UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

QUALITY EVALUATION OF PASTRIES (CAKE, PIE AND BREAD) PRODUCED WITH COMPOSITE FAT (MARGARINE AND SHEABUTTER)

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(BSC HOSPITALITY MANAGEMENT)

A Dissertation in the Department of **CATERING AND HOSPITALITY EDUCATION**, Faculty of **VOCATIONAL EDUCATION**, submitted to the School of Graduate Studies, University of Education, Winneba in partial fulfillment of the requirements for award of the Master of Technology (Catering and Hospitality) degree.

AUGUST, 2014

DECLARATION

STUDENT'S DECLARATION

I, Agnes Kyeremaa Anane-Asamoah declare that this Dissertation, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: ……

DATE: …….

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of dissertation as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: …….

SIGNATURE: ……..

DATE: …….

ACKNOWLEDGEMENT

I will extol the Lord at all times. His praise will always be on my lips. I sought the Lord and He answered me. Psalm 34:1&4 (NIV)

I am equally heavily indebted to my supervisor Dr. Mrs. Patricia Owusu Darko upon whose scrupulous guidance, advice, recommendations, suggestions and patience despite her heavy schedules made the study victorious. I also extend a hand of gratitude to Mrs. Doreen Dedo Opata of hospitality and catering department and Mr. Frank Owusu Sekyere of special education unit both at University of Education Winneba, Kumasi campus. To my colleagues, Mrs. Jacqueline Boamah, Mr. Polycarp Edem Kudovu; Mr. Ebenezer Yaw Amevor and Lucy Giba both deceased of Bolgatanga polytechnic, I say a big thank you for your support. I am also grateful to Mr. Caesar Bobtoya of Zamstec, Bolgatanga.

I owe tonnes of gratitude to my brother, Mr. Obed Anane-Asamoah for his financial support, my dad, Sqn. Ldr.(rtd) Benjamin Anane-Asamoah, my brother Mr. Alex Anane-Asamoh, Madam Elizabeth Nyame and the entire Anane-Asamoah family for their words of advice, encouragement and spiritual support throughout my study. To my uncle, Dr. Kofi Amaano Owusu-Ansah ; Kumasi, may God replenish in double fold whatever you lost for my sake during the period of my study.

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DEDICATION

I dedicate this work to the honour of my God Almighty and the Holy Spirit who has been the strength of my life, my mother the late Margaret Agyabeng, who never lived long enough to see me growing up; my father Sqn. Ldr. (rtd) Benjamin Anane-Asamoah, who has been the source of my inspiration and my daughter Maame Akua Agyabeng Anane-Asamoah, who endured the pangs of loneliness during the period of my study.

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ABBREVIATION/ACRONYMS

CBI - Cocoa Butter Improvers

CBS - Cocoa Butter Substitutes

CRIG - Cocoa Research Institute of Ghana

FAO - Food and Agriculture Organization

GEPC - Ghana Export Promotion Council

Lb - Pound

NARP - National Agricultural Research Institute

SNV - Stichting Nederlandanse Vrijwilligers

USAID - United States Agency For International Development

ABSTRACT

A study was conducted to determine the substitution potential of sheabutter in pastry making. Cake, bread and pie were prepared using different proportions of sheabutter to margarine. Sensory analysis was conducted using a scale of one (1) to five (5). Cakes prepared with equal proportions of sheabutter and margarine were most preferred and recommended for patronage. Bread and cake prepared with equal proportions of sheabutter and margarine were very sensitive to raising agents and heat. Pastries containing high proportion sheabutter were soggy and had poor aftertaste. At room temperature, pastries prepared with 100% sheabutter had longer shelf lives. Cling film packaged pastries had longer shelf life. Aluminum foil packaged pastries deteriorated faster at room temperature. The quantity of flour used in the preparation of 100% sheabutter cakes and 75% sheabutter to 25% margarine cakes had to be reduced so as to obtain a firm texture. It is recommended that catering and teaching institutions must be encouraged to use and introduce students to the use of sheabutter in pastry making. Aftertaste and aroma of the sheabutter pastries need to be improved as these were the major characteristics that deterred most assessors from liking high proportion based sheabutter pastries.

CHAPTER ONE

INTRODUCTION

1.1 Background To The Study

The shea tree is an indigenous and exclusive commodity in West and Central Africa and particularly abundant in the Northern Savannah areas of Ghana (Addaquay, 2004). Shea butter is a fatty extract from the seed of the shea tree *Butryospermum paradoxum*, now called *Vitellaria paradoxa* (FAO, 1988a). It grows naturally in the wild in the dry Savannah belt of West Africa, from Senegal in the West to Sudan in the East, and onto the foothills of the Ethiopian highlands (FAO, 1988a). The shea tree thrives in 19 countries across the African continent. In Ghana, the shea tree flourishes extensively in the Guinea Savannah and less abundantly in the Sudan Savannah (FAO, 1988a). The shea tree is found over almost the entire area of Northern Ghana with few of them also existing in Brong-Ahafo, Ashanti, and the Eastern and Volta Regions in the south of the country (FAO, 1988a).

Ghana could therefore be seen as a country rich in sheabutter due to the abundance of shea trees. Ghana's strength in the sheanut industry is already recognized and is on record as the world's second largest exporter of the shea products behind her northern neighbour, Burkina Faso (Mahama, 2011).The country currently produces some 45,000 metric tonnes of sheanuts annually (Mahama, 2011). On the other hand NARP (1993) outlined that, Ghana is said to have a comparative advantage in the production of sheanuts than any of her West African neighbours due to relatively early maturing trees and better quality of the nuts.

Shea nuts and sheabutter have multiple uses (CRIG, 2002). According to Chalfin (2004), shea butter is locally used for cooking, making soap, leatherworking, dying, and as a medical and beauty aid. Globally, it has been used in producing soaps, candles, margarine, and most significantly, as a substitute for cocoa butter in chocolate production (Chalfin, 2004).

In Ghana, sheabutter is in abundance and sold cheaply in loaves and bowls mostly by women in the markets. In a domestic setting, sheanuts constitute an important source of affordable cooking fat. It is also used in confectioneries and margarines due to the presence of the high melting point stearin fraction (Abbiw, 1990).

Shea butter is used extensively in the food, pharmaceutical, cosmetic industries and often as Cocoa Butter Substitute (CBS) or Cocoa Butter Improvers (CBIs) by chocolate manufacturers and for margarine and baking purposes (Williams and Bolton, 1950; Martin *et al*., 1987, Hall *et al*., 1996). Sheabutter has for a long time, been a remarkably common ingredient in food and soup besides its use as body lotion in rural Ghana especially in the Northern region where the shea trees are mostly grown. This means that the majority of margarine imported to Ghana can be substituted for sheabutter which is cheaper and in abundant supply in the preparation of pastries such as cakes, pies and bread which are some of the commonest pastries and snacks prepared and consumed almost everywhere in Ghana. Nikiema and Umali (2007) indicated that, high quality shea butter is consumed in most West African countries as a cooking fat. Refined fat has been marketed as margarine and baking fat which is used for pastries and confectionery because it makes the dough pliable (Nikiema and Umali 2007). Hence, the importance of sheabutter as a substitute to other imported butters, margarines and oils cannot be disputed.

1.2 Problem Statement

Sheabutter is one of Ghana's indigenous commodities which abounds richly in the northern part of Ghana. Most of the sheabutter produced are exported overseas other than being consumed as baking fat. Producers of sheanuts which are used in the production of sheabutter encounter challenges in marketing their produce to prospective buyers. As a result of this, the sheanuts deteriorate and may go to waste. This situation compels the producers to sell the sheanuts to domestic buyers at very unattractive prices to avoid wastage and loss. This calls for a strategy to be devised to save the sheanuts producers as well as the sheanuts producing industry from collapsing. It is therefore important to exploit the possibility of using sheabutter as a composite fat in baked products. The researcher was thus motivated by this challenge to carry out research in this area.

1.3 The Purpose and Objectives of the Study

The broad objective of this research was to explore the possibility of preparing marketable pastries (bread, pie and cake) using sheabutter and margarine in different proportions.

The study therefore intended to achieve the following specific objectives:

1. To prepare pastries (cake, bread and pie) using different proportions of sheabutter and margarine.
2. To determine and evaluate the sensory attributes of pastries (bread, pie and cakes) produced from sheabutter and margarine.
3. To determine the shelf lives of pastries (bread, pie and cakes) and the appropriate packaging materials for pastries produced from sheabutter and margarine.
4. To assess the cost of producing sheabutter and margarine pastries.

On the other hand, the research will attempt to answer the following questions?

1. Can sheabutter be used in the preparation pastries?
2. What are the sensory characteristics of sheabutter based bread, pies and cakes like?
3. How long can pastries (cake, bread and pie) produced from sheabutter last on the shelf?
4. What type of packaging material and storage condition would be most appropriate for sheabutter pastries (Cakes, bread and pie)?
5. Will the cost in producing both sheabutter and margarine pastries be the same?

1.4. Hypothesis

An assumption was formulated to guide the study. The assumption was that, pastries prepared from sheabutter - margarine composite fat will not differ in sensory and other attributes from those prepared with margarine.

1.5 Significance of the Study

The high price of margarine and other imported baking fats contributes to increasing prices of baked products such as cakes, bread and pie. Meanwhile, northern Ghana is wealthy of sheabutter but the bulk is exported to the international world instead of being used and consumed as a baking fat in Ghana. Companies in Europe are using sheabutter which is a fatty extract from the kernel of a sheanut as a replacement for cocoa butter to make food products (Nurudeen, 2009).

Though, sheabutter has essential nutrients and most of the properties and qualities of fat used in the catering industry, it has not been widely accepted by the industry in Ghana. It is therefore worthwhile to delve into possibility of using sheabutter as a substitute to margarine in baked

products and also assess consumers' acceptability of the product. The use of sheabutter in the manufacture of bread and cakes will ensure that cheaper snacks are available. Production of sheabutter based pastries will contribute to sustain development especially in shea producing areas as well as creating ready markets for sheanuts producers.

Awareness of using sheabutter as cooking and baking fat will be created through this research. The results of this study will encourage and serve as an opportunity for bakers and catering institutions to use and have easy access to a more affordable baking fat for their produce, since sheabutter is in abundant, cheap and easily available in Ghana. Substituting sheabutter for margarine is not only justified by its accessibility and affordability but serves as a potential innovative ground for trainees in catering institutions in the development of recipes and new products for the consumer market which possibly lead to self employment.

The result of the study will also serve as a guide to food technologists in the modification of sheabutter to a more acceptable cooking and baking fat and an efficient patronage by the mass market. Finally, unemployment rate will be reduced because more hands will be needed in the sheanuts and sheabutter processing industries to produce more sheabutter for both national and international consumers.

1.6 Limitation of the Study

The researcher encountered challenges in an attempt to carry out the research. Some of the challenges that posed as threats to the success of the study thereby limiting the researcher's ability to work effectively were:

- Some respondents' unwillingness to deliver information tended to limit the study henceforth volunteering information is key to the success of any research activity. This was a problem encountered on the part of bakers as they were so much engrossed in having their bread dough mixed and kneaded at the various mills that as soon as they are through with their dough they hurried off leaving the questionnaires half way through. The study had intended to obtain detailed information from the bakers as they were one of the major stakeholders who could promote sheabutter in pastry making.

- Language barrier also limited the ability of the researcher since some of the respondents especially the cleaners, pastry sellers and some bakers who did not understand English language well made it difficult as they could not express themselves well to the understanding of the researcher and the researcher also could not understand their local dialect which would have made it easier for both parties.

1.7 Scope of the study

Geographically, the scope of the study covered Bolgatanga polytechnic community and its immediate environs. This scope was chosen because the polytechnic community is a cosmopolitan population. In terms of literature, the availability of journals, articles and publication on sheabutter were used to facilitate the study. The internet was also used to search for information to support the study.

1.8 Layout Of The Study

The study is made up of six chapters. The first chapter entails the introductory aspect; which consists of a general background to the study, the problem statement, the purpose and objectives of the study, hypothesis, significance of the study, limitation and delimitation of the study. The second chapter entails review of literature in sheabutter production systems, propagation of the shea tree, nutritive value, quality of processed sheabutter, problems of sheabutter processing, sheabutter marketing and economic importance, sheabutter substitution potentials of margarine. The chapter concludes with sheabutter in pastry making. Chapter three outlines the research methods and approaches adopted to embark on the study. This included the study area, sample population, sampling procedures and techniques, data collection methods and analysis. Chapter four entails the analyses and presentation of data obtained from the study. Chapter five consists of the discussion of findings. Chapter six provides a summary of the research findings, recommendations and conclusion of the research.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents literature relating to shea butter, its economic importance, varietal and uses.

2.1 Botany of Shea Plant and Varieties

It is a tree species of priority for African genetic resources (FAO, 1988a). The shea tree, or karité in French, is in the Sapotaceae family under the accepted name *Vitellaria paradoxa* (Gaertn. f.), formerly called *Butyrospermum paradoxum* (Gaertn. f.) (Henry *et al.,* 1983 in Boffa *et al*., 1996). Oluwole *et al*., (2004) also stresses that, the Sheanut *(Butyrospernum paradoxum)* is an oil rich fruit obtained from tropical shea tree (*Vitellaria paradoxa),*which is indigenous to the West African savannah zone. Generally, *Vitellaria paradoxa* is a small to medium-sized tree with a minimum height of 7 meters but can also grow to a maximum height of 25meters. Morphologically, the plant is much branched, dense, spreading and round to a hemispherical crown. In mature trees, the trunk is short and usually 3- 4 meters but in exceptional cases 8 meters with a diameter ranging from 0.3 to1 meter but mostly 0.6 meter. Fobil *et al.* (2002) also has it that, the shea tree usually grows to an average height of about 15m with profuse branches and a thick waxy and deeply fissured bark that makes it fire resistant. It bears a fruit of 5-8 cm long and 3-4 cm wide, elliptic, a yellow-green or yellow berry with thick butter-like, mucous pericarp; generally containing only 1 oval or round red-brown seed thus the shea nut, surrounded by a fragile shining shell with a large, round, rough hilum on a broad base. CRIG (2002) also outlined that, the fruits are round and green in colour and maintain the same colour when ripe, except that most ripe fruits are soft to touch.

According to Ferris *et al.,* (2001), there are two main varieties of shea nut; *Vitellaria paradoxa* which is produced in West Africa and *Vitellaria nilotica* which grows in Northern Uganda and Southern Sudan. On the other hand, the genus *Vitellaria* is considered by botanical authorities as monospecific, whereby two subspecies are recognized as *ssp. paradoxa* restricted to Western Africa and *ssp. nilotica* of Eastern Africa.

In Ghana, shea trees (*Vitellaria paradoxa*) grow in abundance in the wild in almost half of the country occurring almost in the entire area of Northern Ghana, with land coverage of over 77670 km2 in Western Dagomba, Southern Mamprusi, Western Gonja, Lawra, Tumu, Wa and Nanumba with Eastern Gonja having the densest stands. This then demonstrates that sheanuts abounds richly in Ghana since almost half of the country is endowed with sheanuts and has the potential to sustain the baking and confectionary industries in Ghana.

2.2 Origin and Cultivation of the Shea Plant

National Research Council (2004) has documented, early travelers observed that the cultures in the vast areas which collectively extend through 13 of today's countries, from Senegal to Sudan and Uganda revolved around shea. One such traveler was Ibn Batuta, who passed through in 1348; another was Mungo Park, the first European to trace the inland flow of the Niger River, in 1796 (National Research Council,2004). This can be linked to statement by Garba *et al* (2008), who stressed that, the nomenclature history and synonymy of the Shea tree follow a very tortuous evolution since the oldest recorded specimen was collected by an European explorer. In addition, CRIG (2002) has also documented, the oldest shea specimen for scientific examination was collected by Mungo Park on May 26, 1797, resulting in the eventual scientific name, Vitellaria paradoxa given to shea.

Vitellaria paradoxa is indigenous to the Guinea and Sudan savanna zone from Senegal to Sudan, and to Western Ethiopia and Uganda, in a belt 500–700 km wide. It is found in the interior, separated from the Gulf of Guinea by forest; only in Ghana and Nigeria does it occur within 50 km from the coast (Nkiema and Umali, 2007). The shea tree grows naturally in the wild, in the dry Savannah belt and semi-arid lands (FAO 1988a) but shea tree occurs extensively in the Guinea Savannah and less abundantly in the Sudan Savannah (Dogbevi, 2007). The shea tree also grows very well on a wide range of soils, including highly degraded, arid, semi-arid and rocky soil (Dogbevi, 2007). It grows profusely in the wild without any special nourishment and attention. The trees grow slowly from seeds, taking about 30 years to reach maturity (Dalziel, 1937), but limiting or stressful conditions such as bush-fires and harsh weather can reduce this (CRIG, 2002).

Dogbevi (2007), reports the shea tree has no capacity for vegetative regeneration and can only be propagated by seed. According to Dalziel (1937), the shea tree when it passes the germination stage in about three to five years becomes fire resistant. However, Dogbevi (2007) also stresses that, once it survives the first five years of its early stages of germination and growth, it grows slowly and takes about 30 years to reach maturity and from here, it can live for up to three hundred years. In the absence of any hazards, including tree felling, it can bear fruit for two hundred years. Nikema and Umali (2007) also have it that, early stem growth is slow whilst branching occurs after 4–7 years. *Vitellaria paradoxa* begins flowering at 10–25 years but early flowers may be sterile, however maturity is reached at 20–45 years as reported by (Nikema and Umali, 2007). Nikema and Umali (2007) further stressed that the fruits develop in 4–6 months

whilst maturation peaks in the rainy season, however fruiting cycles are variable between 2–5 years long.

According to Dogbevi (2007), the trees begin to bear fruits at maturity and start flowering by early November, with picking or gathering lasting from April to August every year. Nikema and Umali (2007) also affirmed that fruits are gathered in the wet season, usually in June–August depending on latitude. When the shea fruits ripen, they fall under their own weight to the floor and are gathered by hand (CRIG, 2002). Fallen fruits are collected from the ground because it is difficult to distinguish between ripening and fully mature fruit (Nikema and Umali, 2007) since the shea fruit whether unripe or riped maintains a green colour thereby making it difficult to distinguish between a ripened and an unripe shea fruit unless the ripened fruits fall to the ground. In Ghana, women pick shea fruits from their husbands' plots, the oldest wife regulates the activity and is responsible for the allocation of farmlands of husband among wives in polygamous marriages (Grigsby and Force, 1993). However, Nikema and Umali (2007) also stated that, harvesting continues for about 2-5 months, and is done mostly by women and children. Men do not participate in shea nut gathering and regard this as the preserve of women and children (CRIG, 2002). The men who traditionally do not pick shea nuts, harvest shea fruits for lunch whilst on their farms (Nkema and Umali, 2007). Every part of this indigenous tree is found to be useful. According to legend among local people no one owns the shea tree (Dogbevi, 2007) because it germinates and grows on its own. Grigsby and Force (1993) also attest that, no one has ownership rights over the trees and gathering is equally open to all. Historically, this implies that the shea tree has been in existence since ancient times and possibly since creation as nobody cultivated it. Moreover, it grows naturally by sprouting and growing on its own and it has therefore not been a common cultural practice to plant shea.

2.3 Methods Of Processing Sheabutter

The Oxford Advanced Learner's Dictionary defined process as 'a series of things that are done in order to achieve a particular result'. In this regard to obtain quality sheabutter acceptable to the consumer market, the raw sheanuts need to be transformed using various interrelated process to achieve the desired quality. The processing of sheabutter begins with the gathering or harvesting of the shea fruits after which it goes through various processes to the final stage of cooling to obtain the basic butter as shown in Figure 2. 1. The method illustrated is the most popular way of processing sheabutter used by most women in northern Ghana. The gathered fruits need to be sorted to remove bad or spoilt ones as it can impact negatively on quality of the sheabutter after processing. The shea fruits gathered from wild contain a lot of unwanted materials whose removal is required before the oil can be extracted from the kernel. In this instance the pre-treatment of the fruits by parboiling is therefore necessary to render it suitable for the oil extraction process. Parboiling then facilitates de-pulping which is the removal of the fleshy mesocarp after which it is sun dried for 5-10 days to reduce the moisture content (Sumbrungu Womens Association Spokeswoman, 2013). Henceforth, drying of the de-pulped fruits facilitates de-husking which is the process employed to remove the hard shell. A variety of methods are used to remove the husks. According to Salunkhe *et al.,* (1992), these methods include trampling, pounding using a mortar and pestle, and cracking between two stones. The kernels are then roasted, grinded or milled into powdery substance which is then mixed with warm or lukewarm water. The resulting semi-solid mixture is then stirred continuously or kneaded into a paste. The paste is allowed to stand, with the emulsion floating on top of the mixture and skimmed off periodically, leaving a brown solid residue devoid of oil which settles to the bottom. The emulsion is then boiled, strained and fetched into bowls and allowed to solidify or

moulded into small loaves like the fist of a baby after solidification and either sent to the market on market days to sell or used as required (Sumbrungu Womens Association Spokeswoman, 2013).

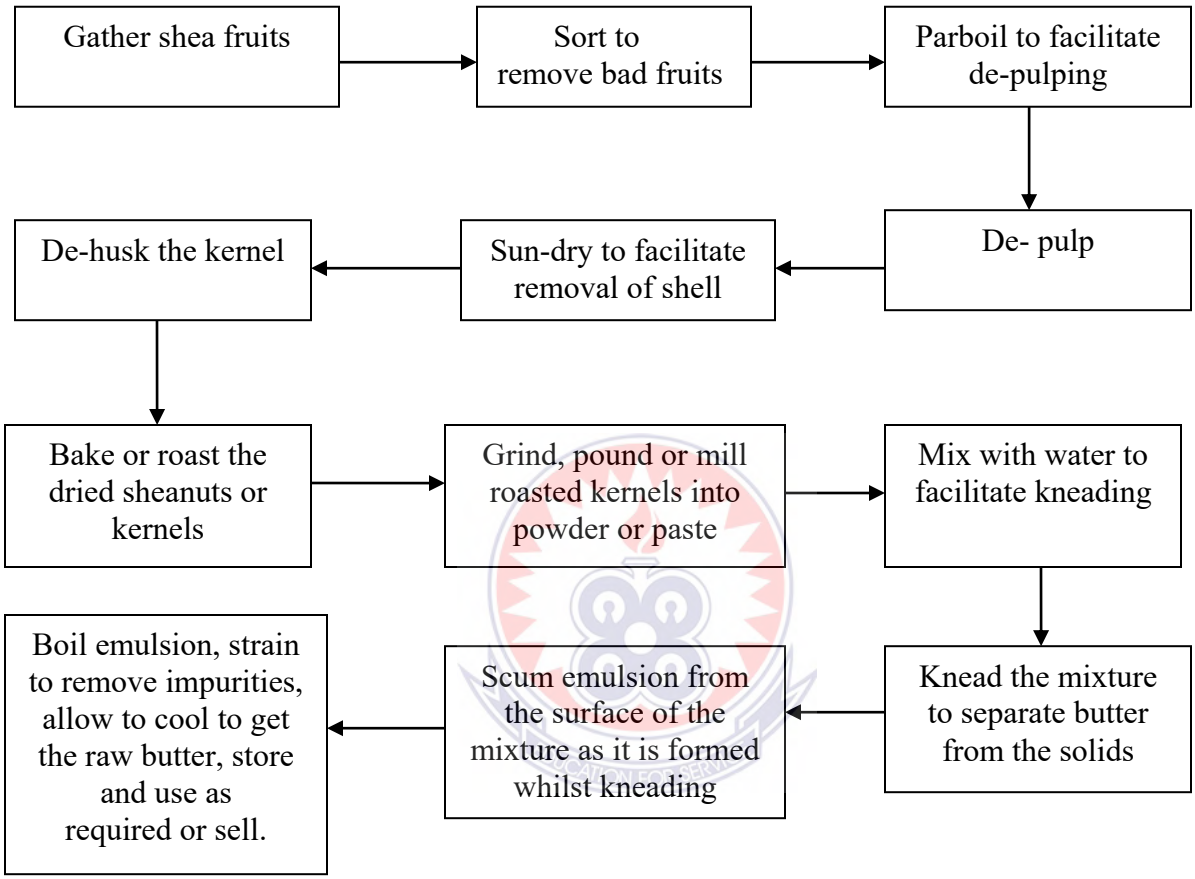

Figure 2.1 Flow Diagram Showing: Stages in Sheabutter Production Process based on observation at Sumbrungu Women's Group sheabutter processing unit in Bolgatanga Municipal, Upper East region (Source: Author's Construct, 2013)

However Addaquay (2004) reported that, in West Africa including Ghana, shea butter extraction process is categorized into three main methods namely: traditional, semi-mechanized and fully mechanized industrial systems.

2.3.1 Manual Traditional System of Production

The traditional system of production has for generations been used by women in northern Ghana. This technique is manually harvesting and processing shea nuts into butter. The traditional method predominates all other methods as outlined by (Addaquaye, 2004) thus this is the method mostly and commonly used by sheabutter producers in the production of sheabutter. All processes are done manually as illustrated in Figure 2.1. The manual method is very tedious and time consuming with a very low extraction rate. This can be attested to statement by Addaquay (2004) who stated that, production of butter from dried shea nuts using manual traditional techniques proves tedious, labour-intensive and inefficient. Addaquay (2004) further stressed that, rural-based women using manual traditional methods extract about 60% of all the crude butter produced in West Africa at an extraction rate of about 20%. However in the view of Addaquay (2004), the manual process involves the following processes: de-pulping the fruit, boiling it, sun-drying the nuts, cracking the shells to remove the kernel, sun-drying the kernels again and finally storing the kernels until they are sold or further processed whilst the processing of shea butter begins from pounding of dry shea kernels through to cooling the oil to obtain crude butter as illustrated in Figure 2.2. There seem to be slight difference between the flow diagram depicting the stages in traditional shea butter by Addaquay (2004) in Figure 2.2 and that of Figure 2.1. In figure 2.1, gathered fruits are sorted unlike figure 2.2. This shows that there have been an improvement in sheabutter processing and quality of sheabutter for the baking industry is assured since the bad nuts which would have led to poor quality butter is now sorted out.

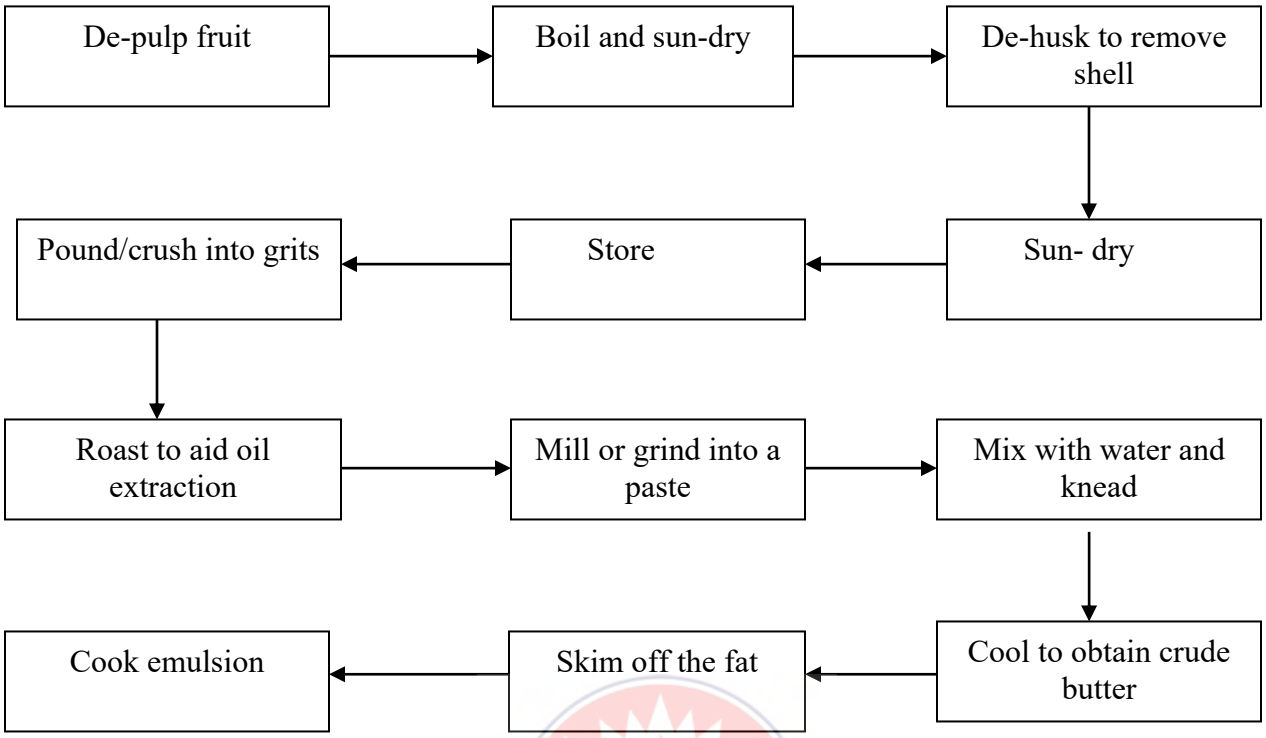

Figure 2.2 Flow Diagram Showing Traditional Butter Production Process

Source: Addaquay (2004)

2.3.2 Semi-mechanized Method

With the semi-mechanized process, mortar and pestle are replaced by grinders and in some locations the process is further mechanized by the use of hand operated oil presses (Vermilye, 2004).

Pufaa (2010) stressed that, the semi-mechanized system of extraction utilizes appropriate technology to mechanize some of the unit operations of the manual traditional system. A nut crusher, roaster, a kneader or a hydraulic/screw press oftentimes complements the manual process and reduces drudgery of the traditional system (Pufaa, 2010). Through the introduction of presses and improved processing, not only is the manual labor of the women reduced, but the amount of fuelwood required for processing is lessened (Vermilye, 2004). According to

Addaquay (2004), such technological advancement has led to an improvement in extraction rate from 20 percent to 35 – 40 percent.

2.3.3 Fully Mechanized Industrial Systems

These are fully mechanized industrial processing plants and they use machine presses, chemical solvents or a combination of the two, to extract the oil (Vermilye, 2004). Addaquay (2004) stressed that, mechanized processing in West Africa yields 30-40% of shea butter from raw nuts however it is more efficient. Addaquay (2004) further stresses that, fully mechanized systems achieve extraction rates of between 42% and 50% and this is relatively higher, compared with 25%-40% of extraction rates of the traditional and semi-mechanized systems.

Despite the efficiency and effectiveness of the fully mechanized industrial system, very few shea butter processors use this method of production. This can be attested to statement by Chalfin (2004) who stated that, although there are a few in Africa who use this system of production, the vast majority of fully mechanized processing occurs in Europe, Asia, and North America. Addaquay (2004) also affirms that, in Ghana there are five shea butter processing plants producing at industrial level. This then calls for the encouragement of more companies and groups as well as investors to resort to the use of mechanized industrial system to boost up sheabutter production for commercial pastry making and the catering industry as a whole.

2.4 Uses of Sheabutter

The shea nut serves as the main source of livelihood for the rural women and children who are engaged in its gathering. CRIG (2002) stated that, sheabutter is the main edible oil for the people of northern Ghana, being the most important source of fatty acids and glycerol in their diet.

Sheabutter has diverse uses and can be used as food, personal care products, medicine and for industrial purposes. Although the fruit pulp is edible, the tree is mainly important for its nut, which contains a kernel with an oil content ranging from 45 to 60% (Oluwole et al., 2004). Chalfin (2004) also states that, cooking with sheabutter, incorporation of sheabutter in soap production, leatherworking, dying, and as a medical and beauty aid are done indigenously. International producers and manufacturers of soaps, candles and margarine make use of sheabutter during the production process of their products (Chalfin, 2004). CRIG (2002) reported that, sheabutter is used in the pharmaceutical and cosmetic industries as an important raw material and or an antecedent for the manufacture of soaps, candles, and cosmetics. CRIG (2002) further stressed that, other important uses of sheabutter include its use as an anti-microbial agent for promotion of rapid healing of wounds and as a pan-releasing agent in bread baking. The healing properties of shea butter are believed to be partly attributable to the presence of allantoin, a substance known to stimulate the growth of healthy tissue in ulcerous wounds (Wallace-Bruce, 1995). Sheabutter of poor quality are used as waterproofing agent whereby they are applied to earthen walls as well as to doors, windows and beehives (Marchand, 1988). On the other hand, Marchand (1988) again states that, the residual meal, as in the case with shea butter, is also used as a waterproofing agent to repair and mend cracks in the exterior walls of mud huts, windows, doors and traditional beehives. The sticky black residue, which remains after the clarification of the butter is used as a substitute for kerosene when lighting firewood (Wallace-Bruce, 1995). This shows that both the sheabutter and its residue left after the clarification process has important uses to mankind. However apart from the sheabutter having numerous uses and placement in the industry, its fruits, flowers, nuts and leaves also serve many purposes. This affirms statement by Soladoye et al.(1989) that, the fruit pulp being a valuable

food source. It is also taken for its slightly laxative properties. The leaves of the shea plant are used as medicine to treat stomachache in children (Millee, 1984). A decoction of young leaves is used as a vapor bath for headaches in Ghana. The leaves in water form a frothy opalescent liquid, with which the patient's head is bathed. A leaf decoction is also used as an eye bath (Abbiw, 1990). The leaves serve as a source of saponin, which lathers in water and can be used for washing (Abbiw, 1990). It has been reported by Agbahungba & Depommier, (1989) that, when a woman goes into labour, branches may be hung in the doorway of her hut to protect the newborn baby from evil spirits.

2.5 Economic Importance of Sheabutter

The shea nut has huge economic value to Ghana and sheanuts producing countries as a whole. It is valued in so many ways and notable among these values is the fact that it is an income generating source so tends to reduce poverty. Notwithstanding, the shea nut industry generates benefits for some of the poorest villages and women who are among the most marginalized in our society. The processing of shea nut into shea butter is a traditional business of women in Northern Ghana which has sustained thousands of households for years. Aboyella (2002) who noted that, shea butter processing and trading are major income generating activities that offer employment to rural women. SNV (2006) reports that sheabutter constitutes a key income source for local women in the northern savannah areas of Ghana. According to SNV (2006), more than 600,000 women in Northern Ghana depend on incomes from the sales of shea butter and other shea-related products as a means of their daily sustenance like supplementing the family food budget and meeting medical and educational expenses. With reference to both SNV and Aboyella's statement, it can be said that, shea butter plays a significant role in poverty alleviation and food security.

TechnoServe Ghana (2004) stresses that, about 3,000 households in Northern Ghana are engaged in the shea industry and it is estimated that the average household size is 13 persons and these households produce and market 4 Million USD worth of sheabutter annually. Meanwhile, about 39,000 rural poor processed and sold 34.2 billion Ghana Cedis worth of shea butter in 1999 (TechnoServe, 2004). This is a massive manifestation of the shea industry as a potential economic sustainable development tool for Northern Ghana and possibly Ghana as a whole.

Hall *et al* (1996) observed that, the harvest season coincides with the early wet season, and the edible fruit pulp forms a substantial addition to diet. Lovett (2004) reports, about 70,000mt of shea is consumed in Ghana annually. Henceforth, the most important role played by shea in northern Ghana is the fact that shea picked by farmers are mainly sold to raise funds for the purchase of food.

According to Kletter (2002), picking of shea coincides with the hunger period in northern Ghana, therefore, pickers sell the commodity immediately to purchase much needed food. Hall et al. (1996) affirms that, the thick pulp covering the fruit is also eaten as a delicious fresh fruit when other foods are very scarce. These reviews stress the importance of sheanuts as a measure to curb hunger during lean season in northern Ghana and more so as a food security measure.

The products from the shea tree are exported in one of two ways as outlined by (Boffa, 2000). Boffa (2000) stressed that, either the nuts themselves after being roasted, are exported in bulk, or the nuts are processed into shea butter within the country of origin and then exported. However, Saul et al. (2003), reports shea products were first recognized as an important export for West Africa during the Colonial period. Notwithstanding, Sheabutter is rated as a foreign exchange earner to Ghana. Ghana's strength in the shea nut industry is already recognized as she is on record as the world's second largest exporter of the shea products behind her northern neighbour,

Burkina Faso. This is affirmed by FAO's estimate of sheanuts production in some prominent sheanuts producing countries in West Africa as illustrated in Table 2.1. However a glance at the data in Table 2.1 shows that, even though there have been fluctuations in sheanuts production, Nigeria seem to be the highest world producer of sheanuts. In this instance Ghana would be regarded as the third largest producer of sheanuts behind her eastern neighbour Nigeria but would still be recognized as the second as the world's second largest producer of the shea products behind her northern neighbour, Burkina Faso.

Table 2.1 FAO Estimates of Shea Nut Production, 1999 - 2006 in Metric Tonnes

Country	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Benin	15000	15000	15000	15000	15000	15000	15000	15000
Burkina Faso	70000	70000	70000	70000	70000	70000	70000	70000
Cote d'Ivoire	30346	30874	30564	31572	26078	26194	27058	27951
Ghana	52000	65000	65000	65000	65000	65000	65000	65000
Mali	85000	85000	85000	85000	85000	85000	85000	53407
Nigeria	369000	369000	371000	410000	414000	414000	414000	414000
Togo	6500	8000	8000	8000	8000	8000	9000	9300

Source: FAOSTAT (2008)

According to Mahama (2011), the country currently produces some 45,000mt of shea nuts and generates about $30m in foreign exchange annually with the potential to reach $90m. Business News (2013), also reported that, the infant industry is an attractive business venture earning about US$30 million in foreign exchange for the national economy.

The Ghana Export Promotion Council outlined the exportation of crude sheabutter by Ghana between the periods of 2000 to 2007 as follows:

Table 2.2 Ghana's Shea Exports: 2000 to 2007

Year	Quantity (MT)	Value (USD)
2000	1,041.50	829,743.20
2001	1,697.74	1,131,346.61
2002	2,539.89	2,584,281.55
2003	1,559.70	1,567,429.59
2004	5,548.44	2,463,114.00
2005	648.09	940,514.29
2006	579.85	896,317.00
2007	10,295.53	7,659,888.00
Total	23,892.74	18,072,634.00

Source: GEPC (2009)

A close look at the data in the table 2.2 above shows the possible manifestation of Ghana's potential to reach $90m annually as a foreign exchange as a result of shea exportation as stated by Mahama (2011) due to the increasing quantity of sheanuts production and exports and moreso increasing demand for crude sheabutter on the international market, as CRIG (2002) stressed that, the demand for vegetable fat and natural products in the Western world has grown significantly in recent years. This makes sheabutter a very essential source of foreign exchange earner to Ghana for the years follow. The economic importance of sheabutter production and trade therefore cannot be overemphasized as CRIG (2002) reports, in the medium-term, it

alleviated poverty amongst the rural women and, in the long-term, provides continuous employment opportunities for rural women and young people.

2.6 Importance of Packaging And Storage of Sheabutter And Pastry Products

Storage conditions are key constraints for quality assurance of the shea *(Vitellaria paradoxa Gaertner)* butter (Hanfo *et al*., 2010). Like all other food items, packaging is an essential component in the storage of sheabutter and its products. Hence, Bearden *et al*. (2001) cited that, packaging is becoming an essential part of the value chain analysis, regarding food safety, characteristics, ergonomics and flexibility. The choice of a package or packaging material and storage conditions can have a great impact on the quality and life span of sheabutter. According to Bearden *et al* (2001), a product's package may perform a number of different functions, including protecting the product until consumed, facilitating consumption of the product, storing the product until it is consumed, promoting the product and facilitating the disposal of the product. Hanfo *et al.,* (2010) again reported that, the common purpose of the package is to protect the content from contamination, expands the shelf life and make the product more convenient for customers to transport, prepare and serve. The principal function of packaging is protection and preservation from external contamination (Robertson, 2006). Coles (2003) also stressed, the principal roles of food packaging are to protect food products from outside influences and damage, to contain the food, and to provide consumers with ingredient and nutritional information. In view of the above statements by the various authors, food packaging can then be concluded as being an aid to retardation of product deterioration, retention of the beneficial effects of processing, extending of shelf-life, and the maintenance or increment in the quality and safety of food.

Baked goods are widely available in many countries and generally, they fall into the main categories of breads, biscuits, cakes, and pastries, and are consumed by people from most income groups (FAO [nd]). FAO [nd] stresses that baked goods such as breads and pastries have a shelf-life in the range of 2-5 days, whereas others, such as biscuits and some types of cake, have a shelf-life of several months, when correctly packaged. In general, baked goods have a short shelf-life. More so, the growth of food-poisoning organisms is less likely to occur in baked goods than in other low-acid foods such as meat, milk, and fish. Bread is usually eaten within one or two days after purchase and the main purpose of packaging is to keep the bread clean. Simple paper or polythene wrapping is often used (FAO [nd]).

The packaging and storage conditions for cakes depend on their moisture content and the relative humidity of the surrounding air. Each cake must be judged by its composition and the intended shelf-life. Light cakes, such as those made from flour, sugar, and egg, have a shelf-life of only a few days if not packaged (FAO [nd]).

The basic concept of a pie is taken to mean a mixture of ingredients encased and cooked in pastry (Davidson, 1999). Storage recommendations for pies and tarts will vary, depending on the filling used. While some will keep at room temperature or in the refrigerator (wrapped in foil) for several days, others are best served on the same day as baked.

In a report by Sekaf International LLC, raw, unrefined sheabutter has an average shelf life of 12 to 24 months without the addition of preservatives and may be refrigerated to extend shelf life. The life of the Shea butter can be prolonged when stored under proper conditions such as storing in a cool area below 50 degrees F, in a dark area and away from direct sunlight (Sekaf, 2002).

However, total germs, yeasts and mould varies with packaging materials and storage duration of sheabutter (Hanfo et al., 2010).

2.6 Packaging Materials

Packaging material is defined by the free dictionary as, any material used especially to protect something. In this revolution of technological advancement, different types of packaging materials abound for different sectors of the food industry. The choice of an appropriate packaging material depends largely on the type and nature of the product on offer as well as its intended storage period. Cooksay (2004) affirms the type of food, chemical composition, size, storage conditions, expected shelf life, moisture content, aroma/flavor and appearance are just a few of the characteristics that must be taken into consideration when selecting the right material for a food product. However, the most widely and commonly used food packages are glass, paper and paperboards, plastics and metals which include aluminum foils as cited by (Marsh and Bugusu, 2007). Meanwhile, a wider variety of plastics have been introduced in both rigid and flexible forms.

2.6.1 Types of Packaging materials

2.6.1.1 Aluminum foil

Aluminum foil is one of the most popular packaging materials used by most food service providers. Marsh and Bugusu (2007) has it that, the foil is made by rolling pure aluminum metal into very thin sheets, followed by annealing to achieve dead-folding properties thus a crease or fold made in the film which will stay in place, allowing it to be folded tightly. The aluminum foil is available in a wide range of thicknesses, with thinner foils used to wrap food

and thicker foils used for trays. Like all aluminum packaging, foil provides an excellent barrier to moisture, air, odors, light, and microorganisms (Marsh and Bugusu 2007).

2.6.1.2 Polyethylene

Polyethylene is the simplest and most inexpensive plastic made by addition polymerization of ethylene and they fall into two basic categories namely: high density and low density polyethylene (Marsh and Bugusu 2007). Marsh and Bugusu (2007) further stressed that, high-density polyethylene is stiff, strong, tough, resistant to chemicals and moisture, permeable to gas, easy to process, and easy to form. It is used to make bottles for milk, juice, and water; cereal box liners; margarine tubs; and grocery, trash, and retail bags where as low-density polyethylene is flexible, strong, tough, easy to seal, and resistant to moisture. Because low-density polyethylene is relatively transparent, it is predominately used in film applications and in applications where heat sealing is necessary (Marsh and Bugusu 2007). Marsh and Bugusu (2007) cited examples of low-density polyethylene as bread and frozen food bags, flexible lids, and squeezable food bottles.

2.6.1.3 Polypropylene

Polypropylene is a clear glossy film with a high strength, puncture resistant and has low permeability to moisture, gases, and odours, which is not affected by changes in humidity (FAO [nd]). Polypropylene can then be best described as a good resistance to chemicals and effective at barring water vapor. It stretches, although less than polythene, it also has good resistance to oil, and therefore can be used successfully for packaging oily products (FAO [nd]). According to Marsh and Bugusu (2007), its high melting point (160 °C) makes it suitable for applications

where thermal resistance is required, such as hot-filled and microwavable packaging. Popular uses include yogurt containers and margarine tubs.

2.6.1.4 Cling Film

Cling film is defined by the Collins English dictionary as a thin polythene material that clings closely to any surface around which it is placed and mostly used for wrapping food.

2.7 Microbial Growth on Stored Pastries

Pastries are one of the commonest snacks enjoyed by Ghanaians and an important source of nutrients in the diets of Ghanaians. However like all other baked products, pastries are prone to microbial attacks. This attests to Saranraj and Geetha (2011) statement that, bakery products are subjected to spoilage problems. These include physical, chemical and microbial spoilage (Saranraj and Geetha 2011). Generally, pastries can be stored under various conditions with the aim of prolonging their shelf and also making them available for consumption at all times but microbiological spoilage is often the major factors limiting the shelf life of products as pastries are attacked by microbes during storage after it has been baked. Certain factors such as cooling process, contamination, packages and the environment contributes to this limitations as most spores are killed during baking. Henceforth, Knight and Mendlove (2006) stressed that for bread to become moldy, it must be contaminated either from the air, bakery surfaces, equipment, food handlers or raw ingredients after baking during the cooling, slicing or wrapping operations.

Knight and Mendlove (2006) further stressed that, mold spore counts are higher in the summer months than in the winter due to airborne contamination in the warmer weather and more humid

storage conditions. Furthermore, moisture condensation on a product's surface, due to packaging prior to being completely cooled, may be conductive to mold growth (Knight and Mendlove 2006). Saranraj and Geetha (2011) reports that, cakes, cookies, short cake, and pancakes are commonly frozen and marketed in the frozen form and Bread has been held fresh for many months by storage at -22°C. This then means that warm environments are not conductive for storage of pastries other than cool environments.

2.8 Shea Butter Substitution Potentials

Sheabutter have varied and wide substitutes in both the cosmetic and food industry. Numerous studies on sheanuts and sheabutter have proved that sheabutter is used as substitutes in place of margarine and or mixed with other commodities or substances that have same and similar properties and characteristics in the production of consumer products as well as non consumables both locally and internationally. Goreja (2004) affirms that, Shea is used throughout the world as a cocoa butter substitute in chocolate production. Declining cocoa tree populations have made sheabutter less expensive than cocoa butter (Goreja 2004) as a result of unstable world market price for cocoa, and the need to find a suitable substitute to cocoa in the confectionery and cocoa butter industry (Hatskevich *et al*, 2011). Goreja (2004) further stresses that, the use of shea butter as a substitute to cocoa butter in chocolate production has made chocolate more affordable, due to sheabutter being less expensive and more firms such as the Mars Corporation, Cadbury and the Swiss firm Lindt all use this cocoa butter substitute. More so, it is easier to work with sheabutter than cocoa butter due to its low melting point (Goreja, 2004).

Masters et al. (2004) also outlined that, over 90 percent of shea nut exports serve the food industry but however, the shea butter is industrially extracted, mainly in Europe, and subsequently separated into a vegetable fat fraction (stearin), which is sold for formulation into

cocoa butter equivalents or improvers (CBEs/CBIs) and margarines, and an oil fraction used as a low-value base for margarines and as a component of animal feeds. In 2003, European Union accepted shea butter as one of the six vegetable fats to serve as a Cocoa Butter Equivalent (CBE), this has resulted in shea being used in combination with palm oil or illipe in most of international products (Carette *et al*., 2009).

Shea butter is not only used as a substitute in chocolate production but also in multitude of goods used in everyday life. USAID (2006) reported that, increasingly, shea butter is used in "natural" and high-end cosmetics and soaps. Goreja (2004) stressed, shea has regained significance and popularity as a clinically proven nourishing moisturizer, either in its own right or as a component of high quality cosmetics and toiletries. Companies such as L'Occitiane, a French perfume company has developed an entire line of cosmetics based on sheabutter, where as Revlon, the Bobbi Brown line of cosmetics and the Unilever corporation all use sheabutter in numerous products sold around the world (Goreja, 2004). Again, Goreja (2004) further stressed that, shea is used in candles, animal feeds, cakes and a wide variety of confections and candies. With reference to the above statements, this means shea butter is a universal substitute as it can be used as a component of wide variety of products needed in daily lives and can be used by both humans and livestock as well.

2.9 Sheabutter in Pastry Manufacture

Shea butter traditionally has been used in the food industry for margarine and pastry (USAID, 2006) as it has been found to have a fat composition similar to cocoa butter, and is used as a substitute for lard or margarine because it makes a highly, pliable dough (Dogbevi, 2007).

Akhter *et al*. (2008) also reported that, shea butter has found market as baking fat and margarine in Europe and Asia**.** These statements attest to the fact that shea butter is being used in place of margarine or in conjunction with margarine or other baking fat mostly by pastry manufacturers internationally in the production of pastries. This can also be affirmed by a statement made earlier by Gorega (2004) as sheabutter being used in the production of cakes. Dough and cakes are pastry based products. Collins English dictionary defines a pastry as:

1. A dough of flour, water, shortening, and sometimes other ingredients,
2. Baked foods, such as tarts, made with this dough,
3. An individual cake or pastry pie.

Shortening is a fat and in this case, shea butter will be regarded as a shortening. Unrefined shea butter is an all-natural, vegan-friendly butter and lard substitute that can be used in baked goods. (Chris, 2010).

In conclusion, the prospects and potential substitution of shea butter for margarine in the baking industry in Ghana is viable based on literature reviewed as most researchers have attested to the substitution of shea butter for in the manufacturing and production of most foods in the food industry

CHAPTER THREE

MATERIALS AND METHODS

This section of the study covers the approaches used in gathering of data for the study. It describes how the sample frame and sample sizes were determined, tools used for data gathering and analyses. It finally expresses how field data was made suitable for presentation.

3.1 Research Design

The focus of this study was to investigate the possibility of substituting sheabutter for margarine in pastry making. Concentration was directed at the sensory characteristics of shea butter based pastries and their qualities in relation to margarine based pastries. A product development and sensory analysis were then considered as appropriate.

3.2 Source of Sheabutter

Unrefined sheabutter was obtained from the open market in Bolgatanga for the production of the pastries whilst the margarine and other ingredients were bought from supermarkets in Bolgatanga. The sheabutter was bought based on its colour and smell. Light yellow-creamlike sheabutter was obtained as the dark coloured sheabutter tend to be of poor quality with strong smell and bright yellow sheabutter tend to have bitter taste.

3.3 Preparation Of Pastries

Cakes, pie and bread were prepared using both sheabutter and margarine in varying proportions. Five samples each of cake, pie and bread were prepared using the following ratios as shown in Table 3.1.

Table 3.1 Proportions of sheabutter to margarine

Sheabutter	Margarine
100 percent	0 percent
50 percent	50 percent
75 percent	25 percent
25 percent	75percent
0 percent	100 percent

All the 100% margarine based pastries were used as a control point for comparison with the other sheabutter based products. The products were prepared at Bolgatanga polytechnic HCIM food laboratory.

Table 3.2 Standard recipe for cake

Ingredients	Quantity
Margarine	1 lb
Castor Sugar	½ lb
Soft flour	1 ½ lbs
Eggs	8 singles (L/S)
Baking Powder	25g
Nutmeg	1 stone (grated)
Vanilla essence	1 drop
Strawberry essence	1 drop
Rum	1 drop

Source: Adopted from Forskett *et al.* (2008)

3.3.1 Preparation Of Cakes

As described by Forsket *et al.* (2008), one pound (1lb) of margarine was substituted for sheabutter and halve pound (½ lb) castor sugar were weighed for the preparation of 100% sheabutter cake (C101). The weighed sheabutter and castor sugar was creamed to a fluffy texture with an electronic cake mixer for forty five (45) minutes. Eight (8) large eggs were whisked and poured gradually unto the creamed sheabutter and then mixed manually with a wooden spoon. One and halve pound (1 ½ lb) of soft flour was sifted with two sachets (25g) of baking powder to which one single stone of grated nutmeg was also added and was gradually folded into the mixture evenly. One drop each of vanilla, strawberry and rum essences were also mixed into the prepared mixture. The prepared cake mixture was poured into greased cake tins and baked in a preheated oven for one (1) hour. One pound (1lb) margarine was used in the preparation of 100% margarine cake (C102). Same ingredients and same quantities as for sheabutter cake were also used for the product (C102). Same procedure as for sheabutter cake was also used for its preparation. For the rest of the cake products, varying proportions of sheabutter to margarine were used. Same ingredients and same quantities as well as same procedure as used for both 100% sheabutter and 100% margarine cakes were also used for the various sheabutter-margarine cakes.

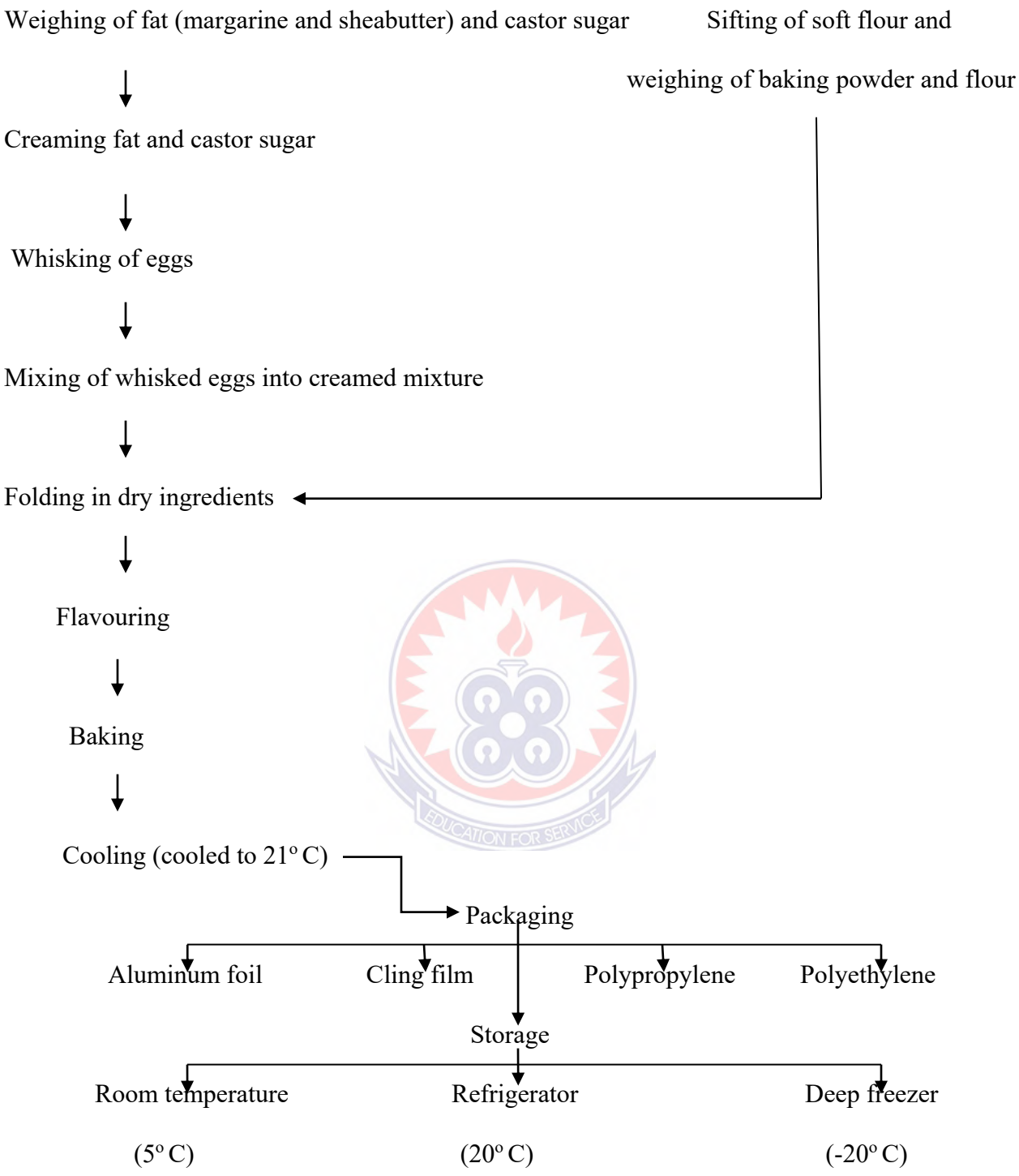

Fig 3.1 Flow Chart Depicting Preparation of Sheabutter-margarine Cakes

3.3.2 Preparation Of Bread

Table 3.3 Standard recipe for bread

Ingredients	Quantity
Margarine	⅓ lb
Castor sugar	⅛ lb
Strong flour	2 lbs
Yeast	25g
Nutmeg	2 singles (grated)
Liquid (½ milk ½ water).	1 ½ pints

Source: Adopted from Fosket *et al.* (2008)

As described by Forskett *et al.* (2008), bread was prepared using ⅓ lb margarine, two pounds (2lbs) strong flour, ⅛ lb castor sugar, (25g) yeast, five grams (5g) salt, 2 singles grated nutmeg and one and a half (1 ½) pint liquid (½ milk ½ water). The margarine was rubbed into the flour to a sandy mixture. All dry ingredients (salt, sugar, nutmeg and yeast) were added and mixed together evenly. The liquid was then added to the mixture, mixed to form dough and then was kneaded with an electronic kneader. The kneaded dough was moulded into loaves, put in greased bread loaf tins and proved and baked in a preheated oven.

In the same way as for the sheabutter bread, ⅛ lb margarine was substituted for sheabutter to prepare 100% sheabutter bread (B121). Same ingredients and same quantities as for sheabutter bread were also used for the production of margarine bread (B122). The same procedure was also used for its preparation. The other bread products were also prepared using varying proportions of sheabutter to margarine, same quantities of ingredients and procedure as used for sheabutter and margarine breads.

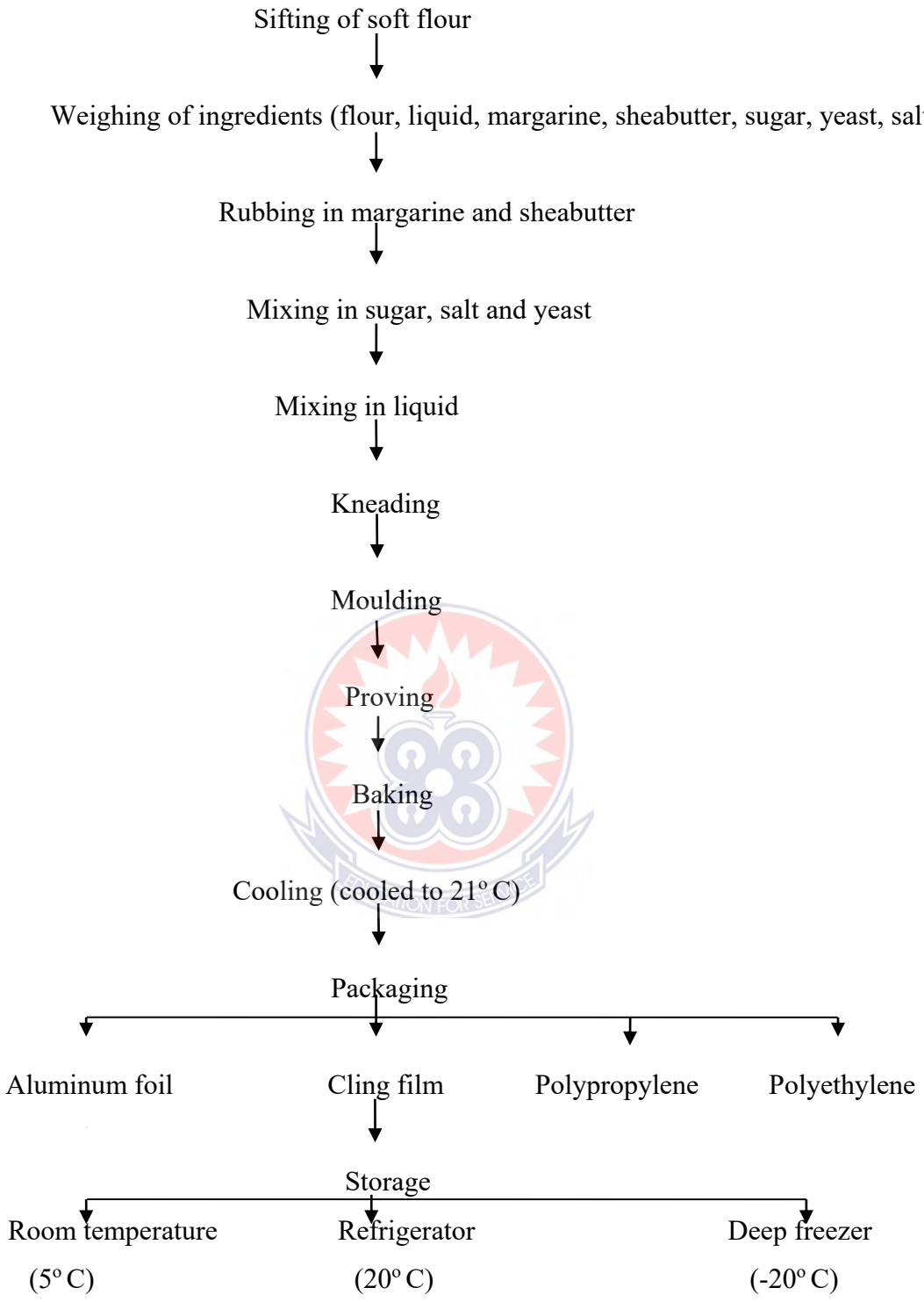

Fig 3.2 Flow Chart Depicting Preparation Of Sheabutter-margarine Bread

3.3.3 Preparation Of Pie

Table 3.4 Standard recipe for bread

Ingredients	Quantity
Margarine	1 ½ lbs
Soft flour	3 lbs
Minced beef	1 lb
Onion	2 m/s bulbs
Nutmeg	1 single (grated)
Water	½ pints

Source: Adopted from Foskett *et al.* (2008)

As described by Fosket and Cesarani, with the preparation of pie, three pounds (3 lbs) soft flour, 1 ½ pounds (1 ½ lbs) margarine three (3) medium bulbs onion (chopped), one pound (1 lb) minced beef, two medium eggs and half (½) pint water were weighed for the preparation of pie. The weighed margarine was rubbed into the weighed flour and salt to a sandy mixture. Water was mixed to form a dough. The dough was then rolled on a floured surface to a thickness of 1mm. It was cut into equal sizes and filled with a mixture of cooked seasoned minced beef and chopped onion. The pie was placed on greased baking sheets, egg-washed and baked in a preheated oven for one hour. On the other hand, one and halve pounds (1 ½ lbs) margarine was substituted for sheabutter in the preparation of 100% sheabutter pie. Same ingredients and same quantities of ingredients as for margarine pie were also used for the product (P111). The same procedure was also used for its preparation. These pies were also cut into the same sizes and placed on greased baking sheets, egg-washed and baked in a preheated oven.

In the same way as for the cake and bread products, varying proportions of margarine and sheabutter were weighed and rubbed in the flour together respectively for the preparation of other sheabutter – margarine pies. Same ingredients and same quantities of ingredients as well as same procedure as used for 100% margarine pie were also used for the various sheabutter-margarine pies.

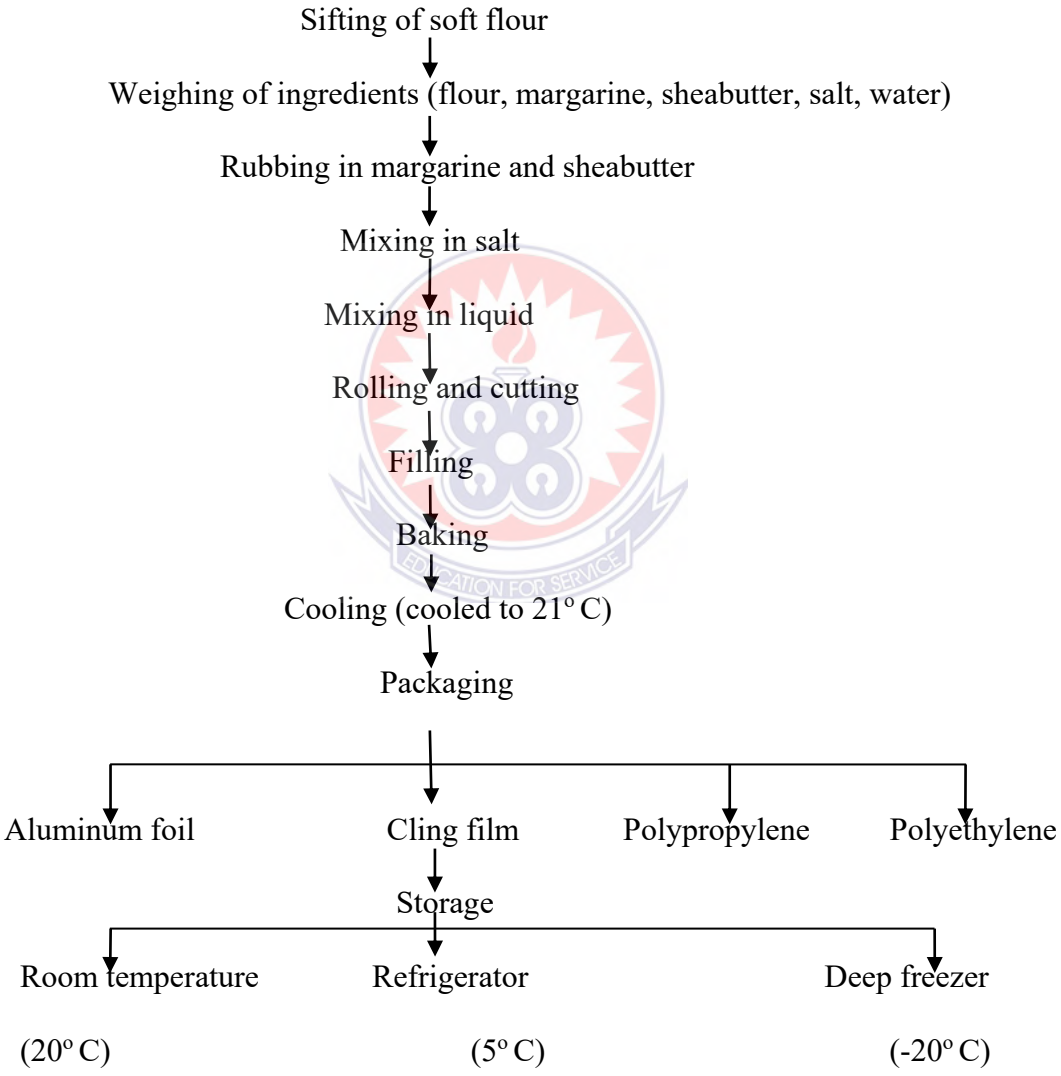

Fig 3.3 Flow Chart Depicting Preparation of Sheabutter-margarine Pie

3.4 Data Collection Method

Primary source of data were collected through sensory analysis and questionnaires. Observations were also made.

3.4.1 Target Population

Emphasis was made on both staff and students of Bolgatanga polytechnic. Some selected pastry sellers and bakers in and around the environs of the polytechnic community and Bolgatanga township were also selected for the study.

3.4.2 Sample Size and Sampling Procedure

A total sample size of 150 untrained assessors drawn from the community of Bolgatanga polytechnic and its environs served as panelists for the study. Systematic random sampling procedure was used to select thirty (30) catering students from three (3) classes from the department of Hotel Catering and Institutional Management. In each class (Year 1, Year 2 and Year 3) the first five (5) students on the first two rows were selected. Accidental sampling procedure which is a non probability sampling method was used to select fifty (50) other students, twenty (20) lecturers, twenty (20) administrative staff and ten (10) cleaners from the polytechnic for the study. This was done by selecting by chance any staff and other students from other department other than HCIM students that passed by or either trooped in to the polytechnic canteen. Five (5) pastry sellers and one (1) baker were also purposively selected from the polytechnic community for the study as they were the only pastry sellers and baker who ply trade at the polytechnic. The remaining fourteen (14) bakers were chosen from two (2) bread mills in Bolgatanga township using cluster sampling procedure. The two mills were selected out of the five (5) mills scattered within the township. One mill was selected from the busiest part of

the township whilst the other was selected from the remote end of the township. The seven bakers each were then picked at random from the two mills.

The catering students, pastry sellers and bakers were chosen for the study because they are the major stakeholders in the promotion of sheabutter in pastry making and in the baking and catering industry as whole.

3.4.3 Sensory Analysis

A structured questionnaire with a scale of 1-5 with interpretations as 1= Dislike strongly, 2 = Dislike slightly, 3 = Like moderately, 2 = like slightly and 1 = Like strongly were used to collect data for the study. The products were coded C101 – C105 for the cakes, B 121 to B125 for the bread and P111 to P115 for the pie. This was to prevent bias in respondent's perception of attributes of products. Sensory analysis was carried out at the polytechnic's canteen. The respondents were briefed on how to respond to the questions using their senses after which questionnaires were left with respondents to respond (Appendix 1). For those who could not read and write, they were assisted to fill the questionnaire. These categories of respondents were mostly made up cleaners and some bakers.

3.5 Determination Of Shelf Life And Appropriate Packaging Material

The shelf lives of the products were tested manually through daily observation for a period of twenty-one (21) days. Four different packaging materials namely aluminum foil, cling film, polyethylene and polypropylene were used to package the products. The sample products were stored under three (3) different storage conditions and these were room temperature, refrigeration

and deep freezing.

3.6 Costing of Sheabutter-margarine Pastries

Table 3.5 Costing for 100% Sheabutter cake (C101)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	1 lb	1.00
Sugar	Lb	2.00	½ lb	1.00
Soft flour	Lb	2.00	1 ½ lb	3.00
Flavour	Bottle	2.00	½ bottle	1.00
Eggs	Singles	0.40p	8 singles	3.20p
Baking Powder	Sachet	0.50p	2 Sachets	1.00
Nutmeg	Singles	0.50	1 single	0.50p
Total				**Gh¢ 10.20P**

Five (5) loaf size cakes were produced at the cost of Gh¢ 10.20P. The cost of one cake from this category cost: Gh¢ 10.20P/5 = Gh¢ 2.04

Table 3.6 Costing for 100% margarine cake (C102)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Margarine	Lb	5.00	1 lb	5.00
Sugar	Lb	2.00	½ lb	1.00
Soft flour	Lb	2.00	1 ½ lb	3.00
Flavour	Bottle	2.00	½ bottle	1.00
Eggs	Singles	0.40p	8 singles	3.20p
Baking Powder	Sachet (12.5g)	0.50p	2 Sachets	1.00
Nutmeg	Singles	0.50	1 single	0.50p
Total				**Gh¢14.70 p**

Five (5) loaf size of cakes were produced at the cost of Gh¢14.70p. The cost of one cake from this category cost: Gh¢ 14.70p/5 = Gh¢ 2.94p

Table 3.7 Costing for 50% sheabutter : 50% margarine cake (C103)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	½ lb	0.50
Margarine	Lb	5.00	½ lb	2.50
Sugar	Lb	2.00	½ lb	1.00
Soft flour	Lb	2.00	1 ½ lb	3.00
Flavour	Bottle	2.00	½ bottle	1.00
Eggs	Singles	0.40p	8 singles	3.20p
Baking Powder	Sachet (12.5g)	0.50p	2 Sachets	1.00
Nutmeg	Singles	0.50	1 single	0.50p
Total				**Gh¢12.70 p**

Five (5) loaf size cakes were produced out of Gh¢12.70p. The cost of one cake from this category cost: Gh¢ 14.70p/5 = Gh¢ 2.54p

Table 3.8 Costing for 75% s for sheabutter : 25% margarine cake (C104)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	¾ lb	0.75
Margarine	Lb	5.00	¼ lb	1.25
Sugar	Lb	2.00	½ lb	1.00
Soft flour	Lb	2.00	1 ½ lb	3.00
Flavour	Bottle	2.00	½ bottle	1.00
Eggs	Singles	0.40p	8 singles	3.20p
Baking Powder	Sachet (12.5g)	0.50p	2 Sachets	1.00
Nutmeg	Singles	0.50	1 single	0.50p
Total				**Gh¢11.70 p**

Five (5) loaf size cake were produced out of GH¢11.70p. The cost of one cake from this category cost: Gh¢ 11.70p/5 = Gh¢ 2.34p

Table 3.9 Costing for 25% sheabutter : 75% margarine cake (C105)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	¼ lb	0.25
Margarine	Lb	5.00	¾ lb	3.75
Sugar	Lb	2.00	½ lb	1.00
Soft flour	Lb	2.00	1 ½ lb	3.00
Flavour	Bottle	2.00	½ bottle	1.00
Eggs	Singles	0.40p	8 singles	3.20p
Baking Powder	Sachet (12.5g)	0.50p	2 Sachets	1.00
Nutmeg	Singles	0.50	1 singles	0.50p
Total				**Gh¢13.70 p**

Five (5) loaf size cakes were produced out of Gh¢13.70p. The cost of one cake from this category cost: Gh¢ 13.70p/5 = Gh¢ 2.74p

Table 3.10 Costing for 100% Sheabutter Bread (B121)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	¼ lb	0.25
Strong flour	Lb	2.00	2 lbs	4.00
Yeast	Sachet	0.50	1 sachet	0.50
Milk	Tins	1.00	1tin	1.00
Nutmeg	Singles	0.50p	2 stones	1.00
Sugar	Lb	2.00	⅛ lb	0.05
Salt	Sachet (200g)	0.50	5g	0.01p
Total				**Gh¢ 6.81p**

Five (5) loaves of bread were produced out of Gh¢ 6.80p. The cost of one loaf of bread from this category cost: Gh¢ 6.81p/5 = Gh¢ 1.36p

Table 3.11 Costing for 100% margarine bread (B122)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Margarine	Lb	5.00	¼ lb	1.25p
Strong flour	Lb	2.00	2 lbs	4.00p
Yeast	Sachet	0.50	1 sachet	0.50p
Milk	Tins	1.00	1tin	1.00p
Nutmeg	Singles	0.50p	2 single	1.00p
Sugar	Lb	2.00	⅛ lb	0.05p
Salt	Sachet (200g)	0.50p	5g	0.01p
Total				**Gh¢ 7.81p**

Five (5) loaves of bread were produced out of Gh¢ 6.80p. The cost of one loaf of bread from this category cost: Gh¢ 7.18p/5 = Gh¢ 1.60p

Table 3.12 Costing for 50% sheabutter : 50% margarine bread (B123)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	⅛ lb	0.12p
Margarine	Lb	5.00	⅛ lb	0.62p
Strong flour	Lb	2.00	2 lbs	4.00p
Yeast	Sachet	0.50	1 sachet	0.50p
Milk	Tins	1.00	1tin	1.00p
Nutmeg	Singles	0.50p	2 singles	1.00p
Sugar	Lb	2.00	⅛ lb	0.05p
Salt	Sachet (200g)	0.50p	5g	0.01p
Total				**Gh¢ 6.68p**

Five (5) loaves of bread were produced out of Gh¢ 6.80p. The cost of one loaf of bread from this category cost: Gh¢ 6.68p/5 = Gh¢ 1.33p

Table 3.13 Costing for 75% sheabutter : 25% margarine bread (B124)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	⅓lb	0.18
Margarine	Lb	5.00	⅛ lb	0.31p
Strong flour	Lb	2.00	2 lbs	4.00p
Yeast	Sachet	0.50	1 sachet	0.50p
Milk	Tins	1.00	1tin	1.00p
Nutmeg	Singles	0.50p	2 singles	1.00p
Sugar	Lb	2.00	⅛ lb	0.05p
Salt	Sachet (200g)	0.50	5g	0.01p
Total				**Gh¢ 7.05p**

Five (5) loaves of bread were produced out of Gh¢ 6.80p. The cost of one loaf of bread from this category cost: Gh¢ 7.05p/5 = Gh¢ 1.41p

Table 3.14 Costing of 25% sheabutter: 75% margarine bread (B125)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	⅛ lb	0.09p
Margarine	Lb	5.00	⅓lb	0.94p
Strong flour	Lb	2.00	2 lbs	4.00p
Yeast	Sachet	0.50	1 sachet	0.50p
Milk	Tins	1.00	1tin	1.00p
Nutmeg	Stones	0.50p	2 singles	1.00p
Sugar	Lb	2.00	⅛ lb	0.05p
Salt	Sachet (200g)	0.50	5g	0.01p
Total				**Gh¢ 7.59p**

Five (5) loaves of bread were produced out of Gh¢ 6.80p. The cost of one loaf of bread from this category cost: Gh¢ 7.59p/5 = Gh¢ 1.51p

Table 3.15 Costing for 100% sheabutter pie (P111)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	Lb	1.00	1 ½ lbs	1.50p
Soft flour	Lb	2.00	3lbs	6.00p
Minced beef	Lb	6.00	1 lb	6.00p
Eggs	Singles	0.40p	2 singles	0.80p
Maggi cube	Cubes	0.10p	1 cube	0.10p
Nutmeg	Singles	0.50p	1 single	0.50p
Onion	Bulbs	0.50	3 bulbs	1.50p
Salt	Sachet (200g)	0.50p	5g	0.01p
Total				**Gh¢ 16.41p**

180 mouth bite pieces of pie from this category were produced at the cost of Gh ¢ 16.41p.

Table 3.16 Costing for 100% margarine pie (P112)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Margarine	Lb	5.00	1 ½ lbs	7.50p
Soft flour	Lb	2.00	3lbs	6.00p
Minced beef	Lb	6.00	1 lb	6.00p
Eggs	Singles	0.40p	2 singles	0.80p
Maggi cube	Cubes	0.10p	1 cube	0.10p
Nutmeg	Singles	0.50p	1 single	0.50p
Onion	Bulbs	0.50	3 bulbs	1.50p
Salt	Sachet (200g)	0.50p	5g	0.01p
Total				**Gh¢ 22.41p**

180 mouth bite pieces of pie from this category were produced at the cost of Gh¢ 22.41p

Table 3.17 Costing for 50% sheabutter : 50% margarine pie (P113)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	lb	1.00	¾ lb	0.75p
Margarine	lb	5.00	¾ lb	3.75p
Soft flour	lb	2.00	3lbs	6.00p
Minced beef	lb	6.00	1 lb	6.00p
Eggs	Singles	0.40p	2 singles	0.80p
Maggi cube	Cubes	0.10p	1 cube	0.10p
Nutmeg	Stones	0.50p	1 stone	0.50p
Onion	Bulbs	0.50	3 bulbs	1.50p
Salt	Sachet (200g)	0.50p	5g	0.01p
Total				**Gh¢ 19.41p**

180 mouth bite pieces of pie from this category were produced at the cost of Gh¢ 22.41p

Table 3.18 Costing for 75% sheabutter : 25% margarine pie (P 114)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	lb	1.00	1 lb	1.00p
Margarine	lb	5.00	½ lb	2.50p
Soft flour	lb	2.00	3lbs	6.00p
Minced beef	lb	6.00	1 lb	6.00p
Eggs	Singles	0.40p	2 singles	0.80p
Maggi cube	Cubes	0.10p	1 cube	0.10p
Nutmeg	Singles	0.50p	1 single	0.50p
Onion	Bulbs	0.50	3 bulbs	1.50p
Salt	Sachet (200g)	0.50p	5g	0.01p
Total				**Gh¢ 18.41p**

180 mouth bite pieces of pie from this category were produced at the cost of Gh¢ 18.41p

Table 3.19 Costing for 25% sheabutter : 75% margarine pie (P 115)

Ingredients	Unit	Unit cost ¢	Quantity	Total Cost ¢
Sheabutter	lb	1.00	½ lb	0.50p
Margarine	lb	5.00	1 lb	5.00
Soft flour	lb	2.00	3lbs	6.00p
Minced beef	lb	6.00	1 lb	6.00p
Eggs	Singles	0.40p	2 singles	0.80p
Maggi cube	Cubes	0.10p	1 cube	0.10p
Nutmeg	Singles	0.50p	1 single	0.50p
Onion	Bulbs	0.50	3 bulbs	1.50p
Salt	Sachet (200g)	0.50p	5g	0.01p
Total				**Gh¢ 20.41p**

180 mouth bite pieces of pie from this category were produced at the cost of Gh¢ 20.41p

CHAPTER FOUR

RESULTS

This chapter presents concise profile of findings obtained from the study.

4.1 Demographic Characteristics Of Respondents

From the data gathered, 60.7 % were females and 39.3% were males. With respect to age, majority of the respondents fell within the age group of 21-30 years. This age group formed 67.3% of the total population sampled. 15.3% were also aged between 31- 40 years 10.7% were between 41 and 50 years with the least being 6.7% aged above 50 years (Appendix 2).

The study further revealed that almost all the assessors were Ghanaians with different tribal backgrounds and these were one hundred and forty eight (148) thus 98.7% whilst two (2) of them being 1.3% were Nigerians. The Frafras dominated (34%) but the minority was Dagomba (0.7) (Appendix A). This could be attributed to the fact that the polytechnic is located within the town of the Frafra's. It was found out that a greater proportion of the respondents were single (59.3%) and the minority (4.0%) were widowed whilst 36.7% were married. With respect to religion, most of the respondents were Christians (77.3%) and the least (0.7%) was a pagan. Moslems and traditionalist formed 19.3% and 2.7% respectively (Appendix 2). In terms of education, majority of the respondents being 80% had tertiary level of education, 5.3% also had secondary education with 3.3% having MSLC education whilst 4.7% had no education. Respondents who were school drop outs and those who had JHS education formed 2.7% each whilst 0.7% each represented those who had primary and technical education respectively (Appendix 2).

4.2 Use Of Sheabutter In Cooking

With regard to cooking with sheabutter, a greater proportion of the respondents (71.3%) had ever used sheabutter in cooking their meals whilst the minority who did not used sheabutter in cooking were 28.7% (Appendix 2). The study revealed that stew was the most common food that the respondents used sheabutter in its preparation followed by jollof rice, koose, tubani and maasa, bambara beans and soup for TZ in a descending order. However the least that sheabutter was used for in cooking was to grease baking pans as illustrated in figure 4.1 below.

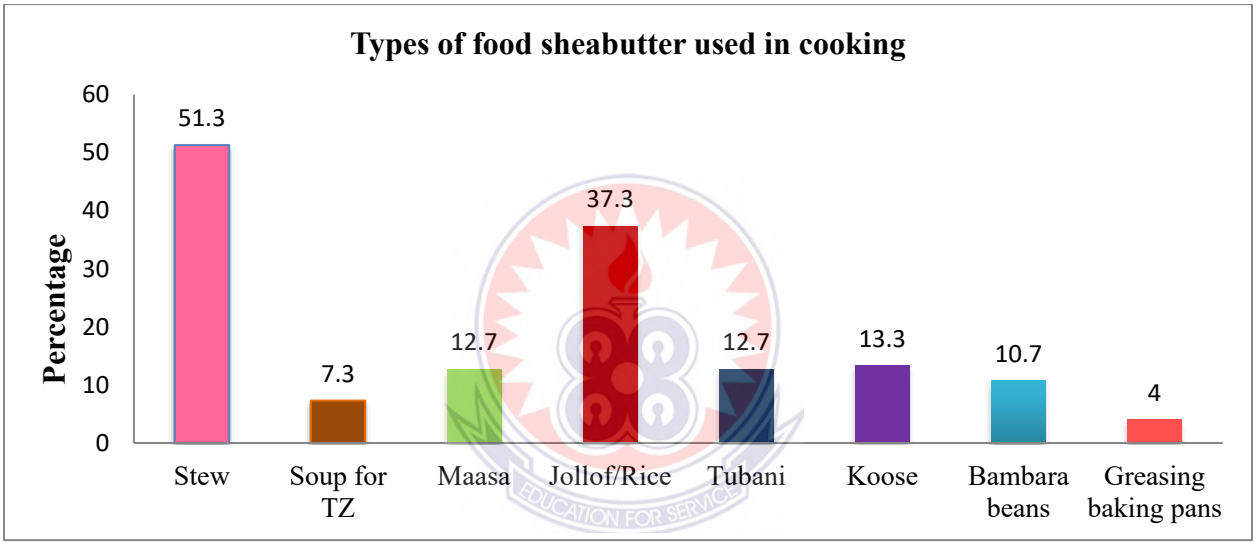

Figure 4.1 Food sheabutter mostly used in cooking

4.3 Sensory Attributes of Sheabutter-Margarine Pastries

The sensory attributes of the pastries are shown in Figures 4.2 to 4.7.

4.3.1 Sensory Attributes of Sheabutter-Margarine Cakes.

As can be seen in Fig 4.2, the taste of sheabutter margarine cakes ranged from 3.6 in C104 to 4.1

in C102. Scores for texture ranged from 3.2 in C101 to 4.4 in C102; whiles colour ranged from 3.5 in C101 and C105 to 4.1 in C102. Aroma also ranged from 3.7 in C102 to 3.1 in C101 ; while aftertaste of the cake ranged from 3.8 in C102 to 3.0 in C101.

Key

C101 = 100% Sheabutter cake

C102 = 100% Margarine cake

C103 = 50% Sheabutter: 50% Margarine cake

C104 = 75% Sheabutter: 25% Margarine cake

C105 = 25% Sheabutter: 75% Margarine cake

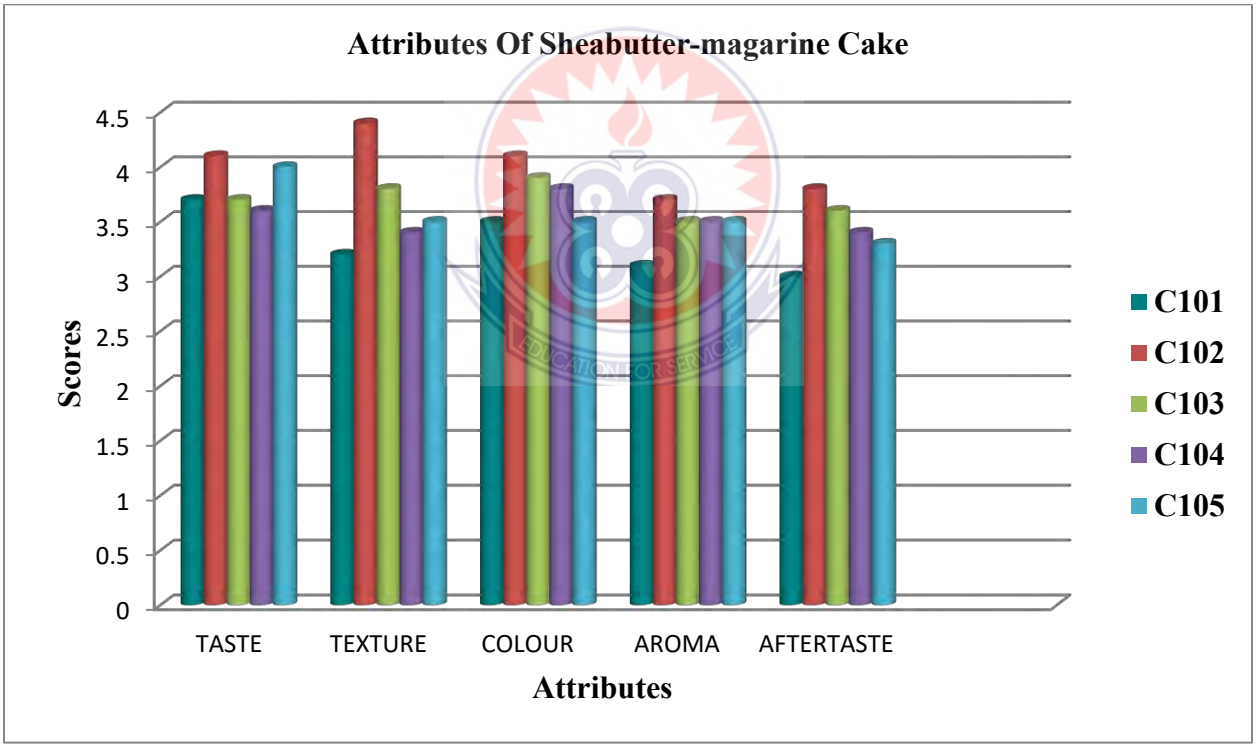

Figure 4.2 Sensory Attributes of Sheabutter-Margarine Cakes (Source: Field Survey, May 2013)

4.3.2 Overall Acceptability Of Sheabutter-margarine Cakes

The result from the data gathered from the study showed that 28% preferred C101, whiles 26% preferred C102. Most respondents 38% generally accepted cake C103 while 25.3% had much preference for C104 but the least accepted cake was C105 with a rate of 8.0% as illustrated in figure 4.3. However, there was no limitation as to an assessor's choice of cake preferred most. Thus, they were not restricted to only one choice of cake.

Key

C101 = 100% Sheabutter cake

C102 = 100% Margarine cake

C103 = 50% Sheabutter: 50% Margarine cake

C104 = 75% Sheabutter: 25% Margarine cake

C105 = 25% Sheabutter: 75% Margarine cake

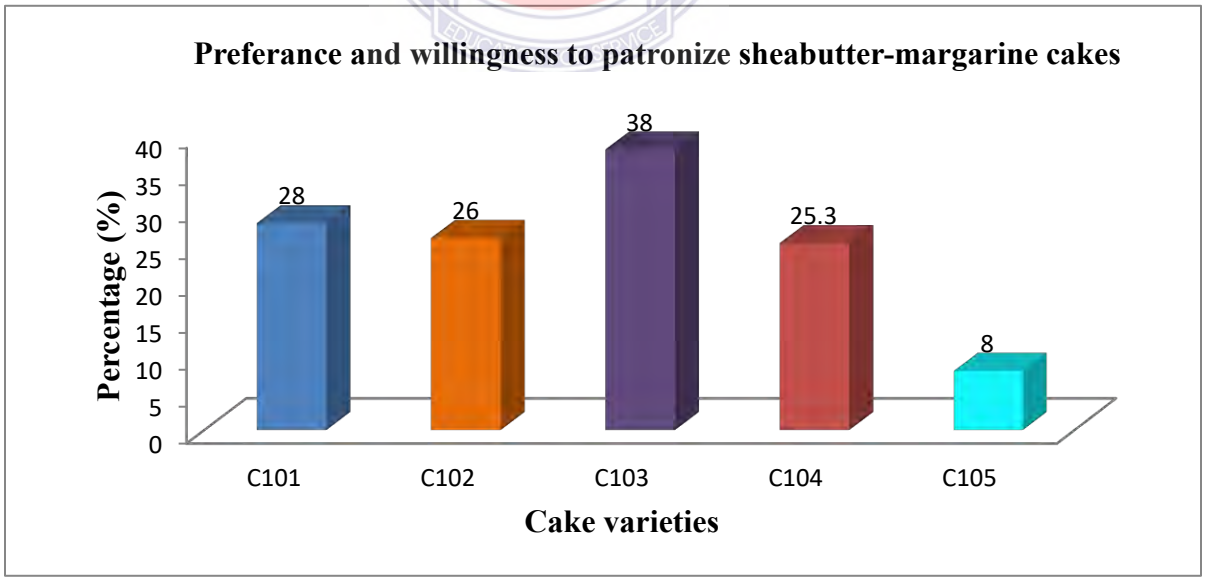

Figure 4.3: Assessor's preference for sheabutter-margarine cakes (Source: Field survey, 2013)

4.3.3 Willingness To Recommend And Patronize Sheabutter-margarine Cakes

The study further revealed that most respondents were willing to patronize the various categories of the sheabutter-margarine cakes for various reasons with 50%: sheabutter 50% margarine cake (C103) having the highest recommendation (Appendix 2)

4.3.4 Sensory Attributes of Sheabutter-Margarine Breads

As can be seen in Fig 4.3, the taste of sheabutter margarine bread ranged from 3.1 in B121 to 4.5 in C102. Texture ranged from 3.2 in B125 to 3.7 in C102; whiles colour ranged from 3.2 in B124 to 3.7 in C102. The aroma ranged from 2.7 in B124 to 3.8 in B122 ; whiles aftertaste also ranged from 3.1 in both B121 and B124 to 3.6 in B122.

<u>Key</u>

B121 = 100% Sheabutter bread

B122 = 100% Margarine bread

B123 = 50% Sheabutter 50% Margarine bread

B124 = 75% Sheabutter 25% Margarine bread

B125 = 25% Sheabutter 75% Margarine bread

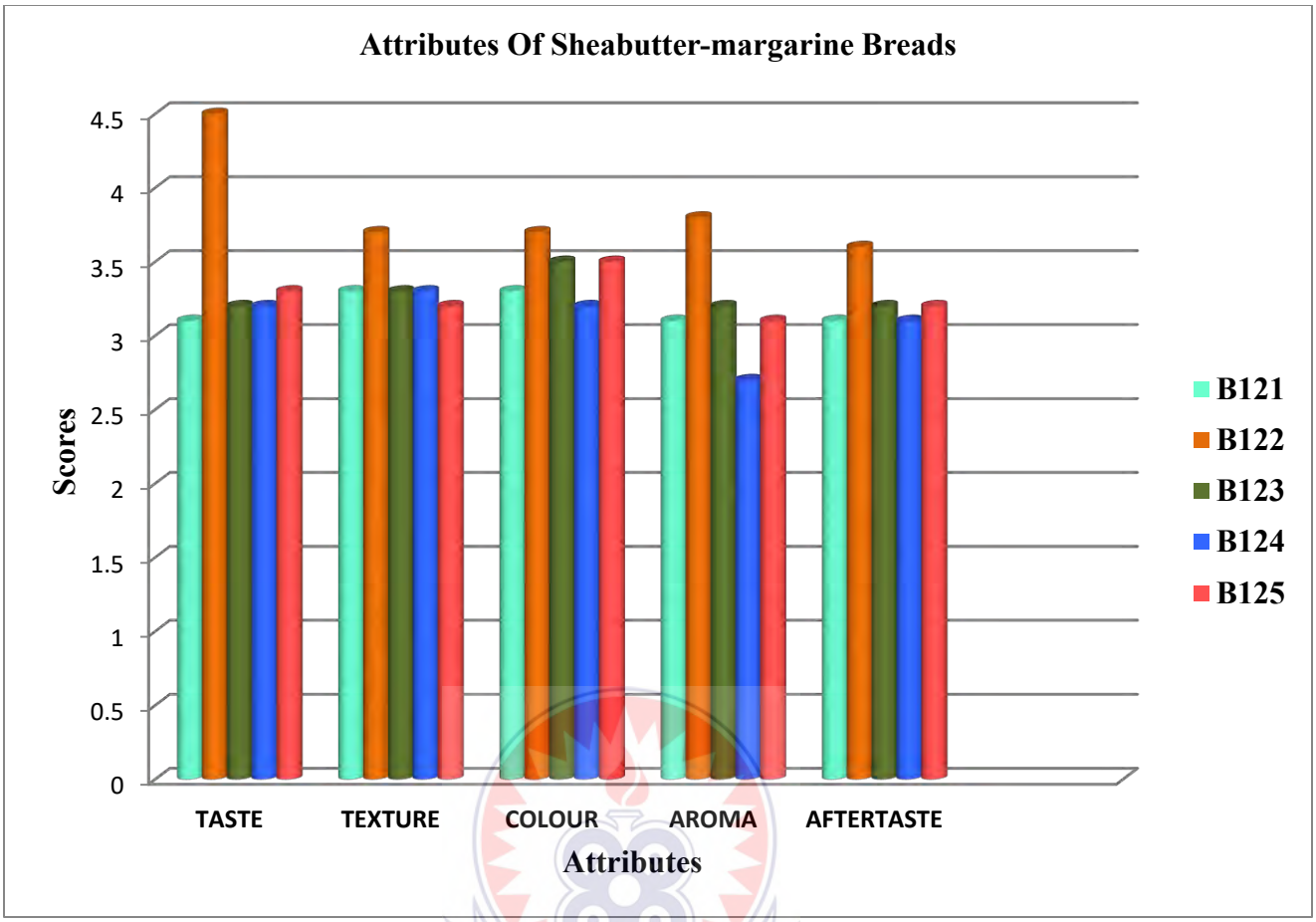

Figure 4.4 Sensory Attributes of Sheabutter-margarine Breads (Source: Field Survey, May 2013)

4.3.5. Overall Acceptability Of Sheabutter-Margarine Bread

The result from the data gathered from the study showed that 21.3% had preference for B121 while 41.3% preferred B122. 29% also preferred B123 where as 25.3 had preference for B124 but the least accepted was B125 which had a rate of 18.7% (28) as illustrated in figure 4.5. The assessors were not limited to the choice of one category of product.

KEY

B121 = 100% Sheabutter bread

B122 = 100% Margarine bread

B123 = 50% Sheabutter 50% Margarine bread

B124 = 75% Sheabutter 25% Margarine bread

B125 = 25% Sheabutter 75% Margarine bread

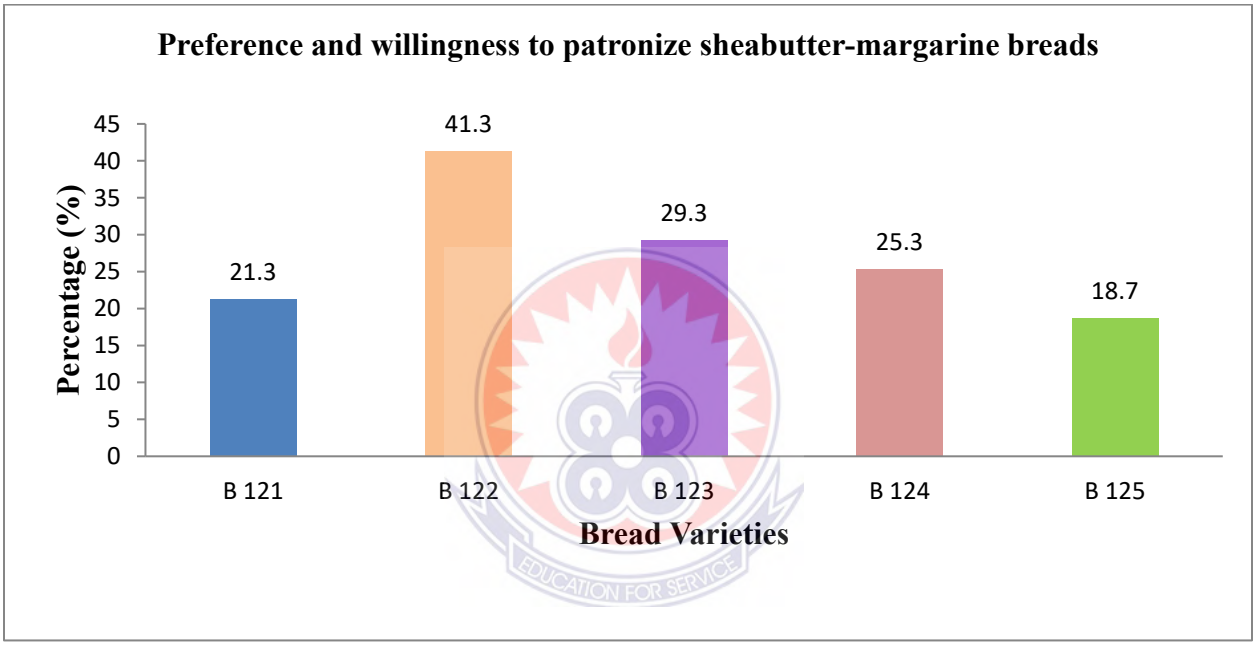

Figure 4.5: Assessor's preference for sheabutter-margarine bread (Source: Field survey, 2013)

4.3.6 Willingness To Recommend And Patronize Sheabutter-Margarine Bread

It was again found that, most respondents were willing to patronize the various categories of the sheabutter-margarine bread for various reasons with 100% margarine bread (B122) having the highest recommendation (Appendix 2).

4.3.7 Sensory Attributes Of Sheabutter-Margarine Pies

As shown in Fig4.6, taste of pies ranged from 3.2 in P114 to 4.1 in P112. Texture ranged from

3.2 in P114 to 3.8 in P112; whiles colour ranged from 2.9 in P114 to 3.6 in P113. The aroma of pies ranged from 3.1 in P114 to 4.2 in P111; whiles their aftertaste also ranged from 3.1 in P111 to 4.0 in P121.

Key

P111 = 100% Sheabutter cake

P112 = 100% Margarine cake

P113 = 50% Sheabutter : 50% Margarine cake

P114 = 75% Sheabutter : 25% Margarine cakes

P115 = 25% Sheabutter : 75% Margarine cake

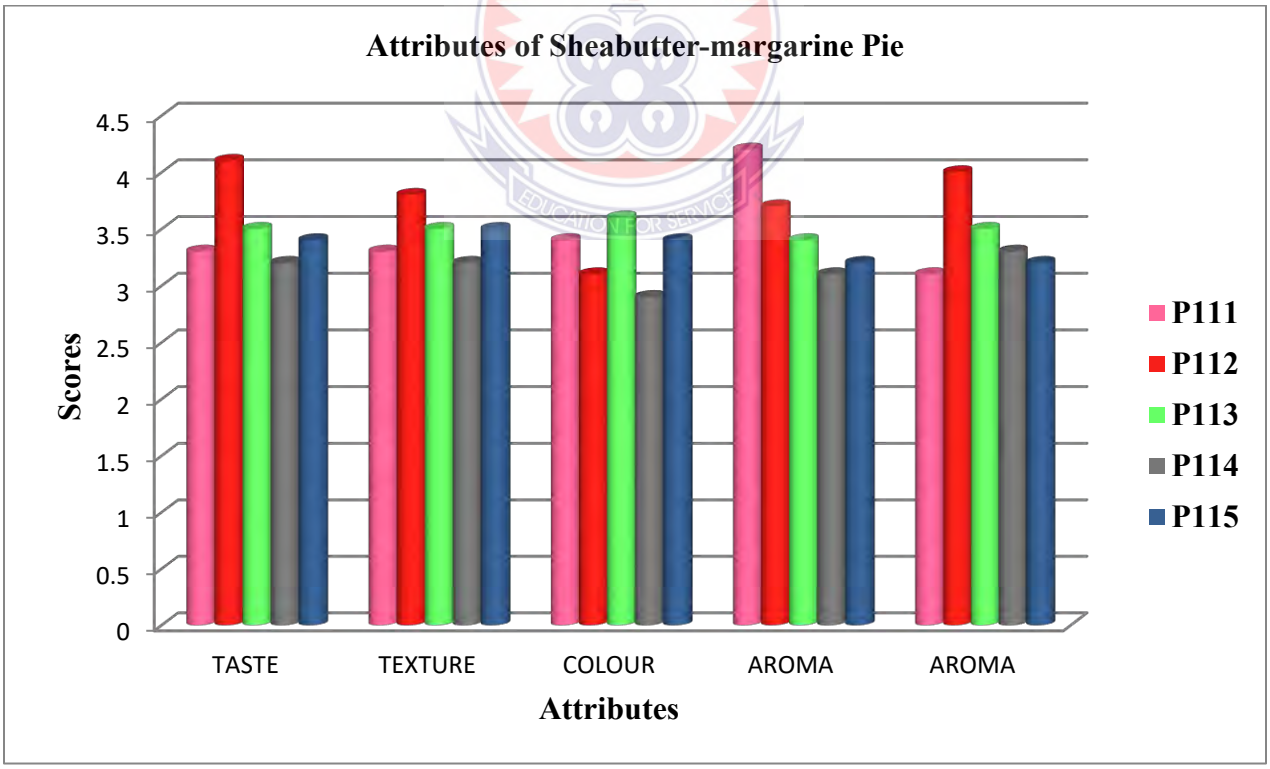

Figure 4.6 Sensory Attributes of sheabutter-margarine Pie (Source: Field Survey, May 2013)

4.3.8 Overall Acceptability Of Sheabutter-Margarine Pie

The acceptance rate for pie was 14.0% for P111 and 42.0% for P112; whiles 28.0% went for P113. P114 and P115 had a preference rate of 19.3% and 18.7% each respectively. This is shown in table figure 4.7 below.

KEY

P111 = 100% Sheabutter pie

P112 = 100% Margarine pie

P113 = 50% Sheabutter 50% Margarine pie

P114 = 75% Sheabutter 25% Margarine pie

P115 = 25% Sheabutter 75% Margarine pie

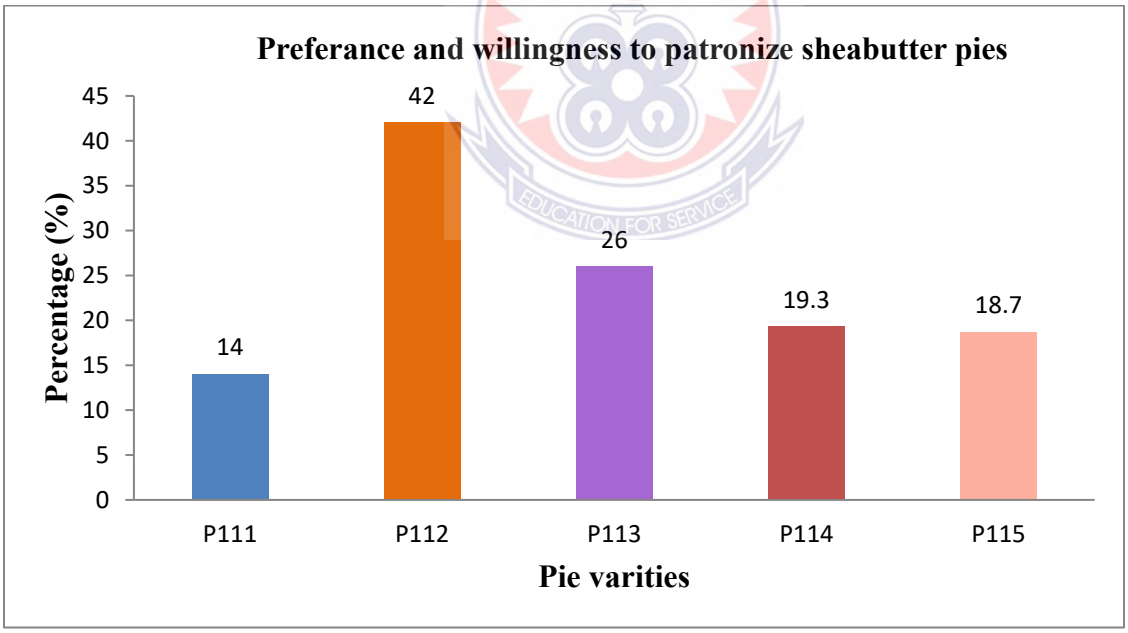

Figure 4.7: Assessors preference for sheabutter-margarine pie (Source: Field survey, 2013)

4.3.9 Willingness To Recommend And Patronize Sheabutter-Margarine Pie

A close look at the study showed that most respondents were willing to patronize the various categories of the sheabutter-margarine pie for various reasons with 100% margarine pie (B122) having the highest recommendation (Appendix 2).

4.4 Preference of Sheabutter To Margarine In The Preparation of Pastries

It was found out from the study that most respondents who represented 48% (72) said they would prefer the use of sheabutter in pastry making for both economic and nutritional reasons (Appendix 2) whilst 44% thus 67 of the respondents said they would prefer the use margarine instead in the preparation of pastries with their reasons that it feels too heavy on the tongue, smell too powerful and makes pastry soggy (Appendix 2).

4.5 Comments

Apart from respondents giving various reasons for their choice of baking fat, some other respondents made some comments in relation to their observation of the sheabutter pastries. Even though majority the of the respondents 56.7% (85) did not make any comment, 22.7% (34) commented that sheabutter should be refined for pastry making so as to increase its patronage whilst 3.3% (5) commented that training should be organized for bakers. On the other hand, 17.3% (26) also commented that sheabutter may not be palatable in some case (Appendix 2)

4.6 Shelf Life of Sheabutter-Margarine Pastries and Packaging Materials

In the case of cakes stored under room temperature, 100% margarine cake packaged in aluminum foil was the first to show sign of spoilage with tiny spots of pink and black mold on

surface (Appendix 3) at 6th day of storage whereas those packaged in polyethylene and polypropylene tended to be moist but showed signs of deterioration at 9th day of storage with the exception of the cake in cling film which was slightly dry with no spoilage signs. 100% sheabutter cake showed no sign of spoilage with all the packages at the early stage. It was observed that as storage increases almost all the cakes in the various packages deteriorated with the exception of those packaged in cling film which only deteriorated in texture. As at day 21, there was no single growth of mold nor change in appearance of the cakes packaged in cling film but they had developed very hard textures. At the same 21 days, 100% margarine cake packaged in aluminum foil was totally decomposed with black, green and yellow mold (Appendix 3) whilst that of polypropylene was also moldy all over but that of polyethylene had black mold almost all over the cake. 100% sheabutter cake packaged in aluminum foil was without mold but hard whilst those packaged in polyethylene and polypropylene also were without molds but crumby as at day 21. Meanwhile 50% sheabutter 50% margarine cake packaged with aluminum foil and polypropylene had good appearance but hard textures and were also without mold as at 21 days of storage whilst that of polyethylene was also without mold but had a slightly firm texture. On the other hand 75% sheabutter 25% margarine cake appeared to be slightly white and crumby without mold with respect to the aluminum foil whilst polypropylene was also without mold but developed a crumby texture instead, meanwhile the cake packaged in polyethylene had developed tiny molds the cake as at 21 days of storage. In the case of 25% sheabutter 75% margarine cake, as at the same 21 days of storage, it also had good appearance with a slightly hard texture and also was without mold with respect to the aluminum foil package but cakes in both polypropylene and polyethylene packages had slightly firm textures and were also without molds. Meanwhile upon observations, no spoilage occurred with the cakes irrespective of the

packages during deep freezing storage. The textures of the cakes tend to be fresh upon thawing of the frozen cakes. However, those that were kept under refrigeration dried up with those stored in cling film resulting in a much drier cake than all the rest.

With respect to the breads, results obtained from observations showed that, at room temperature, as with the cakes, bread packaged in aluminum foil and polyethylene showed early signs of spoilage at day 3 especially with 100% margarine bread (B112) and tended to be totally decomposed at 9 days of storage.

Deterioration begun with tiny black spots on 100% margarine bread at day 3 of storage of the aluminum foil packaged bread. These developed into larger black moulds and then some small greenish mold also appeared alongside the black molds on the bread. At 9th day of storage, the bread was totally decomposed with black, green and some ash/grayish mold all over and very moist (figure 5.7 plate 1) whilst that of polyethylene had only black mold completely covered (figure 5.7 plate 2 right) and polyethylene packaged bread also had white and black mold spotted on the surface (Figure 5.7 plate 3). Meanwhile cling film 100% margarine bread packaged did not showed any sign of spoilage, except that it was hard as it dried up during storage thereby resulting in change in texture (Figure 4.8, plate 4).

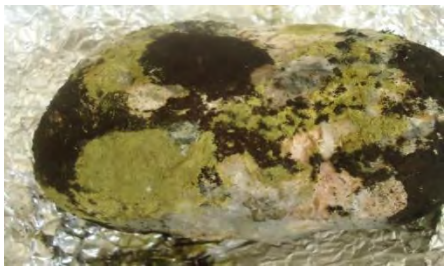

Plate 1: B122 in aluminum foil at day 9

Plate 2: B122 in polyethylene at day 9

Plate 3: B122 in polypropylene at day 9

Plate 4: B122 in cling film at day 9

Figure 4.8 Packaged 100% margarine bread at nine (9) days of storage under room temperature.

On the other hand, in the case 100% sheabutter bread, unlike the cake, deterioration started on the 9th day of storage with aluminum foil packaged bread as large spots with black mold on one side of the bread (figure 4.8 plate 5) whilst that of polyethylene packaged bread very minute black mold growth on a portion of the bread (figure 4.3 plate 6) and polypropylene packaged bread being slightly moldy with very tiny scattered white, pink, yellow and green mold which were not very visible (figure 4.8 plate 7) but no mold growth occurred on cling film packaged bread though had a hard texture as shown below in (figure 4.8 plate 8)

Plate 5: B121 in aluminum foil at day 9

Plate 6: B121 in polyethylene at day 9

Figure 4.9:Packaged 100% sheabutter breads at nine (9) days of storage under room temperature

Plate 7: B121 in polypropylene at day 9

Plate 8: B121 in cling film at day 9

Figure 4.9:Packaged 100% sheabutter breads at nine (9) days of storage under room temperature.

In the case of 50% sheabutter 50% margarine bread stored at room temperature, as at day 9, the aluminum foil packaged bread was decomposed with growth of large spots of black, white and green molds, with a few small spots of pink and grey molds (figure 4.10, plate 9) whilst that of polyethylene package was also decomposed with black molds almost all over (figure 4.10 plate 10 left) and polypropylene packaged bread also tended to have some white mold growth with scattered tiny spotted pink, black and greenish yellowish molds (figure 4.10 plate 11) but just as the other cling film packaged breads, there was no mold growth with that of 50% sheabutter 50% margarine bread stored at room temperature.

Plate 9: aluminum foil

Plate 10: Polyethylene

Plate 11: Polypropylene

Figure 4.10: State of 50% sheabutter 50% margarine bread packaged bread at nine (9) days of storage under room temperature.

With respect to 75% sheabutter 25% bread packaged with aluminum foil and stored at room temperature also went bad on the 9th day of storage with whitish mold growth and black spotted mold on its surface (figure 4.11 plate 12) whilst that of polyethylene was also partly covered with greenish mold and other part also had black mold growth with pink spotted molds (figure 4.11 plate 13). Polypropylene packaged bread of this proportion was not all that moldy but was spotted with few white, pink, and slightly black molds (figure 4.11 plate 14). However cling film packaged bread was not affected by mold yet was very hard in texture.

Plate 12:B124 in aluminum foil.

Plate 13:B124 polyethylene

Plate 14:B124 in polypropylene

Figure 4.11: State of packaged 75% sheabutter 25% margarine bread at nine (9) days of storage under room temperature.

With respect to 25% sheabutter 75% margarine bread which was stored at room temperature in an aluminum foil package deteriorated and reached its peak at 9th day of storage and had same spoilage characters that of 50% margarine as exhibited in figure 4.9 plate 7 whilst that of polyethylene package also had pinkish mold growth underneath instead and with the surface lightly covered with black mold growth and green spotted mold. On the other hand, polypropylene packaged bread also had large black mold growth scattered on surface with a few green spotted mold. As with all other products cling film packed bread had no sign of mold growth or attack throughout the 21 days storage period yet was very hard in texture.

However, same results as with the cakes were recorded for the breads which were stored under deep freezing condition irrespective of the packaging material used. These breads had longer self

lives and they still tended to be fresh upon thawing after 21 days of deep freezing storage at -20^0 C. The tastes of the bread were not affected. Meanwhile the breads stored under refrigeration condition became dry. Notwithstanding the cold condition of storage, mold attacked the 100% margarine bread which was packaged in the aluminum foil.

The various pies that were prepared, package and stored with varying packaging materials under different storage conditions went through similar occurrences during the storage periods. Unlike the breads and cakes, they did not showed early signs of spoilage even though some spoilage occurred it was not as serious as the cakes. Likewise, spoilage started with pie packaged in aluminum foil stored at room temperature with only100% margarine pie which was slightly moldy with a few black, white and pink spotted molds (figure 4.12 plate 15) and 25% sheabutter 75% margarine pie which had begun molding with a small white spotted mold at the centre surface of the pie (figure 4.12 plate 16) whilst the rest changed in texture at 9 days of storage with 100% sheabutter having a slightly soft texture, 50%sheabutter 50% margarine slightly hard and 75% sheabutter 25% margarine being very soft in texture but all pies in cling film package appeared to be very hard in texture and were also without moulds.

Plate 15: P112 in aluminum foil at day 9

Plate 16: P 115 in aluminum foil at day 9

Figure 4.12: State of packaged sheabutter -margarine pie aluminum foil at nine (9) days of storage under room temperature.

Under the same condition at 9th day of storage, 100% sheabutter pie packaged in polyethylene tend to whiten and with a crumby texture though it was not a mould growth whilst 100% Margarine, 50% sheabutter 50% margarine, 75% sheabutter 25% margarine and 25% sheabutter 75% margarine pies developed soft texture, firm texture, slightly firm and slightly soft textures respectively. With regard polypropylene, 100% sheabutter pie whitened without molds but firm other than crumby, whilst 100% margarine and 50%sheabutter 50% margarine pies were firm and slightly firm respectively and were both without molds. 75%sheabutter 25 % margarine also had a very soft texture whilst 25% sheabutter 75% margarine had a soft texture. Both were also not affected by molds at the 9th day of storage.

It was observed that very few visible changes occurred in the pies after 9th day of storage, however as at the 15th day of storage, no mold growth was spotted on 100% sheabutter and 50% sheabutter 50% margarine pies packaged and stored in the aluminum foil however, 100% sheabutter pie continued to whiten, probably due to the changes in the fat composition.. However, 100% margarine pie at this stage of storage in the aluminum package was now covered with yellow, black and green mold and some black spotted mold underneath whilst 25% sheabutter 75% margarine pie also had mold spreading on surface as whiskers. Meanwhile, with polyethylene, there was mold growth on pies of 50% sheabutter 50% margarine pies which tend to be good in appearance but with a slightly hard texture as well as 75% sheabutter 25% margarine which was hard in texture instead at 15 days of storage. However, with regard to polypropylene, 100% sheabutter pie at this stage was very white in appearance but not moldy where as 100% margarine pie was slightly white all over with small tiny black and green mold growth at this stage now. 50%sheabutter 50% margarine pie also was slightly moldy with green molds instead and 75% sheabutter 25% pie had also now developing a light green mold on its

side but 25% sheabutter 75% margarine pie was without mold and firm in texture. All pies in cling film as usual had no mold growth and were all hard with exception of 75% sheabutter 25% margarine which was not as hard as the other pies in texture.

Storage of pies under deep freezing and refrigeration resulted in same occurrences as both the pie and cakes. However, some of the pies stored in plastics (polyethylene, polypropylene and cling film) absorbed moisture as a result of tiny ice crystals that formed in the refrigerator during storage. These made some of the pies very moist and changed in taste but those stored under deep freezing conditions still appeared fresh with good taste upon thawing. No cases of mold growth were recorded in either condition.

4.9 Cost Of Sheabutter-Margarine Pastries

A judicious study of the data on the cost of sheabutter-margarine pastries tends to show a higher cost for that of pie in all cases. On the other hand, the costs of all-margarine based pastries tend to be much higher than those of all-sheabutter based pastries hence being the least expensive. Equal proportions of sheabutter to margarine (50:50) and 75:25 sheabutter-margarine were low in cost, as shown in the data in table 4.1.

Table 4.1 Cost Of Sheabutter-Margarine Pastries

Cake		**Bread**		**Pie**	
Product	Cost Gh¢	Product	Cost Gh¢	Product	Cost Gh¢
C101(100% Sheabutter)	10.20p (5 loaf size cakes each at Gh¢ 2.04)	B121(100% Sheabutter)	6.81p (5 loaves each at Gh¢ 1.36p)	P111(100% Sheabutter)	25.31p
C102 (100% Margarine)	14.70p (5 loaf size cakes each at Gh¢ 2.94p)	B122 (100% Margarine)	7.81p (5 loaves each at Gh¢ 1.60p)	P112 (100% Margarine)	31.40p
C103 (50% Sheabutter 50% Margarine)	12.70p (5 loaf size cakes each at Gh¢ 2.54p)	B123(50% Sheabutter 50% Margarine)	6.68p (5 loaves each at Gh¢ 1.33p)	P113 (50% Sheabutter 50% Margarine)	21.48p
C104 (75% Sheabutter 25% Margarine)	11.70p (5 loaf size cakes each at Gh¢ 2.34p)	B124 (75% Sheabutter 25% Margarine)	7.05p ((5 loaves each at Gh¢ 1.41p	P114 (75% Sheabutter 25% Margarine)	27.41p
C105 (25% Sheabutter 75% Margarine)	13.70p (5 loaf size cakes each at Gh¢ 2.74p	B125 (25% Sheabutter 75% Margarine)	7.59p (5 loaves each at 1.51p	P115 (25% Sheabutter 75% Margarine)	29.41p

Source: Field Survey, May 2013

4.10 Inference From Statistical Analysis

One way ANOVA was performed at the 95% confidence level p-value of 0.05. Therefore any comparison that yielded a p-value < 0.05 is considered significant. The output can be seen in appendix 3. There is no significant difference between the taste of cakes C101 and C103, C101 and C104, 101 and 105. There is however a significant difference in the score for cakes C102 and C103. In terms of texture there is no significant difference between cake C102 and C103 but there were significant difference in the scores of most sheabutter-margarine cakes. The difference between score for the colour of C102 and C103 was not significant. However, the colour of most sheabutter and margarine cakes showed significant differences. (Appendix 3), There is no significant difference between the aroma of C102 and C103 but there was significant difference between the scores in the aroma of C101 and C102, C101 and C103, C101 and C104. Most of the sheabutter and margarine cakes show significant differences between the scores for aftertaste. However, there is no significant difference between the aftertaste of C102 and C103 (Appendix 3).

The scores for taste of most of the sheabutter and margarine bread did not show significant differences. There is however a significant difference between B122 and B123. With regards to texture, there is not significant difference between the scores of most sheabutter and margarine breads. However, there is significant difference between the scores of B122 and B123 (Appendix 3). The scores for the colour of most sheabutter and margarine bread are not significant in differences. There is however significant difference between the scores of B122 and B123. There is no significant difference in most sheabutter and margarine breads but there is significant difference between the scores of B122 and B123, B122 and B124 and between B122 and 125.

Most sheabutter and margarine breads do not show significant in differences. There is however significant difference between the scores of B122 and B123, B122 and 8125 (Appendix 3).

In the case of sheabutter and margarine pie, there is no significant difference between the taste of P111 and P 113, P111 and P114 but there is significant difference between scores of P112 and P113, P113 and P115. P111 and P113 do not show significant difference between textures. However, there is significant difference between scores of P112 and 113, P114 and P115. In terms of colour, P111 and P114 do not show significant difference between scores but the scores of P111 and P113, P112 and P113 show significant difference between colours. There is no significant difference between aroma scores of P113 and P115. There is however significant difference between scores of P112 and P113, P113 and P114. The aftertaste of P111 and P115 do not show significant difference between scores. However, significant difference exists between aftertaste scores of P111 and P113, P112 and 113, and Pii3 and P115 (Appendix 3.)

CHAPTER FIVE

5.0 DISCUSSION OF RESULTS

5.1 General Information on respondents

The findings of the study revealed that most respondents who were of northern origin used sheabutter in cooking most of their meals whilst some bakers also used it to grease their baking pans. This observation agrees with CRIG (2002) that sheabutter being the main edible oil for the people of Northern Ghana and acts as a pan-releasing agent in bread baking. It was observed that, those who mostly used sheabutter in cooking were those aged between 41- 50yrs and those who were above 50 years. Even though some of these group of respondents had tertiary education but the majority had either MSLC, SHS, JHS, primary education or were school drop outs or illiterates. Respondents above 50 years generally mostly liked the pastries with high concentration of sheabutter. This is attributed to the fact that they had lived most of their lives in the north and therefore used to sheabutter meals.

However, on the other hand even though some respondents were of northern origin, they did not use sheabutter in cooking their meals with the claim that, they did not like the smell and taste of sheabutter. It was observed that these groups were mostly made up of the youth and young adults who did not grow up in the north and all had education to tertiary level. These categories of respondents mostly preferred the pastries with low concentration of sheabutter. Notwithstanding, some respondents even though were not of northern origin but yet they ever used sheabutter in cooking their meals and were also therefore willing to patronize sheabutter based pastries.

5.2 Sheabutter Pastry Production

5.2.1 Preparation And Preference of The Characteristics of Sheabutter Cakes

Cakes were successfully prepared using various proportions of sheabutter to margarine but yielded varying results. It was observed that 100% sheabutter cake (C101) took a longer period to cream and also did not increase much in bulk neither did it become as frothy as compared to the other categories of the sheabutter-margarine cakes thereby resulting in stiffer mixture. The sugary taste of the 100% sheabutter cake tended to be very low due to the raw unrefined sheabutter used. Unlike all the other cakes, a scum was formed and bubbled on top of the 100% sheabutter cake during its baking due to the low melting point of sheabutter. The low melting point was as a result of presence of the high stearin fraction (Abbiw 1990). However, the cake tended to be soggier than the other cakes which made the tongue to feel heavy after tasting. This led to most people having dislike for the aftertaste of the 100% sheabutter cake as compared to the 75% sheabutter 25% margarine cake (C104) (Appendix 2) which also had high proportion of sheabutter to margarine though its aftertaste was much preferred.

In the case of 50% sheabutter to 50% margarine cake (C103), the mixture resulted in a very frothy mixture after being creamed and also resulted in a firm mixture with a very good blend of colour and texture. During baking, the cake was the first to rise and the first to be cooked due to the adaptability and pliability of sheabutter. This finding is in agreement with Nikiema and Umali (2007), who stressed on sheabutter being marketed as margarine and baking fat which is used for pastries and confectionery because it makes a pliable dough, therefore this fact cannot be disputed.

However, 100% margarine cake had the highest scores for all of its attributes with 50% sheabutter: 50% margarine cake taking the position of second (2^{nd}) highest score for all of its attributes as well with the exception of its taste (refer to Figure 4.2). Notwithstanding, both the taste of 100% sheabutter cake and 50% sheabutter: 50% margarine cake were equally appreciated at a score of 3.7 making them third (3^{rd}) in ranking with the taste of 25% sheabutter : 75% margarine cake being ranked second (2^{nd}) highest at a score of 4.0.

Interestingly, irrespective of the fact that the attributes of 100% margarine cake (C102) had the leading scores, majority of the respondents had a general preference for 50% sheabutter: 50% margarine cake (103) and were rather willing to recommend and patronize that instead as shown in figure 5.1. The most reason for their choice for this category of cake was that it has a good blend (Appendix 2). On the other hand, 26.0% and 28.0% each were rather willing to recommend C102 and C101 respectively; while 25.3% had much preference and more willing to patronize C104. However the least that the respondents were willing to recommend and patronize was 8% and that is C105. Because assessor's were not limited to their general acceptability of cakes, for this reason, some respondents were willing to patronize more than one category of the sheabutter-margarine cakes which led to an increase in the number of actual sample size used.

5.2.2 Preparation and Preference for Sheabutter Bread

As with the cakes, various proportions of sheabutter to margarine were also used in the preparation of bread. 100% sheabutter bread (B121) took more time to knead and it also resulted in heavier dough thereby taking a longer period to prove although it did not result in a heavy texture upon being baked. However, it had a dry texture and a slightly sour taste which made it

not too good in taste. 100% margarine bread (B122) however had a very good texture. However, apart from the texture, aroma and aftertaste of the 100% margarine bread (B122), upon a close observation, there was not much difference in the texture and other characteristics of the various proportions of the sheabutter breads but there was a slight similarity in colour of all the categories of bread.

The 50%sheabutter 50% margarine bread (B123) was the first to prove and first to rise during baking. This also attests to Nikiema and Umali (2007) assertion in relation to the use of sheabutter as a baking fat due to its pliability. Both 100% margarine bread (B112) and the 50%sheabutter 50% margarine bread (B123) were the first to be well baked even though the later proved and rose earlier.

With respect to the attributes of sheabutter-margarine bread, just like the sheabutter-margarine cakes, 100% bread had the leading scores for all of its characteristics (refer to Figure 4.3). In terms of texture, all the breads had equal scores of 3.3 with the exception of B122 which had the highest score of 3.7. In this instance, the texture of sheabutter-margarine based breads were not affected by the differences in proportion of the various fat used. Henceforth, despite the fact that B124 had some proportion of margarine (75% sheabutter : 25% margarine), its aroma had the least score at the rate of 2.7 (Figure 4.3).

Unlike the sheabutter-margarine cakes, generally respondents' preference and willingness to patronize 100% margarine bread outnumbered the other categories of bread as illustrated in figure 5.2. This attests to the high scores for its attributes. The least accepted bread was B125

which had 18.7%. Considerable number of respondents had preference for the various categories of bread as well, whereby 21.3% accepted to patronize B121 and 29.3% having acceptance for B123 while 25.3% accepted to patronize B124. The assessor's were not limited to their choice in the general acceptability of breads hence some respondents chose to patronize more than one category of the sheabutter-margarine bread thereby leading to an increase in the number of actual sample size used. Assessors' reason for choice of breads varied. While some chose bread based on their attributes others chose bread based on health reasons such as reduction of fat content and balance in organic substance due to combinations (Appendix 2)

5.2.3 Preparation and Preference for Sheabutter Pie

During the preparation of the pies, certain occurrences were observed just as the cakes and breads. The 100% sheabutter pie (P111) and 75% sheabutter 25% margarine pie (P114) had the most challenges in its preparation. There was difficulty with rubbing in the sheabutter into the flour due to its hardness as compared with those with a higher and equal blend of sheabutter to margarine. However the dough of the 100% sheabutter and 75 % sheabutter 25% margarine could not hold together well upon adding the water of which same quantities were also added to all the proportions of pie mixtures. This resulted in difficulty in rolling and turning over as the dough broke up which was not the case with the other pies as they were firm because they were able to hold together. Unlike the cake and bread, 100% margarine pie (P112) was first to bake followed by 50% sheabutter 50% margarine pie (P113). These pies upon baking had an appealing colour and were also soft to the feel but P111 and P124 ended with a crispy texture. Henceforth, the texture of 100% margarine pie (P112) and the colour of 50% sheabutter : 50% margarine pie (P113) were highly rated (refer to figure 4.4). The taste and aftertaste of 100%

margarine pie was most appreciated than those of the other categories of pies. Interestingly, the aroma of 100% sheabutter pie had the best score (Figure 4.4).

With regard to overall acceptability of the attributes of the sheabutter-margarine pies, respondents were not restricted to choose only one product. On this ground, assessors' chose more than one product. This action bloated the actual number of respondents used for the study. Assessors' preference and willingness to patronize sheabutter-margarine based pie varied with reasons same as for those for bread. Just as for the bread, most assessors' preferred and recommended 100% margarine pie (P112) for patronage as shown in figure 5.3. Meanwhile unlike the bread whereby the least recommended bread was 25% sheabutter : 75% margarine bread thus B125, the least preferred and recommended pie was 100% sheabutter as depicted in the data in figure 5.3. Moreso, 26.0 % were willing to patronize P113, where as 19.3% were willing to patronize P114 and 18.7% were also more willing to accept and patronize P115.

5.3 Preference of sheabutter to margarine in pastry making

Despite the fact that some respondents did not like the smell and aftertaste of the sheabutter pastries, the majority of them preferred to use sheabutter in pastry making with some of the reason as sheabutter being cheaper and also to promote its patronage (sheabutter) so as to provide income (Appendix 2) These findings agrees with statements by Aboyella (2002) who noted that, shea butter processing and trading are major income generating activities that offer employment to rural women where as SNV (2006) also stressed that sheabutter constitutes a key income source for local women in the northern savannah areas of Ghana.

5.4 Shelf Life of Sheabutter-Margarine Pastries

As discussed in the methodology, four (4) different packaging materials and three (3) storage methods were used to determine longevity of sheabutter-margarine pastries under personal observations. Occurrences were observed under each condition on days 3, 6, 9,12,15,18 and 21.

The findings obtained from storage of all the pastries showed that polypropylene and polyethylene very susceptible to mold attacks during storage under room temperature. This could be attributed to their permeability to moisture and puncture resistant properties as outlined by Marsh and Bugusu (2007). Aluminum foil packaged pastries had the shortest life span irrespective of the type of pastry and proportions of fat. This is as a result of its moisture barrier properties and ability to fold tightly and is in agreement with Marsh and Bugusu (2007) who stressed on the suitability of aluminum foil as food wrappers due to it being an excellent barrier to moisture. Therefore in this case, moisture is trapped in the packages which then tends to generate heat. These conditions promote microbial growth leading to food spoilage during storage. In this instance the trivial of pastries stored under deep freezing and refrigeration conditions tended to have longer shelf lives due to low humidity under these conditions. On the other hand cling film packaged pastries had the longest shelf life. This is because cling film clings firmly to objects and foods being wrapped thereby leaving no room for air to be trapped in which could have led to possible build up of moisture and warmth. Other hand, 100% sheabutter pastries tend to withstand storage than 100% margarine based pastries which tend to deteriorate quickly on the shelf.

5.5 Cost

Cost incurred in the preparation of the sheabutter-margarine pastries varied irrespective of the same quantity of raw materials used with exception of fat which varied in proportions. Pastries

which had higher concentrations of sheabutter as baking fat accrued less cost than those with higher concentration of margarine. This clearly affirms to Goreja (2004) who outlined sheabutter being less expensive and so being used as a substitute to cocoa butter in chocolate production Henceforth the cost of producing one medium loaf size of 100% sheabutter cake cost Gh¢ 2.04 while cost of producing one medium loaf size of 100% margarine cake cost Gh¢ 2.94p (refer to table 4.4). Thus a difference of Gh¢ 0.90p was accrued in excess in the production of 100% margarine cake over 100% sheabutter cake. Moreso, the cost of producing one medium loaf size of 100% sheabutter bread cost Gh¢ 1.36p while cost of producing one medium loaf size of 100% margarine bread cost Gh¢ 1.60p (refer to table 4.4) hence an excess of Gh¢ 0.24p over that of 100% sheabutter bread. On the other hand, for the sake of the sensory analysis, the pie was cut into mouth bite sizes. The cost accrued in the production of 100% sheabutter pie was Gh¢ 16.41p while that of 100% sheabutter pie was Gh¢ 22.41. Excess cost accrued in the production of 100% margarine pie over sheabutter was Gh¢6.00. This was extremely high as compared to cake and bread.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECCOMMENDATION

6.1 Summary

Generally, the study revealed that:

- Pastries with high proportions of sheabutter resulted in stiff dough which led to hard and dry pastries.
- High proportion of sheabutter cake mixtures (100% sheabutter and 75% sheabutter: 25% margarine) mixed easily with beaten eggs which resulted in a smooth mixture.
- Unlike the high proportion sheabutter cake mixtures, those cake mixtures with high proportions of margarine (100% margarine and 25% margarine: 75% sheabutter) had their mixtures slightly curdled when mixed with beaten eggs but both proportions of fat (50% sheabutter:50% margarine) mixed well with the beaten eggs.
- Balanced proportions of sheabutter to margarine pastries were very sensitive to raising agents and heat and therefore they were the first to prove, rise and bake during baking.
- High proportion sheabutter to margarine pastries were soggy.
- High proportion sheabutter based pastries felt heavy on the tongue
- The taste of 100% sheabutter and 75% to 25% margarine pastries were over-shadowed by the taste of the sheabutter. This gave it an unpleasant taste and aftertaste.
- Cake containing equal proportions of sheabutter and margarine cake was the most preferred by most respondents.
- The aftertaste of all the 100% margarine based pastries were most preferred.
- The aroma of 100% sheabutter pie had the highest score among the aroma of all other pastries.

- Pastries with high proportion of sheabutter (100% sheabutter and 75%:25% sheabutter – margarine) especially cake and pie had the longest shelf life.
- 100% margarine based pastries had very short shelf life.
- Pastries that were packaged in aluminum foil deteriorated faster than those pasties packaged in cling film, polyethylene and polypropylene.
- Cling film packaged pastries had a stable and longer shelf life under all storage conditions.
- Pastries with high proportions of sheabutter involved less cost in their preparation than those with high concentration of margarine.

6.2 Conclusion

Having successfully carried out the research, the following conclusions were drawn based on the findings of the study.

1. Fifteen combinations of pastries (Cakes, bread and pies) were successfully prepared using varying proportions of sheabutter and margarine.
2. Cakes, bread and pie prepared from both sheabutter and margarine had fairly good taste and textures. These turned out to be marketable products which were acceptable and recommended for patronage; hence respondents' willingness to patronize sheabutter based pastries.
3. Sheabutter based pastries had stable shelf lives other than margarine based pastries. Even though unlike the unrefined sheabutter, margarine has been treated with preservatives yet high proportion based margarine pastries could not stay on the shelf under room temperature except for those packaged in cling film.

4. Shelf lives of the various combinations were affected by the type of packaging material used.
5. The best packaging material for sheabutter pastry product is cling film.
6. High proportion sheabutter based pastries are more economical and cheaper to produce.

5.3 Recommendations

To succeed in making sheabutter pastry making a viable venture, it is worthwhile making these recommendations. It is recommended that:

1. The standard recipe should be adjusted to produce more quality sheabutter pastries.
2. The quantity of flour used in the preparation of 100% sheabutter cakes and 75% sheabutter to 25% margarine cakes should be reduced so as to obtain a firm texture upon being baked.
3. The quantity of liquid used in mixing dough for 100% sheabutter bread and pies should be increased as this will make the dough pliable and easy to work with as well as those of bread and pie with fat proportions of 75% sheabutter to 25% margarine. When this is done, a good and more acceptable texture would be achieved.
4. There is the need to work on improving the aftertaste and aroma of the sheabutter based pastries as these were the major characteristics that deterred most respondents from liking the high proportion based sheabutter pastries hence their preference for the margarine pastries bread and pie. Sheabutter should then be refined for pastry making. This situation calls for the attention of food technologists. Food technologies should be encouraged to help in modifying the taste and aroma of sheabutter to an acceptable quality.

5. The government should encourage margarine producing companies and investors in sheabutter marketing in the production of sheabutter as a baking fat other than the bulk being exported to countries overseas whilst large amount of money is spent on the importation of margarine. Processing plants for the production of sheabutter as a baking fat must be set up in the three (3) northern regions where sheabutter is mostly produced. This will facilitate easy access to the crude sheabutter which will serve as the source of raw material which will in turn create a sustainable job and market for sheanuts and sheabutter producers as a whole.
6. Catering establishments and teaching institutions need to be encouraged to use and introduce students to the use of sheabutter in pastry making as this will enable the integration of sheabutter as a baking fat and gradual acceptability of sheabutter pastries by the mass market.
7. A proportion of margarine should be substituted for sheabutter in preparation of pastries for cheaper pastries and economic gain.
8. Workshops, training and outreach programmes must be organized for bakers and potential stakeholders on the use of sheabutter as a baking fat and its potential economic benefit.
9. Further research need to be carried out to ascertain the cause for heaviness felt on tongue after eating high proportion sheabutter pastries as well as improving on cling film packaging which prolongs the shelf lives of the pastries held under room temperature.

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APEENDIX 1

Questionnaire

Substitution Of Sheabutter For Magarine In The Preparation Of Pastries (Cakes, Bread And Pie)

This research is purely for academic purpose and it is aimed at determining the substitution potentials of sheabutter for margarine in pastry making and the market acceptability of sheabutter based pastries in order to make suggestions and find better solutions to problems identified.

***All information given will be treated as confidential.**

Please tick where applicable

SECTION A: DEMOGRAPHIC DATA

1. Gender: ☐ Male ☐ Female

2. Age:

☐ Below 20 years ☐ 21- 25 years ☐ 26- 30 years ☐ 31-35 years

☐ 36 – 39 years ☐ 40-45 years ☐ 41-45years ☐ 50 – 55years

56 and above ☐

3. Nationality……. 4. Tribe …….

5. Marital status:

☐ Single ☐ Married ☐ Widowed ☐ Divorced

6. Religion:

☐ Christian ☐ Muslim ☐ Traditionalist ☐ Pagan ☐ Others

7. Level of Education:

☐ Tertiary ☐ Secondary ☐ Technical ☐ JHS

☐ MSL ☐ Primary ☐ School drop out ☐ None

8. Occupation …….

9. Do you use sheabutter in cooking? ☐ Yes ☐ No

10. It yes what do you mostly use in cooking?

State them:

SECTION B: SENSORY ANALYSIS

Please indicate your level of likeness of characteristics of the sheabutter pastry products using the scale below: Scale of likeness
1 = Dislike very strongly
2 = Dislike slightly
3 = Like moderately
4 = Liked slightly
5 = Liked strongly

11. CAKE

PRODUCT/ CHARACTERISTICS	TASTE	TEXTURE	COLOUR	AROMA	AFTER TASTE
C101					
C102					
C103					
C104					
C105					

11.1 Which of the cake categories are you willing to recommend and patronize?

☐ C101 ☐ C102 ☐ C103 ☐ C104 ☐ C105

11.2 Indicate your reason for choosing the above product category:

……

12. BREAD

PRODUCT/ CHARACTERISTICS	TASTE	TEXTURE	COLOUR	AROMA	AFTER TASTE
B121					
B122					
B123					
B124					
B125					

12. 1 Which of the bread categories are you willing to recommend and patronize?

☐ B121 ☐ B122 ☐ B123 ☐ B124 ☐ B125

12.2. Indicate your reason for choosing the above product category:

……

13. PIE

PRODUCT/ CHARACTERISTICS	TASTE	TEXTURE	COLOUR	AROMA	AFTER TASTE
B121					
B122					
B123					
B124					
B125					

13. 1 Which of the pie categories are you willing to recommend and patronize?

☐ P121 ☐ P122 ☐ P123 ☐ P124 ☐ P125

13.2 Indicate your reason for choosing the above product category:

……

14. Will you prefer sheabutter to margarine in pastry making? Yes / No

15. If yes why / no why?

……

Any other comment:

APPENDIX 2

RESULTS OBTAINED FROM DATA GATHERED

	Frequency	Percentage %
Administrative staff	20	13.3
Other students	50	33.3
Catering Students	30	20.0
Lecturer	20	13.3
Baker	15	10.0
Cleaner	10	6.7
Pastry Seller	5	3.3
Total	150	100.0

Gender

	Frequency	Percentage %
Male	59	39.3
Female	91	60.7
Total	150	100.0

Age

	Frequency	Percentage %
21-30	101	67.3
31-40	23	15.3
41-50	16	10.7
50+	10	6.7
Total	150	100.0

Nationality

	Frequency	Percentage %
Ghanaian	148	98.7
Nigerian	2	1.3
Total	150	100.0

Tribe

	Frequency	Percentage %
Dagaati	5	3.3
Builsa	6	4.0
Kasena	14	9.3
Bisa	3	2.0
Bimoba	3	2.0
Hausa	2	1.3
Akan	11	7.4
Konkomba	2	1.3
Moshie	3	2.0
Dagomba	1	.7
Talensi	8	5.3
Ashanti	9	6.0
Ewe	10	6.7
Waala	3	2.0
Frafra	51	34.0
Kusasi	9	6.0
Mamprusi	7	4.7
Sisala	3	2.0
Total	150	100.0

Marital status

	Frequency	Percentage %
Single	89	59.3
Married	55	36.7
Widowed	6	4.0
Total	150	100.0

Religion

	Frequency	Percentage %
Christian	116	77.3
Muslim	29	19.3
Traditionalist	4	2.7
Pagan	1	.7
Total	150	100.0

Level of Education

	Frequency	Percentage %
Tertiary	120	80.0
Secondary	8	5.3
Technical	1	.7
JHS	4	2.7
MSLC	5	3.3
Primary	1	.7
School drop out	4	2.7
None	7	4.7
Total	150	100.0

Occupation

	Frequency	Percentage %
Library Assistant	5	3.3
Social worker	1	.7
Administrator	14	9.3
Student	80	53.3
Lecturer	20	13.3
Baker	15	10.0
Cleaner	10	6.7
Pastry Seller	5	3.3
Total	150	100.0

Do you use sheabutter in cooking?

	Frequency	Percentage %
Yes	107	71.3
No	43	28.7
Total	150	100.0

If yes, what do you mostly use it in cooking?

Stew

	Frequency	Percentage %
Stew	77	51.3
Soup for TZ	11	7.3
Maasa	19	12.7
Jollof/Rice	56	37.3
Tubani	19	12.7
Koose	20	13.3
Beans/Bambara beans	16	10.7
Greasing baking pans	6	4.0

PRODUCT : CAKE

100% SHEABUTTER (C101)

Taste C101

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	13	8.7
Like moderately	59	39.3
Like slightly	39	26.0
Like strongly	32	21.3
Total	146	93.7

Texture C101

	Frequency	Percentage %
Dislike strongly	10	6.7
Dislike slightly	24	16.0
Like moderately	55	36.7
Like slightly	40	26.7
Like strongly	17	11.3
Total	146	93.7

Colour C101

	Frequency	Percentage %
Dislike strongly	6	4.0
Dislike slightly	15	10.0
Like moderately	49	32.7
Like slightly	51	34.0
Like strongly	25	16.7
Total	146	93.7

Aroma/Smell C101

	Frequency	Percentage %
Dislike strongly	14	9.3
Dislike slightly	28	18.7
Like moderately	44	29.3
Like slightly	43	28.7
Like strongly	17	11.3
Total	146	93.7

After Taste C101

	Frequency	Percentage %
Dislike strongly	19	12.7
Dislike slightly	35	23.3
Like moderately	42	28.0
Like slightly	26	17.3
Like strongly	24	16.0
Total	146	93.7

100% MARGARINE CAKE (C102)

Taste C102

	Frequency	Percentage %
Dislike strongly	-	-
Dislike slightly	11	7.3
Liked moderate	24	16.0
Liked much	49	32.7
Liked very much	62	41.3
Total	146	93.7

Texture C102

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	4	2.7
Like moderately	36	24.0
Like slightly	64	42.7
Like strongly	39	26.0
Total	149	93.7

Colour C102

	Frequency	Percentage %
Dislike strongly	-	-
Dislike slightly	4	2.7
Like moderately	27	18.0
Like slightly	62	41.3
Like strongly	53	35.3
Total	146	93.7

Aroma/Smell C102

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	14	9.3
Like moderately	40	26.7
Like slightly	51	34.0
Like strongly	38	25.3
Total	146	93.7

After Taste C102

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	13	8.7
Like moderately	26	17.3
Like slightly	65	43.3
Like strongly	39	26.0
Total	146	93.7

50% SHEABUTTER: 50%MARGARINE CAKE (C103)

Taste C103

	Frequency	Percentage %
Dislike strongly	-	-
Dislike slightly	17	11.3
Like moderately	40	26.7
Like slightly	50	33.3
Like strongly	40	26.7
Total	147	98

Texture C103

	Frequency	Percentage %
Dislike strongly	-	-
Dislike slightly	3	2.0
Like moderately	48	32.0
Like slightly	68	45.3
Like strongly	28	18.7
Total	147	98

Colour (C103)

	Frequency	Percentage %
Dislike strongly	1	.7
Dislike slightly	4	2.7
Like moderately	38	25.3
Like slightly	56	37.3
Like strongly	48	32.0
Total	147	98

Aroma/Smell (103)

	Frequency	Percentage %
Dislike strongly	4	2.7
Dislike slightly	18	12.0
Like moderately	45	30.0
Like slightly	51	34.0
Like strongly	29	19.3
Total	147	98

After Taste C103

	Frequency	Percentage %
Dislike strongly	-	-
Dislike slightly	14	9.3
Like moderately	55	36.7
Like slightly	46	30.7
Like strongly	32	21.3
Total	147	98

75% SHEABUTTER: 25%MARGARINE CAKE (C104)

Taste C104

	Frequency	Percentage %
Dislike strongly	2	1.3
Dislike slightly	14	9.3
Like moderately	47	31.3
Like slightly	65	43.3
Like strongly	22	14.7
Total	150	100.0

Texture C104

	Frequency	Percentage %
Dislike strongly	1	.7
Dislike slightly	19	12.7
Like moderately	66	44.0
Like slightly	40	26.7
Like strongly	24	16.0
Total	150	100.0

Colour C104

	Frequency	Percentage %
Dislike strongly	2	1.3
Dislike slightly	4	2.7
Like moderately	35	23.3
Like slightly	84	56.0
Like strongly	25	16.7
Total	150	100.0

Aroma/Smell C104

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	21	14.0
Like moderately	45	30.0
Like slightly	50	33.3
Like strongly	31	20.7
Total	150	100.0

After Taste c104

	Frequency	Percentage %
Dislike strongly	4	2.7
Dislike slightly	21	14.0
Like moderately	56	37.3
Like slightly	46	30.7
Like strongly	23	15.3
Total	150	100.0

25% SHEABUTTER:75%MARGARINE CAKE (C105)

Taste C105

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	9	6.0
Like moderately	59	39.3
Like slightly	43	28.7
Like strongly	36	24.0
Total	150	100.0

Texture C105

	Frequency	Percentage %
Dislike strongly	5	3.3
Dislike slightly	22	14.7
Like moderately	40	26.7
Like slightly	55	36.7
Like strongly	28	18.7
Total	150	100.0

Colour C105

	Frequency	Percentage %
Dislike strongly	8	5.3
Dislike slightly	11	7.3
Like moderately	49	32.7
Like slightly	53	35.3
Like strongly	29	19.3
Total	150	100.0

Aroma/Smell C105

	Frequency	Percentage %
Dislike strongly	4	2.7
Dislike slightly	21	14.0
Like moderately	50	33.3
Like slightly	39	26.0
Like strongly	36	24.0
Total	150	100.0

After Taste C105

	Frequency	Percentage %
Dislike strongly	6	4.0
Dislike slightly	20	13.3
Like moderately	54	36.0
Like slightly	49	32.7
Like strongly	21	14.0
Total	150	100.0

Which of the cake categories are you willing to recommend and patronize?

	Frequency	Percent
C101	42	28.0
C102	39	26.0
C103	57	38.0
C104	38	25.3
Q105	12	8.0

Indicate your reason for choosing or refusing the above product

	Frequency	Percent
Feels heavy on the tongue	12	8.0
It gives a good blend	70	46.7
Has good taste and texture	21	14.0
It has soft Texture	10	6.7
Bread dry and not tasty	25	16.7
This combination reduces the fat content	12	8.0
Total	150	100.0

PRODUCT: BREAD

100% SHEABUTTER BREAD (B121)

Taste B121

	Frequency	Percentage %
Dislike strongly	13	8.7
Dislike slightly	27	18.0
Like moderately	47	31.3
Like slightly	45	30.0
Like strongly	17	11.3
Total	149	99.3

Texture B121

	Frequency	Percentage %
Dislike strongly	8	5.3
Dislike slightly	15	10.0
Like moderately	57	38.0
Like slightly	51	34.0
Like strongly	18	12.0
Total	149	99.3

Colour B121

	Frequency	Percentage %
Dislike strongly	8	5.3
Dislike slightly	20	13.3
Like moderately	55	36.7
Like slightly	46	30.7
Like strongly	20	13.3
Total	149	99.3

Aroma/Smell B121

	Frequency	Percentage %
Dislike strongly	6	4.0
Dislike slightly	33	22.0
Like moderately	58	38.7
Like slightly	36	24.0
Like strongly	16	10.7
Total	149	99.3

After Taste B121

	Frequency	Percentage %
Dislike strongly	14	9.3
Dislike slightly	28	18.7
Like moderately	52	34.7
Like slightly	35	23.3
Like strongly	20	13.3
Total	149	99.3

100% MARGARINE BREAD (B122)

Taste B122

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	20	13.3
Like moderately	28	18.7
Like slightly	65	43.3
Like strongly	33	22.0
Total	149	99.3

Texture B122

	Frequency	Percentage %
Dislike strongly	2	1.3
Dislike slightly	13	8.7
Like moderately	35	23.3
Like slightly	75	50.0
Like strongly	24	16.0
Total	149	99.3

Colour B122

	Frequency	Percentage %
Dislike strongly	1	.7
Dislike slightly	12	8.0
Like moderately	35	23.3
Like slightly	75	50.0
Like strongly	26	17.3
Total	149	99.3

Aroma/Smell B122

	Frequency	Percentage %
Dislike strongly	-	-
Dislike slightly	19	12.7
Like moderately	29	19.3
Like slightly	64	42.7
Like strongly	37	24.7
Total	149	99.3

After Taste B122

	Frequency	Percentage %
Dislike strongly	9	6.0
Dislike slightly	13	8.7
Like moderately	27	18.0
Like slightly	64	42.7
Like strongly	36	24.0
Total	149	99.3

50% SHEABUTTER:50%MARGARINE BREAD (B123)

Taste B123

	Frequency	Percentage %
Dislike strongly	8	5.3
Dislike slightly	26	17.3
Like moderately	53	35.3
Like slightly	40	26.7
Like strongly	23	15.3
Total	150	100.0

Texture B123

	Frequency	Percentage %
Dislike strongly	8	5.3
Dislike slightly	19	12.7
Like moderately	51	34.0
Like slightly	54	36.0
Like strongly	18	12.0
Total	150	100.0

Colour B123

	Frequency	Percentage %
Dislike strongly	6	4.0
Dislike slightly	11	7.3
Like moderately	49	32.7
Like slightly	68	45.3
Like strongly	16	10.7
Total	150	100.0

Aroma/Smell B123

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	24	16.0
Like moderately	65	43.3
Like slightly	50	33.3
Like strongly	8	5.3
Total	150	100.0

After Taste B123

	Frequency	Percentage %
Dislike strongly	5	3.3
Dislike slightly	21	14.0
Like moderately	66	44.0
Like slightly	42	28.0
Like strongly	16	10.7
Total	150	100.0

75% SHEABUTTER:25%MARGARINE BREAD (B124)

Taste B124

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	31	20.7
Like moderately	59	39.3
Like slightly	45	30.0
Like strongly	12	8.0
Total	150	100.0

Texture B124

	Frequency	Percentage %
Dislike strongly	5	3.3
Dislike slightly	20	13.3
Like moderately	55	36.7
Like slightly	54	36.0
Like strongly	16	10.7
Total	150	100.0

Colour B124

	Frequency	Percentage %
Dislike strongly	10	6.7
Dislike slightly	21	14.0
Like moderately	53	35.3
Like slightly	49	32.7
Like strongly	17	11.3
Total	150	100.0

Aroma/Smell B124

	Frequency	Percentage %
Dislike strongly	1	.7
Dislike slightly	40	26.7
Like moderately	42	28.0
Like slightly	52	34.7
Like strongly	15	10.0
Total	150	100.0

After Taste B124

	Frequency	Percentage %
Dislike strongly	10	6.7
Dislike slightly	17	11.3
Like moderately	74	49.3
Like slightly	41	27.3
Like strongly	8	5.3
Total	150	100.0

25% SHEABUTTER,75%MARGARINE BREAD (B125)

Taste B125

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	31	20.7
Like moderately	47	31.3
Like slightly	53	35.3
Like strongly	16	10.7
Total	150	100.0

Texture B125

	Frequency	Percentage %
Dislike strongly	11	7.3
Dislike slightly	28	18.7
Like moderately	40	26.7
Like slightly	49	32.7
Like strongly	22	14.7
Total	150	100.0

Colour B125

	Frequency	Percentage %
Dislike strongly	9	6.0
Dislike slightly	17	11.3
Like moderately	46	30.7
Like slightly	58	38.7
Like strongly	20	13.3
Total	150	100.0

Aroma/Smell B125

	Frequency	Percentage %
Dislike strongly	15	10.0
Dislike slightly	23	15.3
Like moderately	53	35.3
Like slightly	39	26.0
Like strongly	20	13.3
Total	150	100.0

After Taste B125

	Frequency	Percentage %
Dislike strongly	12	8.0
Dislike slightly	24	16.0
Like moderately	51	34.0
Like slightly	48	32.0
Like strongly	15	10.0
Total	150	100.0

Which of the product Two(Bread) categories are you willing to recommend and patronize?

	Frequency	Percent
B121	32	21.3
B122	62	41.3
B123	44	29.3
B124	38	25.3
B125	28	18.7

Indicate your reason for choosing the above product

	Frequency	Percentage %
Non-respondents	12	8.0
It gives a good blend of taste and texture	57	38.0
The combination gives a good appearance	8	5.3
The combination gives a balance organic substance	20	13.3
The combination gives a nice flavour	10	6.7
sheabutter makes the bread dry and not tasty	21	14.0
Margarine gives a good taste	19	12.7
This combination reduces the fat content	3	2.0
Total	150	100.0

PRODUCT: PIE

100% SHEABUTTER (B111)

Taste P111

	Frequency	Percentage %
Dislike strongly	12	8.0
Dislike slightly	27	18.0
Like moderately	42	28.0
Like slightly	40	26.7
Like strongly	29	19.3
Total	150	100.0

Texture P111

	Frequency	Percentage %
Dislike strongly	5	3.3
Dislike slightly	23	15.3
Like moderately	54	36.0
Like slightly	52	34.7
Like strongly	16	10.7
Total	150	100.0

Colour P111

	Frequency	Percentage %
Dislike strongly	7	4.7
Dislike slightly	20	13.3
Like moderately	51	34.0
Like slightly	50	33.3
Like strongly	22	14.7
Total	150	100.0

Aroma/Smell P111

	Frequency	Percentage %
Dislike strongly	16	10.7
Dislike slightly	22	14.7
Like moderately	49	32.7
Like slightly	36	24.0
Like strongly	27	18.0
Total	150	100.0

After Taste P111

	Frequency	Percentage %
Dislike strongly	15	10.0
Dislike slightly	29	19.3
Like moderately	51	34.0
Like slightly	35	23.3
Like strongly	20	13.3
Total	150	100.0

100% MARGARINE BREAD B112

Taste P112

	Frequency	Percentage %
Dislike strongly	3	2.0
Dislike slightly	8	5.3
Like moderately	22	14.7
Like slightly	56	37.3
Like strongly	61	40.7
Total	150	100.0

Texture B112

	Frequency	Percentage %
Dislike strongly	-	-
Dislike slightly	6	4.0
Like moderately	47	31.3
Like slightly	58	38.7
Like strongly	36	24.0
Total	147	98

Colour B112

	Frequency	Percentage %
Dislike strongly	-	-
Dislike slightly	3	2.0
Like moderately	40	26.7
Like slightly	61	40.7
Like strongly	43	28.7
Total	147	98

Aroma/Smell B112

	Frequency	Percentage %
Dislike strongly	5	3.3
Dislike slightly	10	6.7
Like moderately	24	16.0
Like slightly	75	50.0
Like strongly	33	22.0
Total	147	98

After Taste B112

	Frequency	Percentage %
Dislike strongly	5	3.3
Dislike slightly	5	3.3
Like moderately	25	16.7
Like slightly	54	36.0
Like strongly	58	38.7
Total	147	98

50% SHEABUTTER: 50%MARGARINE PIE (P113)

Taste B113

	Frequency	Percentage %
Dislike strongly	6	4.0
Dislike slightly	10	6.7
Like moderately	61	40.7
Like slightly	47	31.3
Like strongly	26	17.3
Total	150	100.0

Texture B113

	Frequency	Percentage %
Dislike strongly	4	2.7
Dislike slightly	7	4.7
Like moderately	65	43.3
Like slightly	51	34.0
Like strongly	23	15.3
Total	150	100.0

Colour P113

	Frequency	Percentage %
Dislike strongly	2	1.3
Dislike slightly	16	10.7
Like moderately	42	28.0
Like slightly	66	44.0
Like strongly	24	16.0
Total	150	100.0

Aroma/Smell P113

	Frequency	Percentage %
Dislike strongly	8	5.3
Dislike slightly	6	4.0
Like moderately	65	43.3
Like slightly	46	30.7
Like strongly	25	16.7
Total	150	100.0

After Taste P113

	Frequency	Percentage %
Dislike strongly	7	4.7
Dislike slightly	4	2.7
Like moderately	60	40.0
Like slightly	64	42.7
Like strongly	15	10.0
Total	150	100.0

75% SHEABUTTER: 25%MARGARINE PIE (P114)

Taste P114

	Frequency	Percent
Dislike strongly	4	2.7
Dislike slightly	33	22.0
Like moderately	54	36.0
Like slightly	36	24.0
Like strongly	23	15.3
Total	150	100.0

Texture P114

	Frequency	Percent
Dislike strongly	7	4.7
Dislike slightly	28	18.7
Like moderately	49	32.7
Like slightly	48	32.0
Like strongly	18	12.0
Total	150	100.0

Colour P114

	Frequency	Percentage %
Dislike strongly	2	1.3
Dislike slightly	16	10.7
Like moderately	60	40.0
Like slightly	50	33.3
Like strongly	22	14.7
Total	150	100.0

Aroma/Smell P114

	Frequency	Percentage %
Dislike strongly	10	6.7
Dislike slightly	23	15.3
Like moderately	61	40.7
Like slightly	41	27.3
Like strongly	15	10.0
Total	150	100.0

After Taste P114

	Frequency	Percentage %
Dislike strongly	12	8.0
Dislike slightly	23	15.3
Like moderately	37	24.7
Like slightly	65	43.3
Like strongly	13	8.7
Total	150	100.0

25% SHEABUTTER:75%MARGARINE PIE (P115)

Taste P115

	Frequency	Percentage %
Dislike strongly	-	.-
Dislike slightly	23	15.3
Like moderately	56	37.3
Like slightly	53	35.3
Like strongly	17	11.3
Total	149	99.3

Texture P115

	Frequency	Percentage %
Dislike strongly	1	.7
Dislike slightly	17	11.3
Like moderately	55	36.7
Like slightly	58	38.7
Like strongly	18	12.0
Total	149	99.3

Colour P115

	Frequency	Percentage %
Dislike strongly	4	2.7
Dislike slightly	15	10.0
Like moderately	57	38.0
Like slightly	51	34.0
Like strongly	22	14.7
Total	149	99.3

Aroma/Smell P115

	Frequency	Percentage %
Dislike strongly	7	4.7
Dislike slightly	23	15.3
Like moderately	56	37.3
Like slightly	48	32.0
Like strongly	15	10.0
Total	149	99.3

After Taste P115

	Frequency	Percentage %
Dislike strongly	8	5.3
Dislike slightly	20	13.3
Like moderately	64	42.7
Like slightly	43	28.7
Like strongly	14	9.3
Total	149	99.3

Which of the product the pie categories are you willing to recommend and patronize?

	Frequency	Percent
P111	21	14.0
P112	63	42.0
P113	39	26.0
P114	29	19.3
P115	28	18.7

Indicate your reason for choosing the above product

	Frequency	Percent
Non-respondents	8	5.3
It gives a good blend of taste	54	36.0
It gives a balanced organic substance	22	14.7
Margarine gives a better taste/flavour	35	23.3
Sheabutter taste good and it is healthy	17	11.3
This combination gives it a nice texture and appearance	14	9.3
Total	142	94.7

Will you prefer sheabutter to margarine in pastry making?

	Frequency	Percentage %
Yes	72	48.0
No	67	44.7
Total	139	92.7

If yes, why

	Frequency	Percentage %
It taste good	27	19.4
To promote its patronage and to provide income	9	6.4
It is cheaper	8	5.8
It has good texture	18	12.9
It is nutritious and has no chemicals	10	7.2
Total	72	51.7

If No, why

	Frequency	Percentage %
The smell is too powerful	25	15.7
It feels thick on the tongue	34	21.2
It makes the pastries soggy	8	5.0
Total	63	42

Comments

	Frequency	Percent
Refining the sheabutter will increase its patronage	34	22.7
Sheabutter may not be palatable in some cases	26	17.3
Training on use of sheabuter should be organized for bakers	5	3.3
Total	65	43.3%

SCORES

Taste of Sheabutter-margarine cakes

	Cake Products				
Response	C101	C102	C103	C104	C105
Dislike strongly	2.7%	2.7%	2.0%	-	-
Dislike slightly	2.0%	-	-	1.3%	2.0%
Like moderately	8.7%	7.3%	11.3%	9.3%	6.0%
Like slightly	39.3%	16%	26.7%	31.3%	39.3%
Like strongly	26%	32.7%	33.3%	43.3%	28.7%
Dislike strongly	21.3%	41.3%	26.7%	14.7%	24%
Total	100%	100%	100%	100%	100%

Texture of sheabutter-margarine cakes

	Cake Products				
Response	C101	C102	C103	C104	C105
Dislike strongly	6.7%	2.0	-	0.7%	3.3%
Dislike slightly	16%	2.7%	2.0%	12.7%	14.7%
Like moderately	36.7%	24.%	32.0%	31.3%	26.7%
Like slightly	26.7%	42.7%	45.3%	43.3%	36.7%
Like strongly	11.3%	26.0%	18.7%	14.7%	18.7%
Total	100%	100%	100%	100%	100%

Colour of sheabutter-margarine cakes

	Cake Products				
Response	C101	C102	C103	C104	C105
Non-respondents	2.7%	2.7%	2.0%	-	-
Disliked very much	6.7%	2.0	-	0.7%	3.3%
Disliked much	16%	2.7%	2.0%	12.7%	14.7%
Liked moderate	36.7%	24.%	32.0%	31.3%	26.7%
Liked much	26.7%	42.7%	45.3%	43.3%	36.7%
Liked very much	11.3%	26.0%	18.7%	14.7%	18.7%
Total	100%	100%	100%	100%	100%

Aroma of sheabutter-margarine cakes

	Cake Products				
Response	C101	C102	C103	C104	C105
Non-respondents	2.7%	2.7%	2.0%	-	-
Disliked very much	9.3%	2.0	2.7%	2.0%	2.7%
Disliked much	18.7%	9.3%	12.0%	14.0%	14.0%
Liked moderate	29.3 %	26.7.%	30.0%	30.0%	33.3%
Liked much	28.7%	34.0%	34.0%	33.3%	26.0%
Liked very much	11.3%	25.3%	19.3%	20.7%	24.0%
Total	100%	100%	100%	100%	100%

Aroma of sheabutter-margarine cakes

	Cake Products				
Response	C101	C102	C103	C104	C105
Non-respondents	2.7%	2.7%	2.0%	-	-
Disliked very much	9.3%	2.0	2.7%	2.0%	2.7%
Disliked much	18.7%	9.3%	12.0%	14.0%	14.0%
Liked moderate	29.3 %	26.7.%	30.0%	30.0%	33.3%
Liked much	28.7%	34.0%	34.0%	33.3%	26.0%
Liked very much	11.3%	25.3%	19.3%	20.7%	24.0%
Total	100%	100%	100%	100%	100%

Aftertaste of sheabutter-margarine cakes

	Cake Products				
Response	C101	C102	C103	C104	C105
Non-respondents	2.7%	2.7%	2.0%	-	-
Disliked very much	12.7%	2.0	-	2.7%	4.0%
Disliked much	23.3%	8.7%	9.3%	14.0%	13.3%
Liked moderate	28 %	17.3%	36.7%	37.3%	36.0%
Liked much	17.3%	43.3%	30.7%	30.7%	32.7%
Liked very much	16.0%	26.0%	21.3%	15.3%	14.0%
Total	100%	100%	100%	100%	100%

Taste of sheabutter-margarine bread

	Bread Products				
Response	B121	B122	B123	B124	B125
Non-respondents	0.7%	0.7%	-	-	-
Disliked very much	8.7%	2.0%	5.3%	2.0%	2.0%
Disliked much	18.0%	13.3%	17.3%	20.7%	20.7%
Liked moderate	31.3%	18.7%	35.3%	39.3%	31.3%
Liked much	30.0%	43.3%	26.7%	30.0%	35.3%
Liked very much	11.3%	22.0%	15.3%	8.0%	10.7%
Total	100%	100%	100%	100%	100%

Texture of sheabutter-margarine breads

	Bread Products				
Response	B121	B122	B123	B124	B125
Non-respondents	0.7%	0.7%	-	-	-
Disliked very much	5.3%	1.3%	5.3%	3.3%	7.3%
Disliked much	10.0%	8.7%	12.7%	13.3%	18.7%
Liked moderate	38.0%	23.3%	34.0%	36.7%	26.7%
Liked much	34.0%	50.0%	36.0%	36.0%	32.7%
Liked very much	12.0%	16.0%	12.0%	10.7%	14.7%
Total	100%	100%	100%	100%	100%

Colour of Sheabutter-Margarine Bread

	Bread Products				
Response	B121	B122	B123	B124	B125
Non-respondents	0.7%	0.7%	-	-	-
Disliked very much	5.3%	0.7	4.0	6.7%	6.0%
Disliked much	13.3%	8.0%	7.3%	14.0%	11.3%
Liked moderate	36.7%	23.3.%	32.7%	35.5%	30.7%
Liked much	30.7%	50.0%	45.3%	32.7%	38.7%
Liked very much	13.3%	17.3%	10.7%	11.3%	13.3%
Total	100%	100%	100%	100%	100%

Aroma of Sheabutter-Margarine Breads

	Bread Products				
Response	B121	B122	B123	B124	B125
Non-respondents	2.7%	2.7%	2.0%	-	-
Disliked very much	9.3%	2.0	2.7%	2.0%	2.7%
Disliked much	18.7%	9.3%	12.0%	14.0%	14.0%
Liked moderate	29.3 %	26.7.%	30.0%	30.0%	33.3%
Liked much	28.7%	34.0%	34.0%	33.3%	26.0%
Liked very much	11.3%	25.3%	19.3%	20.7%	24.0%
Total	100%	100%	100%	100%	100%

Aftertaste of Sheabutter-Margarine Breads

	Bread Products				
Response	B121	B122	B123	B124	B125
Non-respondents	0.7%	0.7%	-	-	-
Disliked very much	9.3%	6.0	3.3	6.7%	8.0%
Disliked much	18.7%	8.7%	14.0%	11.3%	16.0%
Liked moderate	34.7 %	18.0%	44.0%	49.3%	34.0%
Liked much	23.3%	42.7%	28.0%	27.3%	32.0%
Liked very much	13.3%	24.0%	10.7%	5.3%	10.0%
Total	100%	100%	100%	100%	100%

Taste of Sheabutter-Margarine Pie

	Pie Products				
Response	P111	P112	P113	P114	P115
Non-respondents	-	2.0%	-	-	0.7%
Disliked very much	8.0%	-	4.0%	2.7%	-
Disliked much	18.0%	5.3%	6.7%	22.0%	15.3%
Liked moderate	28.0%	14.7%	40.7%	36.0%	37.3%
Liked much	26.7%	37.3%	31.3%	24.0%	35.3%
Liked very much	19.3%	40.7%	17.3%	15.3%	11.3%
Total	100%	100%	100%	100%	100%

Texture of Sheabutter-Margarine Pies

	Pie Products				
Response	P111	P112	P113	P114	P115
Non-respondents	-	2.0%	-	-	0.7%
Disliked very much	3.3%	-	2.7%	4.7%	0.7%
Disliked much	15.3%	4.0%	4.7%	18.7%	11.3%
Liked moderate	36.0%	31.3%	43.3%	32.7%	36.7%
Liked much	34.7%	38.7%	34.0%	32.0%	38.7%
Liked very much	10.7%	24.0%	15.3%	12.0%	12.0%
Total	100%	100%	100%	100%	100%

Colour of Sheabutter-Margarine Pies

	Pie Products				
Response	P111	P112	P113	P114	P115
Non-respondents	-	2.0%	-	-	0.7%
Disliked very much	4.7%	-	1.3	1.3%	2.7%
Disliked much	13.3%	2.0%	10.7%	10.7%	10.0%
Liked moderate	34.0%	267.%	28.0%	40.0%	38.0%
Liked much	33.3%	40.7%	44.0%	33.3%	34.0%
Liked very much	14.7%	28.7%	16.0%	14.7%	14.7%
Total	100%	100%	100%	100%	100%

Aroma of Sheabutter-Margarine Pies

	Bread Products				
Response	B121	B122	B123	B124	B125
Non-respondents	-	2.0%	-	-	0.7%
Disliked very much	10.7%	3.3	5.3%	6.7%	4.7%
Disliked much	14.7%	6.7%	4.0%	15.3%	15.3%
Liked moderate	32.7 %	16.0.%	43.3%	40.7%	37.3%
Liked much	24.0%	50.0%	30.7%	27.3%	32.0%
Liked very much	18.0%	22.0%	16.7%	10.0%	10.0%
Total	100%	100%	100%	100%	100%

Aftertaste of Sheabutter-Margarine Pies

	Bread Products				
Response	P111	P112	P113	P114	P115
Non-respondents	-	2.0%	-	-	0.7%
Disliked very much	10.0%	3.3%	4.7%	8.0%	5.3%
Disliked much	19.3%	3.3%	2.7%	15.0%	13.3%
Liked moderate	34.0 %	16.7%	40.0%	24.7%	42.7%
Liked much	23.3%	36.0%	42.0%	43.3%	27.8%
Liked very much	13.3%	38.7%	10.0%	8.7%	9.3%
Total	100%	100%	100%	100%	100%

APPENDIX 3

CAKE

ANOVA

		Sum of Squares	df	Mean Square	F	**p-value**
Taste 1	Between Groups	27.483	4	6.871	7.491	.000
Texture 1	Between Groups	47.598	4	11.900	13.187	.000
Colour 1	Between Groups	42.162	4	10.541	12.634	.000
Aroma 1	Between Groups	27.948	4	6.987	6.174	.000
Aftertaste 1	Between Groups	58.482	4	14.621	13.392	.000

Multiple Comparisons: LSD (Least Significant difference)

			Mean Difference (I-J)	Std. Error	**p-values**	95% Confidence Interval	
Dependent Variable	(I) PRODUCT1	(J) PRODUCT1				Lower Bound	Upper Bound
Taste1	c101	c102	-.534	.1121	**.000**	-.754	-.314
		c103	-.193	.1119	.084	-.413	.026
		c104	-.031	.1113	.779	-.250	.187
		c105	-.091	.1113	.412	-.310	.127
	c102	c103	.341	.1119	**.002**	.121	.561
		c104	.503	.1113	**.000**	.284	.722
		c105	.443	.1113	**.000**	.224	.662
	c103	c104	.162	.1111	.145	-.056	.380
		c105	.102	.1111	.359	-.116	.320
	c104	c105	-.060	.1106	.588	-.277	.157
Texture1	c101	c102	-.699	.1112	**.000**	-.917	-.480
		c103	-.618	.1110	**.000**	-.836	-.400
		c104	-.241	.1104	**.029**	-.458	-.024
		c105	-.321	.1104	**.004**	-.538	-.104
	c102	c103	.081	.1110	.466	-.137	.299
		c104	.457	.1104	**.000**	.241	.674
		c105	.377	.1104	**.001**	.161	.594
	c103	c104	.376	.1102	**.001**	.160	.593
		c105	.296	.1102	**.007**	.080	.513
	c104	c105	-.080	.1097	.466	-.295	.135
Colour1	c101	c102	-.616	.1069	**.000**	-.826	-.407
		c103	-.486	.1067	**.000**	-.696	-.277

		c104	-.333	.1062	**.002**	-.542	-.125
		c105	-.053	.1062	.617	-.262	.155
	c102	c103	.130	.1067	.223	-.079	.340
		c104	.283	.1062	**.008**	.075	.492
		c105	.563	.1062	**.000**	.355	.772
	c103	c104	.153	.1060	.149	-.055	.361
		c105	.433	.1060	**.000**	.225	.641
	c104	c105	.280	.1055	**.008**	.073	.487
Aroma1	c101	c102	-.589	.1245	**.000**	-.833	-.345
		c103	-.421	.1243	**.001**	-.665	-.177
		c104	-.423	.1237	**.001**	-.666	-.180
		c105	-.403	.1237	**.001**	-.646	-.160
	c102	c103	.168	.1243	.176	-.076	.412
		c104	.166	.1237	.179	-.077	.409
		c105	.186	.1237	.133	-.057	.429
	c103	c104	-.002	.1235	.987	-.244	.240
		c105	.018	.1235	.884	-.224	.260
	c104	c105	.020	.1228	.871	-.221	.261
	c105	c101	.403	.1237	**.001**	.160	.646
Aftertaste1	c101	c102	-.842	.1223	**.000**	-1.083	-.602
		c103	-.646	.1221	**.000**	-.886	-.407
		c104	-.413	.1215	**.001**	-.652	-.175
		c105	-.386	.1215	**.002**	-.625	-.148
	c102	c103	.196	.1221	.108	-.043	.436
		c104	.429	.1215	**.000**	.191	.668
		c105	.456	.1215	**.000**	.218	.694
	c103	c104	.233	.1213	.055	-.005	.471
		c105	.260	.1213	**.033**	.022	.498
	c104	c105	.027	.1206	.825	-.210	.264

NOTE: Values in Bold imply that the mean difference is significant at the 0.05 level.

BREAD

ANOVA

		Sum of Squares	Df	Mean Square	F	**p-value**
Taste2	Between Groups	26.692	4	6.673	6.249	.000
Texture2	Between Groups	16.359	4	4.090	4.019	.003
Colour2	Between Groups	21.099	4	5.275	5.378	.000
Aroma2	Between Groups	42.810	4	10.703	10.723	.000
Aftertaste 2	Between Groups	34.456	4	8.614	7.847	.000

BREAD: Multiple Comparisons LSD (Least Significant difference)

			Mean Difference (I-J)	Std. Error	**p-value**	95% Confidence Interval	
Dependent Variable	(I) PRODUCT2	(J) PRODUCT2				Lower Bound	Upper Bound
Taste2	B121	B122	-.530	.1197	**.000**	-.765	-.295
		B123	-.119	.1195	.320	-.353	.116
		B124	-.039	.1195	.745	-.273	.196
		B125	-.146	.1195	.224	-.380	.089
	B122	B123	.411	.1195	**.001**	.177	.646
		B124	.491	.1195	**.000**	.257	.726
		B125	.385	.1195	**.001**	.150	.619
	B123	B124	.080	.1193	.503	-.154	.314
		B125	-.027	.1193	.823	-.261	.208
	B124	B125	-.107	.1193	.372	-.341	.128
Texture 2	B121	B122	-.336	.1169	**.004**	-.565	-.106
		B123	.009	.1167	.937	-.220	.238
		B124	.003	.1167	.983	-.227	.232
		B125	.089	.1167	.445	-.140	.318
	B122	B123	.345	.1167	**.003**	.116	.574
		B124	.338	.1167	**.004**	.109	.567
		B125	.425	.1167	**.000**	.196	.654
	B123	B124	-.007	.1165	.954	-.235	.222
		B125	.080	.1165	.492	-.149	.309
	B124	B125	.087	.1165	.457	-.142	.315
Colour 2	B121	B122	-.423	.1147	**.000**	-.648	-.198
		B123	-.178	.1146	.121	-.403	.047
		B124	.056	.1146	.628	-.169	.280
		B125	-.084	.1146	.461	-.309	.140
	B122	B123	.245	.1146	**.033**	.020	.470
		B124	.478	.1146	**.000**	.254	.703
		B125	.338	.1146	**.003**	.114	.563
	B123	B124	.233	.1144	**.042**	.009	.458
		B125	.093	.1144	.415	-.131	.318
	B124	B125	-.140	.1144	.221	-.365	.085
Aroma 2	B121	B122	-.644	.1157	**.000**	-.872	-.417
		B123	-.086	.1156	.459	-.312	.141
		B124	-.112	.1156	.331	-.339	.115
		B125	-.019	.1156	.870	-.246	.208
	B122	B123	.559	.1156	**.000**	.332	.786
		B124	.532	.1156	**.000**	.305	.759
		B125	.625	.1156	**.000**	.398	.852
	B123	B124	-.027	.1154	.817	-.253	.200
		B125	.067	.1154	.564	-.160	.293

	B124	B125	.093	.1154	.419	-.133	.320
Aftertaste 2	B121	B122	-.577	.1214	**.000**	-.815	-.339
		B123	-.159	.1212	.189	-.397	.079
		B124	-.006	.1212	.962	-.244	.232
		B125	-.072	.1212	.550	-.310	.165
	B122	B123	.418	.1212	**.001**	.180	.656
		B124	.571	.1212	**.000**	.333	.809
		B125	.505	.1212	**.000**	.267	.743
	B123	B124	.153	.1210	.205	-.084	.391
		B125	.087	.1210	.474	-.151	.324
	B124	B125	-.067	.1210	.582	-.304	.171

Values in Bold imply that the mean difference is significant at the .05 level.

PIE

ANOVA

		Sum of Squares	Df	Mean Square	F	**P-value**
Taste 3	Between Groups	76.142	4	19.036	18.671	.000
Texture 3	Between Groups	28.776	4	7.194	8.281	.000
Colour 3	Between Groups	31.009	4	7.752	8.910	.000
Aroma 3	Between Groups	40.610	4	10.153	9.256	.000
Aftertaste3	Between Groups	82.316	4	20.579	19.420	.000

Multiple Comparison LSD (Least significant difference)

			Mean Difference (I-J)	Std. Error	**p-value**	95% Confidence Interval	
Dependent Variable	(I) PRODUCT3	(J) PRODUCT3				Lower Bound	Upper Bound
Taste 3	P111	P112	-.843	.1172	**.000**	-1.073	-.613
		P113	-.200	.1166	.087	-.429	.029
		P114	.040	.1166	.732	-.189	.269
		P115	-.116	.1168	.320	-.345	.113
	P112	P113	.643	.1172	**.000**	.413	.873
		P114	.883	.1172	**.000**	.653	1.113
		P115	.727	.1174	**.000**	.496	.957
	P113	P114	.240	.1166	**.040**	.011	.469
		P115	.084	.1168	.473	-.145	.313
	P114	P115	-.156	.1168	.181	-.385	.073
Texture 3	P111	P112	-.504	.1082	**.000**	-.716	-.291

		P113	-.207	.1076	.055	-.418	.005
		P114	.060	.1076	.577	-.151	.271
		P115	-.163	.1078	.130	-.375	.048
	P112	P113	.297	.1082	**.006**	.085	.509
		P114	.564	.1082	**.000**	.351	.776
		P115	.340	.1084	**.002**	.127	.553
	P113	P114	.267	.1076	**.013**	.055	.478
		P115	.043	.1078	.688	-.168	.255
	P114	P115	-.223	.1078	**.039**	-.435	-.012
Colour 3	P111	P112	-.580	.1083	**.000**	-.792	-.367
		P113	-.227	.1077	**.036**	-.438	-.015
		P114	-.093	.1077	.386	-.305	.118
		P115	-.083	.1079	.441	-.295	.129
	P112	P113	.353	.1083	**.001**	.140	.565
		P114	.486	.1083	**.000**	.274	.699
		P115	.496	.1084	**.000**	.283	.709
	P113	P114	.133	.1077	.216	-.078	.345
		P115	.143	.1079	.184	-.068	.355
	P114	P115	.010	.1079	.925	-.202	.222
	P115	P111	.083	.1079	.441	-.129	.295
		P112	-.496	.1084	**.000**	-.709	-.283
		P113	-.143	.1079	.184	-.355	.068
		P114	-.010	.1079	.925	-.222	.202
Aroma 3	P111	P112	-.583	.1215	**.000**	-.822	-.345
		P113	-.253	.1209	.037	-.491	-.016
		P114	.053	.1209	.659	-.184	.291
		P115	-.035	.1211	.772	-.273	.203
	P112	P113	.330	.1215	**.007**	.091	.568
		P114	.636	.1215	**.000**	.398	.875
		P115	.548	.1217	**.000**	.309	.787
	P113	P114	.307	.1209	**.011**	.069	.544
		P115	.218	.1211	.072	-.020	.456
	P114	P115	-.089	.1211	.465	-.326	.149
Aftertaste 3	P111	P112	-.948	.1195	**.000**	-1.182	-.713
		P113	-.400	.1189	**.001**	-.633	-.167
		P114	-.187	.1189	.117	-.420	.047
		P115	-.128	.1191	.282	-.362	.106
	P112	P113	.548	.1195	**.000**	.313	.782
		P114	.761	.1195	**.000**	.527	.996
		P115	.820	.1197	**.000**	.585	1.054
	P113	P114	.213	.1189	.073	-.020	.447
		P115	.272	.1191	**.023**	.038	.506
	P114	P115	.058	.1191	.624	-.175	.292

NOTE: Values in Bold imply that the mean difference is significant at the .05 level.

APPENDIX 4

PICTURES OF SHEABUTTER-MARGARINE PASTRIES PROJECT

Weighed unrefined sheabutter

100% creamed sheabutter and sugar

Mixing of 100% sheabutter dough for 100% sheabutter pie

Rolling of dough for 100% sheabutter dough for100% sheabutter pie

Pastries being baked in the oven

FRESHLY BAKED SHEABUTTER-MAGARINE CAKES

Freshly baked 100% sheabutter cake

Freshly baked 100% margarine cake

25% sheabutter: 75% sheabutter cake

75% sheabutter: 25% sheabutter cake

50% sheabutter: 50% sheabutter cake

FRESHLY BAKED SHEABUTTER-MAGARINE BREADS

100 % sheabutter bread

100 % margarine bread

50 sheabutter: 50% margarine bread

75% sheabutter: 25% margarine bread

25% sheabutter: 75% margarine bread

FRESHLY BAKED SHEABUTTER-MAGARINE PIES

Freshly baked 100% margarine pie

Freshly baked 100 % sheabutter pie

50% sheabutter: 50% margarine pie

25% sheabutter: 75% margarine pie

75% sheabutter: 25% margarine pie

THE SENSORY ANALYSIS

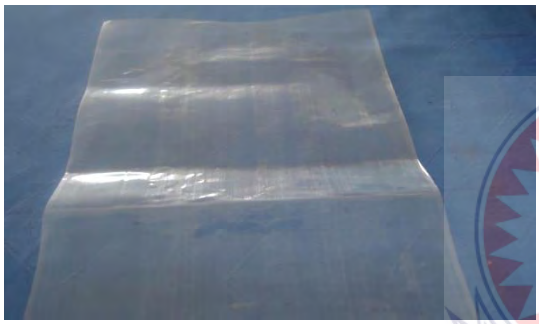
Researcher (in glasses) pre-briefing a section of participants prior to sensory analysis.

Participants assessing the attributes of sheabutter-margarine pastries

PACKAGING MATERIALS

Aluminum foil

Cling film



Polypropylene

Polyethylene

Packaged sheabutter-margarine pastries for storage (Front-Pie, Centre-Cakes, Far end-Bread)

STORAGE LIFE OF SHEABUTTER-MARGARINE PASTRIES AT ROOM TEMPERATURE

100% margarine cake stored in polyethylene at day 9.

100% margarine cake stored in aluminum foil at day 9.

100% sheabutter cake stored in polypropylene at day 9.

100% margarine cake stored in polypropylene at day 9.

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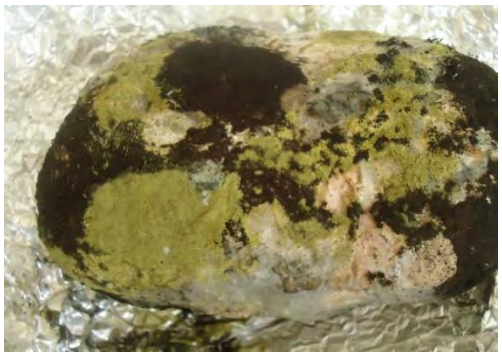
50% sheabutter 50% margarine bread stored in aluminum foil at day 9

25% sheabutter: 75% margarine bread stored in aluminum foil at day 9.



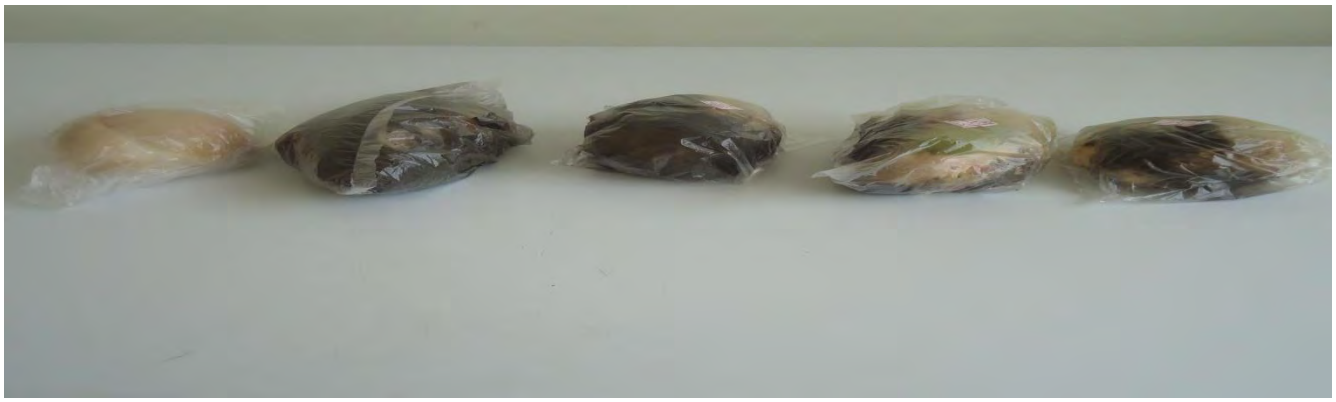
100% margarine bread in aluminum foil at day 9

50 % sheabutter: 50% margarine bread in polypropylene at day 9

100% sheabutter bread in aluminum foil. at day 9.

100% sheabutter bread in polyethylene at day 9

Bread stored in cling film at 21 days. From left to right: 100% sheabutter, 100% margarine, 50% sheabutter:50% margarine, 75% sheabutter :25% margarine, 25% sheabutter :75% margarine.



Bread stored in polyethylene at 9 days. From left to right: 100% sheabutter, 100% margarine, 50% sheabutter:50% margarine, 75%sheabutter:25% margarine, 25%sheabutter :75% margarine.

100% margarine pie in aluminum foil at day 9

100% sheabutter pie in aluminum foil at day 9