Ghana.

Furthermore, the mode of packaging or dispensing of the drink in nylon or plastic containers before retailing, the seemingly unregulated nature of the trade and poor hygienic practices expose the producttopotential contaminants and an increased risk to public health (Ross, 2003). Consequently,street drinks and foods safety has remained a major public health concern globally and more importantly inGhana where people tend to raise questions on the regularization of this critical sector, making street foods and drinks a hazardous source of nutrition (Clarence, et al., 2009).

## 1.2 Problem Statement

'Sobolo'is widely patronized for its use as a beverage and for the medicinal values ascribed to it for cure of cancerous problems, hangover, and nausea among others. As a result, it is massively patronized by Ghanaians making it a lucrative business for the rapidly increasing number of 'Sobolo' vendors.

Annually, over 1.8 million people loose their lives as a result of food borne diseases. (Center for Disease Control and Prevention, 2011). In Ghana, diarrhea has been recognized as one of the major causes of hospitalization, resulting in 16% deaths (Sarkodie et al., 2014). Complains of ill- health were reported as a result of consumption of some commercially produced 'sobolo' (Mensah et al., 2012)

This seem to floor the therapeutic and nutritive values for which the juice is taken. Observations have shown that most 'Sobolo' vendors do not produce the drink under hygienic conditions (Musah et al,2014). Cases of contaminated food substances can be traced from the preparation process (Barro, et al., 2006) as well as packaging and handling of finished product during sales.

Considering the above challenges, this study is to investigate and assess the production process with the ultimate aim of prescribing ideal preparation practices for the productionof'Sobolo'with respect to the seven principles of HACCP.

## 1.3 Purpose of the Study

The current study sought to assess the production process, handling and serving practices and the environmental hygiene producers observed in the production of 'Sobolo'. This will enable the study come out with recommended procedure for 'Sobolo' production with consideration of Hazard Analysis and Critical Control Point

(HACCP) principles along the "farm-to-table chain" that to ensure a healthy 'Sobolo' product for the market.

## 1.4 Specific objectives of the study

The specific objectives of the study were:

1. To establish the production and handling practices in the preparations and sales of 'Sobolo'.
2. To identify any existing lapses in the production and handling practices in the preparation of 'Sobolo' drink likely to expose the product to contamination.
3. To determine the microbial quality of commercial 'Sobolo'
4. To develop ideal production and handling model, guided by the seven principles of HACCP to ensure a healthy and hazard-free 'Sobolo

## 1.5 Research Questions

Towards the achievement of the stated objectives, the following questions have been posed:

1. What production and handling practices are followed in the preparation of 'Sobolo' in Takoradi Municipality?
2. What lapses are there in the production and handling practices in the preparation of 'Sobolo' likely to expose the product to contamination?
3. What is the microbial load of 'Sobolo' with respect to total viable counts?
4. What ideal production and handling model following the seven HACCP principles will ensure a healthy and hazard-free'Sobolo'?

## 1.6 Significance of the Study

Preliminary investigations into declining demand for 'Sobolo' drinks revealed complaints of ill-health after consuming the product. Hence the need for the current study to investigate and assess the production process and practices. The findings of the study will offer vital information for relevant institutions such as food and drugs authority, the health and sanitation directorate and the general public for appropriate surveillance measures to guarantee healthy serving 'Sobolo' product. The study further seeks to propose hygienic ways for 'Sobolo' producers to ensure healthy product for human consumption. What is more, the current study hopes to make significant contribution to existing literature so as to provide a source of reference for future related studies by other researchers.

## 1.7 Delimitation/Scope

The study was conducted in Takoradi Municipality where ten (8) production sites were visited to observe the production processes. Contextually, the study touched on hygiene practices in the production of 'Sobolo', guided by the seven HACCP principles.

## 1.8 Operational Definition

'**Sobolo**': Drink or beverage extract from the calyces of *Hibiscus sabdariffa*plant.

***Food Vendor****:* A food vendor is an individual who sells food, and for the purpose of this study sellers and handlers of 'Sobolo' drink.

***Hygienic Practices***: A set of practices performed for the preparation and handling of 'Sobolo' to ensure a health product.

***Food Safety***:A scientific discipline describing handling, preparation and storage of 'Sobolo'in ways that prevent food-borne illness.

***Contamination***: Infestation of food with pathogenic organisms.

## 1.9 Organization of the Study

The study was organized under five chapters. Chapter One gave the introductory part which covered the background of the study, the main purpose, the objectives and the hypothesis. It further outlined the research questions which guided the attainment of the research objectives, the scope of the study as well as the significance of the study. Chapter Two reviewed previous relevant literature to provide an in-depth knowledge of the topic area. Under this chapter, a review was made on some theories to underpin the current research and extended to various concepts and empirical studies of other authorities. Chapter Three discussed the methodological approach adopted for the study. It explained the research design, sample and sampling procedure as well as data collection methods. The chapter further explained the data collection tools, method of data analysis, and the ethical considerations observed to safeguard study participants and the study settings.The fourth chapter focused on analysis and discussion of the results in relation to prior empirical evidence and the study objectives. The final Chapter Five, summarized the main findings of the study, outlined conclusions and made recommendations for use by all stakeholders.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Description of *Hibiscus Sabdariffa* plant

Over hundred species of *Hibiscus* have been found in tropical regions around the world.*Hibiscus* species are normally used for ornamental purposes but are said to have other benefits such as medicinal properties of which *Hibiscussabdariffa*forms part (Cisse, 2010). *Hibiscus sabdariffa* is an annual herb cultivated for its leaves, stem, seed and calyces. The origin of the crop is traced from India but can now be found in other parts of the world including Central America, West Indies and Africa.The plant thrives in a wide range of soil conditions, it is resistant to short periods of drought, and grows fairly well in relatively infertile soils, but obviously, a soil rich in organic materials and essential nutrients is ideal for commercial cultivation (Thakur, Mehra, Narula, Mahapatra, S., &Kalita, 2013). *Hibiscussabdariffa*bears yellowish flowers with dark red pigment at the centre and its fruits are surrounded by calyces which are fleshy in nature. The reddish fleshy calyx (sepals) that surrounds the fruit is used in preparing the drink called 'Sobolo'in Ghana. The physical and chemical characteristic of *Hibiscussabdariffa* shows that it is a very acidic fruit with low sugar content.Bolade, Oluwalana and Ojo (2009)recall different names of *Hibiscussabdariffa* used in different parts of the world, and cites that as *Hibiscussabdariffa*is called'Sobolo' inGhana, It is called Dah or Bleni in Mali, Wonjo in Gambia and Zobo in Nigeria. In France it is termed asBissap, in Caribbean and Latin America it is known as Sorrel and Rosella in Ndonesia.

In Ghana, the several local names of *Hibiscussabdariffa*plant indicate that the plant is very popular among the people of Northern, Western and certain parts of southern Ghana. The plant is called *Digbemre*or*Injamgbam*(Dagbani); *Rarna*or*Sule*(Hausa);*Bito*(Moshi); *Riaripari* (Guan-Krachi); *Nangana* (Frafra); *Tingyanbam*(Konkomba); *Sakpa*(Ga); *Evema (*Ewe) (Wuliyeng, 2013). The calyces are the most used part of the *hibiscus* plants and they are acquired from the removal of the calyces from the capsules containing the seeds which serves a commercial interest. Literature establishes that fresh forms of the calyces contain calcium, iron, carotene ascorbic acid in 1.72mg, 57mg, 300mg and 14mg per 100 grams (Guardiola, & Mach, 2014). The dried calyces contain a higher amount of vitamin C between the ranges of 260-280 mg per 100g and said to have a higher content of ascorbic acid.

*Figure 2.1: Hibiscus sabdariffa plants*

*Figure 2.2: Fresh Hibiscus calyces*

## 2.2 Uses of *Hibiscus*sabdariffa (traditional, medicinal and nutritional)

The calyces of *Hibiscus sabdariffa*has multi use such as cooking vegetable soup prepared by parboiling with wood ash and washed thoroughly prior to its use for the preparation of soup. In Nigeria, the calyces have been shown to contain anthocyanin which serves as food colorants in food products such as confectionery products, snacks, cake, pudding, ice cream and beverages (Adanlawo&Ajibade, 2006). After oil extraction the residue is fermented and used as cake and the oils extracted serves as castor oil substitute. *Hibiscuscalyces* are used in India in brewing beverages, for producing jams, jellies and also serve as food preservatives (Cisse, 2010). In Ghana for instance, the dried calyces are prepared into a coldand refreshing drink called 'Sobolo'. The drink has gained popularity and acceptance because it iseasily processed at home, served and sold chilled by packaging in plastic bottles, polythene films and cups or glasses when at home or during occasions.

In addition to the traditional uses as explained by Cisse (2010), studies report of the medicinal use of calyces of *Hibiscussabdariffa* because of the antioxidant properties it contains. The consumption of a variety of local herbs and vegetables by man is believed to contribute significantly to the improvement of human health, in terms of prevention or cure of diseases because plants have long served as a useful and rational source of therapeutic agentsGuardiola and Mach (2014) posit that the human body contains natural enzymatic and non-enzymatic antioxidants that defend and protect it from free radicals which are harmful to the body. Therefore, consuming food substances such as 'Sobolo' from the calyces of *Hibiscussabdariffa*containing antioxidants help to enhance protection from free radicals by scavenging (Barro, Bello, Aly, Ouattara, Ilboudo&Traore, 2006).

Cisse, Dornier, Sakho, Ndiaye, Reynes and Sock (2009) report that the *Hibiscuscalyces* of roselle are very rich in vitamin C and riboflavin with some major minerals.*Hibiscuscalyces* are also used as a digestive and purgative agent and a folk remedy for abscesses, cancer and hypertension. Among Chinese and Senegalese for instance, it is used as traditional medicine in the management of hypertension andliver diseases (Cisse*et al*., 2009). Infusions of the leaves and calyces are employed as hypotensive and it is also claimed to decrease the rate of absorption of alcohol and so lessen its effect on the system. The calyces are good sources of antioxidant like anthocyanin and ascorbic acid.What is more, *Hibiscus sabdariffa*has also been found to possess several health benefits. *Sabdariffa*is medically used as an antiseptic, ant bilious, antiscorbutic, aphrodisiac, astringent, purgative, sedative and tonic. It is also a folk remedy for abscesses, cough, and dysuria (Fullerton, Khatiwada, Johnson, Davis & Williams, 2011). In Angola the *Hibiscus sabdariffa*is used as emollient and a soothing cough remedy. The leaves and seeds are used in the treatment of scurvy, which suggests the presence ofvitamin C. In Senegal, the leaves are used in the treatment of conjunctivitis. After oil extraction of *Hibiscus sabdariffa*seeds, Senegalese moisten the residue and apply it to cure wounds. Leaves are applied as a poultice to heal sores and ulcers especially inCentral Africa (Guardiola& Mach, 2014).

Studies have showed the constituents of *Hibiscus sabdariffa*plant to include citric, tartaric acids, hibiscin, and malic acids, delphinidin, anthocyanin hibiscitrin, gossypitrin, sabdaritrin and cyanidin. The plant has also exhibited antifungal, antiparasitic and antibacterial actions. Studies on the medicinal use of *Hibiscus sabdariffa* has not been that massive but Musah, Nii-trebi, Nwabugo and Asmah (2014) in a study found *Hibiscus sabdariffa*calyx extract suitability as colouringagent

for paediatric syrups in which the colour conformed to the blood pressure (BP) standard.

The calyces of *Hibiscus sabdariffa*are mainly used for the preparation of beverages, especially as tea and coffee substitute for people who are sensitive to stimulants. It is also used in preserves, jelly, juice, or as a sauce (Ajayi, Oluwoye& Williams, 2014) and also in making roselle wine, gelatin, pudding and cakes. The calyces can be used for colouring food and drinks (Oboh&Elusiyan, 2004). The leaves and calyces are also used as a cooked vegetable or used to make a soup. In Senegal, sauces made with the leaves and calyces, are eaten with tuber and cereals. Additionally, in the United States of America, the leaves are used for salads, and the red fleshy calyx used in fruit salads.

Also, during the dry season, especially in Côte d'Ivoire, the dried calyces are ground to powder and used in sauces. The plant is used as feed for livestock after the harvest of calyces. In many West African countries, the green leaves of the plant are eaten as a potherb orare added to a soup prepared with groundnut and "dawadawa". The *Hibiscus sabdariffa*seeds are eaten roasted as a snack or ground into meal (Burt, Volel&Finkel, 2016). The seeds are used as groundnut substitute in times of scarcity. Nigerians ferment roselle seeds to make 'sorrel meat' cake. The oil of roselle seed is extracted and used for cooking.

Nutritionally, *Hibiscussabdariffa*is highly rich in vitamins, minerals and bioactive compounds such as organic acids, phytosterols, and polyphenols. Major mineral compositions as established in Barro et al. (2006) include Sodium (96.66 g/100g), Potassium (49.35 g/100g), Phosphorus (36.00 g/100g), and Magnessium (38.65 g/100g).

## 2.3 Theoretical Underpining

A theory is a body of interrelated proposition,statement and concepts subjected to empirical verification (Omari, Quorantsen, Omari, Oppey&Asigbee, 2014). Omari et al. further explain that systematic application of theory in a research study is helpful to understand the events, activities, behaviours and /or situations, thereby providing complex and comprehensive conceptual understanding of things, giving different lenses to researchers to look at the research problems. The current study makes use of Health Belief Model (HBM) which was developed initially by Rosen stock in 1966 and further by Becker and colleagues throughout the 1970s and 1980s(Cisse, 2010). Cissereports that the (HBM) was one of the first theories of health behaviour developed to help understand behavioural patterns that emerged from the Public Health Service in United States.

According to the model, health related actions depend on the simultaneous occurrence of three components: the belief of a perceived threat to health; the existence of sufficient motivation to make health salient; and the belief that following a particular health recommendation would be beneficial in reducing a perceived threat (Acheampong, 2005).Studies have identified six main variables of HBM to include perceived susceptibility, perceived severity, perceived threat, perceived benefits, perceived barriers and cues to action. These six key constructs influence an individual's decisions as to whether to take action to prevent or screen for an action (Annor&Baiden, 2011).

Health Belief Model has some strength. Cisse (2010) posits that HBM has direct implications for intervention designs. The second strength is that HBM provides a profile of the beliefs of the population under study to allow for relevant and efficient interventions. The model also makes testable predictions such as large

threats might be offset by perceived costs while small threats might attract large benefits. Health Belief Model can therefore be presented as shown on Figure 2.2

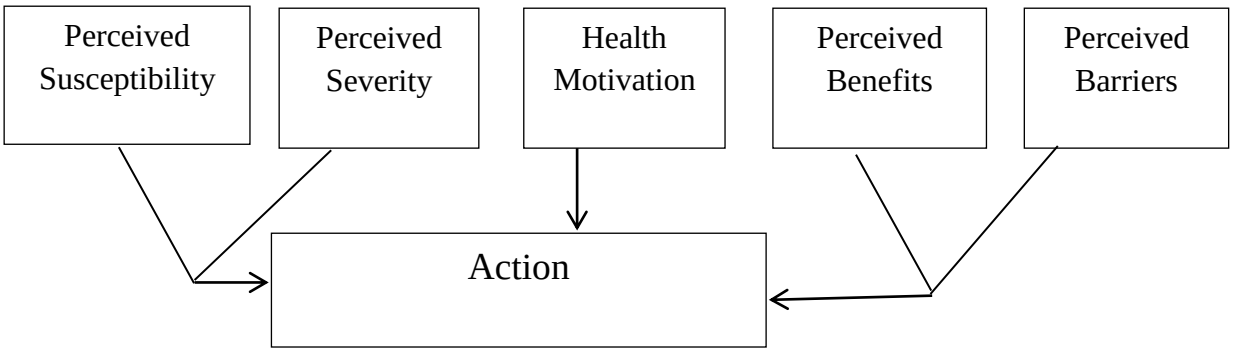



**Figure 2.3 Health Belief Model** **Source:Cisse, (2010)**

In the instance of the current study, it is postulated that production of hygienic and safe 'Sobolo' drink as a health related action cannot be dissociated from perceived threat to health due to the high possibility of food contamination along the process. It is therefore advocated for adequate motivation on the part of producers and handlers of 'Sobolo' drink to have adequate motivation to make sustenance of good health paramount as suggested in the Health Belief Model (HBM). In essence, the current study embraces HBM's proposition that following a particular health recommendation such as the Hazard Analysis and Critical Control Point (HACCP) principles will be beneficial in reducing the perceived threat (contamination or food poison).

## 2.4 Food safety

Burt, VolelandFinkel(2016) defined food safety as any food item devoid of any biological, chemical or physical hazards capable of causing harm to the consumer. The presence of these harmful contaminants not originally present in the food is believed to be introduced by humans although some do occur naturally. Food

safety also refers to all those hazards whether chronic or acute, that may make food injurious to the health of the consumer. This makes food safety non-negotiable, that is, the consumer has no control over the consequences once contaminated food is ingested. Food borne diseases are transmitted through consumption of contaminated food, drink or water. Improper washing of the *Hibiscus* leaves may introduce physical and chemical hazards into extracts leading to contamination of the product 'Sobolo'. Besides, use of unhygienic water for preparation, dressing with contaminated ice, improper storage, the use of unclean harvesting equipment, production in unclean surroundings and places where dust and flies are not properly controlled may also act as sources of contamination (Musah, Nii-trebi, Nwabugo&Asmah, 2014). Consequently, the drink could be a potential source of transmission of microbial contaminants, notably *Escherichia coli*, *Salmonella sp.*, *Shigella sp.*, *Staphylococcus aureus*and some filamentous fungi. Some of these contaminants cause serious disease conditions like typhoid, dysentery, enteric fever and peripheral as well as systemic mycoses, which represent threats to human health (Burt, Volel&Finkel, 2016).

Several cases of food-borne diseases occur in developing countries annually as reported in several studies. Annually, over 1.8 million people lose their lives as a result of food borne diseases (Center for Disease Control and Prevention, 2011). There are cases where food-borne diseases occur in the homes of individuals which are not accounted for in reports related to food-borne diseases. An assumption is made that the incidence of food-borne diseases in developing countries is actually higher than reported. Children who suffer from food-borne diseases sometimes have negative effect on their growth and development (WHO,2011). Bacterial contamination has been reported to be abundant in foods sold and prepared in Nigeria (WHO,2011).

The Food and Agricultural Organization (FAO) of the United Nations and the World Health Organization (WHO) have stated that the most prevalent health problem and an important cause of loss in economic productivity is as a result of diseases that arises from contaminated food (WHO,2011). An estimation of about 84,000 deaths occurred from diarrhoea outbreak as a result of consumption of foods that are contaminated in the years 2004 to 2008 this accounted for 25% of deaths among infants below the age of five while 297,104 out patients were reported with similar cases of food-borne illness (Rane, 2011).

In Ghana, the Food and Drugs Authority (FDA) reported in 2006 that Ghana recorded 90,692 deaths in the area of food and personal hygiene-related illnesses alone but 297,104 patients were reported at the various Out-Patient Departments of clinics and hospitals with similar cases (Koopmans&Duizer, 2005). An incidence due to cholera outbreak resulted in 922 cases being reported in various health facilities in the Cape Coast metropolis and the loss of four lives (Atoagye, 2012). Large amounts of money from both government and developmental partners are channeled into solving food-borne diseases yearly (Atoagye, 2012). Tackling food and water safety together would serve as an essential tool to reduce the diseases, reducing the level of contamination associated with food to minimize unsafe food that are consumed and this wouldgo a long way to ensure that individuals enjoy good health which turns to improve the economic growth in developing countries.

The growing movement of people, live animals in food handling, and the emergence of new pathogens or antibiotic resistance in pathogens all contribute to increasing food safety risks (Rane, 2011). The burden of food borne diseases though preventable remains huge contributing to worldwide morbidity. The WHO estimates that each year, unsafe food makes at least two billion people, representing about one

third of the global population ill worldwide. Simple prevention techniques could significantly reduce this burden (WHO 2011). The number of reported outbreaks of food-borne illnesses has been high, both in developed as well as developing countries (Abdalla, Siham, Alian&Amel, 2008). Food contamination in developing countries is caused by many factors including traditional food processing methods, inappropriate holding temperatures, and poor personal hygiene of food handlers which is really seen in the street food vending industry in Ghana.

Although Ghana has implemented several policy mechanisms to control food contamination, several sources of contamination still exist that are difficult to control. Poor sanitary conditions like open gutters, flies, improper waste disposal, and overcrowding are still persistent dangers to food hygiene (Sarkodie et al., 2014). An estimated hospitalization in Ghana due to food related diseases stands at 420,000 per year, with an annual death rate of 65,000 people (Sarkodie et al., 2014). Even vendors who exhibit knowledge about food hygiene still find it difficult associating dirty hands with the transmission of diarrheal pathogens in Ghana.

## 2.5 Wayside Vendors and Food safety

Food vending has become an important public health issue and a great concern to everybody, probably due to widespread food borne diseases, associated with mushrooming of wayside food vendors who lack adequate understanding of the basic food safety issues (Oghenekohwo, 2015). Major sources contributing to microbial contamination are the place of preparation, utensils for cooking and serving, raw materials, time and temperature abuse of cooked foods and the personal hygiene of vendors. Various studies (Palinkas et al., 2015;Oghenekohwo, 2015) have identified the sources of food safety issues involved in street foods to be microorganism

belonging to the genus Bacillus, Staphylococcus, Clostridium, Vibrio, Campylobacter, Listeria, Salmonella. Application of sound risk analysis policies is being advocated to provide a scientific base to the host of risk management option which Ghana, among other countries, may need to explore to ensure public health and safety.

With the grip of sudden and unprecedented urban growth, and an increase in the size of the labour force, the demand for non-traditional services has gained momentum. Food vending has shed its disorganized, lower class image and is becoming a viable, important informal-sector industry. Vended foods are not only appreciated for their unique flavors, convenience and the role which they play in the cultural and social heritage of societies, they have also become important and essential for maintaining the nutritional status of the populations (Ifeadike, Ironkwe, Adogu&Nnebue, 2014). Besides offering business opportunities for developing entrepreneurs, the sale of street foods can make a sizeable contribution to the economies of developing countries. In India for instance, the national policy for urban street vendors/hawkers state that street vendors constitute approximately 2% of the population of a metropolis (Okojie&Isah, 2014).

Vended foods are perceived to be a major public health risk due to lack of basic infrastructure and services, difficulty in controlling the large numbers of street food vending operations because of their diversity, mobility and temporary nature (Olawale, 2011).Olawale perceives that a general lack of factual knowledge about the epidemiological significance of many street vended foods, poor knowledge of street vendors in basic food safety measures and inadequate public awareness of hazards posed by certain foods has severely hampered the deployment of a precise scientific approach to this very serious issue of public health and safety.

Food vendors are street food sellers who sell ready-to-eat foods or drinks in a street or other public place, often from a portable stall. While some street foods are regional, many are not, having spread beyond their region of origin. Rane (2011) defines street food as any minimally processed food sold on the street for immediate consumption. Annor andBaiden(2011) describe “street-vendor foods” or its shorter correspondent “street foods” or “wayside goods” as ready-to-eat foods prepared and/or sold by vendors and hawkers especially in the streets and other public places. Most street foods are also classed as both finger food and fast food and are inexpensive on average than restaurant meals.

Food poisoning and other food borne diseases could occur through poor hygiene practices, especially in areas where food and drinks are served. In most cities around the world, selling of whole meals on the streets is an important means to generating income. Unfortunately, the emergence of informal food businesses can cause health problems if the foods are not prepared and handled under hygienic conditions (Da-Costa-Rocha, Bonnlaender, Sievers, Pischel& Heinrich, 2014). The current study concords with Da-Costa-Rocha’s(2014) justification for a critical study into the operations of food vendors to ascertain whether they are adhering to proper hygiene practices. Global and local street vendors are a vital source of cheap food (Burt, Volel&Finkel, 2016). But street foods often do not meet proper hygiene standards, in large part because of weak regulatory systems, inadequate food safety laws, lack of financial resources to invest in safer equipment, and lack of education for food-handlers. Research on food -borne illness risk factors indicates that most outbreaks in food service establishments can be attributed to the improper food preparation practices by food workers (Rane, 2011;Nurudeen et al., 2014).

Globalization of food trade has focused its attention on strengthening measures taken to ensure quality and safety, especially on finished foods, and different countries have developed specific regulations to ensure food safety and hygiene (Nurudeen et al., 2014). Food and personal hygiene are known to prevent several food-borne diseases when practiced. It is broadly acclaimed that deliberate or accidental contamination of food due to improper handling of food might endanger the lives of consumers. Several hygiene practices such as poor personal and environmental hygiene, inadequate storage of food and drinks, improper preparation and cooking are known to compromise the safety of food.

In the last decade, street food vending has expanded rapidly to provide a wide range of inexpensive foods for public consumption. This industrial expansion is however not without problems. The increasing relevance of food consumed away-from home brings new challenges for public health policies (Chukuezi, 2012). Food safety is now a major public health concern and cases of outbreaks have recently been recorded, both in Ghana and Africa at large (Musah et al., 2014). Food is consumed mainly to build and support life but otherwise is seen and reported that food can pose detrimental effect to the health of consumers through chemical, biological or physical hazards. In most developing countries food vending remains a growing industry providing daily foods for most urban dwellers (Musah et al., 2014; Atoagye, 2012). Sorrel drink 'Sobolo' made from *Hibiscus sabdariffa*is now a widely patronized drink sold on the streets and well patronized during ceremonies in Ghana.

Globally, wayside food vending is a business practiced in many countries especially in Africa. Foods are seen being sold in the urban cities around places like work, schools, hospitals, universities, railway stations, bus terminals and taxi ranks in the urban areas (Kok&Balkaran, 2014). This practice has become an acceptable

lifestyle in many developing countries, especially in Africa. Street food vendors in most cities usually have varieties such as snacks, drinks and even full meals. The street food business is now a large food industry providing affordable food for majority of the population and income for the vendors (Scallan, Hoekstra, Angulo, Tauxe, Widdowson, Roy&Griffin, 2011).Wayside foods represent a significant part of urban food consumption for millions people on a daily basis especially for low-and-middle-income consumers. For many low income people, street foods maybe the least expensive and most accessible means of obtaining nutritionally balanced meal outside their homes. In developing countries, street food business provides a regular source of income for millions of men and women who have dropped out from schools, most people are able to engage in this business because the activity requires low initial investment. This activity also promotes the work of local agricultural producers and food processors and contributes to local and national economic growth (Scallan et al., 2011). Guardiola and Mach (2014)state that there is an assumption that by their nature, street food contamination is inevitable, but a huge number of people depend on this source for nutrition and economic livelihood.

Food safety is a vital issue in both developed and developing countries in that food-borne illness contribute to millions of illnesses and thousands of deaths annually (Scallan*et al*., 2011). This is becoming a vital public health issue, since a large number of people have their meals outside home and thus, they are exposed to food-borne illness that originate from street food vends. In view of that, the World Health Organization (WHO, as cited in Sarkodie*et al.,* 2014) has developed five main preventive steps to enhance food safety which include "thorough cooking of food; thorough re-heating of stored food; avoiding contact between raw foods and cooked food; and protection of food from insects, rodents and other animals".

## 2.6 Preparation of *Hibiscus* beverage 'Sobolo'

'Sobolo'is a made from extracting the anthocyanin in the calyces, it is indigenous and said to be non-alcoholic. The calyces are either boiled with water or left in water over night. It is sieved with a colander to remove the calyces. The extract is sweetened with sugar, fruits, ginger, spices and other flavours are added to enhance its taste, the drink is stored refrigerated (Okojie&Isah, 2014). In a typical Nigerian community, Bolade, Oluwalana&Ojo(2009) observed a traditional process flow for the preparation of 'Sobolo' drink as displayed on Figure 3.

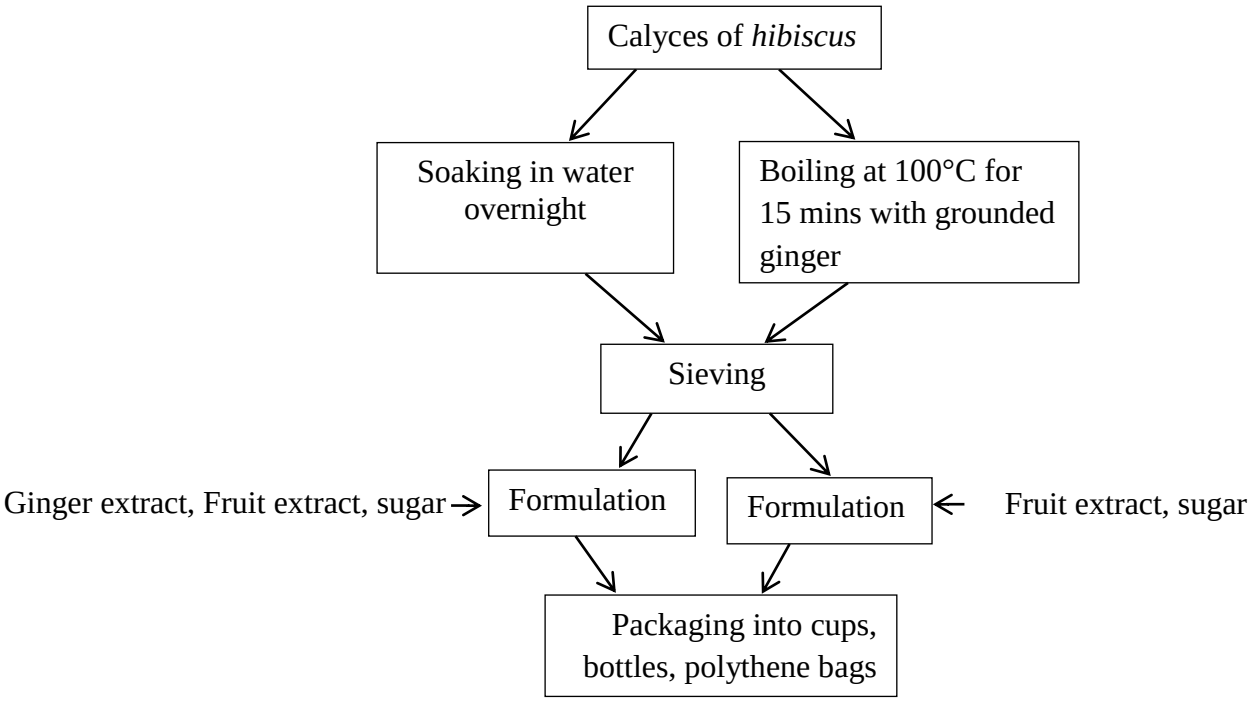



**Figure 2.4: Traditional process flow of 'Sobolo' drink**

Source:Bolade, Oluwalana and Ojo(2009)

Similar observations were made by Cisse (2010) in Senegal,tracing the preparation of ‘Sobolo’ drink from harvesting of fresh flower through shelling to obtain the calyces. The calyces are dried, boiled, filtered, extracted (the aqueous), and formulation follows before packaging for refrigeration. Cisse (2010)presents the flowchart of ‘Sobolo’preparation as shown on Figure 4.

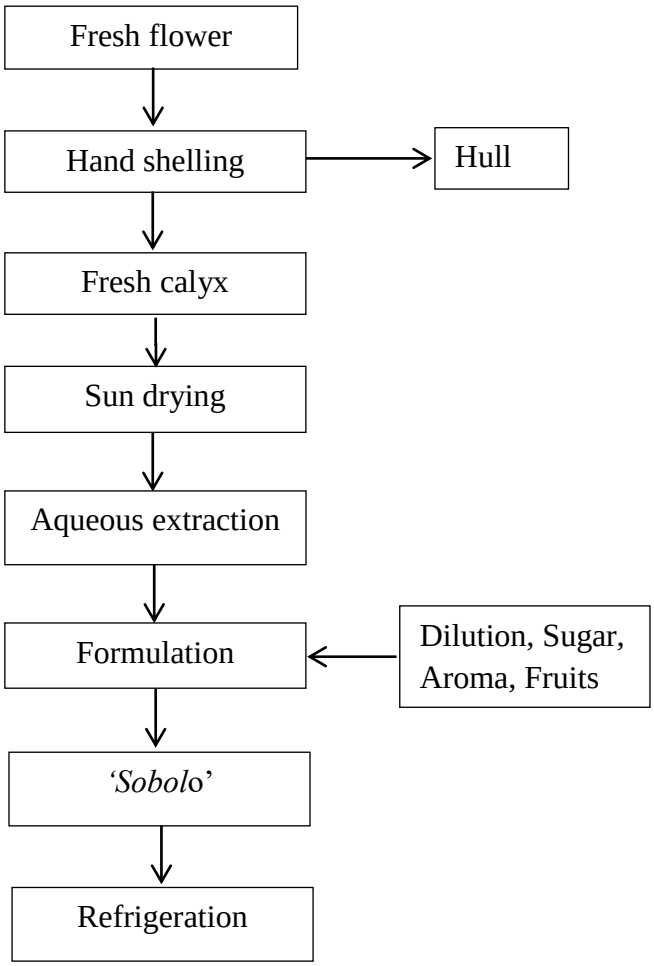



**Figure 2.5: Flowchart ofprocessing ‘Sobolo’**

Source: Cisse(2010)

The extraction operation is carried out at the temperatures of 25–100 °C. After extracting the aqueous solution, filtration is carried out,sugar and other additives, artificial flavourings and fruit juices or fruit pieces (pineapple,strawberry and ginger) may be added (Cisse, 2010). A suitable solvent is brought into contact with the mixture. The solvent should be one that the element of interest is soluble in and insoluble to the other substances present within. Extraction includes Liquid-liquid phase *extraction*, and Solid-liquid phase *extraction* (Cisse, 2010; McKay, Chen, Saltzman& Blumberg, 2010). During preparation some producers use cold water for extraction whereas others extract in hot water during boiling. A study on optimization of hot water extraction andsweetness level in beverage production by Omemu, Edema, Atayese and Obadina(2006) revealed that extraction period of 30 minutes at a constant temperature of 100±2 °C is the best stage of extraction.

## 2.7 Hygiene Practices and Food Vending

In medicine and in the home (domestic) and everyday life settings, hygiene practices are used as hindering measures to reduce theincidence and spreading of disease (Ewansiha, 2014). According to Singh, Kaur, Singh, Youdon, Kaur and Marwaha (2017), hygiene is the science and practice of maintaining health and preventing diseases in every catering establishment that provides food. Suffice it to mention that conscious effort must always be put in place to protect people as well as the environment from bacteria in order to eliminate contamination of the food that people eat (WHO, 2010). Therefore hygiene can be defined as all the necessary practices and conditions that are exhibited by individuals in their daily activities to ensure the prevention of diseases and to maintain good health.

Food hygiene is the set of basic propositions used to check environmental factors during production, preparation, selling and serving food in such a way to ensure that food eaten is of good quality. Food hygiene depends largely on the personal hygiene practices of food vendors (Singh, et al., 2017).Ewansiha(2014) also interprets hygiene as the preservation of health involving all measures that ensure the safety and quality of food during its preparation and handling and identifies these measures as adequate storage of both raw and cooked foods including the right preparation and cooking procedures. Food hygiene, according to Chapman et al., (2010), represents those factors which influence the health and wellbeing of an individual. The factors include observance of simple rules about health behaviors including cleanliness among others. Foods cooked under unhygienic conditions provide plenty of opportunity for transfer of bacteria as well as growth or survival of bacteria and other pathogens. The hygiene and sanitation aspect is the most important factor that could possibly have a negative impact on food quality (Chapman*et al*., 2010).

According to Ewansiha(2014), washing of hands, utensils and dishes are often done in bowls or pots of water. It is worth noting that disinfection is occasionally carried out and this eventually attracts pests to the vending sites especially when there is inadequate refuse disposal (Oghenekohwo, 2015). Furthermore, foods prepared at these sites put consumers' health at risk as food is often not refrigerated at the right temperatures.

Most studies conducted in Ghana concerning various aspects of food hygiene over the past decade have revealed poor food hygiene knowledge and attitudes of street food vendors, with personal hygiene least observed by the least educated (Acheampong, 2005). Most of the vendors have either no formal education or few years of schooling and therefore are simply ignorant of proper food handling and their tendency to transmit pathogens is higher.

## 2.8 Hazard Analysis of Vended Foods

The foremost health hazard related with street foods including ‘Sobolo’ drink is microbial contamination, while transmission of parasites, pesticide residues, the use of unpermitted chemical additives, environmental contamination and limited access to safe water have also been identified as possible hazards (Rane, 2011). The potential for the contamination of street foods with pathogenic microorganisms has been well documented and several disease outbreaks have been linked with the consumption of contaminated street foods (Rane, 2011). The risk of microbial contamination is dependent on the type of street food and how the food is prepared. The risk associated with food is influenced by food type, pH, and method of preparation, water availability, handling, exposure temperature, and holding time (Rane, 2011).

Other factors implicated in causing microbial contamination include poor food preparation and handling practices, inadequate storage facilities, the personal hygiene of vendors, and a lack of adequate sanitation and refuse disposal facilities (Chukuezi, 2012; Abdalla*et al*., 2008). Poor hygiene, inadequate access to potable water supply and garbage disposal, and unsanitary environmental conditions such as nearness to sewers and garbage dumps further exacerbate the public health risks associated with street foods (Abdalla*et al*., 2008). Traditional processing methods that are used in preparation, inappropriate holding temperatures and poor personal hygiene of food handlers are some of the main causes of contamination of street-vended food (Zeru&Kumie, 2007; Van Tonder*et al*., 2007).

From the initial contamination of raw foods with pathogenic bacteria to subsequent contamination by vendors during preparation (Burt, Volel&Finkel, 2016), the factors that should be considered for analyzing the hazards ‘Sobolo’ production or vending are many. The conditions under which some producers operateare reported to

be unsuitable for the preparation and selling of food (Oghenekohwo, 2015;Oboh&Elusiyan, 2004). Seen as hazardous, Oboh&Elusiyan(2004) reports of situations where food is prepared either at home or at stalls, which are located on the street side and are made up of wood, polythene bags, and tins and the place of preparation is not always clean, well-lit and not far from source of contamination. Preparation surfaces used by some vendors have remains of foods prepared earlier that can promote cross contamination. Most of these foods are not coveredand are exposed to flies and dust, which may harbor food-borne pathogens. In 70–90% of the cases, presence of animals, insects and liquid wastes in food preparation areas have been reported (Zeru&Kumie, 2007).

Unsanitary handling of foods by some vendors has been commonly found to be the source of contamination (Abdalla, Siham, Alian&Amel, 2008). Vendors can be carriers of pathogens like Escherichia coli, salmonella, shigella, campylobacter and aureus who eventually transfer these foods borne hazards to the consumers. The hands of the food handlers are the most important vehicle for the transfer of organisms fromfaeces, nose and skin to the food (Abdalla et al., 2008). It is often observed that contamination of foods is also linked to the waste generated by food processing, that is usually dumped near the vending or processing site. The lack of facilities for liquid drainage, wastewater and garbage disposal encourages wastes to be thrown into nearby streets and gutters. Such areas, according to Koopmans&Duizer(2005)tend to be ideal habitats for rodents, breeding points for flies and media for growth of microorganisms. A study done in Africa (Guardiola& Mach, 2014) revealed that 85% of the vendors prepared foods like fish, fruit salads, and beverages in unhygienic conditions, given that garbage and dirty waste were conspicuously close to the stalls. In these areas large amounts of garbage accumulates which provide harborage for

insects and animal pests that are linked to enteric disease transmission (Shigella, Salmonella and E. coli). In a related study, Annor and Baiden (2011) report that quality of raw materials used in the preparation of‘Sobolo’ drink is very important as their contamination can persist through preparation and or cooking. Abdalla et al. (2008) hold the view that contaminated water can create a public health risk when it is used for drinking, washing of foods,incorporated in the food as an ingredient and used in theprocessing of food or used for washing equipment, utensils and hands. It is a well-known vehicle for enteric pathogens such as E. coli, Salmonella spp. and Campylobacter spp. among others (Zeru&Kumie, 2007). Studies carried out in different regions of Asia, Africa and South America have frequently pointed the unavailability of potable water for various activities at the vending site as a major concern. Due to the shortage of clean potable water, many vendors tend to reuse the water, especially for cleaning utensils and used dishes (Zeru&Kumie, 2007).

Studies done in Trinidad and Tobago to find out the bacteriological quality of the water used by some food vendors revealed frequent contamination with coliforms and fecal coliforms (Oghenekohwo, 2015). It was reported that 35% of foods were contaminated by E. coli while 57.5% of water used by vendors were contaminated by coliforms. These reports were similar to the findings that the stored water used by consumers and vendors, at the vending site, showed heavy bacteriological contamination of faecal origin (Olawale, 2011). Such heavily contaminated water is a primary source of diarrheal diseases to the food consumers. When water samples from storage tanks used by some vendors were checked at different localities in Pune, India, it was revealed that 29.6% of the water samples were not conforming to the WHO standards of potability and had coliform counts of more than 16/100 ml. While fecal coliform counts were more than 16/100 ml in 15.5% of water samples, 4.5% of samples were positive for E. coli and 2.7% for enter pathogenic E. coli. Similarly,

pathogens like Salmonella and Shigella were detected in the water used by vendors for dishwashing (Oboh&Elusiyan, 2004).

Other area of concern in a study of food safety is the use of proper utensils for cooking and storage of prepared food. Guardiola and Mach (2014) reiterate that poor quality of material coupled with improper practices may lead to toxin formation, pathogen growth or recontamination. The design, construction and maintenance of equipment and utensils is very important to food safety, as their poor maintenance may lead to the inability to effectively clean and sanitize surfaces. This may then result in the buildup of residues of food, facilitating microbial growth, leading to an increased likelihood of contamination. As some containers will leach hazardous chemicals like copper, lead and cadmium into food, use of equipment and utensils incompatible with the food being handled, shouldbe avoided. This has been observed particularly with acidic food and beverages (Guardiola& Mach, 2014).

An important issue influencing food contamination and contributing to further increase in contamination is food storage temperature. The preparation of food long before its consumption, storage at ambient temperature, inadequate cooling and reheating, contaminated processed food, and undercooking are identified as the key factors that contribute to food poisoning outbreaks (Olawale, 2011).Olawalestates that foods are often held for several hours after cooking and this includes overnight holding at ambient temperaturesuntil sold, and thus can harbor high microbial populations. According to Oboh and Elusiyan (2004), food handling personnel play an important role in ensuring food safety throughout the chain of food production, processing, storage and preparation. Mishandling and disregard of hygienic measures on the part of the food vendors may enable pathogens to come into contact with food and in some cases to survive and multiply in sufficient numbers to cause illness in the consumer.

In an observation, Ross (2003) cited that some food handlers may introduce biological hazards by cross contamination after handling raw materials when they suffer from specific diseases and physical hazards by careless food handling practices. Most of the vendors pack the food in polythene bags for their customers. When packing these foods, they blow air into the polythene bags to open them, in this process a number of pathogens can be passed on to the consumer, Ross (2003) therefore advises that a logical step towards reducing the risks of food borne illness from foods would be controlling the steps in food preparation and sale that may contribute to the contamination, growth and survival of the microbes responsible for food borne illness. Koopmansand Duizer (2005) concords with Ross (2003) and add that the efforts made should focus one educating the food handlers, improving the environmental conditions under which the trade is carried out, and providing essential services to the vendors to ensure safety of their commodities.

## 2.9 Empirical Study

Studies have established varying levels of knowledge and practices of food hygiene. In Omemu et al. (2006), it was observed that respondents had a reasonable level of awareness on food hygiene. Though respondents were found to have satisfactory food hygiene attitudes, results of the individual components of hygiene practices, like hand washing with soap, medical screening and certification, proved that vendors did not follow strict food hygiene practices. In a related study (Rane, 2011),results indicate that awareness on food hygiene was translated into practice among vendors. The findings revealed that awareness on food hygiene was almost universal (89.5%), and as a result, almost all vendors (87%)operating within the study area were practicing food hygiene.

Contrary to this finding, Ewansiha (2014) in evaluating food hygiene awareness and practices of food handlers in Kumasi found that vendors had little understanding and awareness about food hygiene issues and a few respondents had knowledge on food-borne diseases, such as typhoid and cholera and their ways of transmission.Rane's (2011) survey of 530vendors in India, indicated that most consumers did not associate unsafe food with food borne illnesses. The pathways of disease transmission most often mentioned were flies, garbage, gutter and fecal materials. Similar contamination routes were also mentioned by respondents of this study, including hands, flies, dust from roads, untidy surroundings and rubbish.

In a research conducted by Chukuezi (2012) in Nigeria, it was found that despite the efforts of the government to regulate the activities of vendors and other catering institutions, some food and beverage suppliers were not hygiene compliant. The microbial count from these suppliers with the worst food hygiene checks, such as no headgears, gloves worn by food handlers, were the highest but were least at suppliers with the best-observed food hygiene checks. This observation suggests that when food hygiene checks are strictly followed, contamination could be reduced and the efforts of the government in this regard could prove beneficial if adhered to.

According to Zeruand&Kumie (2007), there is strong statistical evidence that 70% of all bacterial food poisoning is caused by caterers. This is greater than occurrences reported from any other food sector. Most of these food poison outbreaks are due to the inadequate time and temperature control of food, whereas the remaining thirty per cent is as a result of cross-contamination (Okereke, Iroka&Chukwuma, 2015). A number of studies have found that such foods are sometimes held at improper temperatures, or mishandled by food vendors and sold in dirty environs (Okereke et al., 2015; Chukuezi (2012; Sutton& Austin, 2015). All these contribute to

the infection of seemingly tasty food by different disease-causing parasites. Similarly, a study by Burt, Volel &Finkel 2016) assessing food handling practice of 10 processing street food vendors operating in Manhattan, New York City established that more than half of the vendors (67%) approached served food with bare hands. Adzaml (2015), in their study found that most food vendors have barely any formal education which are also important factors contributing to food-borne related diseases as they are considered to be of very little or no educational background and hence have low understanding of food safety issues. However, other scholars have proposed that even though training leads to increased knowledge of food safety, it does not necessarily imply positive food handling behaviour (Dun-Dery&Addo, 2016).

Studies in Ghana on various aspects of food hygiene over the last decade revealed that most food vendors have inadequate food hygiene knowledge and attitudes that affect the personal hygiene of the vendors Alfers&Abban, 2011).AlfersandAbbaninvestigated food safety knowledge and practice of‘sobolo’ producers from a representative urban university campus in Quezon City,Philippines. The study established that among the 54 street foods, concepts were established particularly on topics that dealt with health and personal hygiene, food contamination and good manufacturing procedures. Nevertheless, vendors seemed not to be well-informed in terms of food legislation and waste management. The study established a significant gap between knowledge and practice on these topics and this was fundamentally attributed to the inclinations of street food vendors to compromise food safety for financial issues.

A comparative analysis from the chi-square test by Chapman, Eversley, Fillion,MacLaurin& Powell (2010) reveal that the cleanliness of vendors’ fingernails, as well as the adequacy of food protection from flies, is linked to the training of food

vendors on food hygiene and safety since it indicated a statistically significant difference. Suffice it to mention that food vendors trained in food hygiene and safety would possibly keep their fingernails clean and adequately protect their food from flies and dust. The study also demonstrated that training of food vendors on food hygiene and safety had a significant association with crucial food hygiene and safety practices such as medical examination, hand hygiene and protection of food from flies and dust. This stresses the importance of training among food vendors to ensure the continuation of best practices in the street food vending business thereby protecting public health. The work done by Duhain (2011) showed the presence of 30 % faecal coliforms in the food samples which showed high possibility of contamination from other pathogenic organisms. In a work done by Omemu, Edema, Atayese&Obadina(2006) on the microflora of *Hibiscus sabdariffa*'Sobolo' juice where dried calyces were bought and prepared into juice, It was compared to commercially sold 'Sobolo'on the streets. The comparison was done based on microbial load. The findings showed lower counts for laboratory prepared 'Sobolo'than the ones sold on the streets.

Correct handling of 'Sobolo' drink during all stages of its preparation and storage is vital in reducing the incidence of food-borne illness (Braide, Oranusi& Peter-Ikechukwu, 2012). However, between 10 and 20% of food-borne illness both in Australia and the United Kingdom is estimated to be as a result of consumer food handling behaviour (Palinkas, Horwitz, Green, Wisdom, Duan&Hoagwood, 2015). A systematic review of food safety studies identified that consumers commonly implement unsafe food handling behaviours during domestic food preparation (Koopmans&Duizer, 2005).

# CHAPTER THREE

# METHODOLOGY

## 3.1 Study Design

As explained by Kumar (2005), research design is a procedural plan that the researcher adopts to answer questions vividly, objectively, accurately and economically. The design for the study was both observationaland explanatory descriptive survey where visits were made to the production sites to observe the physical environment within which the product 'Sobolo' is prepared, the production process and other practices for informed data. Respondents were also made to explain some practices in the production of the 'Sobolo' drink. Data wasanalyzedqualitatively to enable study findings to be generalised from a sample to the entire population of the study. The analysis of the qualitative data was inductive to allow research findings to emerge from the frequent, dominant or significant themes inherent in raw data, without the restraints imposed by structured methodologies. Using thematic analysis, the study demonstrated analytical rigour in the stages of coding and the identification of emergent themes through the use of Nvivo as analytical tool.

## 3.2 Population for the Study

A research population is generally a large collection of individuals or objects that represents the main focus of a scientific query. Population for this study (N=122) comprised all the people involved in the production of 'Sobolo' drink at the production centres including the caterers who manage the enterprises.

## 3.3 Sample and Sampling Techniques

In a description of sample, Turner (2010) stated that a sample is derived from the population to ensure they exhibit same characteristics. Sampling therefore is the act of selecting respondents from the target population and a sample size is the number of respondents actually used to participate in the study (Turner, 2010; Sutton & Austin, 2015). A total of twenty (20) respondentsfrom ten (10) production sites including one (1) caterer/managerwere initially sampled but fifteen (15) of them actually granted interview for the purpose of data collection. Convenience sampling technique was adopted, which seasoned researchers (Feglo&Sakyi, 2012; Cresswell, 2003; Acharya, Prakash, Nigam &Saxena, 2012) posit as appropriate in selecting participants because they are often readily and easily available. This sampling technique is therefore non-probability.

## 3.4 Data Collection Tools

The study made use of an interview guide and observational guide developed from the literature reviewed and in line with the research objectives relating to the study context/variables to collect data for the study. The use of interview guide is justified for its open-ended nature to reap the advantage of allowing room for more detailed submissions from respondents (Allison et al., 2014), though organised in line with the study objectives. Again, Afele (2006) posits that qualitative interview allows the interviewees a degree of freedom to explain their thoughts and to highlight areas of particular interest and expertise they have, as well as to enable certain responses to be questioned in greater depth.

## 3.5 Data Collection Procedure

Interviews were conducted at the various production centres. Respondents were given explanation of the practical relevance of the study before engaging them in a conversation, using an interview guide (Burns & Grove, 2005) to discuss the production process and hygiene practices. The interviews were conducted as professional conversations that consisted of an agreed dialect in which the interviewer follows the conversational threads opened up by the interviewee and guides the conversation toward producing a full account of the situation under investigation.

Studies (Thomas, Silverman& Nelson, 2015) recognise the possibility of respondents digressing from the main themes, as the reverse side of the use of interview guide but responses were regulated with well-tailored follow-up questions to keep respondents on track. Clues were also given respondents if they seem to digress from the questions being discussed, following the suggestions of Burns and Grove (2005). Respondents were allowed to use any of the local spoken dialects in Ghana, but preference was be given to Fante, Twi and English languages. As an interview goes on, notes were jotted and full recording of the conversation were made to a recording machine without missing a word. A maximum of twenty (20) minutes was spent on interrogating each respondent.

The study also made use of observational guide. A check list was developed from the literature reviewed and in line with the research objectives relating to the study context/variables to collect data. Areas of concern in relation to safety and hygienic practices thus, personal hygiene, food hygiene, kitchen hygiene, environment\surroundings, materials and equipment were outlined in line with the standards of the Environmental Protection Agency (EPA) and the Foods and Drugs

Authourity (FDA) were outlined and observed. Observations made were documented for references.

### 3.6 Data Analysis Technique

The essence of data collection in research is to interpret and analyse and to transform information (data) into a meaningful form in order to answer the original research question(s) or to solve the study objectives (Palinkas, et, al., 2014). The method of analysis chosen for this study is the qualitative approach of thematic analysis. The analysis of qualitative data was inductive to allow research findings to emerge from the frequent, dominant or significant themes inherent in raw data, without the restraints imposed by structured methodologies. Thematic analysis, most widely used qualitative approach to analyzing interviews (Turner, 2010), was adopted. The thematic analysis is a method used for identifying, analysing, and reporting patterns (themes) within the data. What counts as a theme is that it is something which captures the key idea about the data in relation to the research question and which represents some level of patterned response or meaning within the data set.

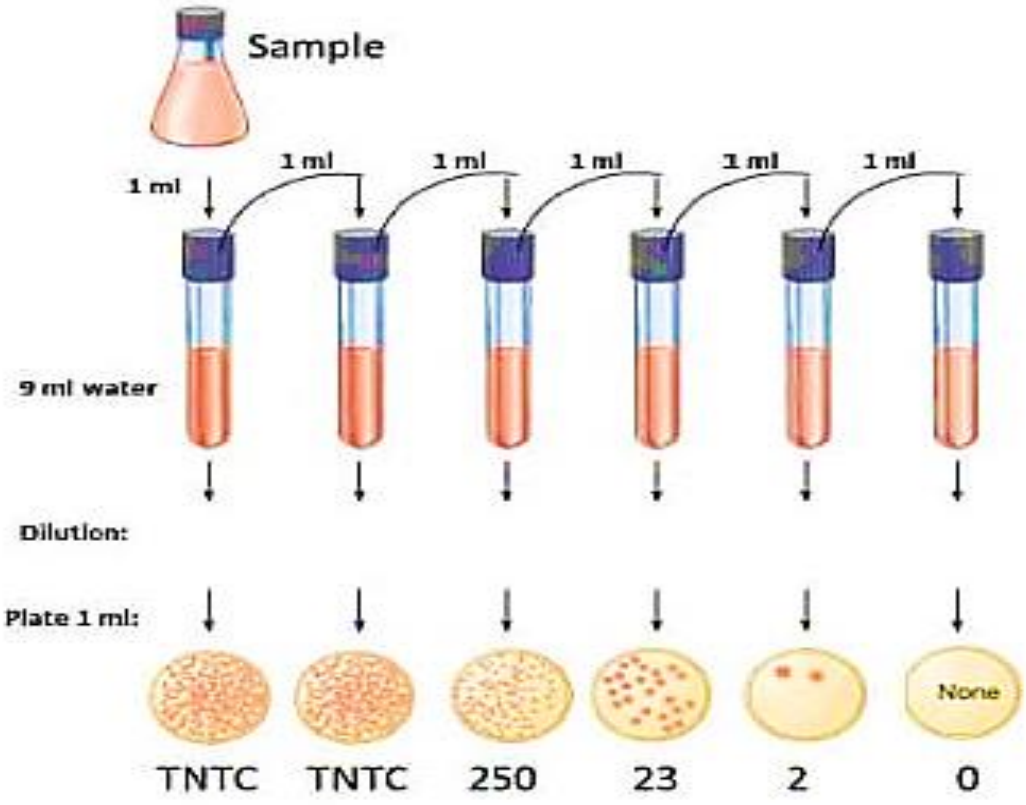
Turner (2010) points out that, patterns (themes) are identified through a rigorous process of data familiarization, data coding, and theme development and revision. Familiarization with data was ensured in the current study through self-transcription and translation of the interview data. The audio recordings of the interview were listened to severally to ensure accurate translation and transcription. All interviews were directly translated into English, thoroughly by the researcher. Miles, and Huberman (2009) support that data translation is necessary to enable researchers understand the meaning of linguistic features. The translation of

transcripts was carried out soon after the interview to consider any clarification and was done on Microsoft Word Office. The text was then transported onto Nvivo analytical software and stored on nodes for references. Coding then followed by highlighting texts and pulled to the tree nodes. Using the available tools on Nvivo subsequently, concepts, categories and themes were developed for narration and discussion of study results in line with the research objectives and questions.

Justifiably, rigorous thematic approach used in the current study can produce an insightful analysis that answers the selected research questions. This approach complements the research questions by facilitating an investigation of the interview data from two perspectives: first, from a data-driven perspective and a perspective based on coding in an inductive way; second from the research question perspective to check if the data were consistent with the research questions and providing sufficient information.

Microbiological Analysis was conducted using the pour plate method. The total viable count and total coliform count were determined using the pour plate method in accordance with the American Public Health Association (APHA) guidelines developed in 1992. A ten-fold serial dilution was first done to the $5^{th}$ dilution. That is, from 1:10 to 1:100000 where 1ml of each sample was added to 9ml of sterile normal saline of which the 1ml of the resultant 10ml was taken and added to another test tube containing another 9ml sterile normal saline. This procedure is repeated until the $6^{th}$ dilution is complete. One millilitre (1ml) from each of the test tubes containing the dilutions were cultured on plate count agar and incubated at 37 degrees Celsius for 24 hours after which the bacterial colonies were counted. This procedure was done in triplicates.

The bacteria were identified by sub-culturing the distinct colonies on nutrient agar and taken through the various identification processes such as gram staining and biochemical reactions (oxidase test, catalase and triple sugar iron test). MacConkey agar was used to isolate and identify enteric bacteria. Bacteria identified were *Bacillus sp, Listeria monocytogenes and Escherichia coli.* These microorganisms can cause serious illness such as typhoid, dysentery, enteric fever and peripheral as well as systemic mycoses, which represent threats to human health (Burt et al.,2016).



# CHAPTER FOUR

# DISCUSSION OF RESULTS

## 4.1 Demographic Data of Respondents

The demographic data collected and analysed covered gender, age, educational attainments, number of years in the 'Sobolo' business, and marital status of respondents. Other areas of interest were respondents' religious denomination, ethnicity, why respondents chose to be in the business and any training they might have acquired in 'Sobolo' production or food vending in general. Data collected on gender of respondents has been presented on Figure 4.1.

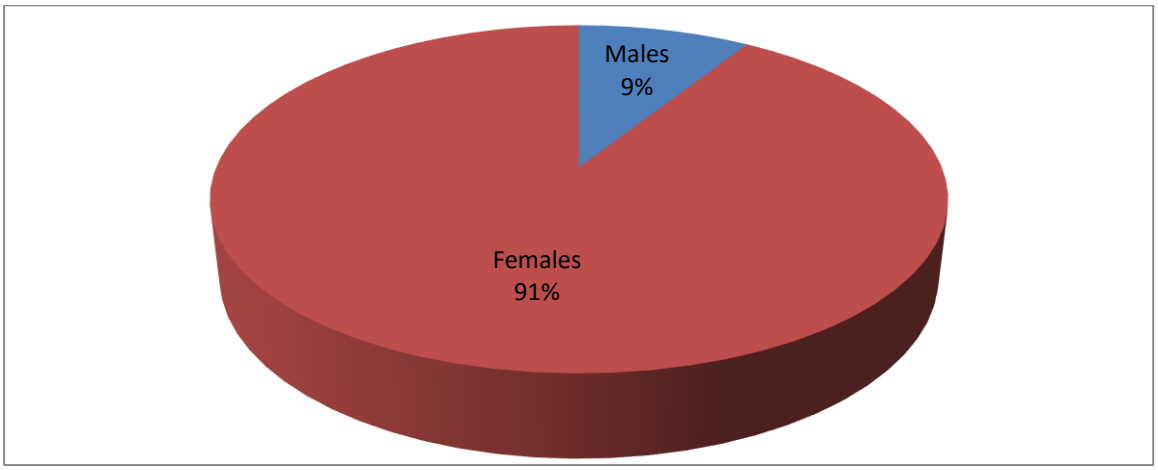



Figure 4.1 Gender of Respondents

Obviously, the business is female dominated showing as many as 91% of producers being females with only a few of 9% who were found to be males. Similar to the findings in Acheampong (2005), reported majority of females being food vendors in theNorthern region of Ghana though the two study settings might have similar characteristics. Further on demographic data, Figure 4.2 presents the age categories of respondents.

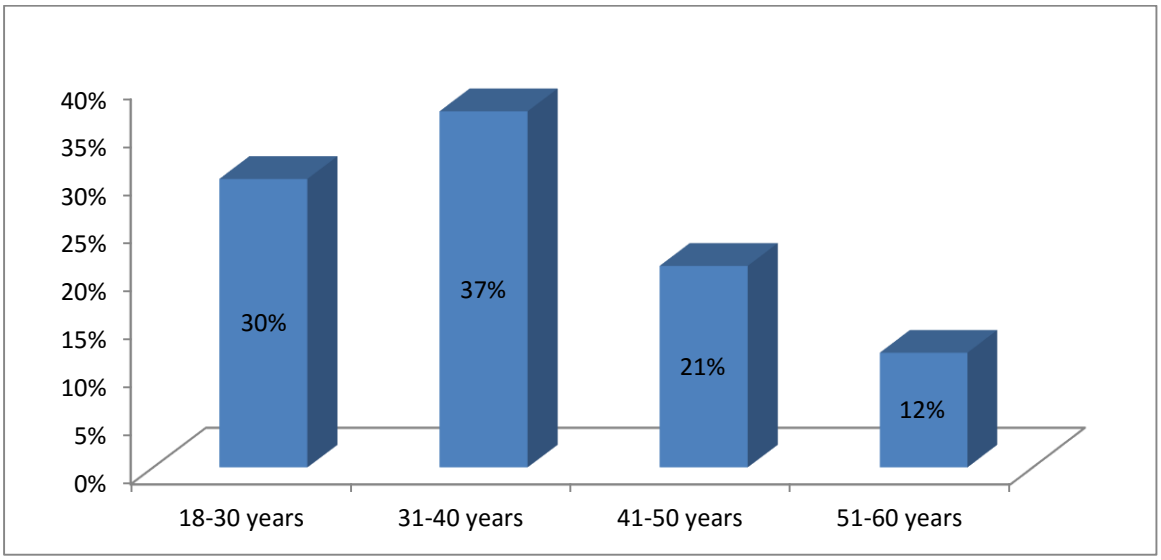


Figure 4.2 Ages categories of respondents

The current study has reported variations in the age of vendors. None of the producers of 'Sobolo' was found to be below eighteen years or above sixty years. But it can be seen from Figure 4.2 that the youth of age 18-40 years constituted the majority of 67% of respondents whilst the aged group of more than 40 years was represented by 33%. However,Ajayi, Oluwoye and Williams' (2014) study found age not to be a determinant ofvendors' knowledge and practice of food hygiene.Respondents were also interrogated on their educational attainments and had the data presented on Figure 4.3.

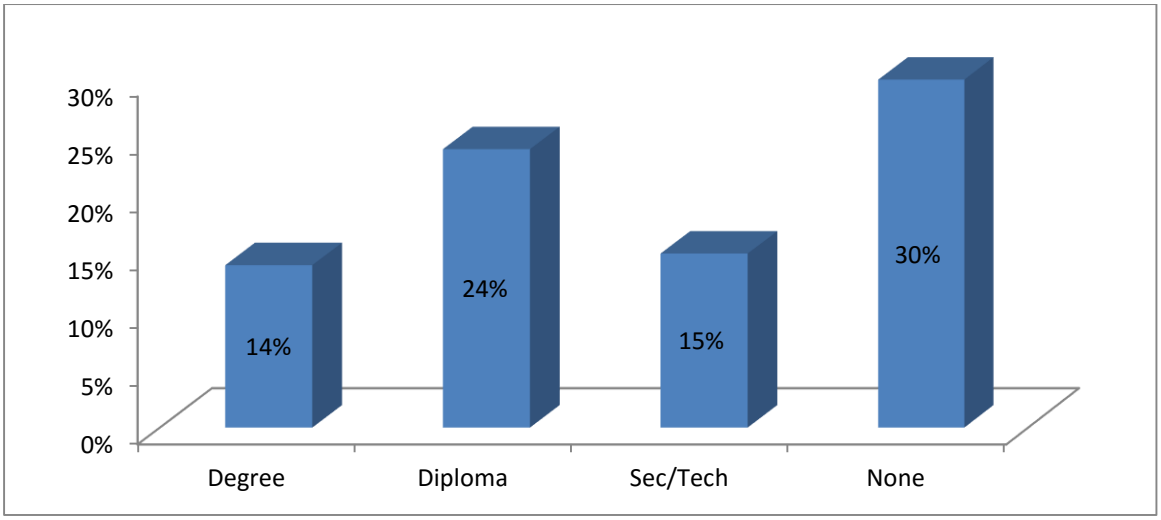



**Figure 4.3 Educational attainments of Respondents**

Approximately 70% of the respondents have had some level of formal education to the extent that some degree holders (14%) and diploma holders (24%) are engaged in 'Sobolo' business, nearly one-third (30%) had no formal education. Overall, it can be stated that producers are expected to exhibit high level of hygiene practices in the preparation of 'Sobolo'if knowledge and practice are in direct relationship (Burt, Volel&Finkel, 2016). The study further inquired about how long respondents have been in 'Sobolo' business and obtained the data on Figure 4.5.

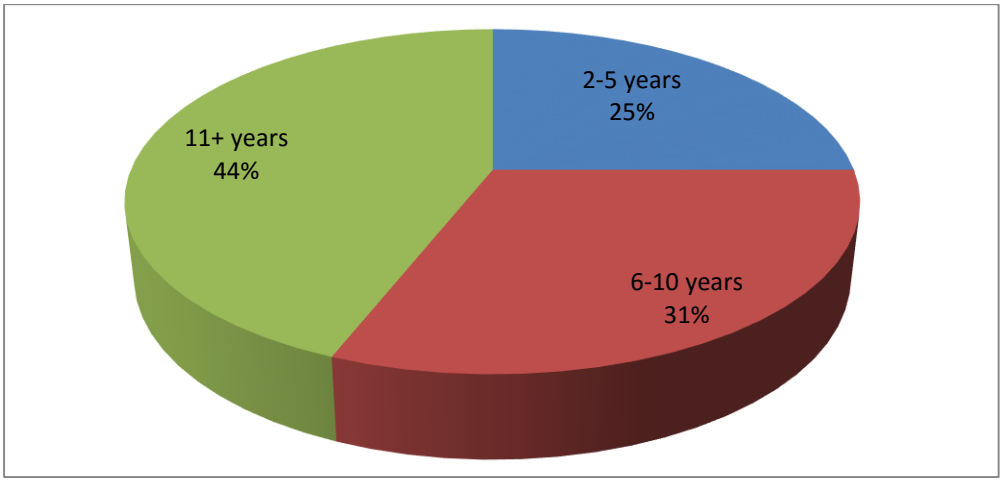



**Figure 4.4: Years in business**

Only about a quarter of the respondents have been in 'Sobolo' business for five years or less. Appreciably, about 75% of the producers have been in the business for 6 or more years. On respondents' religious denomination, the study gathered that Christians took the majority of 61% whilst 22% of them were represented by Muslims and 17% presented themselves as traditionalist. The ethnic background of respondents also presented Akans with 46%, Guans with 28%, Ga/Adangbewith 18% and 8% for other tribes.

It can further be observed that 'Sobolo' producers were in the business for three main reasons, some (34%) engage as the main source of income whilst others (41%) disclosed that they were in business to supplement their main businesses but a few of them (25%) took 'Sobolo' production as a hobby. Incredibly, most of these 'Sobolo' producers (84%) have not had any professional training in 'Sobolo' production or food vending in general. Only a few of 16% of respondents could affirm that they had some training from their tertiary, secondary/vocational training or learnt the production through apprenticeship. Overall, it is clear from respondents' demographic profile that they were selected without any prejudice as far as gender, religion or ethnic considerations are concerned.

## 4.2 Production and handling practices in the preparation of 'Sobolo'

Data obtained from 'Sobolo' producers' interview was coded unto the analytical tool (Nvivo) after transcription to generate the themes and sub-themes. Themes were analysed and discussed, with quotations where necessary making reference to respondents coded as R1 referring to respondent 1, R2 referring to respondent 2, R3 referring to respondent 3 and so on. To begin with, data was processed on respondents' knowledge on food hygiene and resulted in three themes

which addressed description of food hygiene, why observe food hygiene and the means through which 'Sobolo' can get contaminated as presented on Table 1.

**Table 4.1: Knowledge on food hygiene.**

| Concepts | Themes | Sub-themes |
|---|---|---|
| Food hygiene | Description of food hygiene | -stop spread foodborne diseases<br>-production of quality food<br>-prevents 'Sobolo' from contamination |
| | Why observe food hygiene | -exposure to flies<br>- exposure to dust<br>-unclean hands |
| | Means of contamination | |

### 4.2.1 Knowledge on Food hygiene of 'Sobolo' producers

Most of the respondents showed adequate level of knowledge on food hygiene giving various related explanations to food hygiene. Some respondents explained food hygiene as measures to hinder the spread of food-related disease. Others described food hygiene as practices of maintaining good health and preventing diseases in catering establishments. As commonly indicated, most respondents were quoted as saying that:

> "*food hygiene boarders on basic practices to check environmental and personal factors in the preparation and serving of food in such a way to ensure that food eaten is of good quality*" (R1, R15, R2).

Most areas touched in the explanation for food hygiene included the environment in which the food item is prepared, and the persons preparing it. Some respondents added that

> *"caterers must observe personal hygiene, they must know food safety behaviours and also ensure that materials and equipment being used are clean and safe"* (R1, R2, R13).

The extent of knowledge displayed in the current study corroborates the findings in Burt, Volel&Finkel (2016) in which almost all the respondents described food hygiene in relation to behaviours and practices that ensure that food prepared and served is healthy and the consumption does not cause food-borne diseases.

### 4.2.2 Rationale for food hygiene practices

Food hygiene depends largely on the personal hygiene practices and to tidy up the compound where we prepare our drink. Responding to why food hygiene must be observed, it was commonly recorded that:

> "when we *observe food hygiene we prevent the food from getting contaminated by disease causing agents*" (R6,R4,R8). "*When we follow food hygiene practices people see that our* 'Sobolo' *is neat and we have good market because they do not get sick when they drink*" (R7,R11,R16).
>
> The discussion on this theme is not adequate. Relate this outcome to literature

### 4.2.3 Source of contamination.

Respondents were quick to cite the possible means by which food can be contaminated, quoting some respondents as saying that:

> "*food can cause illness if it is exposed to flies and dust due to filthy environment, when the preparation equipment are dirty as well as touching food items when the hand is dirty*" (R6, R2).

Similarly, respondents in Chukuezi (2012) and Da-Costa-Rocha, Bonnlaender, Sievers, Pischel, & Heinrich (2014) among others cited common means of food contamination to include dirt, flies and improper cleaning of food working surfaces and utensils used to prepare 'Sobolo'. Improper washing of the *Hibiscus* leaves may introduce microorganisms into extracts leading to contamination of the product ('Sobolo') and subsequent development of food poisoning when the product is consumed.

Visits were made to the production sites to personally observe things by the researcher as a complement to what respondents disclosed in the interviews granted to them. Observations made at each step of the production process showed varying scenarios as some ensured food safety and hygiene practices but others rather showed the reverse as indicated in Table 4.2.

Majority of the areas studied predisposed the product to degree of contamination, from personal hygiene to environmental cleanliness, through food hygiene practices and treatment of materials and equipment. To establish the production and handling practices in the preparations of 'Sobolo', themes that emerged include handling of 'Sobolo' leaves (calyx) and utensils, extraction of 'Sobolo' and packaging as presented in Table 4.3.

**Table 4.2:Production and handling practices, themes and subthemes**

| Concepts | Themes | Sub-themes |
|---|---|---|
| Handling of 'Sobolo' leaves (calyx) | Storage of leaves | -length of time for storage<br>-how and when stored |
| | Treatment of calyx | -sorting out<br>-washing |
| Extraction | Type and length of extraction | -cold extraction<br>-hot water extraction |
| | Formulation | -spicing<br>-sweetening |
| Packaging and storage | Bottling and use of polythene bags | -used and new bottles<br>-washing of bottles |
| | Storage temperature | -blow to open polythene bags |

*Source: Field Data (2020)*

### 4.2.4 Storage of ‘Sobolo’ leaves (calyces)

Respondents confirmed that they have store rooms where they keep ‘Sobolo’leaves (calyx) for approximately 3 to5 days before completely used up. It was observed that the leaves (calyx) were stored in sacks and with other foodstuffs in the room where some remain in the store rooms for many days before use resulting in some of the leaves deteriorating due to poor handling and/ or storage conditions Respondents reported that adequate time was not spent to sorting out foreign materials (physical hazards) such as insects, other weeds and gravels among others leave the finished product unsafe for consumption. This observation is corroborated by Feglo&Sakyi(2012).

### 4.2.5 Sorting and washing of sobolo leaves (calyces)

‘Sobolo’ leaves (calyx) were not sorted. Foreign materials such as; sand, debris, weeds, animal droppings, polythene, glass (were not separated before extraction. Calyces were found not washed before extraction as explained by respondents during interviews. The leaves were only soaked with questionable source of water for extraction. Meanwhile, Feglo&Sakyi(2012) advised that the quality of water used in the preparation of ‘Sobolo’is essential since contaminated water contain pathogens such as *E. coli*, *Salmonella spp*. and *Campylobacter spp* and might predispose the end product to contamination. Apart from the water added to the calyces during boiling the addition of water to the drink at further stages of production did not go through any form of treatment.

The utensils were seldom washed, causing build-up of residues of food which facilitates microbial growth. These observations were similar to a study conducted by (Barro*et al*., 2006). Cardinale*et al.*(2005) adds that serving utensils used at the production and vending sites are often contaminated with *Micrococcus*sppand *Staphylococcus*sp. which may originate from the water used in dish washing and food preparation surfaces.

### 4.2.6 Extraction method

Preparation of 'Sobolo'under unfavorable conditions prior to consumption might influence food contamination. Most producers confessed and were found to be doing cold water extraction of 'Sobolo'. The few who adopted hot water extraction were found extracting below boiling point under five minutes. Some respondents explained and were quoted that:

> "*we do cold water extraction for overnight and add spices for consumption" (R3, R6, R15) "We extract* for *some hours,( three or four hours) with cold water and then boil the leftover leaves for about five minutes before we let it cool down for packaging"* (R6, *R4, R6, R8, R11, R2,* ).

The observations here portray a contradiction to a study on optimization of hot water extraction and sweetness level in beverage production by Omemu, Edema, Atayese&Obadina (2006), which revealed that extraction period of 30 minutes at a constant temperature of 100±2 °C is the best stage of extraction.

### 4.2.7 Formulation of juice extract

Spicing or formulation with ginger, sugar pineapple was commonly done after extraction as popularly found in Senegal (Cisse, 2010) except in few cases where it was done during extraction. Some producers were found substituting ginger with powdered pepper and sugar with concentrated flavourings and colourings. No addition of antibacterial agents (preservatives) were recorded. Some producers reported that:

> *"we always add the ginger to spice it during the boiling stage and add sugar and fruit extracts like pineapple and water melon after extraction". "We think it is the best thing to do because many people commend our drink"(*R1, R12 ) added.

### 4.2.8 Packaging of 'Sobolo'.

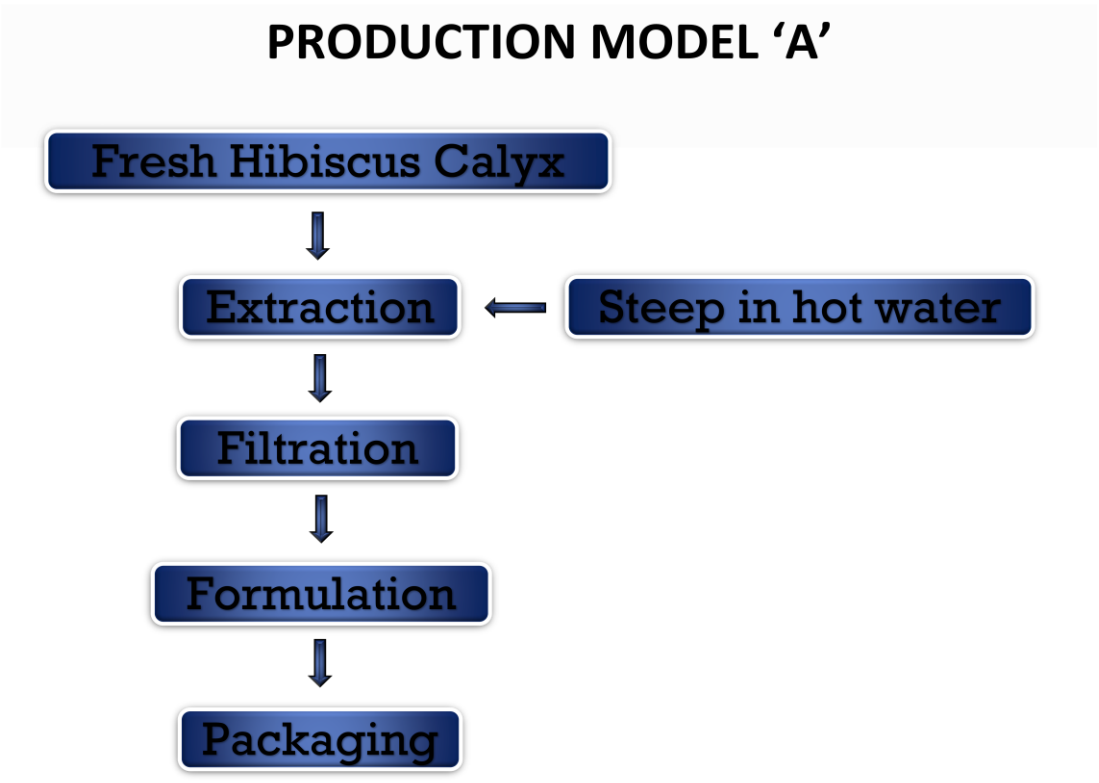
Packaging followed formulation. Plastic bottles (used and new) used mineral water bottles and polythene bags were used to package for sale. Respondents reported that the bottles were washed with clean water but observations were that the used bottles showed remnants of 'Sobolo' served earlier indicating that bottles were not thoroughly washed. There is therefore the possibility of pathogenic microorganisms developing in the bottles and thus promoting cross contamination (Zeru&Kumie, 2007).

**Table 4.3: Observations made at 'Sobolo' production sites**

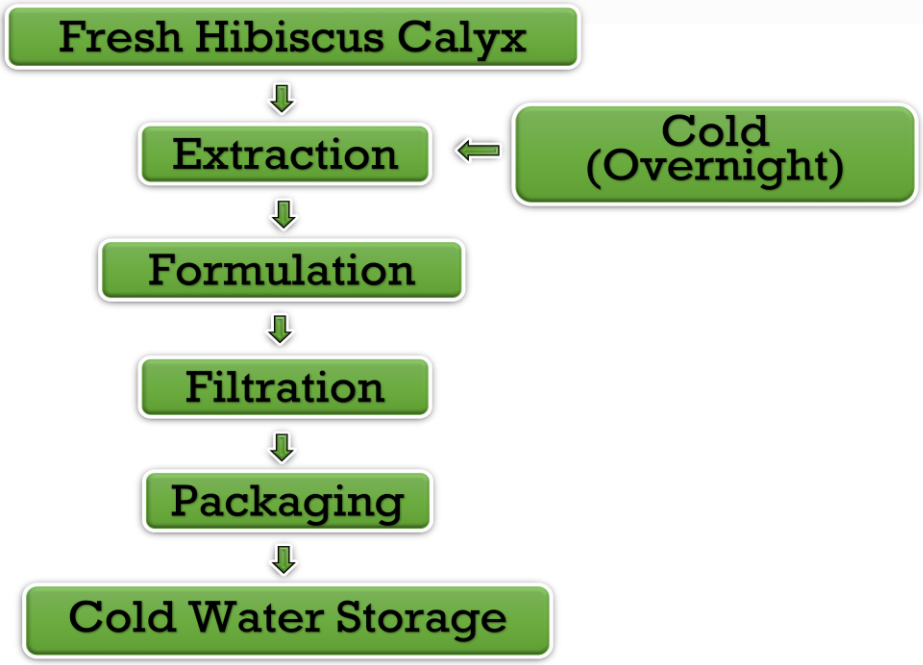
| Source | Comments |
|---|---|
| | Finger nails were generally kept clean. |
| | Heads were clean but uncovered. |
| Personal hygiene | A few producers used apron and gloves but there were no open wounds observed. |
| | Handkerchiefs were repeatedly used when coughing or sneezing but a few used tissues were disposed off properly. |
| | Hands were washed before handling leaves but not with soap. No hand gloves were used. Nose masks were hardly worn. |
| | Most vendors did not have the health certification which was required by law. |
| Environment/surrounding | Water drainage system was generally good. |
| | Use of pipe borne water was common but others fetched water from hand-dug well. |
| | No production site was close to toilet facility but open gutters were too close to some production sites |
| | Waste/refuse was not properly disposed off. |
| | No use of pest or insect control mechanisms. |
| Food hygiene | Calyx and utensils were not fully protected from flies/insects. No proper sorting of physical hazards. |
| | Leaves (Calyx) used in the production are mostly deteriorating. |
| | Leftover drinks were kept in refrigerator. |
| | Leaves (Calyx) are packed in sacks and stored in a very moist storage rooms together redundant items |

| | |
|---|---|
| Equipment, materials and structure. | Surfaces of utensils have remains of drinks prepared previously.<br>Leaves (Calyx) were washed but water used was not that clean.<br>Packaging materialswere reused but not washed with clean water.<br>Production sites of\r rooms were not in good condition. Sandy floors, less ventilation, poor lighting, no trap doors or nets. |

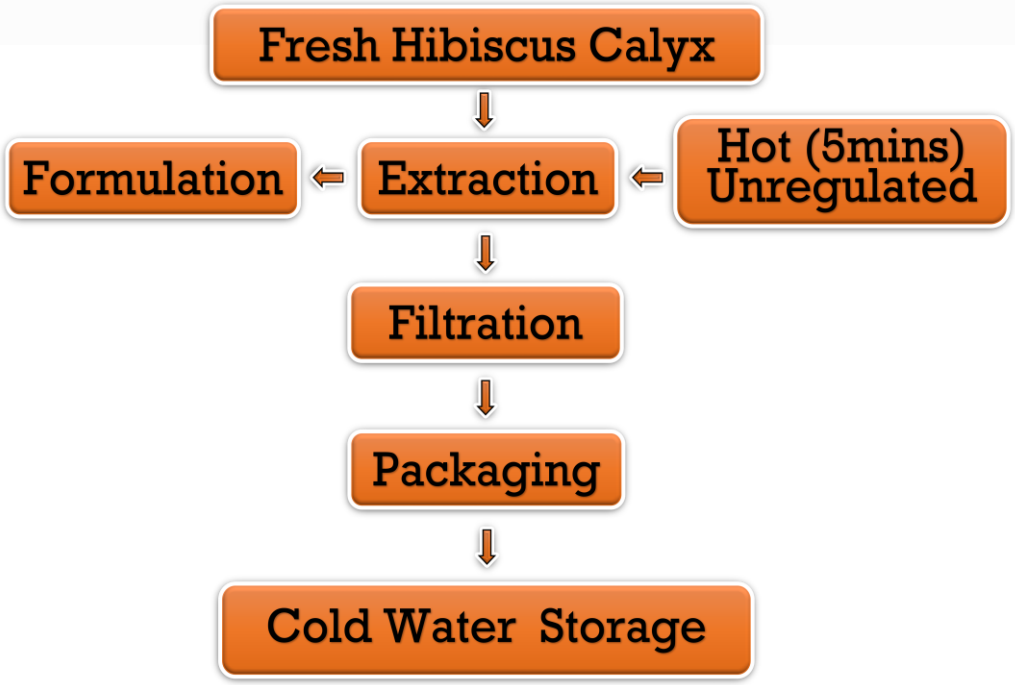
**4.3 Observation of handling and production practices of 'sobolo'**

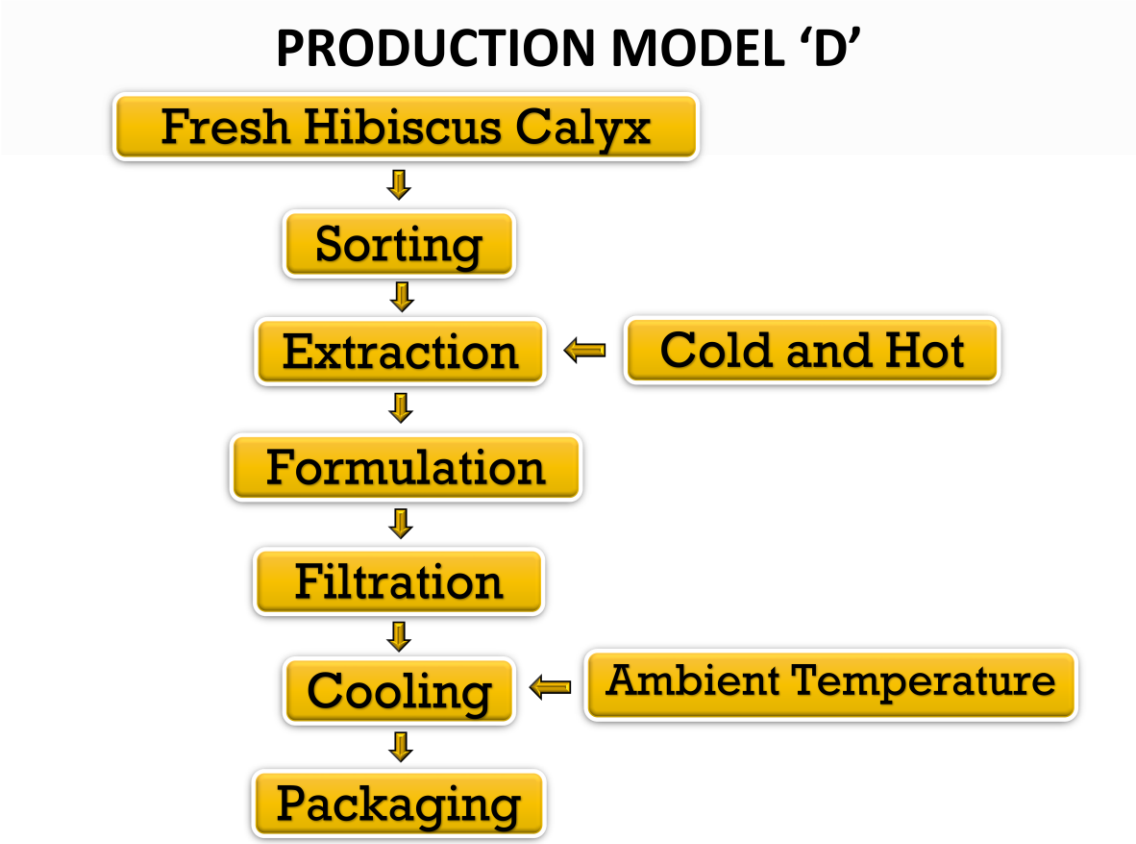


## PRODUCTION MODEL 'B'




## PRODUCTION MODEL 'C'






**4.4 Microbial load of 'Sobolo' Samples**

'Sobolo' vended in the market also contributes to the risks of food-borne diseases if food safety and hygiene measures are not considered. In this study, the presence of total viable counts and total coliform count were assessed in samples from four (4) different street vendors. Total viable counts can be used to measure the level of overall bacterial contamination of food or beverage samples tested. The mean microbial load of the food samples analyzed is presented in Table 4.4.

**Table 4.4: Mean Microbial load of 'Sobolo' samples**

| SAMPLE | TOTAL VIABLE COUNT CFU\ML | BACTERIA PRESENT |
|---|---|---|
| MODEL A | $9.3 \times 10^6$ | *Bacillussp, Escherichia coli,* |
| MODEL B | $9.1 \times 10^6$ | *Bacillussp, Listeria monocytogenes, Escherichia coli,* |
| MODEL C | $1.75 \times 10^4$ | *Bacillussp* |
| MODEL D | $9.6 \times 10^6$ | *Bacillussp, Escherichia coli,* |

The standards by the International Commission for Microbiological Specification for Foods (ICMSF) set in 1996, states that ready-to-eat foods with plate counts between $0\text{-}10^3$ is acceptable, between $10^4\text{-}\leq 10^5$ is tolerable and $10^6$ and above is unacceptable. Therefore, only sample C showed minimal microbial load of $1.75 \times 10^4$cfu\ml which falls within the acceptable range. The three other samples A, B and D rather fall within the unacceptable category and thus require immediate attention in the production and handling processes/practices.

The microbial test further revealsinTable 4.4 that all the 'Sobolo' samples were contaminated with mixed microflora.*Bacillussp and Escherichia coli* (*E.coli*) are the predominant organisms.The presence of *Escherichia coli*and other enter bacteria is an indication of possible faecal contamination of the calyx, water, cross-contamination by producers/handlers and poor hygienic processing practices (Oghenekohwo, 2015). Nurudeenet al. (2014) add that the occurrence of *Bacillus spp* may be as a result of its spores forming character that resist heat. Contamination of foods with *Bacillus spp* could have resulted from inappropriate processing, incomplete heating, or secondary contamination via contact with contaminated equipment and utensils. *E. coli* are almost exclusively of fecal origin and their presence is thus effective confirmation of

feacal contamination. Proper hygiene and safe food handling are key to preventing the spread of *E. coli* (Olawale, 2011).

Subsequently, a fifth (controlled) sample of 'Sobolo' produced under the proposed ideal HACCP production and handling modelwas tested and had the results in Table

## 4.5 Ideal production and handling model following the Hazard Analysis and Critical Control Point (HACCP) principles

Following the seven principles of HACCP as presented in Figure 4.6, the study initially obtained first information from 'Sobolo' producers and continued with personal observations by the researcher at production sites.

Based on data gathered and the lapses identified, the study was guided by the seven HACCP principles and then proposed an ideal production and handling model for the production of 'Sobolo'.

### 4.5.1 Conduct a hazard analysis.

Stage one-hazard identification. This was made at the first stages where storage of 'Sobolo' leaves (calyces) through their handling and that of equipment and cleanliness of the environment where 'Sobolo' is produced. It was noted that contamination with *Salmonella ssp* is possible resulting from cross contamination with stained and uncleaned utensils, contamination with *E.Coli* resulting from exposure to flies and unclean hands with which producers touch the drink. This corroborates the findings in Nurudeen, et al., 2014) and Oghenekohwo (2015). The second stage A hazard team develops a list of potential biological, chemical or physical hazards which may be introduced, increased, or controlled at each step in the production process. , the HACCP team reviews the ingredients used in the product,

the activities conducted at each step in the process and the equipment used, the final product and its method of storage and distribution, and the intended use and consumers of the product.

### 4.5.2 Determine the Critical Control Points (CCPs).

A critical control point is defined as a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level. The potential hazards that are reasonably likely to cause illness or injury in the absence of their control must be addressed in determining CCPs.

Complete and accurate identification of CCPs is fundamental to controlling food safety hazards. The information developed during the hazard analysis is essential for the HACCP team in identifying which steps in the process are CCPs.

Critical control points are located at any step where hazards can be either prevented, eliminated, or reduced to acceptable levels. Examples of CCPs may include: thermal processing, chilling, testing ingredients for chemical residues, product formulation control, and testing product for metal contaminants. CCPs must be carefully developed and documented. In addition, they must be used only for purposes of product safety. For example, a specified heat process, at a given time and temperature designed to destroy a specific microbiological pathogen, could be a CCP. Likewise, refrigeration of a precooked food to prevent hazardous microorganisms from multiplying, or the adjustment of a food to a pH necessary to prevent toxin formation could also be CCPs. Different facilities preparing similar food items can differ in the hazards identified and the steps which are CCPs. This can be due to differences in each facility's layout, equipment, selection of ingredients, processes employed.

The CCPs identified in the preparation of ‘Sobolo’ were:

1. Sorting,
2. extraction
3. Storage/holding

### 4.5.3 Establish critical limits

A critical limit is a maximum and/or minimum value to which a biological, chemical or physical parameter must be controlled at a CCP to prevent, eliminate or reduce to an acceptable level the occurrence of a food safety hazard. A critical limit is used to distinguish between safe and unsafe operating conditions at a CCP

Each CCP will have one or more control measures to assure that the identified hazards are prevented, eliminated or reduced to acceptable levels. Each control measure has one or more associated critical limits. Critical limits may be based upon factors such as: temperature, time, physical dimensions, humidity, moisture level, water activity ($a_w$), pH, titratable acidity, salt concentration, available chlorine, viscosity, preservatives, or sensory information such as aroma and visual appearance. Critical limits must be scientifically based. For each CCP, there is at least one criterion for food safety that is to be met. The critical limits and criteria for food safety may be derived from sources such as regulatory standards and guidelines, literature surveys, experimental results, and experts.

Studies recommend extracting ‘Sobolo’ under a constant temperature of about 100$^{o}$C for 30 minutes (Olawale, 2011). This will help reduce or prevent biological hazards (pathogenic).

### 4.5.4 Establish monitoring procedures

Monitoring is a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification. Monitoring serves three main purposes. First, monitoring is essential to food safety management in that it facilitates tracking of the operation. If monitoring indicates that there is a trend towards loss of control, then action can be taken to bring the process back into control before a deviation from a critical limit occurs. Second, monitoring is used to determine when there is loss of control and a deviation occurs at a CCP, i.e., exceeding or not meeting a critical limit. When a deviation occurs, an appropriate corrective action must be taken. This step also provides written documentation for use in establishing a monitoring system.

In the production of 'Sobolo', producers need to maintain the temperature for the boiling process at 100 for 30mins and the required freezing point ($5^{o}C$) when packagedand stored in a refrigerator or freezer.

### 4.5.5 Establish corrective actions.

The HACCP system for food safety management is designed to identify health hazards and to establish strategies to prevent, eliminate, or reduce their occurrence. However, ideal circumstances do not always prevail and deviations from established processes may occur. An important purpose of corrective actions is to prevent foods which may be hazardous from reaching consumers. Where there is a deviation from established critical limits, corrective actions are necessary. Specific corrective actions should be developed in advance for each CCP and included in the HACCP plan. As a minimum, the HACCP plan should specify what is done when a deviation occurs, who is responsible for implementing the corrective actions, and that a record will be

developed and maintained of the actions taken. Individuals who have a thorough understanding of the process, product and HACCP plan should be assigned the responsibility for oversight of corrective actions in the production of 'Sobolo', producers must set a corrective action plan to remedy over boards and thus when temperature levels as CCP limits are not under control.

### 4.5.6 Establish verification procedures.

Verification is defined as those activities, other than monitoring, that determine the validity of the HACCP plan and that the system is operating according to the plan. These processes should take place during the development and implementation of the HACCP plans and maintenance of the HACCP system. Validation of 'Sobolo'production should include the scientific justification of the heating times and temperatures needed to obtain an appropriate destruction of pathogenic microorganisms. For each of the CCPs of 'Sobolo' production, validation is required to ensure that the HACCP plan is duly implemented to ensure a safe 'Sobolo'. Validation of HACCP should be conducted when there is an unexplained system failure, packaging change or new hazards recognized.

In addition, a periodic comprehensive verification of the HACCP system should be conducted by an unbiased, independent authority. Such authorities can be internal or external to the food operation. This should include a technical evaluation of the hazard analysis and each element of the HACCP plan as well as on-site review of all flow diagrams and appropriate records from operation of the plan. In the case of 'Sobolo' production, the external authorities for verification is the Food and Drug Authority(FDA), Ghana Standard Authority(GSA) or the Environmental Protection

Agency(EPA). If the results of the comprehensive verification identifies deficiencies, the HACCP team modifies the HACCP plan as necessary.

### 4.5.7 Establish record-keeping and documentation procedures

Generally, the records maintained for the HACCP System should include the following:

1. A summary of the hazard analysis, including the rationale for determining hazards and control measures.

2. The HACCP Plan

   Listing of the HACCP team and assigned responsibilities.

   Description of the food, its distribution, intended use, and consumer.

   Verified flow diagram.

   HACCP Plan Summary Table that includes information for:

   Steps in the process that are CCPs

   The hazard (s) of concern.

   Critical limits

   Monitoring

   Corrective actions

   Verification procedures and schedule

   Record-keeping procedures

   The current study proposed an ideal production and handling model presented in Figure 4.5 to ensure healthy and hazard-free ‘Sobolo’.

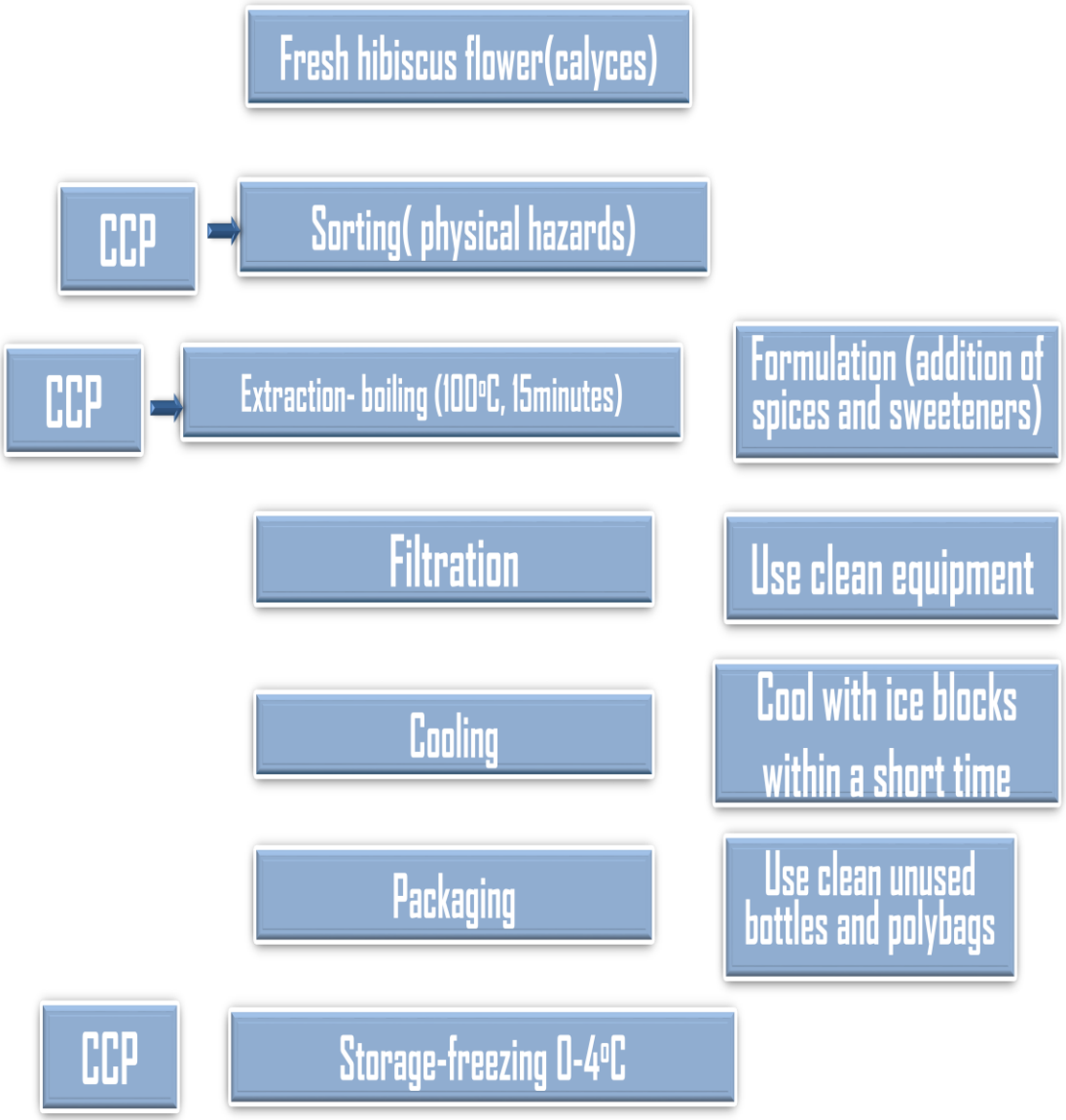



**Figure 4.5 Proposed production and handling model for'Sobolo' production**

**Table 4.5: Microbial load of standardised 'sobolo' sample**

| SAMPLE | TOTAL VIABLE COUNT CFU\ML | BACTERIA PRESENT |
|---|---|---|
| Controlled | $8.0 \times 10^2$ | *Bacillussp* |

Source: *Field Data, 2020*

The total viable count for the controlled sample was $8.0 \times 10^2$ cfu\ml, which indicates that Bacillus spp contained in the sample is not harmful to human health, following the standards by the International Commission for Microbiological Specification for Foods (ICMSF) set in 1996. The standards states that ready-to-eat foods with plate counts between $0\text{-}10^3$ is acceptable, between $10^4\text{-}\leq 10^5$ is tolerable and $10^6$ and above is unacceptable.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATIONS

## 5.1 Conclusion

Concluding on the key findings of the study, four different methods of producing ‘sobolo’ commercially were identified; the hot extraction method, the cold extraction method, the cold and hot extraction method and the hot steeping or brewing method.

Most ‘sobolo’ producers had theoretical knowledge on food hygiene but seldom practiced in the production process of ‘sobolo’

Again, personal hygiene of ‘sobolo’ producers was not at its optimum because they sneeze without tissues, they seldom wear aprons or cover or washed hands thoroughly with soap before handling ingredients for the production of ‘sobolo’.

Most production sites had poor drainage system and refuse were poorly disposed off hence, attracting flies, insects and rodents likely to cause food contamination. Cooking utensils and bottles for packaging sometimes showed remains of drinks previously served, thus recording it as a critical control point to address in order to prevent microbial development. Most ‘sobolo’ producers preferred the cold extraction method being the simplest, easiest and less expensive method.

Few producers who adopted the boiling method extracted below the required temperature of $100^0$c for 15minutes. Formulation with spices and sweeteners were mostly added after extraction but should ideally be added during hot extraction to kill any pathogenic bacteria that may cause food contamination. Drinks served from this practice could be hazardous to human health.

The results of the microbial analysis revealed that all 'Sobolo' samples from the four existing production methods revealed some level of contaminations with *Bacillus ppp, E.coli,* and *Listeria monocytogenes*. *Bacillus spp* and *E.coli* were the predominant organisms. 'Sobolo' samples obtained from the study setting showed total viable count (TVC) of $10^6$ cfu\ml indicating the presence of pathogens.

Finally, a standardised production model was developed emphasizing on the critical control points (CCPs) of Hazzad Analysis and Critical Control Points (HACCP). Microbial analysis of 'sobolo' produced from the standardised model indicated a TVC of 8.0 x $10^2$ cfu\ml which is acceptable according to food safety standards of ICMSF

## 5.2 Recommendations

Based on the findings from the study and the conclusions outlined the following recommendations are made:

1. 'Sobolo' producers must ensure high standards of personal hygiene and food safety practices with appropriate outfit and maintain clean hands before handling food items.
2. Producers must ensure environmental cleanliness with proper refuse disposal devoid of flies and insects as agents of contamination.
3. Producers must use at all times well dried, sorted and washed calyx for 'Sobolo' production. The use of high quality calyx ensures the production of healthy drink for human consumption.
4. Hot water extraction should be adopted and boiling of extract must be done at a constant temperature of 100$^o$C for at least 30 minutes to be well-cooked.

5. Packaging materials like bottles should be kept tidy inside-out to avoid harbouring bacterial for contamination.
6. Environmental agencies as well as Food and Drugs Authority (FDA) should step up supervisory and monitoring schemes at production sites to ensure sanity at all times.
7. Environmental agencies, FDA and NGOs should take up projects to educate 'Sobolo' producers and other food vendors in the adoption of HACCP principles in their production practices.

## 5.3 Suggestion for Future Study

It is further recommended for a future study into the types and quality and of ingredients for locally prepared 'Sobolo'in Takoradi Municipality in Ghana.

## REFERENCES


Abdalla, M.A., Siham, E.S., Alian, Y.Y.H.A. &Amel, O.B. (2008). Food safety knowledge and practices of street food-vendors in Khartoum city.*Sudan Journal of Veterinary Science and Animal Husbandry*, 47:126–136.

Acharya, A. S., Prakash, A., Nigam, A. &Saxena, P. (2012). Scientific study designs for research: an overview. *Indian Journal of Medical Specialist*, 3, 191-194.

Acheampong, I. (2005). *Food hygiene of the cafeteria facilities of the UniversityofGhana.*Legon: University of Ghana Press.

Adanlawo, I. G. &Ajibade, V. A. (2006). Nutritive value of two varieties of Roselle (*Hibiscus sabdariffa*) calyces soaked with wood ash. *Pakisrtan Journal of Nutrition*, 5(6), 555-557.

Adzaml, K. (2015). Safety and quality evaluation of street foods sold in Zaria, Nigeria. *Food Control*, 9(2), 8–11.

Afele, M. (2006). Street food boom in Ghana spurs calls for better hygiene. *Bulletin of the World Health Organization*, *84*(10), 772–773.

Ajayi, O. A., Oluwoye, J. O., & Williams, L. L. (2014). Policy options on reduction of foodborne diseases. *Food and Nutrition Bulletin*, *4*(6), 266–271.

Alfers, L., &Abban, R. (2011).*Occupational health and safety for indigenous caterers in Accra, Ghana.*Cambridge, Massachuset, USA: WIEGO.

Allison L. Hopkins, Marnie G. and Lamm, J. F. (2014).*Hibiscus*sabdariffa L. in the treatment of hypertension and hyperlipidemia: a comprehensive review of animal and human studies. *Fitoterapia, 8(5),* 84–94.

Annor, A. G.&Baiden, E. A. (2011). Evaluation of food hygiene knowledge, attitudes and practices of food handlers in food businesses in Accra,Ghana. *Food and Nutrition Sciences, 2, 830 -36.*

Atoagye, G. (2012). Microbial Quality of Locally Prepared *Hibiscus* Tea in Accra Metropolis, Ghana.*IOSR Journal of Environmental Science, Toxicology and Food Technology*, *8*(11), 23–27.

Barro, N., Bello, A.R.,Aly, S., Ouattara, C. A. A., Ilboudo, A., &Traore, A. S., (2006). Hygienic status and assessment of dishwashing waters, utensils, hands and pieces of money from street food processing sites in Ouagadougou (Burkina Faso).*Africa Journa of Biotechnol*, 5(11), 1107-1112.

Bolade, M. K., Oluwalana, I. B., &Ojo, O. (2009). Commercial practice of roselle (*Hibiscus*sabdariffa L.) beverage production: Optimization of hot water extraction and sweetness level. *World Journal of Agricultural Sciences*, *5*(1), 126–131.

Braide, M., Oranusi, T. S. & Peter-Ikechukwu, P. (2012).Investigation of the antispasmodic potential of Hibiscus sabdariffa calyces.*Journal of Ethno pharmacology*, 5(3), 23-39.

Burns, N. & Grove, S. K. (2001).*The practice of nursing research: Conduct, Critique andUtilization*, 4th edition, Philadelphia: WB Sanders, pp 223.

Burt, B. M., Volel, C., &Finkel, M. (2016). Safety of vendor-prepared foods: evaluation of 10 processing mobile food vendors in Manhattan. *Public Health Reports*.

Cardinale, A. &Rice, R. P. (2005). Inhibiting effects of *Hibiscus sabdariffa* on low-density lipoprotein oxidation and ant hyperlipidemia in fructose-fed and cholesterol-fed rats.*Journal of food science*, 84(15), 1989-1996.

Centers for Disease Control and Prevention. (2011). *2011 Estimates of foodborne illness in the United States*. Retrieved May 11, 2020,http://www.cdc.gov/features/ds Foodborne Estimates

Chapman, B., Eversley, T., Fillion, K., MacLaurin, T., & Powell, D. (2010). Assessment of food safety practices of food service food handlers (risk assessment data): testing a communication intervention (evaluation of tools). *Journal of Food Protection*, *73*(6), 1101-1107.

Chukuezi, C. (2012). Food Safety and Hygienic Practices of Street Food Vendors in Owerri, Nigeria.*Studies in Sociology of Science*, 1(1): 50-57.

Cisse, M. (2010).Literature review and Background information of Bissap (*Hibiscus* sabdariffa L.).*African Food Tradition*, (December), 1–15.

Cisse, M., Dornier, M., Sakho, M., Ndiaye A., Reynes, M., &Sock O. (2009). The Bissap (*Hibiscus sabdariffa*.): Composition and Principal Uses. *Fruits* 64, 179-193.

Clarence, S. Y., Nwinyi, O., &Chinedu, S. N. (2009).Assessment of bacteriological quality of ready to eat food (Meat pie) in Benin City metropolis, Nigeria.*African Journal of Microbiology Research*.Academic Journals.

Cresswell, J. (2003). *Research design: qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: SAGE Publications.

Da-Costa-Rocha, I., Bonnlaender, B., Sievers, H., Pischel, I., & Heinrich, M. (2014).*Hibiscus*sabdariffa L. – A phytochemical and pharmacological review.*Food Chemistry*, *165*, 424–443.

Donkor, E. S., Kayang, B. B., Quaye, J., &Akyeh, M. L. (2009). Application of the WHO keys of safer food to improve food handling practices of food vendors in a poor resource community in Ghana. *International Journal of Environmental Research and Public Health*, 6(11), 2833–2842.

Duhain, L. (2011). Composition and Biological evaluation of *Hibiscus sabdariffa* seeds.*Plant food Human Nutrition*, 49, 27-34.

Dun-Dery, B. &Addo, Y. F. (2016).Anti-hypertensive effect of *Hibiscus sabdariffa* calyx infusion in spontaneously hypertensive rats and a comparison of its toxicity with that of wistar rats.*Cell Biochemistry functions*, 7, 198-207.

Ewansiha, J. U. (2014). Evaluation of the antimicrobial activity of roselle (*Hibiscus sabdariffa L*.) leaf extracts and its phytochemical properties.*Peak Journal of Medicinal Plant Research*, 2(1), 1-5.

Feglo, P., &Sakyi, K. (2012).Bacterial contamination of street vending food in Kumasi, Ghana.*Journal of Medical and Biomedical Sciences*, 1(1), 1–8.

Fullerton, M., Khatiwada, J., Johnson, J.U., Davis, S., & Williams, L.L. (2011). Determination of antimicrobial activity of sorrel (*Hibiscus sabdariffa*) on Escherichia coli O157:H7 isolated from food, veterinary, and clinical samples. Department of Food and Animal Sciences, Alabama A & M University, Normal, Alabama, USA.*Journal of Medicinal Food*, 14(9), 950-956.

Gilbert, R., Louvois, J. De, & Donovan, T. (2000).Guidelines for the microbiological quality of some ready-to-eat foods sampled at the point of sale. PHLS Advisory Committee for Food and Dairy Products.*Public health/PHLS*.

Green, A., Wisdom, D. K., Duan, F. &Hoagwood, G. (2015).Production and quality evaluation of wine produced from zobo extract (*Hibiscus sabdariffa*) and the effect of the extract on hypertensive wistar rats. Nigeria food science Technology, 16(5), 26-32.

Guardiola, S., & Mach, N. (2014). Therapeutic potential of *Hibiscus*sabdariffa: A review of the scientific evidence. *Endocrinología Y Nutrición (English Edition), 61*(5), 274–295.

Ifeadike, C. O., Ironkwe, O. C., Adogu, P. O., &Nnebue, C. C. (2014). Assessment of the food hygiene practices of food handlers in the Federal Capital Territory of Nigeria. *Tropical Journal of Medical Research*, 17(1), 10-23.

Kok, H. &Balkaran, C. P. (2014).Physicochemical characteristics of roselle (*Hibiscus sabdariffa*).*Nutritional food science*, 3(12), 68-73.

Koopmans, M. &Duizer, E. (2005). Foodborne viruses: An emerging problem. *International Journal of Food Microbiology*, 90(1):23-41.

Kumar, R. (2005). *Research methodology: A step-by-step guide for beginners* (2nd ed.). London: Sage Publications.

Maxwell, J. A. (2012). *A realist approach for qualitative research*. Los Angeles: Sage.

McKay, D.L., Chen, C.Y., Saltzman, E., & Blumberg, J.B. (2010).*Hibiscus sabdariffa*L. Tea (tisane) lowers blood pressure in prehypertensive and mildly hypertensive adults. *The Journal of Nutrition*, 140, 298–303.

Mensah, P., Yeboah, M. D., Owusu, D. K. &Ablordey, A. (2002). Street Foods in Accra, Ghana: how safe are they? *Bulletin of the World Health Organization*, 80(7):546-554.

Miles, B., &Huberman, A. M. (2009).*Qualitative Data Analysis*. Thousand Oaks (CA): Sage Publications Ltd.

Musah, B. O., Nii-trebi, N. I., Nwabugo, M. A., &Asmah, R. H. (2014).Microbial Quality of Locally Prepared *Hibiscus* Tea in Accra.*Journal of Environmental Science, Toxicology and Food Technology*, *8*(11), 23–27.

Nurudeen, A., Lawal, A. O. and Ajayi, S. A. (2014).A survey of hygiene and sanitary practices of street food vendors in the Central State of Northern Nigeria.*Journal of Public Health and Epidemiology*, 6(5): 174-181.

Oboh, G., &Elusiyan, C. A. (2004).Nutrient Composition and Antimicrobial Activity of Sorrel Drinks (Soborodo).*Journal of Medicinal Food*, *7*(3), 340–342.

Oghenekohwo, J. E. (2015). The pattern of Food Hygiene and Environmental Health Practices among Food Vendors in Niger Delta University.*European Journal of Food Science and Technology*, *3*(1), 24-40.

Okereke, P., Iroka, J. &Chukwuma, S. R. (2015).*Extraction and Colours of Roselle (Hibiscus sabdariffa) juice*.Unpublished Masters' thesis.Submitted to the Department of Chemistry., University of Ibadan, Ibadan, Nigeria, p10.

Okojie, P. W., &Isah, E. C. (2014). Sanitary conditions of food vending sites and food handling practices of street food vendors in Benin City, Nigeria: Implication for food hygiene and safety. *Journal of Environmental and Public Health*, *2014*, 6.

Olawale, A. S. (2011). Studies in concentration and preservation of sorrel extract. *African journal of biotechnology*, 10(3), 416-423.

Omari, R., Quorantsen, E. K., Omari, P., Oppey, D., &Asigbee, M. (2014).Prevailing Food Safety Practices and Barriers to the Adoption of the WHO 5-Keys to Safer Food Messages in Rural Cocoa-Producing Communities in Ghana.*Internet Journal of Food Safety*, *16*, 36–44.

Omemu, A., Edema, M., Atayese, A., &Obadina, A. (2006). A survey of the microflora of *Hibiscus*sabdariffa (Roselle) and the resulting“ Zobo” juice. *African Journal of Biotechnology*, *5*(3), 254–259.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., &Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research*, *42*(5), 533-544.

Rane, S. (2011).Street vended food in developing world: Hazard analyses. *Indian Journal of Microbiology*.51, 100–106.

Ross, I. V. A. (2003).*Hibiscus sabdariffa*. In: Medicinal plants of the world. New Jersey: Humana Press; 267-275.

Sarkodie, N. A., Bempong, E. K., Tetteh, O. N., Saaka, A. C. and Moses, G. K. (2014). Assessing the level of hygienic practices among street food vendors in SunyaniTownship.*Pakistan Journal of Nutrition*, 13(10): 610-615.

Scallan, E., Hoekstra, R. M., Angulo, F. J., Tauxe, R. V, Widdowson, M.-A., Roy, S. L., Griffin, P. M. (2011).Foodborne illness acquired in the United States--major pathogens.*Emerging Infectious Diseases*, *17*(1), 7–15.

Singh, C., Singh, H., Singh, H., Singh, B., Kaur, J., Singh, N., Youdon, T., Kaur, H., &Marwaha, H. (2017).Assessing the Hygiene Practices among Street Food Vendors in Mohali.*The International Journal of Indian Psychology*, Volume 5, Issue 1, 121-146.

Sutton, J., & Austin, Z. (2015). Qualitative research: data collection, analysis, and management. *The Canadian journal of hospital pharmacy*, *68*(3), 226.

Thakur, C. P., Mehra, R., Narula, C., Mahapatra, S., &Kalita, T. J. (2013).Food safety and hygiene practices among street food vendors in Delhi, India.*International Journal of Current Research*, *5*(11), 3531-3534.

Thomas, J. R., Silverman, S. J., & Nelson, J. K. (2015). Research Methods in Physical Activity,
7th Edn Champaign. *IL: Human Kinetics*.

Turner, G. F. (2010). *Medicinal plants and traditional medicine in Africa*.John Wiley and Sons Ltd. New York, Pp 256-257.

Van Tonder, I., Lues Jan, F. R., &Theron, M. M. 2007.The Personal and General Hygiene Practices of Food Handlers in the Delicatessen Sections of Retail Outlets in South Africa. *Journal of Environmental Health*, 70 (4): 33-8.

Volel, T. &Finkel, U. (2016).Consumer knowledge of foodborne microbial hazards and food-handling practices.*Journal of Food Protection, 59*(3), 28–35.

WHO (2011).*Foodborne diseases: A focus on health.* WHO, Geneva.

Wuliyeng, G.T. (2013) *Examining the Hygiene Practices Among Street Food Vendors in Nsawam and Adoagyiri*. Unpublished master's Thesis Submitted to University of Ghana.

Zeru, K., and Kumie, A. (2007). Sanitary conditions of food establishments in Mekelle town, Tigray, North Ethiopia. *Ethiop.J.HealthDev,* 2(1):1-9.

## APPENDIX A

## UNIVERSITY OF EDUCATION, WINNEBA

## DEPARTMENT OF HOSPITALITY AND TOURISM EDUCATION

## DATA COLLECTION INSTRUMENTS

I am Georgina Dadson, a postgraduate student of University of Education Winneba, conducting a research in partial fulfilment of the requirement for the award of Master of Philosophy in .Hospitality and Catering. You are hereby requested to grant an interview to help me undertake a study to "Assess the production process of 'Sobolo'. Please, be assured that your identity is not required here and any information you provide will be held confidential. Please, answer the questions to the best of your knowledge, understanding and experience. None of your responses will be wrong or right.

Section A: Socio-Demographic Data

1. Gender: Male [ ] Female [ ]
2. Age group (in years):18 – 30 [ ] 31 – 40 [ ] 41 – 50 [ ]
   51- 60 [ ] above 60 years []
3. Highest educational qualification:

Degree [ ] Diploma [ ] Secondary/Technical [ ] Basic level [ ] None [ ]

4. Years at present job:1year [ ] 2 -5 years [ ] 6 -10years [ ]Above10 years [ ]

5. Marita status: Single [ ] Married [ ] Divorced/Widowed [ ]

6. Religion: Christianity [ ] Islam [ ] Traditional [ ] Others (specify) .....

7. Ethnic group: Akan [ ] Guan [ ] Ga/Adangbe [ ] Others (specify) .....

8. Why in 'Sobolo' business: Main source of income [ ] Keep family business [ ]

As a hobby [ ] To supplement main business [ ]Others (specify) .....

9. Any professional training in food vending: Yes [ ] No [ ]; if yes, at what level?

Tertiary [ ] Vocational/Technical [ ] Apprenticeship [ ]

## INTERVIEW GUIDE

Section B: Production and Handling Practices

1. What do you know about food hygiene?

   *Prompts:* about safety of food, about the person preparing it, about contamination.

2. For what reason do we need to observe food hygiene?

   *Prompts:* to prevent diseases, to prepare wholesome food etc

3. By what means can our food 'Sobolo' drink be contaminated?

   *Prompt :*Flies, dirt, dust, etc

4. How long do you store raw the leaves (Calyx) before using to prepare the drink?

   *Prompt:*1 day, 1 week, 1 month, etc

5. How and where do you store the leaves (Calyx) before using to prepare the drink?

6. How do you treat the leaves (Calyx) before extraction?

   *Prompt:*Sorting for foreign materials, drying, hand shelling, machine shelling, etc

7. What do you use to extract the juice?

   *Prompt:* Cold water, hot water, boiling, etc

8. How long does extraction take?

   *Prompt:* 15 minutes, 30 minutes, 1 hour, overnight, etc

9. Do you steep before extraction?

10. Do you spice during or after extraction?

11. What do you do after extraction?

    *Prompt:* filter etc

12. Do you add any antibacterial agent and at what point in the process?

13. Do you formulate and what materials do you use?

    Prompt:sugar, aroma, fruit juice, ginger, etc

14. Do you refrigerate or sell out straight?

15. What packaging materials do you use?

    Prompt: polythene bags, bottles, cups, etc

16. How do you treat the packaging materials before use?

    Prompt: wash, sterile, blow air into polythene, etc

17. How do you store the finished product?

    Prompt: freeze, refrigerate, put ice block on etc

## APPENDIX B

## OBSERVATION GUIDE

Section D: Personal, Environment/surrounding, Food hygiene, Materials and other equipment

| **Source** | **Comments** |
|---|---|
| ***Personal hygiene*** | |
| 1.Finger nails | |
| 2.Hair | |
| 3.Use of apron and gloves | |
| 4.Open wound | |
| 4.Behaviour when coughing, sneezing, talking | |
| 5. Hand washing before handling Leaves | |
| ***Environment/surrounding*** | |
| 1. Protection from flies/insects, domestic animals, etc | |
| 2. Water drainage system | |
| 3. Source of water | |
| 4. Tidiness of site | |
| 5. Disposal of waste/refuse | |
| 6. Nearness to toilet facility | |

| | |
|---|---|
| ***Food hygiene*** | |
| 7. Treatment of leaves (Calyx) | |
| 8. Storage of leaves and finished product 'Sobolo' | |
| 9. Handling of leftover drinks | |
| 10. Quality of leaves (Calyx) | |
| ***Materials and other equipment*** | |
| 11. Cleanliness of cooking utensils | |
| 12. Use of disinfectant | |
| 13. Washing of leaves (Calyx) | |
| 14. Treatment of packaging Materials | |
| 14. Reuse of unsold drinks | |

*Thanks for your participation*

## APPENDIX C

Boiling **of 'Sobolo'** Leaves


**Filteration of 'Sobolo'**


**Packaged ‘Sobolo’**