UNIVERSITY OF CAPE COAST

CHEMICAL COMPOSITION OF SELECTED ARTIFICIAL FOOD ENHANCERS IN GHANA

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BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature..... Date ……

Name: Veronica Akwaah

Supervisor's Declaration

I hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of the thesis laid down by University of Cape Coast.

Supervisor's Signature …… Date ……

Name: Prof. (Mrs.) Sarah Darkwa

ABSTRACT

The study looked at artificial food seasonings/enhancers and their composition at Subin Sub Metro of Kumasi. Descriptive research and Experimental designs were used. Eighty respondents were sampled purposefully from artificial food seasonings sellers for the descriptive research aspect of the study. Ten most purchased seasonings were selected and analysed in the laboratory. The data collected were analysed using IBM/SPSS Version 25 for Windows. The demographic data of the respondents were presented using frequencies and percentages. Results from objective 3 were compared to recommended standards. The hypotheses formulated were tested with the help of one sample t-test and chi-square 0.05 alpha. The results showed that the most purchased artificial food seasonings were Jara, Minazen, B-3 Chicken, A-one Beef, Mr. Chef, Samu, Onga chicken, Adja, Remie chicken and Maggie Cube. The chemical constituents found in the artificial food enhancers included Acid insoluble ash, Arsenic, Fat, Iron, Lead, Nitrogen, Sodium chloride and Total ash. There were no statistically significant differences in the types and levels of chemical components of the selected food seasonings from the market and the recommended standards ($p<0.05$). The compounds found were in line with recommended standards for consumption. The list of the most bought seasonings and their associated chemical constituents showed that if consumed in reasonable amounts, may not necessarily cause any health problems.

KEY WORDS

Food seasoning

Food Enhancers

Constituents

Chemicals.

.

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DEDICATION

To my husband Mr. Wilson Nketia Siaw and children Afriyie, AB, Papa Frimpong, Kweku Nhyira and Emmanuel.

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CHAPTER ONE

INTRODUCTION

Background to the Study

Globalisation and the enhancement of new technological tools have brought about relevant modifications in people's most eating habits. For some years now, foods rich in artificial chemicals are introduced into our daily lives (Gomes, Oliveira, Carvalho, Menezes & Peron, 2013; Moura, Santana, Ferreira, Sousa & Peron, 2016). These ingredients are often referred to as micro-ingredients and contain flavourings that are essential to the food industry in deliberating unique sensory taste and smell properties for food products (Xu, Gu, Wang, Ju, Wang, Ruan &Feng, 2015; Marques, Silva, Sousa, Ferreira & Peron, 2015). The complex composition of flavourings or seasonings contains an extensive range of chemical composites, such as additives, colorants, diluents, and many others. (Brasil, 2007; Koca, Erbay & Kaymak-Ertekin, 2015). The food industry classifies them into natural flavourings, nature-identical, and synthetic artificial.

The global standardisation of flavouring or micro-ingredients is used frequently by the Food Safety Agencies, Food and Agriculture Organisation (FAO) and the Association of Flavour and Extract Manufactories (FEMA) (Xuet al., 2015). In Brazil, these are unrestricted by the National Sanitary Surveillance Agency (ANVISA) through Resoluçãoda Diretoria Colegiada (RDC) Resolution 2 (Brasil, 2007). However, reports provided by these governing authorities are often not detailed; they do not provide the concentrations and compounds found in these substances. The Acceptable Daily Intake (ADI) has not reported the flavouring tolerable dose limit found

for separating food kind (Marques et al., 2015; More et al., 2012; Zengin et al., 2011; Moura et al., 2016; Xu et al., 2015; Brasil, 2007;).

Food has always been considered for its nutritional value, especially for the energy and the bodybuilding abilities it provides which are necessary for life. The significant components of food are carbohydrates, proteins, and fats. For this study, all the minor components present in food, not necessarily for their nutritional value, but may play fundamental roles are studied. Excellent flavour are necessary to make food attractive and eating provide pleasure. Also, preservatives and other additives prevent food spoilage and contamination. Compounds like sweeteners may reduce caloric intake, and the use of nutraceutical compounds may benefit health (Ferla, 2017).

Food seasoning or flavouring is an ingredient that adds flavour to food, for instance, salt, pepper, and other spices. Spices are local vegetables or foreign origin with sweet-smelling features and warm, delicious taste used in enhancing flour or foods (Cobley, 2002). Within the catering service, home kitchen, restaurants, and commercial food joints. Seasonings are used as a substitute for common salt. In the preparation of beef, soups, stews, and other foods, such seasonings are used instead of salt. Several of these ingredients are used sometimes as seasonings, flavouring, and flavour enhancers. Some examples of the seasonings include onions or other alliums spp. (gallic, shallots, leek, chives), buds (cloves) and berry (black pepper).

When added to different foods, a blend of ingredients and seasonings changes dietary composition (Susan & Anne, 1998). Substances in the unique seasonings of vegetables mostly contain some units that are not found in some of these vegetable products or spice (Borget, 1993). Inorganic elements in the

form of mineral elements perform several functions such as the regulation of acid-base steadiness, nerve energisation and muscle impairment, co-factors in enzyme-catalyzed reactions, and organic elements in the body, e.g., calcium (Morton &Merril, 2001).

Condiments and spices mostly used for seasoning and flavouring are plant products that enhance food taste, drugs, and beverages (Dziezak, 1989). Spices are the esoteric food supplement used over the decades to improve the delicious food quality; the amount and kinds of spices patronized by tropical countries are vast. These spice ingredients give foods their distinctive flavour, or piquancy aroma, and colour. Some spices, such as fenugreek, can also change the quality of food. The fact that their discrete scent inspires the hungriness is a shared experience. Aside from using spices as flavourings and seasonings, there are several recognitions regarding its usage, such as therapeutic including stomachic antispasmodic and anthelmintic, carminative, and tonic (Nadkarni &Nadkarni, 1976).

Humans have been using spices since ancient times as nutritional agents (Kaefer& Milner, 2008). Their food security and conservation function have been noted however, they were mainly flavouring and colouring agents. Spices have shown some relevance in thwarting and treating a wide range of chronic ailments, aging, inflammatory diseases, cardiovascular neurological, and metabolic disorders (Gottardi et al., Prasad & Tyagi, 2016).

Additives are based on the new food sector and play a vital role in enhancing food's colour, taste and smell, nutrient structure and processing and shelf life (Wu, Zhang, Shan &Chen, 2013; Wang, Wu & Gao, 2015). Although additives have become a key element in food processing, consumer

fears are still not lessened about their possible consequences (Amin, Azad, & Samian, 2013; Cai& Liu, 2014). There has been a transitional difference in consumers' quality of life for decades and an increase in demand for all-natural, non-additive foods. As a result, the list of possible food safety risks have been suggested for several synthetic food additives, and many consumers believe that the use of food ingredients is improper or not considered acceptable (Christensen, Mørkbak, Jensen, & Evald, 2011; Chen, Wu, Lu, Zhong, Xie, Li, Luo, & Guo, 2015).

An artificial taste is synthesized rather than derived from the natural product from other additives. Artificial flavours typically only involve a small amount of natural flavour (Bloom, 2017). Sometimes only one flavour chemical in the natural extract, but they are missing in the other so that the specific combination cannot precisely replicate the flavour (Bloom, 2017). Therefore, artificial flavours have started appearing in the industry. Food flavours and colourings are used widely to improve the natural performance of chemicals added to food. Colouring food can make food more appealing while adding food flavours, or adding new flavours to other bland products (Liji 2018).

Singh and Davidson (2018) described four general categories of food additives. According to them, they are the sensory agents, preservatives processing agents, and nutritional additives. Nutritional additives help to regain nutrients that have been lost or damaged during processing, enriching, or enhancing other foods to cure dietary disorders. Food fortification started in 1924 when iodine was included in the table salt to avoid goitre.

With advancements in technology and research, food spices and seasonings are being produced in the chemical laboratory to enhance food taste. The literature figures out that several of the spices are of Eastern origin; since the exploration of the New World; there has been the addition of spices such as epazote, annatto, allspices, sweet peppers, vanilla, chili peppers, and chocolate, which have for a time now been used for food seasoning and therapeutic reasons (Ceylan & Fung, 2004).

The addition of vitamins to countless diets is to enhance their dietary value. For example, filling milk and cereal products with vitamins A and D, and fruit beverages filled with vitamins C. Processing agent: multiple agents are applied to food to help process or preserve the product's desired quality. The sensory agent contains colorants, flavourings, and sweeteners. Food preservatives have become an indispensable supplement in some food trades these days. In understandable terminology, any substance that impedes food weakening caused by microorganisms, enzymes, or any other chemical reaction is a food preservative. Many individuals suffer from hunger due tothe unavailability of food (World hunger and poverty facts and statistics, 2016).

Most artificial food additives convey opposing health effects at high doses. More importantly, most of the artificial food preservatives have some adverse health effects at high doses. For instance, findings from vitro have shown that potassium benzoate and sodium benzoate portray genotoxic effects (Zengin*et al.*, 2011). This problem can be solved, however, by adhering to appropriate daily intake values (ADI). Of course, certain artificial food conservation items have positive health effects at a nontoxic level, while their effects are detrimental at toxic levels.

One fundamental principle of the legislation is that the chemicals should not deceive consumers in food (FDA, 2009). All flavour enhancers should be added to foodstuffs in limited quantities. If there are no planned quantitative limits or MPLs for using a food additive, its usage should be on the production methods that are only required to attain the anticipated industrial effect (Food Safety Authority of Ireland, 2010). Unauthorized food additives and all registered food additives will induce negative health consequences until daily consumption is more than necessary.

Taste organ that spots the five basic senses of taste cover the tongue: bitter, sour, umami, Salty, and sweet. Good taste and different senses play a crucial role in our food pleasure and digestion. The smell, sight, and taste of food – amazingly tasty food – stimulates the production of digestive juices (such as saliva in the mouth and HCl in the stomach) and helps the body for food (Tsakos, n.d). It retains its natural flavour as food is stored, and as it remains on a store shelf for weeks, natural chemicals in food start to crumble, decreasing their shelf life and altering the way they taste. This is where the flavour industry comes into play. It is therefore important that these artificial food enhancers are thoroughly examined to ascertain their health benefits or otherwise on consumers.

Statement of the Problem

For decades, several enhancements in consumers' preference through food seasonings, artificial food seasonings are being used more in cooking. Many artificial food additives have been added to recommended food safety hazards, and many consumers believe that food additives are inappropriate or unjustified (Laba, 2016; Okeahialam, 2017).

Although the use of food additives during food processing have become standard practice globally, consumers are more concerned about their potential risks. Studies indicate that excessive use of some artificial seasonings, especially those that do not meet the required recommended standards in terms of their chemical constituents, can be very harmful to human health when used over time (Laba, 2016; Okeahialam, 2017; Takyi, 2018).The studies of Laba (2016), Okeahialam (2017), and Takyi (2018) noted that artificial food seasonings might contain some questionable ingredients and high amounts of salt-related chemicals. For instance, excessive use of monosodium glutamate (MSG) in artificial seasoning production has been linked to such diseases as fibromyalgia, liver inflammation, memory problems, or migraines (Laba, 2016).

The chemical compositions of artificial food seasonings are indicated often on their labels. However, this is often deceptive since most of these manufactures do not comply with the Ghana Standard Authority's specifications (FDA, 2009) and the World Health Organisation (WHO) recommendations. FDA provides the chemical composition of the standardised food seasonings and WHO, but the consuming public may not be aware. The artificial food seasonings' actual composition is not displayed; even if they are, it may not necessarily be the correct one. It is in light of the above problem that this study was conducted to examine the levels of the chemical composition of artificial food seasonings used in Ghana.

Purpose of the Study

The purpose of the study was to investigate the levels of chemical composition of artificial food seasonings sold on the Ghanaian markets for

consumption and compare them to the required recommended standards by the FDA.

Research Questions

1. What are the most commonly used artificial food seasonings on the Ghanaian market?
2. What is the chemical composition of food seasonings on the Ghanaian market?
3. What is the relationship between chemical constituents of food seasonings and the required standards?
4. Which factors influence consumers' preference for the types (natural and artificial) of food seasoning?

Hypotheses

The following hypotheses were tested:

Ho_1: There are no statistically significant differences in the level of chemical constituents of the selected food seasonings on Ghanaian market and the standards.

Ho_2: Determinants have no influence on consumer preference for type of artificial food seasoning.

Significance of the Study

It is hoped that findings from this study would impart policy on the use of artificial enhancers. It would inform consumers on the potential risk in using artificial enhancers. It will also create awareness to the general public on the use of artificial food seasoning. The last but not the least is that the findings will serve as empirical bases for further study in this area.

Delimitations

The study covered ten popular artificial food seasonings and spices sold by market women in the Subin-Sub Metro in Kumasi. The standards set by the World Health Organisation in 2007 and 2017 was the reference point in comparing the artificial food seasonings and spices.

Limitations

The study faced a lot of challenges in getting relevant literature on the artificial or synthetic food seasonings. The study faced a challenge during data collection. The sellers of artificial food seasonings were not comfortable with the study thinking it was a disguised way to take them out of business. Also, the data analysis kits were not in a single chemical laboratory hence, I had to be shuttling between two laboratories which were located in Cape Coast and Accra. Getting the standards for the chemical constituents for the study had actually delayed the work unduly. Despite the challenges, the results of the study was not affected.

Organisation of the of the Study

The rest of the study is presented in four other chapters. The relevant literature of the study is presented in Chapter Two, and Chapter Three presents the methodology used in approaching the entire study. The results and discussion of the results are presented in Chapter Four while the summary, conclusion and recommendations constitute Chapter Five.

CHAPTER TWO

LITERATURE REVIEW

This chapter deliberated the conceptual framework of the study and the history of Seasonings and Spices. Also, literature was reviewed on food seasonings and their purpose in food, advantages, and disadvantages of using spices as preservatives, artificial food seasonings, advantages and disadvantages of using artificial food seasonings, seasonings' chemical composition, and their antioxidant activity and chemical properties of spices. In addition, information on enhancing taste with artificial food seasonings, the threshold of toxicological concern, are presented in this chapter.

Conceptual Framework of the Study

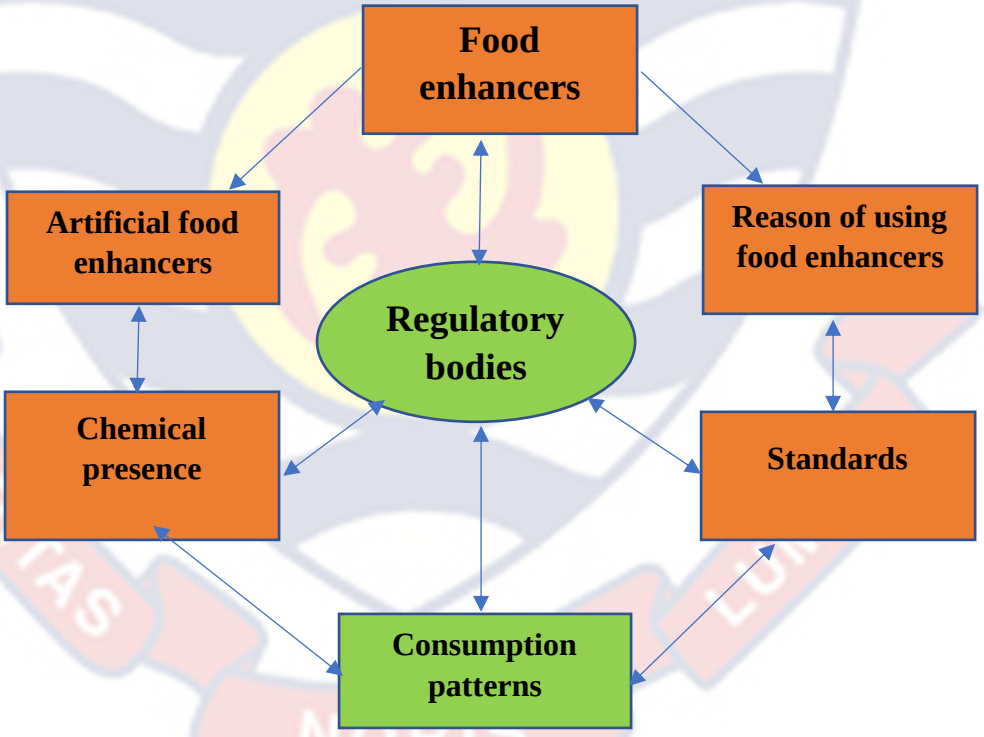

Figure 1: Conceptual Framework on Artificial food Enhancers.

Source: (Researchers construct)

The conceptual framework of the study had seven distinct constructs that have been connected with arrows. The author's construct of the conceptual framework includes 'artificial food enhancers', ‘Reason of using food enhancers’, 'standards', ’consumption patterns’, ‘regulatory bodies’, 'chemical presence’ and artificial food enhancer. Food enhancers generally consist of two categories thus natural and artificial food enhancer however my focus was on artificial food enhancers. Food enhancers have chemicals in them, which has to be regulated by the regulatory bodies. The constituents must meet the standards of the international food regulators, Ghana standard authority and those of the recipient countries where these artificial food seasonings would be consumed. They have to regulate the quantum of each chemical found in any artificial food enhancers. The pattern of food consuming enhancers depend on the individual showing why they use the enhancers. This conceptual framework is used because the researcher is investigating the chemical present in artificial food enhancers and this bothers on the regulatory authorities. The regulatory authorities will have to keep their standards. However is not all the artificial enhancers that are regulated in the country because some pass through the unapproved routes to the country.

The chemical constituents and the standards have to meet a standardised criterion set in the food industries and other regulatory bodies. This conceptual framework is connected to this work because all the artificial food seasonings in Subin Sub Metro in Kumasi are obtained from an outlet or shops. The artificial food seasonings in the market now have standards and chemical constituents. The constituents are known to the manufacturers and the regulatory bodies in Ghana.

Empirical Review

History of Seasonings and Spices

Ancient cultures, such as Indians, Incas, Aztecs, and Chinese, have been utilizing spices from prehistoric times. Like modern societies, spices were used to improve the taste of food and establish different taste profiles. Spices have been used to preserve meat and fish, mask contaminated food, counteract harmful odours, and manufacture cosmetics and perfumes.

Early cultures understood the medical importance of spices and used them to treat illnesses and plague as antidotes for poisoning. Spices like garlic, oregano, and cinnamon have been used as germicides since medieval times to fight against the plague's spread (Raghavan, 2007). Many cultures have claimed that spices ought to have a power surge and were used for religious and ritual purposes. Chilli peppers, which are essential spices in today's delicacies, have grown wild in the Andes and have been used for 10,000 years. Chile peppers were conveyed from South America to Central America, Mexico, North America, the Caribbean, and all parts of the globe. In Mexico, archaeological excavations reveal Chilli pepper existence dates back to 7000 BC. Anthropologists find it a challenge to define with assurance when chili peppers were first cultivated. The Native Americans initially started cultivating chillies between 5200 and 3300 BC even before the Spanish migrated to settle in Mexico in the sixteenth century. Aztecs were the major producers at that time increasing dozens of pods at that time. Today, all trained cultivars are gotten from five tamed types of chile peppers, and none vary widely from those tamed by Native Americans.

In trading, the South western United States, and parts of Mexico in the Pre-Columbian Americas, dried chilli peppers are still in use. Chilli pepper (maize, cacao bean, sugar, and chilli pepper beverage) and the "Posole" (a corn and chilli pepper stuff) were several foods flavoured by the Aztecs and Mayans. In Central and North American hothouse jungles, Vanilla planfolia, a climbing, tropical orchid was rampant. It fermented and gave the Aztecs an unforgettable aroma as the vanilla fruit jacket slipped down to the bush floor until it became ripe. Vanilla pods, known to the Aztecs as "tlixochitl" or "black pod," were cultivated from remote climbing vineyard found in the South western Jungles.

This natural plant was later domesticated, and the Aztecs grew its vines. Vanilla was used as a stimulant and flavouring for the nerves and was thought to be an aphrodisiac. The Aztecs combined the smooth vanilla taste with chocolate, chilli, corn kernels, and honey to make "royal" drinks reserved for society's elite. According to folklore, this flavoured chocolate cocktail, served in golden cups, was presented to the Spanish conquistador Cortez by the great Aztec emperor Montezuma. In Mexico and Guatemala, the Mayans, Toltecs, and Aztecs took the cocoa seeds, roasted them, ground them in stone into powder, and whisked the flour with hot water to make tchacahoua (Mayan) or tchocoatl (Aztec). This drink was considered a sacred meal, often combined with chili peppers, honey, or ground maize. Allspice is the fruit of a perpetual tree that has grown nuts on many Caribbean islands, particularly Jamaica and Cuba, in southern Mexico and Central America (Raghavan, 2007).

In preserving the bodies of their ancestors or founders, the Indian Mayan preserves or kept all spice berries. Early Spanish explorers wanted the fruit of the unripe allspice berry, which resembles a large black peppercorn. These berries then were called pepper, from which we get the pimento name. The Vedas refer to “mustard (baja), turmeric (haridra), long pepper (pippali), and sour citrus (jambira), written in Sanskrit between 1700 and 800 BC”. The Sanskrit language itself however, contains words for spices that represent the India's well-established use of spices. The Sanskrit word for tamarind (chincha) has aboriginal roots, for example (Chaieb et al, 2007).

Haridra, or turmeric, originates from the Munda, a pre-Aryan population in most northern India. The Vedas denote to Nishadas, a culture that translates into "turmeric eaters." The Aryans watched down on those spices. Garlic, leeks, mushrooms, and onions are listed in Vedic literature as native foods despised by the Aryans. Some scholars explain that this aversion emerged from standard practice when fertilizing these crops with human waste manure”. Later, Vedic writings suggest that early North Indians were interested in the far-reaching trade of spices. The Vedas report that the Aryans used black pepper (maricha) from South India and asafoetida (hingu) from Afghanistan. In the Buddhist period (800 to 350 BC), ginger, cumin, and cloves from other parts of Asia were brought to North India. Its complete domestication has hidden the roots of ginger (Achinewy, Denny & Mendham, 1995).

Cumin is native to Southeast Asia, but there are wild forms in India. Around 300 BC, Cumin appears in Vedaic writing and seems to be a native of the Middle East. The Sanskrit word for Cumin, jeeraka, comes from Persian.

Cloves originated in the Moluccas of East Indonesia. It first appeared between 350 BC and AD 1. in Ramayana, an Indian epic. Clove may have originated from Malaysia to India since "Lavanga" seems to come from Malaysia's clove bud, "bungalavanga," the Sanskrit word for clove (Raghavan, 2007).

The Dravidians were South India's predominant civilization. Their food was flavoured with tamarind, black pepper, lemon, cardamom, cinnamon, cloves, turmeric, and pomegranate. In southern India, specifically in the Karnataka and Kerala states, pepper plants, cinnamon and cardamom have grown wild. Mysore was famous for its cardamom in Karnataka, and Kerala was renowned for its black pepper. Although cinnamon also grew wild in South India, Sri Lanka, off the coast of South India, had the best cinnamon. In addition to flavouring foods, spices played a significant role in early Indian people's spiritual and social lives. Because of their relation to the light, the yellow and orange colours were considered auspicious and festive. Consequently, turmeric and saffron have been used in religious rituals and daily life's significant personal occasions, such as births, weddings, and funerals (Chaieb et al, 2007).

Food Seasonings and their Purpose in Food

Food seasoning, such as salt, peppers, and other spices, is a material that adds flavour to food. Spices are indigenous or exotic vegetable substances that are aromatic and have hot piquant tastes, used to improve the flavour of foods, or add the stimulant ingredient found in them (Cobley, 2002). Seasonings can also be used in several other industrially processed food products to substitute traditional salt and food preparation in all catering, restaurants, home kitchens, etc. These ingredients are extremely appropriate

for making salty and spicy flavourings for soups, meat, and other diets. The food structure is altered by the ingredient mixture and seasonings when added to different food products (Susan & Anne, 1998). For enzyme operations, mineral elements such as potassium, magnesium, and calcium are essential and are included in food seasonings (Merril & Morton, 2001).

In specific places such as India, China, Indonesia, East, and West Africa, spices, as seasonings, forms a vast trans boundary trade element. Consumers use seasonings to cook food in all parts of Nigeria, and some of these seasonings are known to encourage womb expansion in pregnant women (Achinewy, Denny & Mendham, 1995). It is an indicator that spice is used and continues to be recognized in most homes in almost every part of the world. In different countries, the selling of spices means that their use is also growing.

Spices are components of plants that are used as preservatives, colorants, or therapeutic purposes because of their properties. Spices have been recognized for a long time, because of the chemical compounds, such as, anthocyanins, terpenes, phenylpropanoids and flavonoids (Torres, Gassara, Kouassi, Brar & Belkacemi, 2015) found in spices, the interest in spices is remarkable. Spices including cloves (eugenol), cinnamon (cinnamaldehyde), and cumin (cuminaldehyde),etc., are identified and investigated for their antimicrobial and antioxidant properties because of their important synthetic chemicals (Raybaudi et al., 2008; Turgis et al, 2009).

According to Torres et al., (2015), These spices can be used as preservatives to replace chemical preservatives in several meal, particularly in treated meat. Other properties that provide various applications for spices, such as insecticides, medicines, colorants, and natural flavouring, are also

conferred on spices' by their chemical compounds. Spices have useful properties, such as antioxidant activity levels comparable to conventional chemical antioxidants used as a natural alternative to synthetic preservatives (Torres *et al*., 2015).

Some seasonings are called flavour enhancers. Flavour enhancers increase the way you perceive the food's flavour without changing the prepared dish's actual flavour. They do not add to a dish. Flavour enhancers do this by affecting taste buds. Flavour on the other hand, is an ingredient that changes the natural flavour of the foods to which it is added. It enhances the productivity of tasting the dish (Andrews, 2016).

Advantages and Disadvantages of using spices as Preservatives

The antioxidant and antimicrobial activity of spices have shown significant conservatives exploit for food, but other factors need to be examined before ensuring spices' effectiveness as preservatives. As indicated spices have various degrees of flavour and aroma, but several of them are considered as stable (Torres, Gassara, Kouassi, Brar & Belkacemi, 2015; Rasooli, 2007) (Torres, Gassara, Kouassi, Brar & Belkacemi, 2015; Rasooli, 2007).

A healthy alternative to additives in meat products is essential oils from spice extracts, but the primary issue is that when essential oils are used in meat, their antimicrobial properties reduces inceenlarged amounts of fat protein meat defends the bacteria from the act of essential oils. Monocytogenes in pork liver, bacon, is related to the essential oils' fatty meat interaction process (Carraminana, Rota, Burillo & Herrera, 2008). Hence a more excellent ratio of spices may be necessary to ensure antioxidant and

antimicrobicaction, but the strong flavour of spices may affect the flavour of meat and disturb its fair value (Karre et ai., 2013)

Essential spice oils also entail mining method that brands the entire process expensive and does not imply more excellent microorganism activity because for example, in meat, these essential oils can dissolve in the fatty phase of meat. Therefore, the use of spices in meat and other foods may be a better option for preservation, as less complexity, lower costs and similar antimicrobial activity are present (Herwita and Idris, 2007).

More importantly, the effectiveness of spice ingredients against microorganisms differs depending on the food, and the same ingredients may be useful for one type of meat, not another. A mixture of clove and oregano in broth culture was a suppressant activity for L. monocytogenesbut not shown to have the desired effect in meat slurry (Lis-Balchin, Steyrl & Krenn, 2003). To prove its antimicrobial effect on every meat kind, treatment methods for spices need to be tested in vitro and vivo.

Artificial Food Seasonings

Artificial flavouring depicts any constituent to convey a flavour not acquired from spices, Berries, buds, bark, herbs, edible yeast, vegetable or vegetable juice, meat, seafood, chicken, eggs, packaged foods or flavour enhancers, raw materials, leaves or related plants (Tsakos, 2012). In other words, chemicals without extract from the natural environment include non-natural flavours. Integrating chemicals made from uneatable constituents, such as wood chips or petroleum, produce artificial flavours. Like natural flavourings artificial flavours are produced to have the exact smell and taste (Ameritas, 2017).

Artificial flavours are patented chemical formulas owned by creating flavour businesses. The desire for highest level ingredients made by flavour manufacturers (such as Givaudan) has given rise to a large number of companies or industries held in secret and with legitimate reason. Flavour companies hire a range of experts from chemists to chefs to 'cook up new flavours from various 1,300 ingredients approved by the FDA. Manufacturers do not want to share their recipes, and customers do not want to hear that the delicious flavour of chicken emerges from a combination of additives, rather than the actual stuff at their Stouffer meal (Tsakos, 2012).

It is also possible to classify flavours as non-natural flavours, spices, or natural flavours. According to the FDA (21 CFR Part 101), organic flavours, spices or natural flavours, artificial ingredients or artificial flavours are classified as any substance to impart flavours other than spices, fruit or fruit juice, plant or vegetable juice, edible yeast, herbs, bark, buds, roots, leaves or similar plant materials, meat, fish, poultry, eggs, milk products, among others.

According to the U.S. Food and Drugs Administration (FDA), the spice is an "aromatic vegetable substance in the whole, broken, or ground form, the significant function of which in food is seasoning rather than nutrition and from which no portion of any volatile oil or other flavouring opinion has been uninvolved" (Sung, Prasad, Yadav & Aggarwal, 2012). Over 100 several kinds of spices are manufactured globally, with Asia identified as the leading manufacturers of spices, precisely pepper, cloves, cinnamon, ginger, and nutmeg. Simultaneously, thyme, basil, coriander, chives, watercress, dill tips, celery leaves, and bay leaves are grown abundantly in Europe (Prasad, Gupta &Aggarwal, 2011). Ginger, sesame seed, allspice,

nutmeg, and pepper, are grown plentifully in America (Prasad, Gupta &Aggarwal, 2011).

Aromatic herbs and spices encompass organic substances, causing irritation or allergy to the respiratory system or skin (also known as active substances). Situations of occupational asthma, skill allergies, and other respiratory challenges acknowledged by scholarly papers from the literature were aromatic herbs and the spice sector. In the mixing, grinding, and packaging of seasonings and spices, operators are exposed predominantly to dust concentrations (Roberge, Aubin & Cloutier, 2012). In almost any packaged food, especially ready-to-eat items, spices, and herbs are present and are mostly used by the customer without any processing for flavouring purposes (Pilizota, 2014). Between 2010 and 2013, the intake of spices and herbs in the European Union (EU) increased by 1.7 percent yearly, with a cumulative demand of 385,000 tonnes in 2012. China is currently the leading producer of spices and herbs, although there are many countries in the same field of production (CBI Market Intelligence, 2015). Besides adding flavour to food production, spices, and herbs can also safely and naturally improve food products' shelf life (Holley & Patel, 2005).

The Utilisation of some spices is to optimize recipes' palatability/taste and sensory presence (Coleman, 2015). The spicy flavours of spices activate salivation and encourage digestion. Spices also enhance the appearance of some manufactured goods. Spices, together with salt, seem to retain meats with an impeccable taste in mixtures. Pungent spices' uses are to alleviate certain foods' salty taste (Shiny Spices, 2013). Aromatic spices that mask the onion's foul breath include cinnamon, cloves, mint, and many others. Spices

also increase meat flavour or fish while seasoning meat and fish (Shiny Spices, 2013). Based on the season, where and how it is grown, treated, transported, and processed, the strength of the spices' flavour and accuracy are subject to change (Ockerman & Basu, 2004).

Today, all the spices' proprieties contribute to many spices, from coloured spices to aromatic spices, used since prehistoric periods. The actual usages of the spices are their natural colouring agents (Ravindran, Babu&Shiva, 2006), flavouring, antioxidants (Shobana & Akhilender, 2000), and antimicrobials (Ceylan & Fung, 2004). The spices' application corresponds mostly to the food industry for medicinal purposes (Shan, Cai, Brooks & Corke, 2007), perfumes, and fine cuisine (Peter & Shylaja, 2012).

Adding various synthetic flavouring agents to the solution with alcohol, glycerol, propylene glycol, imitation, artificial extracts, essences, and flavours are prepared to formulate an extract, essence, or flavour resembling the flavour of the fruit, spirit, or liqueur is labelled. Several choices of flavourings including brandy, butterscotch, lime, rum, cherry, lemon, vanilla, and banana, cover these preparations. Some have only a few ingredients, others a lot. Synthetic vanillin, umarin (now prohibited in the United States and Canada), heliotropin, glycerol, water, and caramel colouring may be prepared with imitation vanilla extract.

Imitation strawberry flavour may contain 10, 12 or more organic synthetic chemicals, including aldehyde C16, aldehyde C14, benzyl acetate, methyl anthranilate, amyl acetate, amyl butyrate and ethyl propionate, with solvents and added colour, following the art, ability and experience of the particular manufacturer in producing the fullest and most natural flavour

(Metych, n.d.) Along with other organic chemicals, imitation brandy flavour may contain ethyl oenanthate, methyl succinate, ethyl acetate, and ethyl propionate. Some synthetic organic chemicals give imitation flavourings a distinctive note, such as allylcaproate and ethyl butyrate for pineapple, benzaldehyde for almond, benzyl butyrate for raspberry, and citral for lemon (Metych, n.d.).

Many adverse reactions are known to be caused by artificial flavours, including: allergic reactions, chest pain, DNA damage, fatigue, headaches, nervous system depression, brain damage. Seizures, nausea, dizziness, and more are also other symptoms. Identifying the root cause of symptom(s) is almost impossible without labelling the specific ingredients in artificial flavours (Tsakos 2012). According to the United States Department of Agriculture's National Organic Program, "more than 700 of the 1,323 chemically defined flavouring substances in the United States comprise aliphatic acyclic and acyclic alcohols, aldehydes, ketones, carboxylic acids and related esters, lactones, metals, and acetals. Other structural categories include aromatic, heteroaromatic, and heterocyclic substances with characteristic organoleptic" properties

Many artificial flavours include ingredients such as tar and crude oil that are also used to make artificial colours. The numerous health impacts associated with them are therefore not surprising. However, what is remarkable is that little documented research is available and practically no studies on the effects of artificial flavours are published (Tsakos, 2012).

Due to flavour considerations, the use of spices in food is often restricted since antidote antimicrobial agents may surpass the level of

organoleptic acceptance (Brull & Coote, 1999; Pandit & Shelef, 1994). Even at moderate levels, the integration of spices and other antimicrobial agents may increase food storage life and microbial protection. Spices and their derivaives have been established to be appropriate alternatives for inclusion in food conservation systems and may sometimes act as primary or adjuvant antimicrobial compounds.

Advantages and Disadvantages of using artificial food Seasonings

Synthetic antioxidants, if applied at concentrations allowed by law, are effective, pure, reasonably inexpensive, readily available, and harmless. Their only downside is that they are accused of being chemical products. Most customers therefore prefer natural antioxidant because they assume there are no additives (Pokorný &Parkányiová, 2017). Some of the advantages of synthetic food seasonings include:

- Ensure consistency of quality
- Make food more appetising – colouring
- Improve texture – physical conditioning agents
- Increase shelf life – preservatives
- Increase nutritive value
- Reducing the risk of food poisoning – preservatives
- Improve taste – flavouring
- Prevent waste – preservatives
- Provide wider variety of foods

Disadvantages of synthetic food seasonings identified were

- Some additives destroy nutrients e.g. sulphur dioxide destroys vitamin B

- Bulking agents can deceive consumers
- Allergies: migraine, hyperactivity, rashes e.g. tartrazine
- Sweeteners can leave bitter aftertaste e.g. saccharine
- Little known about cumulative or combined effect of additives.

Taste and flavour of Food

Taste and flavour, although the two are often confused, are not the same things. The flavour is how, based on a combination of senses, we perceive food and other substances, including taste, touch, and smell (as much as 80% of what we perceive as taste actually comes from smell) (Spector, 2014). In addition, the concept that there is a distinction between "natural" chemicals, such as those found in fruits and vegetables, and those chemicals' synthetic version is just a bad way of looking at the world (Spector, 2014).

Chemicals make up all foods (and everything else around us), whether they occur naturally or are made in a laboratory. That means a reaction to chemicals is all we smell or taste. For instance, the damping of cloves comes from a chemical called Eugenio and from the compound cinnamaldehyde, cinnamon, which is just the dried inner-bark of specific trees, gets its aroma and flavour (Spector, 2014). However, Spector (2014) has concluded that chemicals contain both artificial and natural flavours. The source of chemicals is the distinction between natural and artificial flavourings. In the laboratory, these edible items are processed to create natural flavourings from everything that can be consumed (i.e. meat and leafy greens). Artificial flavours come from anything processed that is inedible (i.e. petroleum).

Flavour enhancer is defined as a food additive in the form of seasoning powder that can add, improve and create taste and flavour and is commonly

made from meat or poultry, rarely discovered from fish (Beutling, 1996). I, iron, and cobalamin were sufficiently contained in the seasoning powder product, which had a positive effect on human health. The produced seasoning powder has a low water content and may demonstrate the product's stability during storage (Mahendradatta, Tawali, Bastian, & Tahir, 2011).

Artificial flavouring substances in food thus mean that flavouring substances, whether or not the product is processed, are not identified in a natural product intended for human consumption

Why is there an argument for the use of artificial flavours at all? In artificial flavours, synthetic chemicals generally cost less to produce than finding natural sources of chemicals (Spector, 2014). Synthetic chemicals are also potentially safer because they have been rigorously tested and used, according to Spector, 2014. It can be eco-friendlier to produce them since it does not first require growing food fields.

Chemical Composition of Seasonings and their Antioxidant Activity

The antioxidant activity of spices is related to their chemical composition, mainly to the presence of polyphenols and other biologically active compounds (Yashin, Yashin, Xia, & Nemzer, 2017). Therefore, an acceptable limit of 0.0 µg/g for cadmium and lead in food seasonings has been set by the World Health Organisation (WHO, 1983); 0.4 µg/g for calcium, potassium and sodium. A study in Nigeria showed that in food seasonings, calcium, potassium and sodium were below what had been recommended by the National Food and Drug Administration Control Agency (NAFDAC). As found in the sampled seasonings, the composition was below the 0.4 µg/g limit (Muhammad, Kabir & Adeleke, 2011).

In Minna in Nigeria, eight food seasonings were studied. The investigations were carried out using atomic absorption spectrophotometers on the concentrations of certain mineral elements, such as sodium, potassium and calcium, and two heavy metals, cadmium and lead. Royco had the highest concentration of calcium as one of the seasonings (0.022+0.001μg/g), with Onga classic having the lowest (0.002+0.00 μg/g). The highest level of potassium was (0.020+0.016 μg/g) inVedan, and the lowest in Ajinomoto (0.003+0.001 μg/g). Sodium was highest in Dinor (0.021+0.011 μg/g) and lowest in Knorr (0.003+0.002 μg/g) (Muhammad, Kabir &Adeleke, 2011).

Chemical properties of Spices

Spices have many characteristics that make them special, such as their aroma, but their chemical elements allow spices to be used as additives in diet, among other things. There are many uses for spices, such as flavouring agents, medicinal agents, preservatives and colouring agents. Spices and their extracts have preservative and natural antioxidant properties, spice extracts are common, and antibacterial, antifungal and antiviral activities are confident of them (Hernández, Aguirre, Nevárez, Gutierrez & Salas, 2011).

Spices exhibit antimicrobial activity due to several chemical compounds and inhibit the growth of pathogens in meat and other foods. Phenolic compounds, flavonoids and terpenes, which are the basis of the properties and uses of spices, such as eugenol and cinnamaldehyde cloves, are the main components of all spices and are related to their antimicrobial and antibacterial activity. Cinnamon also contains cinnamaldehyde with antimicrobial effect, but contains other chemical compounds, such as

antioxidant pine, which have these properties and are common to several of them (Chaieb, Hajlaoui, Zmantar, Ben, Rouabhia, Mahdouani & Bak, 2007).

Food flavour regulation for human Consumption

All over the world, flavouring micro ingredients are standardized and permitted for use by food safety agencies *Food and Agriculture Organisation* (FAO) and *Flavour and Extract Manufacturers Association* (FEMA) (Xu, Gu, Wang, Ju, Wang, Ruan &Feng, 2015), and, in Brazil, by the National Sanitary Surveillance Agency (ANVISA) through RDC Resolution 2 of January 15th, 2007 (Brasil, 2007). However, the compounds and concentrations present in these substances have never been reported in detail by any of these regulatory authorities, and the Required Daily Intake (ADI) and the tolerable dose limit of flavourings for each sort of cuisine have not yet been specified (Brasil, 2007; Zengin, N., Yüzbaşioğlu, Unal, Yilmaz &Aksoy, 2011; More, Raza& Vince, 2012; Xu et al., 2015; Marques, Silva, Sousa, Ferreira & Peron, 2015; Moura, Santana, Ferreira, Sousa & Peron, 2016).

Technical regulations of FAO and FEMA mention the need to carry out detailed toxicological studies of flavourings especially at the cellular level, to determine whether or not the need for more detailed research on the toxic effects to organisms (Xu*et al.*, 2015; Marques *et al.*, 2015; Moura*et al.*, 2016). Cytotoxic and mutagenic activity of genotoxic agents almost always cause significant adverse effects, such as the development of tumors, after prolonged exposure in the body (Almeida, et al. 2012). Thus, rapid, realistic and reliable test is necessary to identify these agents' potential toxicity at an early stage (Rothfuss, et al. 2011).

The EU has guidelines for the artificial food seasonings and includes

- List of approved additives
- Approved additives have been well tested
- In EU every approved additive has E number (except flavourings)
- The E no. or name must be on labels
- Additives should not reduce nutritive value
- Cannot be used to disguise faults
- Must not be a health hazard
- Must not mislead consumer
- Must be used in smallest possible effective quantity
- Colourings not allowed in fresh fruit, veg. meat, poultry, fish
- Preservatives and BHA, BHT and colourings not allowed in baby food.
- Sweeteners not permitted in food for infants or young children

Enhancing taste with artificial food Seasonings

Seasonings are composites encompassing one or more spices that are added to food either during its production or in its preparation prior to serving. It enhances the food's natural flavour and thereby increases its consumer acceptance (Farrell, 1990). Spices are used to spice meat products, providing a distinctive flavour characteristic of these products. The mixture of different spice ratios generates an almost infinite variation in the supply of meat products (Gadekar, Thomas, Anjaneyulu, Shinde & Pragati, 2006). The meat seasoning must be prepared in such a way as to enhance the meat's natural taste. The flavour of the products should not be overwhelming or decreased, but the product should be balanced with a blended, well-rounded flavour without noticeable, undesirable taste (Gadekar, Thomas, Anjaneyulu, Shinde

& Pragati, 2006). A successful meat product, either new to the market place or existing and unsuccessful, can be distinguished by proper spice selection. All kinds of meat products will not be flavoured to a desirable extent by any specific spice blend (Gadekar, Thomas, Anjaneyulu, Shinde & Pragati, 2006). In meat products and those more suited to Indian palates, a variety of spices, seasonings and flavourings are used (Tainter & Grenis, 1993; Peter, 2003).

Many food ingredients have been called 'taste enhancers' including monosodium glutamate (MSG), NaCl, and sweeteners, but their main effect is simply adding more molecules that generate distinct sensations of taste odour (Kamp, 2008). In fact, tasters such as MSG, salt, and sweeteners do not increase other chemosensory properties, but instead add additional meaty/savoury, salty, or sweet properties. Experimental studies have shown that MSG may not affect the level of other food additives, like salts, sweeteners, amino acids, acids or bitter compounds at concentrations up to 0.005 mol^{-1} per litre. From those in the perspective of introducing another quality of flavour to the food called umami in Japanese), MSG is a taste enhancer that enhances palatability rather than modifying the strength of other additives (Kamp, 2008). Similar findings concern the enhancing of NaCl and sweeteners that introduce salty taste or sweetness to meat; by decreasing the bitter components of certain food substances, they also enhance its palatability. Thus, from the point of view that they add extra tastes to the food and improve palatability rather than potentiating the taste intensity of other ingredients, MSG, salt, and sweeteners are taste enhancers (Kamp, 2008).

It is possible to apply analogous reasoning to flavours. In order to compensate for the loss of smell perception in older people, commercial

flavours are often added to food for the elderly (called 'flavour enhancement'). Flavours consist of mixtures of odorous molecules which after chromatographic and mass spectrographic analysis of natural products, can be extracted directly from natural foods or synthesised. Simulated flavours are flavour enhancers only from the point of view that the total number of molecules interacting with receptors in the nose and mouth on chemosensory membranes is increased.

Odour intensification can enhance palatability, induce more salivation, generate greater stimulation of the olfactory and limbic system of the brain, and promote immune function through mechanisms described below under the positive health benefits of chemosensory enhancement. While two distinct senses perceive odorants and tastants, with the addition of odorant molecules, the perceived intensity of the tastant can also increase. For example, the addition of odorants, especially for congruent taste/odour mixtures such as sucrose/strawberry and sucrose/lemon, increases perceived sweetness intensity (Kamp, 2008).

Much of the food and drink we eat every day derives its flavour from artificial flavourings. Although they are a huge part of the modern food industry, for most people, artificial flavourings remain a mystery. Five distinct tastes can be captured by the human tongue: sweetness, saltiness, sourness, bitterness, and umami (savoury). Every other feature that caused up the flavour needs to come from the food's flavour, and almost 80% of the taste is calculated to come from the smell. It is where chemicals come into play when they can change the smell and taste of food and drink, both regular and artificial (Kamp, 2008).

Flavours are very nuanced, with thousands or even hundreds of chemicals combining to create a specific flavour profile for each food and beverage. Tea, for example, has 47 different chemicals that make up its flavour, while that of the taste of coffee is almost 100. However, certain flavours have a dominant chemical aspect that imparts its distinctive flavour to any food that is applied to it even on its own (Akwaah, 2020).

Common artificial food seasonings sold in Ghana

The common artificial food seasonings sold in Ghana include Remie chicken, Remie fish, Maggie cube Maggie shrimps, Onga cubes, Sankofa, Samu, Minnazen, Adja and, Doli (Akwaah, 2020).

Threshold of toxicological Concern

Toxic healthy intake thresholds usually include the first two stages of this process. NOAELS are calculated, either from animal experiments or from human findings, and are converted into acceptable dose levels or health-based guidelines, such as acceptable daily intake (ADI). This conventional approach, which has been in continuous use for over 50 years, typically includes the availability of toxicological evidence on each substance to carry out a safety evaluation.

The toxicological propensity of toxins to which individuals are exposed by diets ranges by up to 6 or more percentage points. It implies that the exposure at which toxic effects are induced, in terms of the amount of drug absorbed per unit body weight, differs significantly between the drugs. Many aspects affect the inherent toxicity of chemicals, including chemical reactivity, metabolism and toxic kinetics, and biological processes' innate toxicity. Among chemical compounds, the toxin's key determinant is the chemical

composition; knowledge accrued over time suggests that functional groups' existence on a molecule is the determining factor of inherent toxicity. For example, mechanical features contributing to DNA reactivity and subsequent carcinogenesis have been developed for most chemical carcinogens (Ashby & Tennant, 1991).

Awareness that toxicity is a feature of the chemical composition and the degree of exposure is focused on the Thresholds of Toxicological Concern (TTC) definition, and the TTC method can be used to promote risk assessment of substances present at low levels of diet for which there is little or no toxicity evidence. The method is geared on the idea that it is possible to assess a human exposure threshold value for pollutants, below which there is a very low likelihood of any substantial human health threat (Munro, Ford, Kennepohl & Sprenger, 1996).

During the last two decades, the TTC principle has been developed and refined. Regulatory bodies have long been involved in this idea because of a wide range of sources. Humans can be exposed to small concentrations of an enormous amount of naturally occurring and human-made chemicals. Rulis (1986, 1989, 1992) initially suggested the TTC concept as a means for the USFDA to eliminate needless criteria for the testing of material packaging components that could pass into foods in insufficient quantities. Rulis (1986, 1989, 1992) applied a statistical approach to establishing a level of risk for food touch products, based on the premise that carcinogenicity would be the most critical impact at low exposures.

Rulis (1986) transformed the potential (expressed as TD50 values) of 343 oral administration carcinogens into an exposure dispersion calculated by

simple linear extrapolation to present a theoretical lifetime cancer risk of 1 in 1 million. His analysis showed that it was highly likely that dietary emissions to organic chemicals at or below 0.05 µg/kg diet would not pose a carcinogenic risk to humans, irrespective of their chemical composition. Hence, no data on animal toxicity had to be obtained to assess such exposure levels (Gold, et al. 1984).

Natural food Seasoning

Typically, natural flavours are complex mixtures of plant or fruit-derived chemicals. There may be one prevalent flavour compound in several examples and thousands or even hundreds of other elements. It is this complex mixture which gives a richer, more complex flavour to natural extracts. However, it is typically the primary chemical of flavour that can be detected by the sense of taste or another's scent. In contrast, rather than being derived from a natural source, an artificial taste is synthesized from other chemicals. Artificial flavours typically contain just a limited quantity of one of the same flavour chemicals present in the natural extract, but skip the others, so that the flavour of the complex mixture cannot be wholly duplicated (Bloom, 2017).

Regulation of Food Seasonings and Spices

Considering the European Food Safety Authority's recommendations, appropriate limits have been defined for nitrites and nitrates used in meat to ensure products' microbiological safety. Regulation (EU) No. 1129/2011 of 11 November 2011 amending Annex II to Regulation (EC) No. 1333/2008 of the European Parliament and of the Council by creating, with effect from 1 June 2013, the Union List of Food Additives (Sindelar, 2012; Stephanie, 2014). The addition of nitrites prevents toxin production by non-proteolytic spores of

strains of *Clostridium botulinum*. However, the incorporation of the highest allowable quantities of these compounds was abandoned in ready-to-eat cooked meat products.

The restrictions limit just the maximum permitted concentrations of drugs, as stated above, which may be inserted into the product during manufacturing. In practice, it is possible to distinguish the residues of nitrites and nitrates, and the protection of the commodity is determined by the quantity of these substances added during processing (Sindelar, 2012; Stephanie, 2014).

In comparison, nitrates can only be used in the products that are not subject to any thermal treatment, and the highest quantity that can be used is 150 mg/kg of the substance. Heating the nitrates contributes to the production of carcinogenic nitrosamines. Besides, vitamin C's inclusion can then be used to prevent a flawed transition process between nitrites and nitrates. In the case of traditional meat products referred to in Annex II to Regulation No. 1129/2011, the maximum number of nitrates used in the products referred to is 300 mg/kg, whereas it was 180 mg/kg for nitrites (Sindelar, 2012; Stephanie, 2014). 250mg/kg of nitrates and 175mg/kg of nitrites, respectively, are the maximum residues in the finished products (Sindelar, 2012; Stephanie, 2014). The amount of lead in meat shall not exceed 0.1 mg/kg in compliance with Commission Regulation (EC), No.1881/2006 of 19 December 2006 laying down the maximum thresholds for toxic elements in food products, while the level of cadmium shall not exceed 0.05 mg/kg.

The enforcement threshold introduced by the USFDA assumed that components of the migrating packaging content may be carcinogenic. A TTC

value of 1.5µgperson per day was calculated from the distribution of TD50 values in the Gold et al. (1989) carcinogen database, meaning that 1 in 10 compounds measured may be a carcinogen: there is a 96 percent chance that the risk of cancer will be 1 in 1 million or less at this intake. If it were possible to rule out the carcinogenic potential, higher threshold values could be produced for non-carcinogenic components.

Munro et al. (1996) subsequently extended the studies conducted by USFDA (1995), Rulis (1986, 1989, 1992) and Munro (1990) by collecting a database of over 600 reference substances from which NOEL amounts were derived. Their reference database included the toxicity in terms of NOELs for a variety of organic and inorganic chemicals of different structures, similar to the efforts of previous employees, and grouped its chemical structure using the decision-tree of Cramer et al. (1978) into three basic classes. The structural classification depends on the little precept that chemical structure is synonymous with inherent toxicity. This resource database was used to derive a human exposure threshold with no security risk for each of the three functional units and which can be extended to substances without any toxic effects.

Munro et al. (1996) mapped the transmission of NOELs, organised as per the three structural categories of Cramer et al. (1978), for 600 chemical substances which included dietary supplements, medicines, synthetic chemicals and pesticides. In each of the three functional units, the 5th percentile of the NOEL value distribution was determined. These NOEL 5th percentiles were then translated into values of human exposure thresholds, referred to as TTCs, by dividing the NOEL 5th percentile by a 100-fold

uncertainty factor for each structural class. For the structural groups I, II and III of Cramer et al. (1978), the TTC values were 1800, 540, and 90 µg/person per day, respectively. Because the TTC method matches threshold values for exposure in humans with exposure data, it involves sound human health risk forecasts.

Subsequent work carried out by Kroes et al. (2000, 2004) attempted to evaluate further the suitability of the thresholds proposed by Munro et al. (1996) for the distribution of NOELs for different specific forms of toxicity, such as developmental toxicity, neurotoxicity and immune toxicity. Neither of the end-points investigated produced TTC values lower than the TTC for Cramer et al. (1978) structural class III of 90 µg/person per day, except for neurotoxicity induced by organophosphorus compounds, and all classes of substances examined (including endocrine-disrupting chemicals) would be accommodated within the TTC based on the 1.5 µg/person per day carcinogen database.

The decision-tree also contains a TTC focused on the carcinogenic forces associated with 730 compounds mainly taken from the Gold et al. (1989) carcinogen database (Gold & Zeiger, 1997), for possible genotoxic carcinogens. Analyses by Cheeseman et al. (1999) suggested that it was possible to use the TD50 values for various structural signals to distinguish the most active genotoxic carcinogens. For those compounds that included unique structural signals for genotoxicity, Kroes et al. (2004) integrated a TTC value of 0.15µg/person per day into their decision-tree. Substances with aflatoxin, azoxy and nitrosamine-like groups were omitted because these substances would give a high likelihood of a theoretical lifetime risk of cancer greater

than 1 in 1 million at such an intake. Other substances with structural genotoxicity alerts, on the other hand, will present a 95 percent likelihood of less than one in a million threats. Metals and metal-containing compounds and proteins were also omitted since certain forms of substances were not included in the database from which TTC values were obtained.

Due to long half-lives and vast species, differences in toxic kinetics, polyhalogenated dibenzodioxins, dibenzofurans, or biphenyls were also excluded. The TEF approach would also evaluate such substances so that the TTC concept would not be appropriate. The rationale for the TTC value of 0.15 µg/person is equivalent to the TTC value of 1.5 µg/person, with specific compound formulations presumed as the DNA-reactive carcinogens, rather than 1 in 10 in the higher-value formulation.

The TTC of 0.15 µg/person per day is intended to enable timely advice to be given to risk managers on potential risks arising from deficient levels of a structural genotoxicity alert compound or positive evidence of genotoxicity and is not intended to provide a rationale for deliberately adding such a compound to the food supply.

A major benefit of the TTC model is that it provides a framework for concentrating resources on the enormous importance of public health problems. Substances with exposures below the relevant TTC have a low human harm potential and a low testing priority. The procedure gives confidence that substances consumed in minimum quantities only have a small possible threat. The TTC also provides a reasonable and science-based alternative to animal testing for harmless substances and minimal exposure.

In the United States, flavours are currently regulated by the FDA under the authority of the Food Additives and Amendment Act (FAA) of 1958 (Adams & Smith, 2004). Under the FAA, the FDA is in charge for certifyingoriginal food additives, together withflavours, before being used in food products (Adams & Smith, 2004). In the prevailingmonitoring system, all flavours are either GRAS ("generally 1 recognised as safe") ingredients or flavour additives that must bepermitted for use by 2 FDA (Adams & Smith, 2004).

The Ghana Standard Authority (GSA) has a broad range of services and activities specified below:

- Inspection of Products
- Laboratory Testing
- System Certification
- Sale of Standards (National and International)
- Product Certification
- Calibration, verification and inspection of weighing and measuring devices.
- Standards Development and Adoption

According to the Ghana Standards Authority (2018), GSA's services are to help the general public be safe when consuming food or any food-related things. There are expectations for the public to be mindful of what they are expected to do about the food and drinks prepared. Such food preparation should come within the framework of the prescribed guidelines for good health and nutrition. In industrial companies, the agreed requirements must be

met in the manufacture or production of any drinks or food they wish to prepare for sale to the consumer public.

Also, the Ghana Food and Drug Authority has the following functions: (FDA, 2018)

- It is responsible for protecting the public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, and medical devices; and by ensuring the safety of our nation's food supply, cosmetics, and products that emit radiation.
- Manufacturing, marketing, and distribution of tobacco products to protect the public health and to reduce tobacco use by minors.
- Advancing the public health by helping to speed innovations that make medical products more effective, safer, and more affordable and by helping the public get the accurate, science-based information they need to use medical products and foods to maintain and improve their health.
- FDA fulfills this responsibility by ensuring the security of the food supply and by fostering development of medical products to respond to deliberate and naturally emerging public health threats.

Health implications of Arsenic and Lead in Foods

According to WHO (2009), Lead exposure is estimated to account for 0.6% of the global burden of disease, with the highest burden in developing regions. Some common health implication of heavy metals in human includes kidney disease, damage to the nervous system, dimenition intellectual capacity, heart diseases, bone fractures, cancer and death (Jarup, 2003). Exposure of pregnant women to high levels of lead can cause miscarriage,

stillbirth, premature birth and low birth weight, as well as minor malformations (IPCS, 1995).

Summary of Reviewed Literature

History has indicated that the use of spices and seasonings has been with humanity over the years. The concept of food seasonings or spices was to help update the mind of people on food flavours. Food flavours are to enhance taste of foods. The use of natural and artificial food seasonings came to the fore due to the advancement in technology. Research in the food industry found ways to improve upon food tastes and enhance food flavours.

Artificial food seasonings have different chemical compositions, and has toxic elements that are not permissible to children and adult use. Literature has indicated that there are advantages as well as disadvantages in using spices and food seasonings. It was evident in the literature that artificial food seasonings do have harmful side effects when consumed. Because of this, countries have safety standards to help control the use of artificial food seasonings.

CHAPTER THREE

RESEARCH METHODS

This section of the research report focused on the research design, study location, population, sample and sampling procedure, data collection instruments, data collection procedure, validity and reliability of the instruments, pre-testing of the questionnaire, data analysis, and ethical consideration.

Research Design

Descriptive and Experimental research designs were adopted for the study. According to Amedahe (2000), experimental study is where the researcher tries to control at least one independent variable, monitors certain related variables, and examines or observes what happens to the subjects as a result. Descriptive research design is a scientific technique which entails monitoring and describing the behaviour of a subject without manipulating it (Shuttleworth, 2008). It requires the collection of data to respond to questions relating to the current situation of the study subject (Gay, 1992).

Also, descriptive design describes a phenomenon without manipulating any causative variable to determine cause and effect (Amedahe, 2006). According to Amedahe (2006), the result from the analysed data from the field would report on the state of affairs. It also results in a description of data, whether in words, pictures, charts, or tables. A descriptive study is designed to determine a particular phenomenon's existing situation and the issues revolving around it.

Experimental research is any research approach in which a number of variables are kept constant while the other variables are evaluated as the focus

of the experiment (Nunan, 1992). The researcher has a stronger hold over variables to obtain the desired result, and the results are particular. Once the results are analysed, they can be applied to various other similar aspects and can be used in association with other research methods (Nunan, 1992).

Study Location

The location for the study was Subin Sub-Metro in Kumasi Metropolis. The Subin sub-metro is located within the Kumasi Metropolis, the second largest and most populous city in Ghana. Kumasi is also a significant tourism destination; based on attractions in areas like the Manhyia Palace, the Cultural Centre, the Okomfo Anokye sword, the Barekese dam, Lake Bosomtwe, the Military museum among others. As a result, there are many catering establishments. Data were collected from the market women who sell spices to determine the most commonly used artificial food seasonings in order to select samples for the experimental analysis. The detailed map of Subin Sub-Metro is presented in Figure 2.

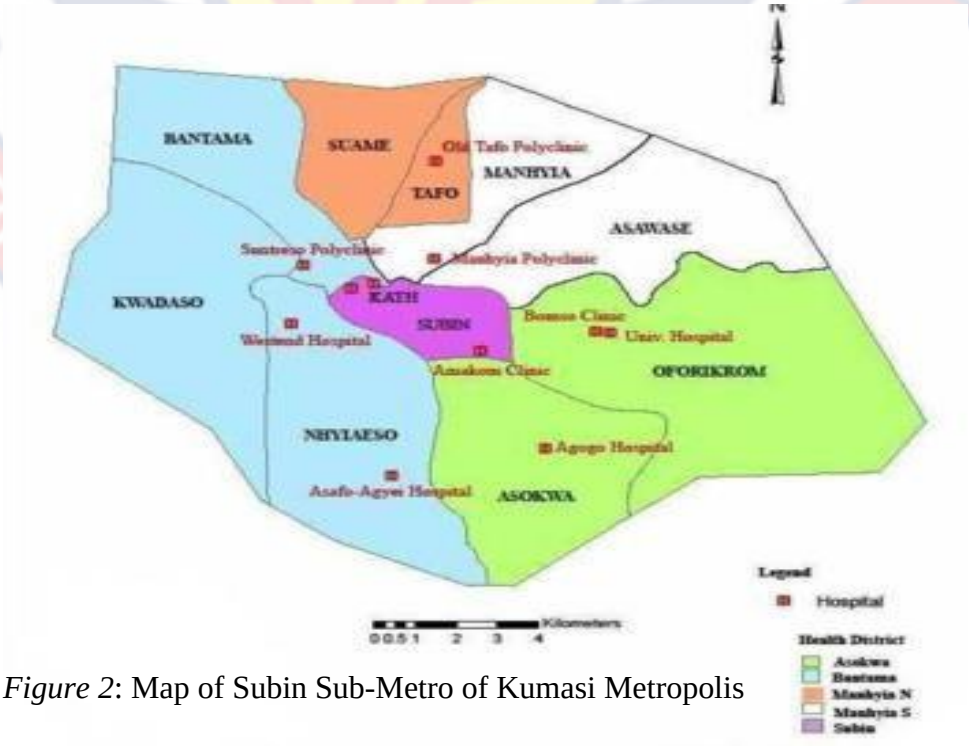

Figure 2: Map of Subin Sub-Metro of Kumasi Metropolis

Population

A population is the general group from which the researcher wishes to obtain data (Frankel & Wallen, 2006). According to Amedahe (2004), the target group that a researcher is interested in obtaining information and making assumptions is known as the population. Target population is therefore a collection of people who have one or more similar traits that are of importance to the researcher. In the case of this study, the target population constituted all the market women in the Central Market in the Subin-sub Metro in Kumasi who sell artificial food seasonings.

The estimated population of the women who sell artificial food seasoning in Kumasi Metropolis Assembly (KMA) was 500 (KMA Queen Mother of Spices, 2020). The target population of women who sell artificial food seasoning in the Subin Sub metro market was 100 (KMA Queen Mother of Spices, 2020). The target population was given by the 'Queen Mother of Spices' when her she was interviewed in the first week of February, 2020 as part of familiarization to the field. The market was surveyed upon collecting the needed documentation and introduction from the 'Queen Mother of Spices'. The target population was interviewed to determine the common artificial food seasonings being sold in the Subin Sub-metro market. The various brand of the artificial food seasonings sold in Kumasi metropolis was given to be 50.

Sampling Procedure

The study sample was ten different brands of artificial food enhancers and 80 market women who sell artificial food enhancers. Purposive and stratified sampling technique were used to sample the market women and ten

different brands of artificial food seasonings that are mostly bought from these market women. Purposive sampling was used to get the required data from the right persons with the reason that no other food or item sellers in the Subin Sub metro market can give accurate information relating to the artificial food seasonings other than them. In view of this, purposive sampling was deemed as appropriate sampling technique to be used. Purposive sampling is a non-probability method of sampling that seeks information-rich cases that can be studied in a comprehensive way (Patton, 1990) and target individuals who happen to be available and accessible at the time of the study (Cohen, Manion & Morrison, 2007).

Stratified sampling was also adopted to obtain a sample population that best represents the entire population being studied, making sure that each sub-group of interest is represented. In the Subin Sub metro market like other market settings in Ghana, most people sell different items and they cannot even be classified in any category. Artificial food seasonings are sold in combination of different items and even including natural food seasonings. To actually focus on the particular artificial food seasonings, stratify sampling helped to group the seasonings into sub-groupings to be distinct for data to be collected on them.

Using Krejcie and Morgan (1970) sample determination table, 80 artificial food seasoning sellers were sampled from the 100 identified sellers in the Kumasi Central market. The market was divided into four zones where these artificial food seasonings are sold. The zones were North, South, East and West. A quota of twenty respondents were assigned to each zone since twenty multiplied by four equals to eighty. The shops were numbered and

written on a piece of paper for each zone and folded into a bowl. The piece of paper containing the numbers for the shops in the bowl was then selected at random with replacement to represent each zone. The above process was then repeated for the other three zones. Selecting each shop synonymously represents a particular seller to give equal chance to all the 80 sellers to be selected for the study without bias.

Ten most preferred brands of artificial food seasonings were selected after the 80 respondents were determined through the sampling techniques discussed earlier on in this section. The respondents were asked through interview which brands of the artificial food seasonings their clients commonly preferred and the result was ranked. The ranking of the responses from the sellers was done from the most to the least preferred artificial food seasoning and the top ten artificial food seasonings were selected for chemical laboratory analysis

Data Collection Instrument

According to Taherdoost (2016), a structured interview guide is a series of predicted standardised interview questions designed to assess or elicit information from a candidate on a range of quality essential topics, or phenomena to come out with a finding for decision making.

Interview guide and chemical evaluation forms were used for data collection. Interview guide was used to identify the brands of artificial food seasoning names that are mostly patronized by consumers in the Subin Sub metro. The chemical evaluation form was used to compare the standards set by Ghana Standards Authority and WHO after chemical analysis of the samples.

Data Collection Procedure

An introductory letter from the Vocational and Technical Education Department of the University of Cape Coast to introduce the researcher to the women who sell artificial food seasonings. Research assistants were recruited and were taken through training on the procedures to help conduct interviews. The team introduced itself to the Market Women Association in Subin Sub Metro market in order to explain the purpose of the study to them. Eighty market women were interviewed to find out the common brands artificial food seasonings people buy. All Covid -19 protocols were observed.

A simple frequency table was prepared to determine the ten artificial food seasonings that were mostly purchased by consumers as indicated by the 80 respondents. Informed consent form was given to the respondents to complete to give their approval before given out information for the study (See details of Consent Form in Appendix A). The artificial food seasoning were analysed at the Ghana Standard Authority (GSA) and University of Cape Coast chemical laboratory in the Agricultural Department. The samples were analysed on Lead (Pb), Arsenic, Nitrogen, Total ash, Acid insoluble ash, Fat and Sodium chloride, results were compared to standards set by the WHO (2007, 2017).

Validity and Reliability of the Instruments

The interview guide was validated by a test run carried out at the Asawase Sub-Metro market in Kumasi. Data was collected from the Asawase Sub Metro and consulted experts from the food Lab in the University of Cape Coast to go through the interview guide. Content validity was ensured by review of the interview guide by expert in the food industry.

Pre-Testing of Instrument

Pre-testing of the instrument was done to ensure the interview guide's reliability to prevent ambiguity of the items. Ten respondents were interviewed concerning which food seasonings sold and purchased by the general public. The sampling procedure (purposive and snowballing sampling) sampling for data collection for the primary data was replicated as done during the instrument's pretesting.

Ethical Consideration

Ethical clearance was sought from the Institutional Review Board (IRB) at the University of Cape Coast. Before the commencement of the study, permission was also sought from the queen mother of the market women before data was collected. Respondents were informed about the purpose of the study and assured of their anonymity. Respondents had the option to opt-out of the process at any stage of the data collection.

Proximate analysis of artificial food enhancers

The methodology used in determining acid insoluble ash, arsenic, fat, iron, lead, nitrogen, sodium chloride, and total ash of the sampled artificial food enhancers used for the study is presented below. The artificial food enhancers that were used in the study include Remie Chicken, Minazen, Maggie cube, Onga, Mr. chef, Adja, A-one Beef, Jara, B- 3 chicken and Samu Beef. The sampled products were arrived at after interviewing the market women on the most patronized seasonings.

Fat determination

Reagents

1: Petroleum Spirit

Procedure

In a 50x10 mm Soxhlet extraction thimble, between 10- 12g of the milled samples was measured. This was moved to the Soxhlet extractor with a 50ml size. A new, dry, round bottom flask of 250ml was weighed and approximately 150 ml of petroleum spirit added and the Soxhlet extractor attached. Extraction was conducted for 6 hours using a heating mantle as a heating source. After 6 hours, the flask was removed and kept for 2 hours in an oven at 60^{oc}. The round bottom flask was removed, weighted and cooled in a desiccator. The percentage of fat/oil was calculated as follows.

$$\text{Crude Fat (\%)} = \frac{W\,(g) \times 100}{\text{Sample}\quad (g)},$$

Where W is Weight of Oil

Protein determination

The kjeldahl method was used for the determination of protein in three phases: digestion, neutralisation or distillation and titration.

Digestion

About 0.2g of each sample was weighed into a 100 ml Kjeldahl flask. 4mL of the digestion reagent was added and the samples digested at 360C for two hours. A blank was prepared without a sample and digested in the same way. The digests were transferred quantitatively to 50ml of volumetric flasks after digestion (and converted to volume).

Distillation

This was carried out in a steam distillation apparatus. The distillation apparatus was flushed with distilled water for about twenty (20) minutes. After

washing out the apparatus, five (5) millilitres of boric acid indicator solution was poured into a 100 ml conical flask placed under the distillation apparatus's condenser with the condenser's tip wholly immersed in the boric acid solution. The trap funnel transferred an aliquot of the digest into the combustion chamber. To begin distillation, 10mL of alkali sample was added and about 50mL of the distillate was obtained.

Titration

The distillate was titrated with 0.1N HCl solution until the solution changed from green to the initial colour of the indicator (wine red). Digestion blanks were also treated and removed from the titre value of the sample. The titre values obtained were used to calculate the nitrogen and protein contents. The conversion factor used was 6.25.

$\%_{\text{Total Nitrogen (\%N)}} = (\text{Sample titre value} - \text{Blank titre value}) \text{ X } 0.1 \text{ x} 0.01401 \text{ x } 100$

$sampleweightX$ 10

AOAC (2008).

Determination of ash value

To determine the ash value and percentage method, the method recommended in Indian pharmacopoeia (Anonymous, 1966) and British Pharmacopoeia (Anonymous, 1973) was followed.

Preparation of Ash-In a Silica crucible beyond the burner, 3gm of the specimen was vaporized. The carbonated material was heated at 600650^{o}C in a muffle furnace for six hours. The ash that was created was white and carbon free. It was cooled on the ashless filter paper and weighed.

Determination of acid-insoluble ash- The ash was heated for 5 minutes with 25ml of concentrated hydrochloric acid. The ashless filter paper crucible

accumulated insoluble matter and washed, ignited and weighed with hot water. The percentage of insoluble acid ash was established with regard to the air-dried sample.

Analytical procedure for NaCl determination

Weighed 2.5-3.0g of finely comminuted of a thoroughly mixed and finely mixed sample into a 300 ml flask of Erlenmeyer. Samples were run using a reagent blank and a sample previously analysed as a recovery. An addition of 25.0 mL of 0.1000 ± 0.0005 N AgNO3 solution was added to the specimen and solution's intimate contact and solution, and an addition of 15 ml of HNO3 concentration. Enough chips to the boil and cook down until the meat is digested. A small quantity of lactose to the blank reagent was added. Note: The solution switches from a cloudy white to a yellow colour. While boiling, small portions of KMnO4 solution was added to turn the solution dark brown. Boiling continued until the colour vanished. Small portions of KMnO4 was added until the solution retained a dark colour for several minutes before clearing. Wash the sides of the water bottle. Note: A small amount of lactose was added until the colour disappeared. About 25 ml of water was added; and boiled for about 5 min, and allowed to cool to room temperature in the hood, soaked to the neck of the flask and diluted to about 150 ml with distilled water. An addition of about 5 ml of diethyl ether (optional), and about 2 mL of the ferric alum indicator, and swirl to crystallise the precipitated AgCl (the diethyl ether does not need to be added if results are rounded to 0. 1 percent). Titrated the excess AgNO3 with the KSCN solution to a constant and salmon-coloured endpoint.

Calculations

Procedure

Percent $_{NaCl}$ = 25.0 mL − (mL KSCN) (R)](N AgNO3)(5.85)

[Sample Weight)

Where R = mL_____ AgNO3

mL KSCN

As determined in Standardization of AgNO3 and KSCN

Preparation of Sample Solution for the Determination of N, K, Na, Ca, Mg, P, Zn, Cu, Fe, Pb& As

The preparation of sampling solutions for elemental analysis involves the process of oxidation required to eliminate organic matter by acid oxidation, before a thorough elemental analysis can be performed.

Sulphuric Acid-Hydrogen Peroxide digestion

350mL of hydrogen peroxide, 0.42g of selenium powder, 14g of lithium sulphate, and 420ml of sulphuric acid were part of the digestion mixture. The digestion procedure states that between 0.1000g to 0.2000g of the oven-dried ground sample was pondered into a 100ml Kjeldahl flask, and 4.4ml of the mixed digestion component was added, and the samples were digested for two hours at 360oC, as outlined in Stewarte et al. (1974). Blank digestion (digestion without a sample of the digestion mixture) was carried out in a similar manner. The digests were quantitatively transferred into 100 mL volumetric flasks after digestion and composed up to volume.

Determination of Iron, Copper, and Zinc using atomic Absorption Spectrophotometer

Standard solutions for Fe, Cu and Zn solutions of 1, 2 and 5µg/mL were prepared. In the atomic absorption spectrophotometer (AAs), the standard solutions were aspirated, and the respective calibration curves were plotted on the AAS. As the sample solutions were aspirated, they were given their respective concentrations.

Calculations

$$\text{Fe } (\mu g/g) = \frac{C \times \text{solution volume}}{\text{Sample weight}}$$

$$\text{Cu } (\mu g/g) = \frac{C \times \text{solution volume}}{\text{Sample weight}}$$

$$\text{Zn } (\mu g/g) = \frac{C \times \text{solution volume}}{\text{Sample weight}}$$

Determination of Lead (Pb)

Under a steady rise (about 50 ° C / h) in temperature, test segments are dried and then ashed at 450 ° C, 6 N HCl (1 + 1) is applied and the solution is evaporates. In 0.1N HNO3 the trace is dissolved and the analytes are calculated by flame and graphite processes.

Reagents: (a) Water – redistilled or deionised (b) Hydrochloric acid A.R (6N) – Dilute 500 ml HCl to 1 litre with water (c) Nitric Acid A.R 0.1M – dilute 7

ml conc. acid to 1 litre. (d) Nitric acid concentrated (Sp. Grade 1.40) (e) Standard solution of lead prepared as follows:

(1) Lead Standard solution– 1mg / ml. Dissolve 1.000 gm Pb in 7 ml conc HNO3 in 1 litre volumetric flask. Dilute to volume with water. Commercially available standard solutions for AAS may be used for all metal standards

Determination of Arsenic (As) by colorimetric molybdenum blue method

Nitric acid and sulphuric acid were used to digest the sample. The digest is prepared with saturated ammonium oxalate solution after the digestion/oxidation is finished to eliminate yellow coloration due to nitro compounds, fats, etc. Arsine was produced using zinc and HCl from the digest and trapped in the solution of NaOBr and treated with ammonium molybdate to form a blue compound that absorbs 845 nm.

Data Analysis

The data analysis for the study was carried out in two folds; quantitative and qualitative data. The interview instrument was screened to ensure that all the items were responded to. The results from the laboratory work were coded and entered into IBM-SPSS for further analysis. The statistical software that was used for data analysis is called IBM Statistical Package for Service Solution (SPSS) for Windows version 25.

Frequencies and percentages were generated for respondents' biographical data and objectives one and two. The third objective was analysed by comparing the allowed standards to the result from the chemical laboratories. In testing the hypothesis one, one sample T-test at alpha level was used. Hypothesis two was tested using Chi-Square. And the results were presented in tables.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presented the results from the field in relation to the research objectives. The result presented in this chapter was what actually took place on the field. No variations or so ever was done to the information provided by the respondents. The ethical considerations that have been outlined in Chapter Three of the thesis were carried through to the later. The analysis, findings, and discussion were all focused on the actual data presented in this chapter.

The result presentation has been presented in two parts for clarity sake. The demographic characteristics of the respondents and information relating to the food seasonings form the first aspect of the result presentation. The second part of the result is about the chemical compositions of the most preferred food enhancers as specified by Ghana Standards Authority (GSA).

Demographic Characteristics of Respondents

Table 1 : Gender, birth year and Educational Level

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	11	13.75
Female	69	86.25
Year of Birth		
1960 – 1964 [58]	9	11.25
1965 – 1974[50.5]	17	21.25
1975 – 1984[40.5]	14	17.5
1985 – 1989[33]	23	28.75
Others	17	21.25
Educational level		
Tertiary	14	17.5
Secondary	25	31.25

Basic	25	31.25
Non- formal	7	8.75
In-formal	9	11.25

Source: Akwaah (2020)

The result in Table 1 presents the gender, age and the educational background of retailers who were interviewed. The result indicated that the females were far more than the male which represents a little over six times of the sample size. The result shows how more the women were as compared to the male is not much of a surprise. This is anchored on the fact that in Ghana, women are well noted to be engaging on buy and sell. It is however, in recent times that one could find male before their wares to sell. The interesting aspect of this result is that though males sell, they do not occasional sell food seasonings in the market.

The birth year of the sampled respondents indicated that 23 persons aged were 33 years and 50 years plus who have been trading in food seasonings were 17. As much as nine respondents were aged 58 years. The general picture about formal educational background of the respondents is that almost all have some sort of education and it is only nine of them that have informal education. The intriguing fact that has been revealed in the result is that those who sell food seasonings in the Kumasi Central market included tertiary graduates. Secondary and Basic school leavers had also participated in the study. Most of the respondents (%) were Secondary and the Basic school leavers.

Table 2: Year Respondents started selling in the Market

Year start selling in market	Frequency	Percentage
1970 – 1980	0	0
1981 – 1990	7	8.75
1991 – 2000	14	17.5
2001 – 2010	20	25
2011 – 2020	39	48.75

Source: Akwaah (2020)

In every enterprise, one needs to work with experience since this helps to create efficiency. The respondents were asked to provide the number of years they have been selling the artificial food seasonings. The result indicated that from 1970 to 1980 none of the respondent was selling food seasoning. However, from 1981 -1990, seven of the respondents were selling. Twice the number of the respondents that started selling from 1981 to 1990 started selling from 1991 -2000

From 2001, the number of the respondents selling increased. It can be gleaned from the result as in Table 2 that people have started selling food seasonings for 39 years in the Kumasi Central Market.

Table 3: Food seasoning first sold by Respondents Characteristics

Food seasoning first sold	Respondents	Percentage
Yes	45	56.25%
No	35	43.75%
Total	80	100

The result in Table 3 indicates that, 45 persons had sold food seasoning the first time in the Kumasi Central Market.

Table 4: Marital status and Religious Affiliation of Respondents

Characteristics	Frequency	Percentage
Marital status		
Married	35	43.75
Single	25	31.25
Widowed	12	15
Divorced	8	10
Religion affiliation		
Christian	61	76.25
Islamic	19	23.75
Traditional	0	0
Other	0	0

Source: Akwaah (2020)

The marital status of the respondents is presented in Table 4. The result shows that most (35) respondents were married and eight were divorced. The result can be interpreted as these people are mature and they could be said to be responsible. In the case of their religious affiliations, Christians were more (61) as compared to the other religious persons (Islamic and Traditionalist). In the case of number of children respondents have, 59 have children and 21 did not have any child. (Table 4).

Table 5: Amount earned in selling artificial food Seasoning

Amount (GHC)	Frequency	Percentage
40.00	5	6.25
45.00	3	3.75
50.00	4	5
60.00	5	6.25
70.00	6	7.5
80.00	7	8.75
100.00	15	18.75
150.00	1	1.25
200.00	6	7.5
300.00	1	1.25
308.00	2	2.5
400.00	3	3.75
500.00	3	3.75
600.00	4	5
700.00	1	1.25
800.00	1	1.25
900.00	1	1.25
1,000.00	5	6.25
5000.00	1	1.25
Amount not disclosed	6	7.5

Source: Akwaah (2020)

Selling of food seasonings has been revealed to have started in 1981 and as the years go by, the number of persons engaging in the selling of food seasoning increases as presented in Table 2. The result in Table 5 confirms

this with the earnings from the sale of the food enhancers. The earnings started from forty cedis (GHC 40. 00) by five persons to a maximum earning of one thousand cedis (GHC 1,000.00) in a month. Six of the respondents however, did not disclose the amount of money they earn, which could be due to the fact that they were not certain of my identify.

Table 6: Source of seasoning/spices supply

Variables	Frequency	Percentage
Manufacture	3	3.75
Wholesale	52	65
Retailer	25	31.25
Others	0	0

Source: Akwaah (2020)

Table 6 presents the result on the source of seasoning that were sold. The result revealed that their supplies come from three main sources. The sources include manufacturers, wholesalers, and retail suppliers. The most common source of supply of food seasonings is wholesalers, 52(65%). Buying products on wholesale price comes with a lot of benefits to the supplier and the purchaser. However, it was presumed that the person buying at wholesale price has a lot to gain. The purchaser has the opportunity to return goods that have issues/faults. Another advantage of people buying from wholesalers is the high margin of profit to the purchaser. The above enumerated reasons might have explained why 65% of the respondents have been getting their supply from the wholesale sources.

Table 7: Natural and Artificial Spices Sold in the Market

S/N	Name of spice	Frequency	Percentage
A. ARTIFICIAL SEASONINGS			
1	Borbor	1	1.25
2	Boukom	1	1.25
3	Maxi	1	1.25
4	Remie mixed spices	1	1.25
5	Saffrom	1	1.25
6	Aromate	2	2.5
7	Curry powder	2	2.5
8	Maggi mixpy	2	2.5
9	Maggy three mix	2	2.5
10	Nut meg	2	2.5
11	Onga	2	2.5
12	B-3 chicken	2	2.5
13	Jara	2	2.5
14	Remie stew	2	2.5
15	Tiger	2	2.5
16	A-One Beef	3	3.75
17	Adja	3	3.75
18	Samu beef	3	3.75
19	Maggi cube	3	3.75
20	Mr. Chef	3	3.75
21	Thyme rosemary	3	3.75
22	Turmeric Cumin	3	3.75
23	Minazen	4	5
24	Remie chicken	5	6.25
B. NAURAL SEASONINGS			
25	Garlic	2	2.5
26	Ginger	2	2.5
27	Black pepper	2	2.5
28	Chily pepper	2	2.5
29	Cinnamon	2	2.5
30	Onion	2	2.5
31	Paprika	2	2.5
32	Pepper corn	2	2.5
33	Cloves	3	3.75
34	Mint	3	3.75
35	White pepper	3	3.75

Source: Akwaah (2020)

Table 7 presents the results of the natural and artificial spices that are being sold in the Kumasi Central Market. The result showed that 35 different spices (natural and artificial) are sold in the market. The different types of spices sold in the Kumasi Central market provides options for consumers to select from.

Table 8: Common Names of Food Seasoning Customers Buy

Food seasoning	Frequency	Percentage
Maggie cube	20	25
Minazen	13	16.25
Mr. Chef	17	21.25
Onga cube	10	12.5
Onga all seasoning	11	13.75
Remie chicken	9	11.25

Source: Akwaah (2020)

The seasonings consumers buy most are presented in Table 8. The result showed that the most purchased artificial food seasonings consumers buy is Maggi cube with a frequency count of 20 representing 25%. Followed by 'Mr. Chef' with a count of 17 (21.25%). The least demanded artificial seasoning was 'Remie chicken' with a frequency count of 9 representing 11.25%.(Table 8).

Table 9: How Fast-food seasonings are sold and the Quantity Purchase

Characteristics	Frequency	Percentage
How long does it take you to sell out your seasonings		
A day	10	12.5
A week	59	73.75
A month	10	12.5
Others	1	1.25
Quantity sold weekly		
Pieces	33	41.25
Packs	19	23.75
Boxes	23	28.75
Cartons	5	6.25
Others	-	0
State of selling seasonings		
In their original package	64	80
Repackaged into smaller quantities	16	20
Packaged products with ingredient list		
Yes	69	86.25
No	11	13.75
Reading label before buying		
Yes	41	51.25
No	39	48.75

Source: Akwaah (2020)

The result in Table 9 presented how fast and quantity of food seasonings sold in the market (Kumasi Central Market). 73.75% of the market women said that the seasonings are mostly sold within a week. This showed the rate at which the seasonings were demanded on the market. People have been preparing foods on daily basis and they have to make it taste nice so the demands of the artificial food seasonings also increased.

On the issues of the quantity that have been sold, the respondents gave different figures. The least number of quantities sold in a week was 33 pieces and the most number sold was five cartons. This is an indication that there was a growing number of demands for seasonings. The seasonings are sold in their original pack and this was confirmed by 64 responses. Sixteen of the respondents have indicated that they do repackage the seasonings into smaller quantities. The re-packaged seasonings do have their ingredients list pasted on them. The costumers also have been reading the labels on the seasonings before they buy but some do not even read the labelling. On the case of attaching ingredient list to the re-packaged seasonings, 11 of the respondents have indicated that they do not attach the list of ingredients to the repackaged seasonings.

Table 10: Monitoring of Artificial Food Seasonings Sold in the Market

Characteristics	Frequency	Percentage
Monitoring by FDA		
Yes	0	0
No	80	100
Sending samples for laboratory analysis		
Yes	0	0
No	80	100
NGOs collecting samples for assessment		
Yes	0	
No	80	100
Enquiry about chemical composition		
Yes	15	18.75
No	65	81.25
Seller using products		
Yes	63	78.75
No	17	21.25

Source: Akwaah (2020)

In doing sample monitoring on the market to ensure the safety regulation of the artificial food seasonings, the result has been presented in Table 10. The result thus showed that no official from the Food and Drugs Authority have gone to the market to interact with the artificial food seasoning sellers. Also, the respondents indicated that to the best of their knowledge, no government official has collected any sample from the market to examine its constituent(s). On the part of Non-governmental Organisations (NGOs)

sending samples of artificial food seasonings to the chemical laboratory for assessment, all the 80 respondents have responded in the negative.

The study sought to know if customers who buy artificial food seasonings do care to know the chemical composition of artificial food seasonings. Fifteen of the responses were 'yes' and 65 of the responses were also 'No' to the question. It can be deduced that less than 19% of the respondents actually care for their health to some extent. These consumers to extra mile to know what they are going to consume. Those selling the artificial food seasonings too were using the seasonings to cook as well (63) representing 78.75%. With respect to those who use the artificial food seasonings for cooking, only 17 (21.25%) of the respondents do not use the seasonings to cook.

Sixty-three sellers have indicated that they do cook with the artificial food seasonings themselves. Few of the common reasons they have indicated were, '*because it make meal tasty and colourful*', '*to make food colourful', ' to enhance the taste and the aroma of the food', 'makes food smell good', 'give unique taste to food', 'make food attractive', 'to enhance flavour', 'it makes the food taste incredible', 'it makes food nice',…*

The response on whether the market women supply food seasonings to restaurants/chop bar operators had 48 of respondents affirming that they do supply restaurants/chop bar operators and 32 of them indicated they do not that. On the issue if they use artificial enhancers, 34 indicated they do while 46 respondents said no.

Table 11: Food Enhancers Supplied by the market women

Characteristics	Frequency	Percentage
Supply to restaurants/hotel/chop bar		
Packs		28
Pieces	24	30
Boxes	20	25
Cartons	1	1.25
Others	7	8.75
How often supplies are done		
Always	26	32.5
Sometimes	34	42.5
Not at all	20	25
Factor which Influence the food enhancers purchased		
Taste	55	68.75
Colour	6	7.5
Flavour	18	22.5
Texture	1	1.25
Category of customers		
Literate	30	37.5
Non-literate	50	62.5

Source: Akwaah (2020)

The result in Table 11 presents the quantity of food seasonings that were supplied to restaurants/hotels/chop bar, how often the supplies are made and what actually influences customers to buy food enhancers.

On the issue of how much information that is available on artificial food enhancers/seasonings, almost all made it known that they know it helps to enhance the taste, colour, flavour of meals. The respondents have indicated that preference for one over other food enhancers, 46 of them have indicated 'Yes' and 33 also indicated 'No'. The preference for particular food enhancers were in favour of

'*Remie', 'Mint', 'Mr. Chef, 'Onga', 'Onga all seasoning', and 'Paprica*'.

Complaints about the use of artificial food seasonings had only 20 responses from the participants. Nine of them said 'Yes' and 11 participants indicated 'No'. All the complaints received about the use of the food enhancers was on the expiry date of the products they do buy. And to keep their customers, they have to change for them if they do bring a sample of what they bought as evidence.

Research Objective 1

Determine the most commonly used artificial food seasoning on the Ghanaian market

In answering the research objective one, the result has been presented in Table 12 for analysis and discussion. Frequency and percentage have been used to present the result.

Table 12: Artificial Food Seasonings Customers Buy Most from Kumasi Central Market

S/N	Food seasoning	Frequency	Percentage
1	A- One Beef	10	12.5
2	Maggi Cube	8	10
3	Jara	8	10
4	Minazen	8	10
5	B-3 Chicken	8	10
6	Maggi mixpy	7	8.75
7	Adja	7	8.75
8	Remie chicken	7	8.75
9	Samu	6	7.5
10	Onga chicken	6	7.5
11	Mr. Chef	5	6.25
Total		**80**	**100**

Source: Akwaah (2020)

Table 12 indicated that the customers buy 11 different artificial food enhancers from the market (Kumasi Central Market). The response count as to how much the customers come to buy the seasonings has shown that One Beef was the most bought item. The second and third bought seasonings were 'B-3 Chicken' and 'Minazen' respectively. The number of preferences for the artificial food seasoning was so close to each other. The customers might be patronizing the seasonings due to the taste, colour, flavour or texture. Well blended flavours and tastes in food seasonings help the product to be desirable degree of an acceptance which is consistent with (Gadekar, Thomas,

Anjaneyulu, Shinde &Pragati, 2006). Consumers having the taste and flavour in their psyche, there is no way they would be opting to buy something that they have not used in cooking their meals or have not tasted before. Every consumer has preference and would like to pay for just that.

A particular characteristic of the seasoning would inform the customer as to what to buy. For instance, a customer could go to market wanting a particular food seasoning to buy while more others are there. It does not mean the customer does not know what he/she is looking for. The preference for the seasonings by the respondents being close to each other samples signifies that their demands are of a premium.

The market simply operates on the usual economic principle of demand and supply. The sellers would be importing some selected artificial food seasonings more into the market because that is what consumers want more. It does not worth it to import on to the market what is not in much demand. At least every business person wants to gain or make profit. This thus fit into the demand and supply accession that has been made earlier. One-Beef for instance would be imported more into the country. Even if they are locally produced, the company of One-Beef would be producing this particular product more to flood the market. In producing more of the product may be done with proper surveillance of the product so that too much is not produced to reduce their sale.

Research Objective 2

Assess the chemical analysis of selected commonly used food seasonings on the Ghanaian market.

The result for the chemical analysis of the commonly used food seasonings has been presented in Table 13. The result has indicated that eight different chemical constituents which include Acid insoluble ash, Arsenic, Fat (%), Iron (ug/g), Lead, Nitrogen, Sodium chloride and Total ash. The value of acid insoluble ash in the food enhancer ranges from .12 to .41. The lowest value is .12 which is for 'Remie Chicken' and 'Adja 'respectively. In the case of the highest value (.41), Jara was the seasoning that had the highest value.

The Arsenic constituent in the seasoning detected has values ranging from .74 to 1.07. The values are so close to each other and the values are very close to one (1). The low value for the seasoning is for Samu Beef and the highest value is for B-3 Chicken. In the case of the percentage fat in the seasoning, it was recorded that the low value of .65 is for Samu Beef and highest value is 2.43 with respect to Minazen. The range value of iron presence in the seasonings is from 139.91 to 171.62 for A-One Beef and Samu Beef respectively. It can be seen that the values for the iron content were so high relative to acid insoluble ash, arsenic and fat.

Lead quantity found in the food seasonings range from .01 to .34. I can be gleaned from the range of values that the values are smaller with respect to the earlier discussed values for other chemical constituents. The Nitrogen value also ranges from .19 for B-3 Chicken and a high value of 2.75 for Mr. Chef. The values are small and close to each other. The sodium chloride presence in the food seasonings tested has a low value of 36.32 and higher

value of 52.96. The values were so close to each other to the extent that the difference between the low value and the next higher value is 10.58. The low value that has been recorded is for 'Remie Chicken' and the higher score is for 'Samu Beef'. The other set of values are having a difference of either 4 or 5. The total ash for 'Remie

Chicken' is 36.69 while that of the higher value is for 'Mr. Chef' seasoning. It can therefore, be concluded that the different chemical constituents that have been found in the sampled artificial food enhancers/seasonings have varied quantities in the seasonings. The chemical constituents found include Acid insoluble ash, Arsenic, Fat, Iron, Lead, Nitrogen, Sodium chloride and Total ash. This result has thus confirmed what WHO (1983) has found in an earlier study that artificial food seasonings contained lead, sodium chloride and others.

The worrying finding was the presence of heavy metal in the artificial food seasonings. Lead as metal does not digest in the human stomach since it is not meant in digesting metal let alone lead. This lead would be in the digestive system for long a time and who knows when it would be egested. The more it stays in the digestive system, the more its problem to it. (Journal, 2010).

The presence of Sodium Chloride in the artificial food seasonings is to help in preserving the shelf-life of the seasonings. Also, the NaCl is to help give salty taste to foods or dishes that has been used to prepare. The argument of much salt in food has been an issue due to its negative effect on the health of people. Normal salt has been proven to affect blood pressure of humans.

Blood pressure of human when it is high or low kills(Laba,2016; Okeahialam,2017; Takyi,2018).

Table 13: Chemical Composition of Artificial Food Enhancers

	Artificial FoodEnhancers									
Chemical constituents	**Remie Chicken**	**Minazen**	**Maggie cube**	**Onga**	**Mr. Chef**	**Adja Beef**	**A-One**	**Jara**	**B-3chicken**	**Samu Beef**
Acid insoluble ash	0.12	0.19	0.13	0.14	0.22	0.12	0.19	0.41	0.21	0.22
Arsenic	0.94	0.98	0.78	0.86	0.98	0.92	0.78	0.87	1.07	0.74
Fat (%)	1.44	2.43	1.26	2.34	1.08	2.39	1.50	2.05	1.96	0.65
Iron (ug/g)	157.89	143.62	151.32	160.98	156.97	164.05	139.91	158.19	150.78	171.62
Lead	0.05	0.04	0.02	0.09	0.09	0.26	0.34	0.02	0.02	0.01
Nitrogen	0.88	1.05	1.90	2.67	2.75	1.23	2.74	1.21	0.19	0.31
Sodium chloride	36.32	52.08	48.04	46.96	52.42	49.89	51.92	48.9	52.86	52.96
Total ash	**36.69**	**54.17**	**47.53**	**45.19**	**59.18**	**53.54**	**55.56**	**44.02**	**53.92**	**53.09**

Source: Akwaah (2020)

Research Objective 3

Establish if the chemical constituents of the selected food seasonings meet the required standards.

In determining whether the chemical constituents in the selected artificial/enhancers on the market meet the WHO (2007, 2017) standards the market samples were analysed and the results compared to WHO standard. The result forten (10) most patronized artificial/enhancers in Kumasi central market are presented in Table 14.

The WHO standard for total ash is 12%. Meanwhile, the values that have been found in the 10 commonly bought samples have their values ranging from 36.69% to 59.18% and this show the established chemical constituents in the food enhancers have more amount of total ash. The recommended value of acid insoluble is 0.05% in artificial enhancers. However, what has been found in the analysed result could be gleaned from Table 11 so far more than what has been recommended. For instance, the acid insoluble for 'Remie Chicken' and 'Aja' were 0.12% which is the least value and this is even far more than the recommended quantity was permitted.

In terms of the percentage fat being 10% per the internationally recommended value, it could be seen that values ranged from 0.19% through to 0.41%. The recorded values for the seasonings on the market were far lower than the international recommended figure. In the same vein, the figures for sodium chloride (NaCl) were all lower than the WHO (2007; 2017) permitted value of 55.0%. The value for iron as allowed by WHO (2007; 2017) was 300 ug/g and in comparing this to all the recorded values after the laboratory analysis were either half or a little above half of the standard value (300 ug/g).

The value for the iron quantity ranges from 139.91 ug/g through to 171.62 ug/g.

Nitrogen has been detected from the analysis and the quantity varies in each seasoning type. The range of value started from a low as 0.88 and ran through to a high value of 2.75 for Onga and Mr. Chef respectively. With exception of A-one Beef, Mr. Chef and Onga, all the other seasonings had their values below the recommended value of 2.0%. The lead (Pb) quantity that has been recommended is 1.0mg/kg.

It can therefore be gleaned from the values recorded for the various seasonings started as low as 0.01mg/kg to 0.34mg/kg. The high value is for A-one Beef and the lowest value is for Samu Beef. The last but not the least constituent that has been found in the analysed sample is Arsenic (As). The recommended value is 1.0mg/kg and a critical gleans at the analysed values, only one of the seasonings B-3 chicken, has more than the recommended value of 1.0mg/kg. The value of the Arsenic quantity ranges from 0.74mg/kg to 1.07mg/kg.

In the analysis done on Table 11, none of the seasonings met the recommended value for total ash and acid insoluble. However, the fat, iron, nitrogen, lead and arsenic quantity found have met by the recommended value as determined by WHO (2017; 2007). It can therefore be concluded that the artificial food seasonings have largely met the recommended standards.

Table 14: Established Chemical Constituents on Artificial Food Seasonings

Standards(WHOandGSA)	The Chemical Constituents of the Artificial Food Seasonings on the Kumasi market							
	Total Ash (12) %	**Acid Insoluble Ash (0.05mg/kg)**	**Fat (10%)**	**NaCl (55.0%)**	**Fe (300ug/g)**	**Protein (2.0%)**	**Pb (1.0mg/kg)**	**As (1.0mg/kg)**
Adja	53.54	0.12	2.39	49.89	164.05	1.23	0.26	0.92
A-one Beef	55.56	0.19	1.50	51.92	139.91	2.74	0.34	0.78
B-3 chicken	53.92	0.21	1.96	52.86	150.78	0.19	0.02	1.07
Jarah	44.02	0.41	2.05	48.9	158.19	1.21	0.02	0.87
Maggie cube	47.53	0.13	1.26	48.04	151.32	1.90	0.02	0.78
Minazen	54.17	0.19	2.43	52.08	143.62	1.05	0.04	0.98
Mr Chef	59.18	0.22	1.08	52.42	156.97	2.75	0.09	0.98
Onga	45.19	0.14	2.34	46.96	160.98	2.67	0.09	0.86
Remie Chicken	36.69	0.12	1.44	36.32	157.89	0.88	0.05	0.94
Samu beef	53.09	0.22	0.65	52.96	171.62	1.31	0.01	0.74

Source: Akwaah (2020) *None of the artificial food seasonings met the WHO & GSA standards

Hypotheses 1

Ho: There are no statistically significant differences in the level of chemical constituents of the selected food seasonings on Ghanaian market and the standards.

H_1: There are significant differences in the level of chemical constituents of the selected food seasonings on Ghanaian market and the standards.

Table 15: Result of One Sample T-test for chemical constituent in Artificial Food Seasonings

Constituent	N	Mean	Std. Dev.	T	df	Sig. (2-tailed)
Total Ash	30	50.2899	6.53565	32.089	29	.000
Pb	30	.1037	.11467	-42.815	29	.000
%Fat	30	1.7103	.59909	-75.790	29	.000
As	30	.8923	.09992	-5.902	29	.000
%Fe	30	155.5356	10.35862	-76.387	29	.000
%NaCl	30	49.2386	4.85847	-6.495	29	.000
Acid Soluble	30	.1971	.08439	9.547	29	.000
%N	30	1.5959	.85677	-2.583	29	.015

Source: Akwaah (2020)

The element/constituent found in the samples has been tested against the standard by WHO (2017; 2007). The standards for the constituents have been used as a measure to compare the result that has been found on the field. The standards for Total Ash, Pb, %Fat, As, %Fe, %NaCl, Acid Soluble and %N are 12,1,10,1, 300, 55, 0.05 and 2 respectively. The result for the Total Ash has mean value of 5.29 and standard deviation of 6.54 with significant (2-tailed) to be 0.00. The result is significant; $p<0.05$ at $t(29) = 32.089$; $p = .00$.

In testing the lead (Pb) result with the standard value of one (1), the mean values that have been recorded was 0.1037 and the standard deviation is 0.11467. The p-value of 0.00 was less than the alpha value of 0.05 in testing the hypothesis with $t(29) = -42.815$; $p = .00$. The p-value was thus less than the alpha value hence, the result was significant. In the case of %fat present in the artificial food seasonings, the result indicated that the mean was 1.7103 and standard deviation of 0.599.

The p-value of 0.00 which was less than the alpha value of 0.05 for testing the hypothesis. The result showed that $t(29) = -75.790$; $p = 0.00$ and with reference to the alpha value ($\alpha = 0.05$), the result for %fat presence was significant. The mean and standard deviation value for Arsenic (As) are 0.8923 and 0.099 respectively. The result has indicated that $t(29) = -5.902$; $p = 0.00$ for Arsenic (As) was significant.

In testing the significance level of %Fe at 0.05 of alpha, the result indicated that the mean and standard deviation were 155.5356 and 10.358 respectively. The $t(29) = -76.387$; $p = 0.00$ was significant at the alpha value. The %NaCl found has 49.2386 and 4.85847 for the mean and the standard deviation respectively. The $t(29) = -6.495$; $p = 0.00$ and this result is

significant with a reference to the alpha value of 0.05 in testing the hypothesis. In the case of the Acid insoluble ash that has been found in the artificial food seasonings, the mean and standard deviation values were 0.1971 and 0.0849 respectively with t(29) =9.547; p = 0.00. In comparing the p-value to the alpha value of testing the hypothesis, it can be seen that p<0.05 hence, the result was significant. The last but not least constituent found in the artificial food seasonings was nitrogen (N). The result thus showed that the mean and standard deviation result of 1.5959 and 0.85677 respectively was seen to be significant at the t(29) = -2.583, p =0.00 with reference to the alpha value of 0.05.

In reference the p-values in Table 14, all the values were less than the alpha value (p<0.05). It can therefore be concluded that the results are significant at the alpha value of 0.05. Hence, the null hypothesis was rejected in favour of the alternative hypothesis which states; there were significant differences in the level of chemical constituents of the selected food seasonings on the Ghanaian market.

The result for the study indicated that there was significant difference in the constituents found in the seasonings as compared to the standards. The result as found from the field was worrying. This worrying issue of food poisoning was foreseen in Europe by their government and the parliament passed regulations (EU) No. 1129/2011 in 2011. This regulation was an amendment to what was passed in 2008 (Sindelar, 2012; Stephanie, 2014). The frequent change in the regulation to check food standards is to protect their citizenry from unnecessary food poisoning and diseases that might come as a result of consuming food products that do not meet their standards.

It is worrying in the sense that what has been tested and approved to be safe for the consumption of human has been discarded. The manufacturers perhaps had submitted a correct and acceptable product to Ghana standard authority and time goes on, the manufacturers introduced variations. The introduction of variation in the manufactured products perhaps was done to increase their profit margin. The companies are only thinking of what would come into their account forgetting that they are actually killing people. The Lead and Arsenic for instance are very poisonous elements that cause damage to the human system. According to this finding of the presence of Lead and Arsenic which are heavy metals poses a lot of toxic to the human body (Munro, Ford, Kennepohl &Sprenger, 1996). The threshold of toxicology is therefore very important to be of concerns to consumers and agencies that are to regulate the level of such constituents.

In reference to the author's construct for conceptual framework, it was clear that the link between the chemical constituents and the standards were broken and not continuous. The Ghana standard Authority is actually not in tune with what is happening in the Ghanaian market. This accession is made in view of why standards that are not accepted to be sold and consumed on their Ghanaian market are on the shelf for sale.

GSA (2018) has provided standards to helping the general public to be safe when deciding on what products to consume. It is the sole responsibility of the Ghana Standard Authority (GSA) to ensure the safety of consumers, especially the artificial food seasonings (GSA, 2018). The argument could be that the regulatory agency (GSA) is not aware where those products were brought into the market. Persons selling artificial food seasonings are doing so

for the pocket and think less about the health and wellbeing of their consumers. Therefore, GSA has the legal backing to cease those products which do not meet the standard for consumption. However, this might be happening at the blind side of their eyes which raises an eyebrow.

Another point worth considering was that the actual manufacturers might be using the accepted standards to do their calibration of what quantity and value allowable but unscrupulous people might be taking advantage of the system to produce their own thing and mixed with the genius ones. In taking for instance the above accession holds then there is big task ahead of the gatekeepers in the country.

The borders of the country need to be secured the more to prevent the entering of food seasonings that do not meet the accepted standards. Already, there is a popular notion that the Ghanaian borders are porous and this calls for a second look. The agencies working at the air and sea ports of Ghana needs to do their best to prevent the importation of sub-standard artificial food seasonings that come in to more or less kill the citizenry.

Hypothesis 2

2. Ho: Determinants have no influence on consumer preference for type of artificial food seasoning.

H_1: Determinants have an influence on consumer preference for type of artificial food seasoning.

In determining the influence of consumer preference for type of artificial food seasoning, factors such as taste, colour, flavour and texture were used in Cross-Tabulation to calculate the Chi-Square of the data. The results are presented in Tables 18 and 19 for analysis and discussion. Remie was the

sample that had most preferred count for taste and this was followed by Aja and B-3 artificial food seasonings. In the case of colour, the respondents Aja and A One beef had two counts as well. Maggi and Samu had a count of one each and the others did not have any count at all. Flavour for the seasonings was counted as much as four for Remie and Maggi had no count from the respondents. Texture was counted for Aja only with a frequency of one while the rest of the seasonings had no count with respect to texture.

The Pearson Chi-Square result as in Table 19 had indicated that Asymptotic Significance (2-sided) has 0.508. The sample size for the study is 80 and the alpha (α) value for testing the hypothesis is 0.05. The Asymptotic Sig. (2-sided) value = 0.508; p = 0.508 is greater than the alpha value (0.05). The study therefore fails to reject the null hypothesis which states that 'Determinants have no influence on consumer preference for type of artificial food seasoning'. The result is therefore not statistically significant. Hence, there is no association between influencing factor and the type of artificial food seasoning consumers determine to buy in the Kumasi Central Market ($\chi^2(27, N=80) = 26.193, p=0.508$).

Table 16: Influencing Factor Versus Sample Preference

		Count	6	5	6	2	4	3	2	2	23	2	55
		% within	10.9%	9.1%	10.9%	3.6%	7.3%	5.5%	3.6%	3.6%	41.8%	3.6%	100.0%
	Taste	Influencing Factor	60.0%	50.0%	75.0%	50.0%	80.0%	75.0%	50.0%	66.7%	85.2%	40.0%	68.8%
		% within sample	7.5%	6.3%	7.5%	2.5%	5.0%	3.8%	2.5%	2.5%	28.7%	2.5%	68.8%
Influencing		% of Total											
Factor	Colour	Count	2	2	0	0	1	0	0	0	0	1	6
		% within	33.3%	33.3%	0.0%	0.0%	16.7%	0.0%	0.0%	0.0%	0.0%	16.7%	100.0%
		Influencing											
		Factor											
		% within sample	20.0%	20.0%	0.0%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%	20.0%	7.5%
		% of Total	2.5%	2.5%	0.0%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	1.3%	7.5%
		Count	1	3	2	2	0	1	2	1	4	2	18
		% within	5.6%	16.7%	11.1%	11.1%	0.0%	5.6%	11.1%	5.6%	22.2%	11.1%	100.0%
		Influencing											
	Flavour	Factor											
		% within sample	10.0%	30.0%	25.0%	50.0%	0.0%	25.0%	50.0%	33.3%	14.8%	40.0%	22.5%
		% of Total	1.3%	3.8%	2.5%	2.5%	0.0%	1.3%	2.5%	1.3%	5.0%	2.5%	22.5%

Continue Table 16 from next page....

	Count	1	0	0	0	0	0	0	0	0	0	1
	% within Influencing	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	Factor texture											
	% within sample	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
	% of Total	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
	Count	10	10	8	4	5	4	4	3	27	5	80
	% within Influencing	12.5%	12.5%	10.0%	5.0%	6.3%	5.0%	5.0%	3.8%	33.8%	6.3%	100.0%
Total	Factor											
	% within sample	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
	% of Total	12.5%	12.5%	10.0%	5.0%	6.3%	5.0%	5.0%	3.8%	33.8%	6.3%	100.0%

Source: Akwaah (2020)

Table 17: Chi-Square Tests of Consumer Preference for Artificial Food Seasonings

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	26.193[a]	27	.508
Likelihood Ratio	25.781	27	.531
Linear-by-Linear Association	1.113	1	.291
N of Valid Cases	**80**		

Source: Akwaah (2020) * a. 35 cells (87.5%) have expected count less than 5.

* The minimum expected count is .04.

The result has shown that consumers' preference was not influenced by taste, flavour, colour and texture. What may be accounting for this finding is that though women go to market to buy food seasonings for use, they may not be bent to get a specific product using any influencing factor (taste, flavour, colour and texture). Consumers are kin to enhance the taste of their food hence the issue of a particular flavour do not come to play when selecting artificial food seasonings. Some of the artificial food enhancer users may prefer to use any of the influencing factors but this is not significant per the result that has been obtained.

Preparing food in general has approaches that need to be adhered to else the food may not taste well despite the amount and quantities of additives that has been added. Therefore, the consumers may need a little food enhancer to give the food a taste this might have explained why the influencing factor was not used as criteria in buying artificial food seasonings on the market. The study's finding has sink with Coleman (2015) that spices are mainly used to improve the appearance of diet.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter looks at the summary, conclusions and recommendations found in the study. The chapter gives suggestions for further studies.

The research problem had led to the three research objectives and two hypotheses that guide how solution could be found to the problem statement.

The variables in the problem statement helped to come out with the appropriate thematic areas for the literature review. The literature review was in two main sections; which include theoretical and empirical literature. The literature review had helped to under pin the entire study and also gave it a clearer overview of what had been done relating to study. The research methods guided how the study ought to be approached so as to attain the scientific solution to the problem. In more specific, the research designs that have been adopted for the study were experimental and descriptive research design. The study area was done in Subin Sub-Metro; Kumasi Metropolis. The sample for the study has been in two folds. The sampling was done for participants and the type of food seasonings that were being sold in the Kumasi Central Market. A total of 80 market women and 10 commonly sold artificial food enhancers were used for data collection. The data collection from the respondents was aided by questionnaire and the laboratory analysis was done in the University of Cape Coast Agricultural laboratory and Ghana Standard Authority laboratory. The data collected has been analysed using the appropriate statistical tools and the results presented in tables for discussion.

Summary of Key Findings

The analysed results for the research objectives and the hypotheses have revealed the following:

1. The commonly bought artificial food seasonings in the Kumasi Central Market were Jara, Minazen, B-3 Chicken, One Beef, Mr. Chef, Samu, Onga chicken, Adja, Remie chicken and Maggi Cube.
2. The chemical constituents found in the artificial food enhancers (Jara, Minazen, B-3 Chicken, One Beef, Mr. Chef, Samu, Onga chicken, Adja, Remie chicken and Maggi Cube) were Acid insoluble ash, Arsenic, Fat, Iron, Lead, Nitrogen, Sodium chloride and Total ash.
3. The result has shown that the artificial food seasonings have largely met the recommended standards for consumption.
4. The results are significant at the alpha value of 0.05 ($p<0.05$) and the null hypothesis (There are no statistically significant differences in the level of chemical constituents of the selected food seasonings on Ghanaian market and the standards).
5. Determinants have no influence on consumer preference for type of artificial food seasoning and the result is therefore not statistically significant (χ^2 (27, N=80) =26.193, p = 0.508).

Conclusions

In knowing the chemical constituents of artificial food enhancers in the current study would go a long way to help consumers to make informed decisions. The presence of heavy metals such as lead and arsenic in the sampled

artificial food enhancers in the current study is a worrying revelation that could deter potential consumers in patronizing them. This could lead to be loss of income on the part of the sellers and some people would not have the taste of what they enjoy most.

The study has established the fact that regulatory officials do not visit markets to survey on the artificial food enhancers whether they do meet the standards or not. This could be leading to so many complications which borders on health and finance. The health of persons that patronize the restaurants and 'chopbars' were at risk since the cooks were not concerned about the constituents of the artificial food enhancers. The cooks were after their money to the detriment of their customers' health.

The artificial food enhancers come with other preservatives to make them last longer on the shelf and some of these preservatives do bringside effects to foods they were used to prepare. Consumers buy food seasonings in general not because of their attributes but how they have been presented to the general public by friends and adverts to be good for cooking. The results therefore brought to the fore what used not be clear to general public about the composition and quantity of chemical constituents in the food seasonings. The study could serve as a basis to talk more on artificial food seasonings and how to make policy regarding its consumption.

Recommendations

The result indicated that the commonly bought artificial food seasonings in the Kumasi Central Market were Jara, Minazen, B-3 Chicken, One Beef, Mr.

Chef, Samu, Onga chicken, Adja, Remie chicken and Maggi Cube. It was therefore, recommended to Food and Drugs Authority (FDA) evaluate the samples to ensure each of them meet the national and international standards regarding their chemical compositions. FDA and Ghana Standard Authority (GSA) could collaborate to regularly publish safe artificial food seasonings to the general public that need to be consumed. This is to enhance health safety issues that relate to the consumption of artificial food seasonings in Kumasi and elsewhere.

Acid insoluble ash, Arsenic, Fat, Iron, Lead, Nitrogen, Sodium chloride and Total ash were the chemical constituents found and some of these constituents are more beneficial to the human body than others. The fat and sodium chloride help the body and much of it could be very dangerous to the body as well. It is therefore, recommended to FDA and GSA to liaise with the industry players to reduce the degree of high concentration of components that pose danger to the human system. Also, lead and arsenic should be pushed by the regulatory authorities (FDA and GSA) to find a better replacement of such components since available literature points to the fact that they are very harmful to humans when consumed in any form.

As at now, though the result has not met the recommended standards of the amount of constituent composition in the artificial food seasoning, FDA and GSA should forward amendment of the current regulation of the law that establish the standard. Regular reviewing of the allowable quantity of the studied constituents should be consistent with the international practices especially in

Europe. Regular law amendments in Ghana would have to ensure the safety of the food seasonings that come to the country. Also, companies manufacturing food seasonings in the country need to be supervised to produce according to standards.

The market has to be scheduled for visit by authorities to flash out products that have their chemical constituents not being consistent with the certification given by the government/regulators. FDA should put in place laws that have been passed by Ghanaian Parliament to assist in checking companies that would like to take undue advantage. The results also indicated that determinants of buying a given food seasonings have no influence on consumer preference for type of artificial food seasoning (χ^2 (27, N=80) =26.193, p = 0.508). It is thus recommended to the market women who deal in artificial food seasonings have to educate their costumers what a particular food enhancer does to food. Consumers need to be educated by FDA and its related agencies on expiring dates on the food seasonings and its negative effects when consumed after expiring since consumers do not demand for expiring dates on products.

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APPENDICES

APPENDIX A

INFORMED CONSENT

Title of Research: CHEMICAL COMPOSITION OF SELECTED ARTIFICIAL FOOD ENHANCERS IN GHANA

Principal Investigator: VERONICA AKWAAH

Affiliation: University of Cape Coast, Vocational and Technical Department Contact Information: Email:frimpomaa79@yahoo.com; Tel.:0243172931

Introduction and Purpose of the **Study**

Consumption of artificial food enhancers in Ghana is on the rise. This study thus investigates the chemical composition of selected artificial food enhancers sold on the Ghanaian markets. Results from the analysis will be compared to probable standards provided by Ghana Standard Authority; and Ghana Foods and Drugs Authority.

Description of the Research

The participants in the study were market women who sell artificial food seasonings in the Kumasi Central Market. Random sampling will be used to select 80%of these sellers on the first visit to the market and their socio – demographic data collected on the second visit. Five of the most common artificial food seasonings mostly patronized by consumers will be identified, purchased and analysed.

Confidentiality

To be anonymous, participants will be given codes to protect their identities and the information they provide will be kept highly confidential under lock and destroyed when the study is completed.

Authorization: By signing this form, you authorize me to use any records, observations, and findings obtained during the study for my thesis, education, publication and/or presentation.

Participation in the Study

Participation in this study is purely voluntary and it has no monetary value attached. You can withdraw from participating at any time with notification in writing or via phone call without causing any problems.

I voluntarily agree to participate in this research programme □

Yes □ No

I understand that I will be given a copy of this signed Consent Form

□ Yes □ No

Name of Participant (print): Signature: Date:

Name of Witness (print): Signature: Date:

Person Obtaining Consent: VERONICA AKWAAH

Signature: Date:

Note: A copy of the signed, dated consent form must be kept by the Principal Investigator(s) and a copy must be given to the participant.

APPENDIX B

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION

QUESTIONNAIRE FOR PARTICIPANTS

Section A: Demographic characteristics of Respondents

1. Which year were youborn .....

1960-1964 { } 1965-1974 { } 1975-1984 { }

1985-1989 { } others { }

2. Sex of Respondent:

Female { }

Male { }

3. What is your Educational level?

Tertiary level { } Secondary level { }

Basic level { } Non Formal Education { }

No formal Education { }

4. Which year did you start selling in the market?

1970-1980 { } 1981-1990 { } 1991-2000 { }

2001-2010 { } 2011-2020 {)

5.What is your religious affiliation?

Christian Religion { } Islamic Religion { }

Traditional Religion { } other Religion ……..

6.Marital Status:

Married { } Single { }

Widowed { } Divorced { }

Other

……

7.Was food seasonings the first items you sold?

Yes { } No { }

If No, what was the first item you sold?……

8.What is your religious affiliation?

Christian Religion { } Islamic Religion { }

Traditional Religion { } other Religion ……..

9.Economic Status: How much income do you make in a month selling artificial food seasonings?.....

……..

10.Do you have children?

Yes { } No { }

If yes, how many children do you have?.....

Information on food seasoning

11. Where do you get the supply of the seasoning/spices you sell?

Manufacture { } Wholesale { }

Retailer { } Others { }

12. List all the spices you sell in the market

……

13. Which of the listed food seasoning/spices are **Natural/artificia**l?

……

……

……

14. Which of the listed food seasonings do people buy most?

……

……

15. What are the common names of the food seasonings/spices your customers buy (*if any*)?

i……. ii……

iii…… iv……

v……. vi……

vii…… viii……

ix……. x…….

16. How fast are the various food seasonings/spices sold out?

A day { } A week { }

A month{ } others { }

17. What quantity do you sell per day/week on the average?

Packs { } Pieces{ }

Boxes { } curtains { }

Others ……

18. How do you sell the food seasonings/spices?

In their original package { }

Repackaged into smaller quantities { }

19. Do the packages come with the list of ingredients on it?

Yes{ }

No{ }

20. If yes to ***Q. 19***, do customers read the label before buying the food seasoning?

Yes { }

No { }

21. Do Food and Drugs Authority (FDA) Officials interacts with you about the sale of artificial food enhancers before?

Yes { }

No { }

22. If yes to above question (***Q21***), can you share with me what it was about?

……

……

……

23. Has any **government** officials come for a sample of artificial food enhancers for laboratory investigation before?

Yes { }

No { }

24. If yes to above question (***Q. 23***) what was the feedback?

……

……

……

25. Has any **Non-government** (NGOs) officials come for a sample of artificial food enhancers for laboratory investigation before?

Yes { }

No { }

26. If Yes to above question (***Q. 25***) what was the feedback?

……

……

……

27. Has any customer cared to know about the chemical composition of the artificial food enhancers/seasoning?

Yes { }

No { }

28. Docustomers ever demand for the chemical composition(s) of the artificial food enhancers they purchase?

Yes { }

No { }

29. If Yes to **Q. 28** what do you tell them?.....……

……

30. Do you personally cook with artificial food enhancer?

Yes { }

No { }

31. If Yes to Q. 30 why?

……

……

……

32. If No to Q. 30 why?

……

……

……

33. Do you supply or sell to restaurants/hotels/chop bar operators?

Yes { }

No { }

34. Have you ever asked why they use the artificial food enhancers?

Yes { }

No { }

35. If Yes to ***Q. 34***, what was their responses?.....

……

……

……

36. If No to ***Q. 34***, why is it that you have not asked?

……

……

……

37. How much quantity do *restaurants/hotels/chop bar*buy in a day/week?

Packs { } Pieces{ }

Boxes { } curtains { }

Others ……

38. How often do *restaurants/hotels/chop bars* come to buy?

Always { }

Sometime { }

Not at all { }

39. What actually do the customers say influence their choice of food enhancers they buy?

Taste { } Colour { }

Flavour { } Texture { }

40. What category of customers normally buy artificial food enhancers from you?

Literate { }

Non-literate { }

Both { }

41. How much information do you have about artificial food enhancers/seasonings?

……

……

……

42. Do you have preference for one over the others?

Yes { }

No { }

If yes. Mention the one you prefer than others and why?

……

……

……

If no why?

……

……

……

……

43. Do any of your customers come to complain about the artificial food enhancers they have bought from you before?

Yes { } No { }

44. If Yes to ***Q.26*** above what was it about?

……

……

……

……

45. What happened after their complaint?

……

……

……

……

APPENDIX C

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

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CHEMICAL EVALUATION FORM

	Artificial Food Enhancers									
Chemical constituents	**A** Remie Chicken	**B** Minazen	**C** Maggie cube	**D** Onga	**E** Mr. chef	**F** Adja	**G** A-One Beef	**H** Jara	**I** B-3chicken	**J** Samu Beef
Lead										
Total ash										
Acid insoluble ash										
Nitrogen										
Fat										

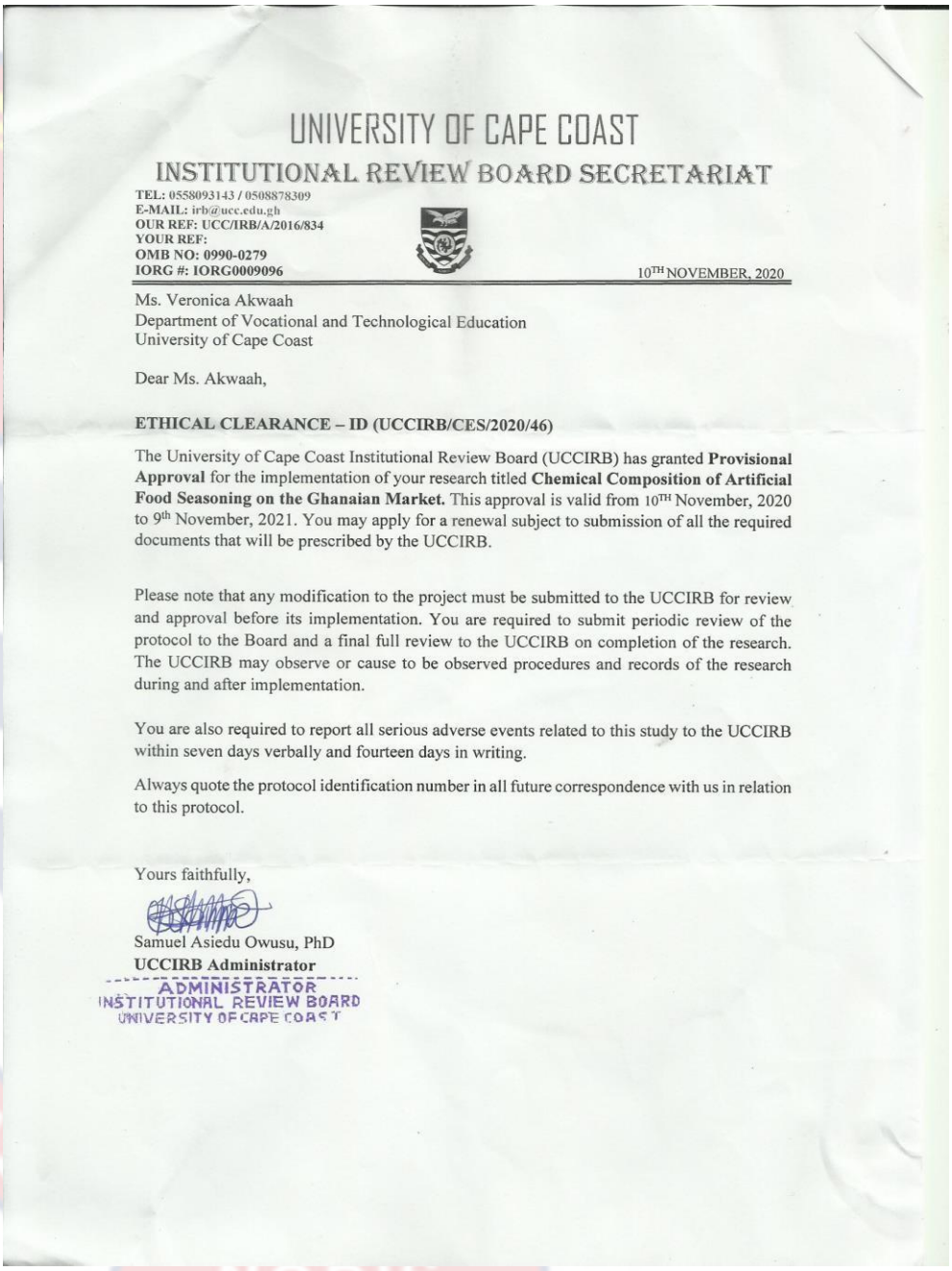
Sodium chloride										
As										

NB: A, B, C, D & E are the coded names of the artificial food enhancers

•*The smell of chemical is what customer mostly used to determine their preferred artificial food enhancers*

APPENDIX D

IRB APPROVAL LETTER



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10TH NOVEMBER, 2020

Ms. Veronica Akwaah
Department of Vocational and Technological Education
University of Cape Coast

Dear Ms. Akwaah,

ETHICAL CLEARANCE – ID (UCCIRB/CES/2020/46)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted **Provisional Approval** for the implementation of your research titled **Chemical Composition of Artificial Food Seasoning on the Ghanaian Market.** This approval is valid from 10TH November, 2020 to 9th November, 2021. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

Please note that any modification to the project must be submitted to the UCCIRB for review and approval before its implementation. You are required to submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Samuel Asiedu Owusu, PhD
UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST

APPENDIX E

PICTURES OF ARTIFICIAL SEASONINGS