



بسم الله الرحمن الرحيم

**Sudan University of Science and
Technology**



**College of Agricultural Studies
Department of Food Science and Technology**

Assessment of the effect addition of baobab (*Adensoniadigatata*) fruit pulp on properties of cow's milk yoghurt

تقييم أثر إضافة بدرة ثمرة التبلاي علي خصائص زبادي
لبن البقر

A Thesis Submitted in Partial Fulfillment for the Requirement of the
Degree of B.Sc in Food Science and Technology

BY:

Emad Eldeen Ali Mohammed
Elzain Elsammani Ali
Marwa Abu Alkhairat Adam

Supervisor:

Prof. Yosif MohammedAhamedIdress

November- 2018.



الآية

قال تعالى :

﴿ وَإِنَّ لَكُمْ فِي الْأَنْعَامِ لَعِبْرَةً نُسْقِيكُمْ مِمَّا فِي بُطُونِهِ مِنْ

بَيْنِ فَرْثٍ وَدَمٍ لَبَنًا خَالِصًا سَائِغًا لِلشَّارِبِينَ ﴾

صدق الله العظيم.

سورة النحل الآية (66)

قال تعالى:

﴿ فِيهَا فَاكِهَةٌ وَالنَّخْلُ ذَاتُ الْأَكْمَامِ ﴾

صدق الله العظيم.

سورة الرحمن الآية (11)

قال تعالى:

﴿ فَتَعَالَى اللَّهُ الْمَلِكُ الْحَقُّ وَلَا تَعْجَلْ بِالْقُرْآنِ مِنْ قَبْلِ أَنْ

يُقْضَىٰ إِلَيْكَ وَحْيُهُ وَقُلْ رَبِّ زِدْنِي عِلْمًا ﴾

صدق الله العظيم.

سورة طه الآية (114)

DEDICATION

To our families

To our doctors

And to our friends

With thank

ACKNOWLEDGEMENTS

Prayers and thanks to **ALLAH** who gave us good health and support to accomplish this study.

Grateful thanks to our supervisor **Prof. YosifMohammedAhamedIdress** who was too patient with our during this study, also for his unlimited assistance and guidance which made this study wrathful. And especial thanks to Animal Production Department for help in production and jica lap staff for help in analysis of yogurt.

Especial thank and genuine gratitude are extended to our **families** and our **friends** for encouragement and support during our study

ABSTRACT

This study was conducted to assess the effect of addition of baobab fruit pulp on properties of cow's milk yoghurt.

Milk was pasteurized to 75 centigrade for 15 minutes and then cooled to 45 centigrade.

skim milk powder (fat was 0.8%, solids non-fat was 95.2% and total solids 96%). was added Fruit bobaob powder (5% (C), 10%(B), 15%(A) was added to control (D) after inoculation with 15 grams (yoghurt culture of lactobacillus delbrueckii subsp bulgaricus and streptococcus thermophiles) from starter culture per 100 millitre from milk Incubation was carried out at 45 centigrade for one hr.

Yoghurt was stored under refrigerator temperature for one week and analysis of chemical ,physiochemical ,sensory characteristics were carried out .Results indicated that addition of baobab fruit powder increased chemical ,physiochemical properties of yoghurt in comparison to control and increase level of ascorbic acid and fibers .The taste ,texture and flavor were better in B judged by panelists ,while general acceptability was better in A and color was better in C .

It could be concluded that addition of fruit pulp improved yoghurt quality.

ملخص الدراسة

أجريت الدراسة بغرض تقييم أثر إضافة بكرة ثمرة التبدي الي زيادي لبن البقر ، وتمت بسترة الحليب عند درجة حرارة 75 م لمدة 15 دقيقة مع إضافة لبن بكرة منزوع الدسم بنسبة دهن 0.8% ، المواد الصلبة الغير دهنية بنسبة 90.2% والجوامد الصلبة الكلية بنسبة 96% ونسب مختلفة من بكرة ثمرة التبدي بنسبة (5% C ، و 10% B ، و 15% A) مضافا اليهما العينة الضابطة ومن ثم التحضين بعد اضافة 15 جرام من البادئ عند درجة حرارة 45م وزمن قدرة ثلاث ساعات ، بعد ستة يوم من الانتاج تم اجراء الاختبارات الكيميائية والفيزيوكيميائية وكذلك الاختبارات الحسية للتذوق النتائج دلت علي عدم زيادة ملحوظة في الخصائص الكيميائية والفيزيوكيميائية للزيادي المعامل مقارنة مع العينة الضابطة .

الطعم والقوام والنكهة للزيادي أفضل في العينة B تبعا لحكم المتذوقين ، ودرجة القبول العام هي الافضل في العينة A واللون هو الافضل في العينة الضابطة .

نستنتج أن اضافة لب ثمار التبدي قد حسنت جودة الزيادي .

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CHAPTER ONE

1. INTRODUCTION

Yoghurt is defined as a coagulated milk product obtained by the fermentation of lactose into lactic acid through the action of *Lactobacillus delbrueckii subsp. bulgaricus* and *Streptococcus thermophilus* from milk with or without additions (Trachoo, 2002).

Yoghurt is a valuable health food for infants and elderly people, and the nutritional constituents of yoghurt are derived from the milk used in the manufacture, in addition to those synthesized by the lactic acid bacteria and those added by the manufacturers (Ayaret *al.*, 2006).

The consumption of Yoghurt has been associated with health benefits which include protection against gastrointestinal upsets, enhancing lactose digestion by maldigesters, decreasing risk of cancer, lowering blood cholesterol, improving immune response, helping the body to assimilate protein, calcium and iron, longevity, diarrhea protection and control as well as maintenance of gastrointestinal microflora (Alyet *al.*, 2004; Fodaet *al.*, 2007; Iwalokun and Shittu, 2007; Vahedet *al.*, 2008; Andronoiuet *al.*, 2011).

The benefits of yoghurt consumption to gastrointestinal function are most likely due to effects mediated through gut microflora, bowel transit, enhancement of gastrointestinal innate and adaptive immune responses (Adolfssoet *al.*, 2004).

Consumers, especially children, demand novel yoghurt formulations more than traditional ones like plain yoghurt. Introduction of various fruit-flavored yoghurts has significantly contributed to the consumption of yoghurt from all ages. A variety of different flavoring ingredients (fruits, natural flavors or synthetic flavors) are currently added to yoghurt. The types

of flavoring materials used are fruits, fruit preserves, canned fruits, frozen fruits and miscellaneous fruit products (Kukuonear and Tarakçi, 2003). Most common fruits used in yoghurt formulae are peach, cherry, orange, lemons, purple plum, boysenberry, spiced apple, apricot, pineapple, strawberry, raspberry and blueberry (Cinbas and Yazici, 2008).

Adenosniadigatata (locally known as baobab) is a fruit producing from al a large tree of widespread occurrence in the semi-arid and some parts of world e.g.madagacar,india and mainland of Africa.

The fruit is rich in high level of vitamin (C) about 74-163 mg for each 100 grams, potassium, calcium, iron, phosphorus, riboflavin (shackle ton, 2000 and van dammed,2010).

Main objectives:-

To produce yoghurt of high quality with added bobaob fruit

Specifics objectives:-

- Determination of physiochemical and sensory charachertics of cow's milk yoghurt .
- -Evaluation of the addition of Baobab fruit pulp on properties yoghurt of cow's mil

CHAPTER TWO

2.1. Baobab

Baobab is the common name of genus of trees (ad Ansonia) other common name include boa, baobab, bottle tree, the tree of life upside-down tree, and monkey bread tree.

The reach heights of 5 to 30 meters and trunk diameters of 7 to 11 meters, its trunk can hold up 120.000 meter for most of year, the tree is leafless and looks very Machlike it has its roots sticking up in the air

2.1.1. Classification

Kingdom: Planate

Division: Magnoliophyta

Class: Magnolipsida

Family: Malvaceae

Genus: Adansonia

Species: Grandldieri

There are nine species; six species live in the drier parts of Madagascar, to in mainland Africa, one in Australia, three in India and Ranchi (Koren, 2010).

2.1.2. Ecology

Baobabs store water in the trunk (up to 120.000 liter) or 32000 us gallons to endure harsh drought conditions, all occur in seasonally arid areas, and are deciduous, shedding their leaves during the dry season, across Africa, the oldest and the largest baobabs began to die in the early 21st century.

Likely from a combination of drought and rising temp, the trees appear to become parched, and then become dehydrated and unable to support their trunks (Longe, 2010).

2.1.3. Description.

baobabs reach height 5 to 30 m (16 to 98 ft.) and have trunk diameter of digitata in Limpopo province, south Africa was considered to be the largest living individuals, with a maximum circumference of 47 m and a diameter of about 95.9 m .the tree has since split into two parts so the widest individual trunk may now be that of the Sunland baobab ,or plat land tree, also in south Africa the diameter of this tree at ground level is 9.3m and its circumference at breast height is 34m(112ft) (Armstrong,1977).

It Documented in Baum (Baum,1995). Darwin documented baobab tree well The St Jag in the Cape Verde Islands in 1832 and he commented is On their size and longevity(Armstrong, 1977). *Adansonia digitata* L. is the most Widely spread of the *Adansonia* species on the African continent Which belongs to the family of Bombacaceae a sub family of the Malvaceae.

Adansonia species comprises of 8 different species with a Large, spectacular, nocturnal flowers (Baum, 1995). It occurs throughout the drier parts of Africa. A second Species is restricted to North-Western Australia (*A. gibbons*), and the Remaining six species are endemic to Madagascar (Wendle,2002).

African baobab is a very long-lived tree with multipurpose uses. It is thought that some trees are over 1000 years old

Using of baobab tree parts 2.1.4.

2.1.4.1. Leaves:

The leaves are staple food for many populations in Africa most

Especially the central region of the continent (Ebert, 2002). In Malawi they are boiled with potash (Williamson, 1975). In Zimbabwe, they provide fresh vegetables that are substituted for the commercially grown leafy vegetables such as cabbages and lettuce (Shackleton, 2002). In the northern part of Nigeria, the Hausas use the leaves for soup e.g. miyan kuaka (Vander, 1994).

2.1.4.2. Fruits pulp:

The fruit pulp is one of the most important parts of the tree this used as food. Ripped fruit pulps are removed from the fibers and seeds by kneading in cold water; and then added to thick grain preparations to make thinner gruels. The dry pulp is either eaten fresh or used to add to gruels on cooling after cooking and that is also a good way of preserving the vitamin content.

The fruit pulp is said to have very high vitamin C content; almost ten times that of an orange (Vandaemme, 2010). Ighodaletat Recorded 337mg.

Ascorbic acid/100g of the pulp for fruits in Nigeria. The Baobab Fruit Company in 2002 recorded 34-200mg/100g of ascorbic acid; and (Pitman, 1972).

Stated levels were higher than in orange. Special attention has been given to measuring vitamin C in baobab fruit pulp due to occasional reports of high content.

2.1.4.3. Seeds:

The Seeds are used as a thickening agent in soups; they are also Fermented and used as a flavoring agent, or roasted and eaten as Snacks (Addey, 1986). When they are roasted, they are sometimes used as a substitute for coffee. Fermentation of powdered de-hulled seeds is known to increase Protein digestibility. It also reduces the trypsin inhibition activity but increases tannin content (salami, 1984). The baobab seeds are ground with peanuts and water and sugar added to make a sauce used with Porridge. Seed pulp is sometimes known as monkey bread and is eaten and traded in the different regions (Shacklton, 2000). The seeds have an Energy value of 1803 kJ/100g approximately 50% higher than leaves, Moisture 8.1%, protein 33.7%, and fat 30.6%, carbohydrates 4.8%, Fiber 16.9% and ash 5.9% (Arnold, 1985). The vitamin C content of the baobab Seeds have not been researched extensively but they are known to contain high levels of lysine, thiamine, CA and Fe (Abbiw, 1990).

2.1.4.4. Seeds oil:

The oils have been used for centuries by local communities for The purpose of food, medicine, cosmetic applications and production Of lubricants, soaps and personal care products. The oils were used in Topical treatment of various conditions such as hair dandruff, muscleSpasms, varicose veins and wounds (Chivandi, 2008). The baobab seeds oils Contained high proportions of linoleic and oleic acid as well as Polite and α -linoleic acid (**Ezeagu, 1989**).

2.2.1. Milk:

Defines as those liquid containing milk proteins, fats, lactose, and various vitamins and mineral and produced by the mammary glands of all adult female mammals after child birth and serves as food for their young.

It should be noted that milk culture is infested with sanctity of the cow in the ancient Egypt, Iran, and India. In the middle age were the men producers of cheese for example bishop, Munster. Thus, before scientific revolution and industrial development in Europe during the nineteenth century, were fabrications and techniques of fermented milk, butter and cheese already had a considerable importance in human life (Konte, 1999- Kebchaoui, 2012.).

Milk must be specific to human consumption i.e. come from well-nourished healthy lactating animals. Milk should have a temperature of +4°C during all apparitions and delivery to the consumer (Koehler, 2013).

2.2.1. Physical properties of milk:

Milk is an emulsion or colloid of butter fat globules within water based fluid that contains dissolved carbohydrates and protein aggregates with minerals.

Because it's produced as a food source for young, all of its contents provide benefit for growth.

The principles of energy (lipids, lactose and protein) biosynthesis of non-essential amino acids supplied by proteins, vitamins, inorganic acids elements and water.

2.2.1.1. Appearance

Both the fat globules and the smaller casein micelles, which are just large enough to deflect light, contribute to the opaque white color of milk.

The fat globules contain some yellow-organic carotene, to impart a golden or "creamy" hue to glass of milk.

The riboflavin in the whey protein of milk has a greenish color which sometime can be discerned in skimmed milk or why products sera2009)

2.2.1.2. Miscellaneous contents:

Other component found in rowscow's milk are living white blood cells mammary gland cells various Bactria and a large number of active enzyme.

2.2.2. Chemical components of milk:

The nutritional value of milk is particularly high due to the balance of the nutrients that compose it The composition varies among animal species and breeds within the same species, and also from one dairy to the other, depending on the period of lactation and diet. Milk is 88% water and 11.4% solids it contains 3.2% fat and 8.13% of fat solids. it is also comprised of calcium (0.11%), phosphate (0.08%) and magnesium (0.21%). (Gautheron and lepouze, 2012).

2.2.2.1. Water:

For all animals, water is the nutrient required in the highest quantity and milk contains a lot of water (88.6%) This amount of water is controlled by the amount of lactose synthesized by the secretory cells of the mammary gland (**Lepouze, 2012**).

2.2.2.2. Protein:

The proteins in milk are of great quality, that is to say, they contain all the essential amino and acid elements that our bodies cannot produce. It is important to remember that proteins are the building blocks of all living tissue. Milk proteins have roughly the same composition as the age protein, except for the amount of methionine and cysteine,

significantly lower. The sulfur amino acids are the limiting factors in milk. (Konte, 1999).

2.2.2.3. Caseins:

The four major caseins that exist naturally in milk are α_1 caseins; α_2 , β and κ Caseins are distinguished by their low solubility at pH 4.6 and are differentiated on the basis of the distribution of exchange and sensitivity to precipitation by calcium (Brule et al 1997).

2.2.2.4. Whey protein:

Other milk proteins are present in the whey serum and whey proteins are defined as soluble proteins in the whey after precipitation of caseins at pH 4.6 and at 20°C. Serum proteins include a first protein fraction (80%) consisted of β lactoglobulin (B LG), β Lactalbumin (LA Da), bovine serum albumin (BSA) and immunoglobulin (Filio, 2006).

2.2.2.5. Fats:

Fat is the main source of energy cow milk is low in polyunsaturated fatty acids that are necessary for human metabolism (Grand-Pierre et al, 1988)

fat is present in milk in the form of an emulsion of fat cells; the concentration of the fat content of milk can be found in small cells suspended in water which varies considerably by race and compositions of feed. Most unsaturated fats in our diet are in the cis-form, and a lower proportion are in the trans form (Stander and Dyerbery, 2003).

2.2.2.6. Carbohydrate:

Lactose is the main carbohydrate of milk it is formed by the union of one molecule of D-GA lactose (engaged by its semi acetyl function) and one molecule of D-glucose (committed by its hydroxyl 4 position). It has a B- Galactoside 1, 4bond (which is hydrolyzed by a β galactoside) and is a 4- glucopyranosyl –B-D galactopyranose .it does not has sweet flavor it Is about (4.5 to 5.2 g / 100 g) contrary to the concentration of fat, that of lactose that of lactose modified by feeding and true step of a dairy race to another it used as substrate during the fermentation of milk by acetic acid bacteria differing in the fermented products such as yoghurt andcheese (**Fillion, 2006**).

2.2.2.7. Vitamins:

Levels of vitamin A, D and E are variable, depending on the season as there is , a slight increase during the pasture season (spring summer). They are fat-soluble ,so it is found n fat and can be lost during skimming .another vitamins are soluble in water are found in the serum the case of ascorbic acid (C)it is present in small quantities in fresh milk is destroyed by contact with air and also during pasturization (Scrod's ,1982) for cow milk ,the milk processing techniques can significantly change the amounts of vitamins vitamin C (**Florence, 2010**).

2.2.2.8. Enzymes:

Enzymes are specific globular proteins produced by living cells. Each Enzyme has its isoelectric point and is susceptible to various denaturing agents such as pH change, temperature, ionic strength,organic solvent (**Carole and Vignola, 2002**).

2.2.2.9. Minerals:

They play an important role in the structural organization of casein micelles, the major salts constituents, potassium, calcium, casein micelles, are distinguished if the content is greater than 0.1g per liter of those containing trace amounts (Florence, 2010).

2.2.2.10. PH:

The pH of milk ranges 6.4 to 6.8 and it changes over time; milk from other bovines and non-bovine mammals varies in composition but has a similar pH.

2.3. Yoghurt:

Definition:

Yoghurt is defined as a coagulated milk product obtained by the fermentation of lactose into lactic acid through the action of *Lactococcus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* from milk with or without additions (Trachoo, 2002).

Yoghurt is a product made from heat-treated milk that may be homogenized prior to the addition of lactic acid bacteria (LAB) cultures containing *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Code of Federal Regulations Section 131.203, 2011). Similarly, (Tamime, 2002).

Yoghurt is a product being manufactured from milk with or without the addition of natural derivatives of milk, such as skim milk powder, whey concentrates, caseinates or cream with a gel structure. These results from the coagulation of bacteria culture. Furthermore, these bacteria must be "viable and abundant" at the time of consumption (Serra *et al.*, 2009).

2.3.1. Yoghurt starter culture:

Micro-organisms are important in dairy product .One of the most important groups of acid product bacteria in the food industry is the lactic acid bacteria (LAB) which are balance for starter culture for dairy products .The proper selection and balance for starter culture is critical for the manufacture of fermented products of desirable texture andflavor (**Adib and Bertr 2009**).

2.3.2. Health benefit of yoghurt:

Yoghurtis a valuable health food for infants and elderly people, and the nutritional constituents of Yoghurt are derived from the milk used in the manufacture, in addition to those synthesized by the lactic acid bacteria and those added by the manufacturers (**Ayaret al., 2006**).

The consumption of yoghurt has been associated with health benefits which include protection against gastrointestinal upsets, enhancing lactose digestion by maldigesters, decreasing risk of cancer, lowering blood cholesterol, improving immune response, helping the body to assimilate protein, calcium and iron, longevity, diarrhea protection and control as well as maintenance of gastrointestinal microflora (**Alyet al., 2004; Fodaet al., 2007; Iwalokun and Shittu, 2007; Vahedet al., 2008; Andronoiuet al., 2011**).

The benefits of yoghurt consumption to gastrointestinal function are most likely due to effects mediated through gut microflora, bowel transit, and enhancement of gastrointestinal innate and adaptive immune responses. The nutrient composition of yoghurt is based on the nutrient composition of the milk from which it is derived, which is affected by many factor, such as genetic and individual mammalian differences, feed, stag oflactation, age, and environmental factors such as the season of the year. Other variable that play a role during

processing of milk ,including temperature ,duration of heat exposure ,exposure to light ,and storage condition ,also affect the nutritional value of final product . In addition, the changes in milk constituents that occur during lactic acid fermentation influence the nutritional and physiologic value of the finished yoghurt. The specific health benefits depend on the strain and viability of the culture in yoghurt, the source and type of milk solids that may be added before fermentation, and the temperature and duration of the fermentation process(**Adolfssoet al., 2004**).

Yoghurt is considered as healthy food due its high digestibility and bioavailability of nutrient and also can be recommended to the people with lactose intolerance,gastrointestinal disorder such as inflammatory bowel disease and irritable bowel disease ,and aids in immune function and weight control ,because of these health benefits associated with yoghurt consumption ,there is an increasing trend for yoghurt and is the fastest growing dairy category in the market in particular ,standard yoghurt and yoghurt drinks. Yoghurt is more nutritive than milk in vitamin content for its digestibility .It is also used as sources of calcium and phosphorous .It is believed that yoghurt has valuable “therapeutic properties” and helps in curing gastrointestinal disorder.Yoghurtmay aid digestion, ease diarrhea,boost immunity and protect against cancer (**O'sullivaet al.,1992**).

Being nutritionally rich in protein, calcium, riboflavin, and vitamin B6, and vitamin B12, yoghurtis considered to have more nutritional benefits than milk.

Benefits of (LAB) bacteria in yoghurt on the gastrointestinal function and health yoghurt and (LAB) bacteria contribute to several factors that enhance the gut function and

health. The made of gastrointestinal flora ,the immune response against pathogens .Gut micron flora play a major role against exogenous infectious bacteria through colonization resistance .Most of the bacteria that cross the barriers stomach and small intestine well be live ,metabolically active and colonized with in the gut ecosystem **(Chandan and Kilara,2013)**.

Yoghurt is one of the most popular fermented dairy products worldwide which has great consumer acceptability due to its health benefits other than its basic nutrition. In general, yoghurt is considered as a nutrition-dense food due to its nutrient profile and is a rich source of calcium that provides significant amounts of calcium in bio-available form. In addition, it provides milk proteins with a higher biological value and provides almost all the essential amino acids necessary to maintain good health. Yoghurt is considered as a pro-biotic carrier food that can deliver significant amounts of pro-biotic bacteria into the body which can claim specific health benefits once ingested. These are usually marketed as bio-yoghurt . Moreover, yoghurt is reported to claim improved lactose tolerance, immune enhancement and prevention of gastrointestinal disorders, because of these known health benefits of yoghurt, consumer demand for yoghurt and yoghurt related products has been increased and became the fastest growing dairy category in the global market. Yoghurt is now being manufactured in a numerous styles and varieties with different fat contents, flavors and textures suitable for different meal occasions and plates as a snack, dessert, sweet or savory food **(O'sullivan *et al.*, 1992)**.

2.3.3. Manufacturing of Yoghurt:

Manufacturing of yoghurt is an ancient technique, which dates back to thousands of years, and the knowledge has transferred generation to generation. However, during the last few decades, it became more rational due to improvement of various fields such as microbiology, biochemistry and food engineering. Today it is a complex activity combined with art and science. The generalized process of yoghurt making is comprised of modifying the original composition of milk, pasteurizing the yoghurt mix, fermentation at thermophilic temperatures (40-45⁰C), cooling and addition of fruits and flavors. The process of yoghurt making is an ancient craft which date back thousands of years, and over the last few decades the process has become more rational due to improvements in such disciplines as microbiology, engineering and chemistry **(Tamime ,Robinson,1999)**.

2.3.4. Main processing steps of yoghurt making:

The main processing steps in the manufacture of this product include milk standardization, heat treatment, homogenization, addition of starter culture and fermentation, next cooling and finally storage of end product .many other processing steps (e.g. Addition of sugar or fruit) practiced for some products **(Lucey, 2002)**.

2.3.4.1. Milk standardization:

In yoghurt production we have to consider important basics in manufacture, that is the fat content should be standardized to the level preferred by the market, and also the total solid is often being increased by adding dried skim milk, condensed milk or skim milk or liquid milk .and the increase in the milk solids is to get amore firm coagulum **(Shori and Baba, 2012)**

Milk solid content of yoghurt seems to be varied from 14-15% in commercial Yoghurt products and the minimum milk solids nonfat content varies from 8.2-8.6% according to the standards and regulations of many countries **(Tamime and Robinson, 1999)**.

According to the Codex Alimentarius Commission yoghurt should have a minimum protein content of 2.7% and a maximum fat content of 15% **(CAC, 2010)**.

In order to achieve this, the FAO/WHO standards specify that milk should be standardized with the minimum SNF and milk fat content of 8.2% and 3% respectively for Yoghurt manufacture. The average composition of bovine milk comprised of 4.5% lactose, 3.3% protein, 3.5% of fat and 0.7% mineral matter. Therefore, it is obvious that the composition of yoghurt is varied according to the variety, and yoghurt mixture should therefore standardize accordingly in such a way that produce an end product with not less than 2.7% of protein and less than 15% of milk fat with a titrable acidity not less than 0.3% expressed as percentage of lactic acid **(CAC, 2010)**.

Stabilizers such as pectin and gelatin are added to the yoghurt mix in order to attain the characteristic properties of yoghurt namely, texture, mouth feel, appearance, viscosity and to inhibit the whey separation **(Tamime and Robinson, 1999)**, **(Lee and Lucey, 2010)**. However, both over-stabilization and under-stabilization may cause quality defects as the over-stabilization results in a “jello-like” springy body of yoghurt, whereas the under-stabilization causes “runny body” or whey separation **(Lee and Lucey, 2010)**.

2.3.4.1. Homogenization:

Homogenization treatment reduces the diameter of fat globules to less than 1µm and ensures uniform distribution throughout the food matrix, thus considered as an important processing step especially for yoghurt with high fat content. Consequently, it results no distinct creamy layer on surface of the yoghurt and improves consistency of the yoghurt. Homogenization is accomplished by using a homogenizer or viscolizer where the milk is forced through small openings at a high pressure in which the fat globules are broken up due to the shearing forces. Typically, milk is homogenized using pressures of 10-20 and 5 MPa in first and second stages, respectively for over 10-17 min (**Lee and Lucey, 2010**).

More recently, ultra-high pressure homogenization has been introduced to the commercial yoghurt manufacture leading to an increase in yoghurt firmness and water holding capacity comparatively to that of the conventional homogenization process (**Serra, et al., 2009**), (**Serra, et al., 2008**).

2.3.4.3. Heat treatment:

It is generally considered that the heat treatment of milk is an essential step in yoghurt manufacturing process that greatly influences the microstructure and physical properties of Yoghurt. Heat treatment has a number of beneficial effects as it will destroy the microorganisms present in milk or yoghurt mixture which can potentially interfere with the controlled fermentation process, will denature the whey proteins that will give the final product a better body and texture, and will release the compounds in milk that stimulate growth of the starter culture microorganisms. In addition, it will help some ingredients to achieve the required state to form gels and protein lattice, that affects the final texture and viscosity of the product while aids in removing dissolved oxygen in the milk and thereby assists the

starter culture growth as they are sensitive to oxygen (**Lee and Lucey, 2010**).

Heat treatment is a continuous- or batch-process involves heating of milk to relatively high temperature and hold in there for pre-determined time period. The time-temperature combinations for the batch heat treatments that are commonly employed in the commercial yoghurt making include 85⁰C for 30 min and 90-95⁰C for 5 min .Alternative time-temperature combinations

availableforthemilkpasteurizationaresummarizedin the Table1. Despite the time-temperature combination used, it is a must to fulfill the minimum requirement to destroy the most heat resistant pathogen currently recognized in milk, *Coxiellaburnetii* that cause Q-fever in human .Heat treatment of milk is important to destroy unnecessary pathogenic organismsand enzymes present in milk

(Tamime and Robinson, 1999).

2.1.Fermentation:Table1: Time-temperature combinations for milk pasteurization process:

Type of holding pasteurization	Process	Temperature (°C)	Time
Low temperature Long time (LTLT)	Batch	62.8	30min
High temperature Short time (HTST)	Continuous	71.7	15s
Higher Heat Shorter Time (HHST)	Continuous	88.3	1s
Ultra-pasteurization	Continuous	137.8	2s
Ultra High Temperature (UHT)	Aseptic	135-150	(4-15)s

Source: Food and Drug Administration,(2011)

After heat treatment,the milk base is cooled to the incubation temperature used for growth of the starter culture an optimum temperature of the thermophilic lactic acid bacteria , i.e., *Streptococcus*subsp.*thermophilus* and *lactobacillusDelbrueckii*subsp.*bulgaricus* ,is around (40-45) °c .Bacterial fermentation converts lactose into lactic acid ,which reduces the pH of milk. During acidification of milk, the pH decrease from 6.7 to ≤4.6 (Lee and Lucey, 2010).

2.3.4.5. Cooling:

When yoghurt has reached the desired pH (4.5-4.6), it will then often blast chilled to refrigerated temperatures (<10°C) in order to stop the fermentation process and there by stops further acid development (Lee and Lucey, 2010).

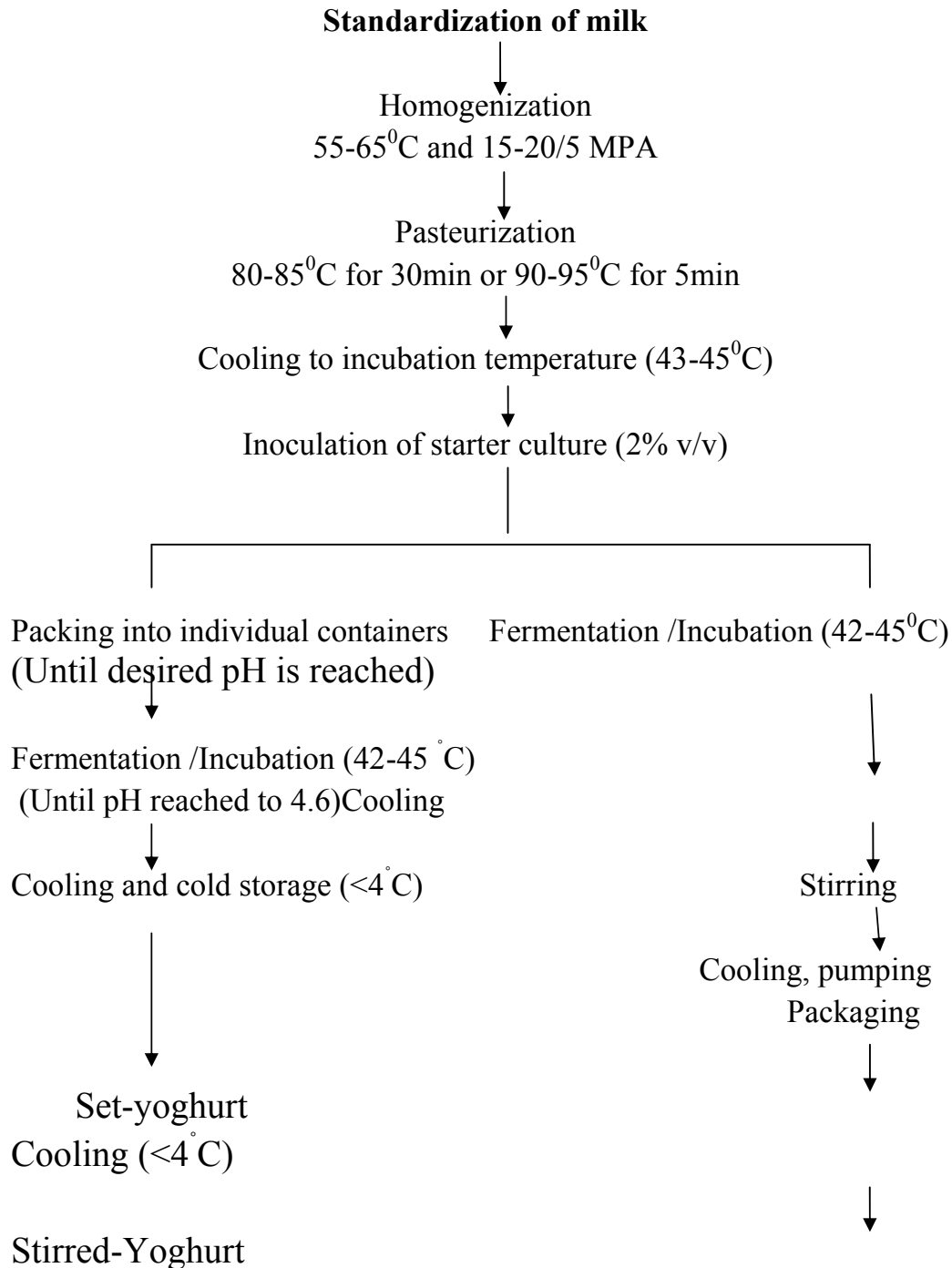


Figure 1: The production steps in manufacture of stirred and set yoghurt are illustrated by (Lee and Lucey, 2010).

2.3.5.Shelf life of Yoghurt :

The shelf life of fresh yoghurt may be only a couple of weeks for unprotected operations and up to 6 weeks or more for well-operated –ultra clean operation and short, even if stored at low temperatures this may be due to the sanitary problems usually associated with its production and due to unhygienic handling of the product, which increases microbial contamination. The high microbial load of yoghurt coupled with the packaging and storage conditions result in the formation of off flavors and undesirable physicochemical changes that eventually lead to rejection of product. One of the most accepted ways extend the shelf life of perishable food products are through the use of bio-preservatives (**Serra *et al.*, 2008**).

2.3.6. Factors affecting the quality of yoghurt:

There are many factors affecting the quality of Yoghurt , but the most important factors are: types and composition of milk, heat treatment, starter culture, storage period of Yoghurt and the additives in yoghurt (**Shori and Baba, 2012**).

2.3.7.Types of yoghurt:

a) Depending on method of production, the industries recognize two main type of yoghurt that is set and stirred, this classification is based on the system of manufacturing and physical structure of the coagulum (**USDA, 2001**)

b) Based on flavor, there are different types of product:

-The first type namely natural or plain yoghurt which is the traditional type with sharp acidic taste.

-The second type is yoghurt with fruit made by addition of fruit and sweetening material to the natural yoghurt .

-The third type is flavored yoghurt which the fruit component is replaced with synthetic and coloring compounds

c) Based on post-incubation processing, yoghurt can be differentiated into:

-Pasteurized yoghurt, which is processed by conventional method of manufacture, in addition to this procedure the Yoghurt undergoes heat treatment, to extend its storage life.

- Frozen yoghurt which is prepared in a conventional mode, but is then deep frozen yoghurt to -20°C .

- Concentrated and dried yoghurt contains total solids of about 24% and 90_94% respectively.

d) Other type of yoghurt in use is yoghurt cheese and acidophilus yoghurt (**Dairy UK, 2009**).

2.3.7.1. Fruit Yoghurt:

Fruit yoghurt belongs to the milk mixer certification and contains additionally fruit or fruit preparation. The differences become depending upon fruit portion:

- Fruit yoghurt or yoghurt with fruit: at least 6% fresh fruit

- yoghurt with fruit preparation: at least 3.5 fresh fruit

- yoghurt with fruit taste: less than 3.5 fresh fruit (Serra *et al.*, 2008).

Fruit yoghurt is yoghurt with added fruit. Fresh fruit must comprise at least six lemons; a minimal portion of two percent is prescribed. In the case of yoghurt with fruit preparation of (fruit flavored yoghurt) the fruit content is lower, higher level of fruit addition into yoghurt would increase sensory quality of the fruit yoghurt (**USDA, 2001**).

2.3.7.1.1.Preparation of fresh fruit:

According to **(Krasaekoopt and Bhatia, 2012)** fruit preparation as follows:

1. Select ripened fruit.
2. Wash the fruit.
3. Remove the skin and seed.
4. Pulp the fruit.
5. Heat the pulp for 15-20 minutes –at 70-80⁰C (with usually stirring) or boil the fruit in boilingwater, or exhibit to steam for 5 minutes.
6. Cool at room temperature.
7. Mix the pulp into stirred yoghurt (e.g.) part pulp to between 3-5 parts yoghurt.For set yoghurt, the fruit is added in the bottom of cup and then the inoculated yoghurtis poured on top and the yoghurtis fermented in the cup for Swiss style yoghurt, then blended with the fermented,cooled Yoghurt prior to packaging.
8. Store as for plain yoghurt.

2.3.8. The nutritional value of yoghurt:

Yoghurtis a highly nutritious and easily digestible dairy product which is a rich source of more than ten essential nutrients in particular, certain minerals and vitamins. The nutritional composition of yoghurtcan be varied according to the strains of starter culture used in the fermentation, type of milk used (whole, semi or skimmed milk) species that milk is obtained (bovine,Goat, sheep). Type of milk solids, solid non-fat, sweeteners and fruits added before fermentation as well as the length of the fermentation process**(USDA, 2001)**.

Table 2: Nutritional composition of different varieties of Yoghurt (Per 100 g):

Components	Whole milk Yoghurt	Low fat Yoghurt	Non fatYoghurt
Energy(Kcal)	79	56	54
Protein(g)	5.7	4.8	5.4
Carbohydrate(g)	7.8	7.4	8.2
Fat(g)	3.0	1.0	0.2
Thiamin(mg)	0.06...	0.12	0.04
Riboflavin(mg)	0.27	0.22	0.29
Niacin(mg)	0.2	0.1	0.1
Vitamin B6(mg)	0.10	0.01	0.07
VitaminB12(mg)	0.2	0.3	0.2
Folate (µg)	18	18	8
Carotene (µg)	21	Trace	Trace
Vitamin D	0	0.1	Trace
Potassium(mg)	280	228	247
Calcium(mg)	200	162	160
Phosphorus(mg)	170	143	151

Source: The Dairy Council, (2013).

However, the general composition of yoghurt is more or less similar to that of milk. Therefore, yoghurt is a rich source of milk proteins, carbohydrate, minerals such as calcium and phosphorous, and vitamins such as riboflavin (B2), thiamin (B1), cobalamin (B12), foliate (B9), niacin (B3) and vitamin A. Milk proteins available in yoghurt is in high quality due to its high biological value and provide almost all essential amino acids necessary to maintain good health. In addition, milk proteins available in yoghurt contain higher content of proline- and glycine- contain amino acids than that in whole milk while performing additional body functions such as enhancing calcium absorption and boosting the immune system. Lactose is the main carbohydrate found in Yoghurt as in other dairy products. Lactose content in raw milk is about 4.6%. However, the

original lactose content in milk is lowered by 20-30% during the fermentation process as the lactose converts into its simple forms of glucose and galactose due to the metabolic activity of lactic acid bacteria. Fat content of yoghurt is highly dependable on the fat content of the original yoghurt mixture. According to the USDA specifications for yoghurt, low-fat yoghurt and non-fat yoghurt, fat content varies from 0.5-3.25% **(USDA, 2001)**.

The fat content of yoghurt is highly subjective as some products; for instance Greek style yoghurt contains a high fat content as high as 10%. Unlike milk, processes that are employed in yoghurt manufacturing such as homogenization and fermentation result in breakdown of some amount of fat into easily digestible and absorbable fatty acids **(Guslandi *et al.*, 2000)**.

Vitamins and minerals found in milk and dairy products are in bio-available form where they are available for absorption and use by body. Yoghurt as of other dairy products is an exceptional source of several B vitamins in particular, riboflavin and thiamin. It is reported that a 150g serving of whole milk plain yoghurt and low-fat plain yoghurt will provide 31% and 30% of an adult's daily riboflavin requirement respectively whereas the same amount of serving of each type of Yoghurt will provide 23% and 45% of an adult's daily thiamin requirement. However, vitamin B12 and B6 are found in significantly lower concentrations than that in milk as *Streptococcus thermophilus* uses these B vitamins for its metabolism. Folic acid /foliate content of yoghurt can be varied depending on the composition of lactic acid bacteria used as some of the LAB species such as *S. thermophilus* and Bifidobacteria synthesize certain vitamins including foliate by their own **(Guslandi *et al.*, 2000)**.

CHAPTER THREE

3.1 Materials:

- Fresh cow milk with pH 6.74, fat 3.3, acidity 0.135, solid nonfat 8.6, total solids 12.
- Skim milk powder with fat 0.8, SNF 95.2, TS 96, moisture 4.
- Yoghurt starter culture (Streptococcus thermophilus and Lactobacillus delbrueckii subsp. Bulgaricus) Chrestanhansan (France).
- Set yoghurt obtained from Diama Dairy Factory containing 14.60% total solid, 3.11% fat. And manufactured from fresh milk, skim powder, stabilizer and yoghurt culture.
- Baobab sample obtained from local market in Khartoum Bahrey.

3.2 Methods:

3.2.1 Preparation of baobab pulp:

The powder was prepared from baobab fruits as follows: the whole ripe fruits were crushed, isolated from thick fiber with hand and sieved by sieve with diameter 1.5 for three times after that take different weights with sensitive balance in plastic plates as follows:

15g of sample A, 10g of sample B, 5g of sample C, we were taken another one as control without adding of baobab powder.

3.2.2 .Manufacture of yoghurt :

Set yoghurt was manufactured as follows: milk was pasteurized to kill any microorganisms. The mixture was pasteurized at 75°C for 15 min followed by cooling rapidly to 45°C, and then inoculated with 3% (v/v) yoghurt culture of

Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus thermophilus (1:1 ratio). After incubation (45°C for 3 hr), the curd was stirred to break, and the fruit powder was added to give three treatments (A, B and C), in addition to the control (D). Yoghurt was stored at 4°C for one week, and chemical, physicochemical, and sensory evaluation carried out.

3.2.3 Proximate analysis of baobab pulp:

3.2.3.1 Moisture content:

Moisture was removed already from baobab powder by sun drying after completed the final ripping operation of baobab fruits with time under environment factors (approximately, 45 centigrade)

3.2.3.2. Protein content:

Protein content of baobab samples determined by Kjeldahl's method (991.20) of (AOAC, 2000). One gram of baobab sample was digested in Kjeldahl digestion flask with concentrated sulfuric acid and digestion tablets until clear solution was obtained. The ammonium trapped in sulfuric acid was released by adding 40% sodium hydroxide and distilled into 50 ml 4% boric acid solution then it was titrated against hydrochloric acid 0.5N to determine the amount of nitrogen. Protein content in baobab was determined by multiplying N% with a factor 6.38.

Nitrogen =

$$\frac{\text{Vol. (sample - blank) HCL} \times \text{normality of HCL} \times 0.014 \times 100}{\text{Weight of sample}}$$

$$\text{Protein (\%)} = \text{N (\%)} \times 6.38$$

3.2.3.3.Fat content:

The fat content in the row materials were determined according to **(AOAC, 2000)**

The method determines the substances which are soluble in petroleum ether (B.p, 40-60⁰ C) and extractable under the specific conditions of Soxhlet extraction method. The dried (crude fat) is then weighed and reported as percentage of the total dry matter. Dried sample of 2 g ±mg was weighed into an extraction with extraction thimble (30×100 mm) and covered with cotton the previously extracted with petroleum ether. Then the sample and a pre-dried and weighed flask containing about 75ml petroleum ether **(No.28111, DOO, England)** were attached to soxhlet extraction unit (Electro Thermal, England)and the temperature was adjusted to(60-70) ⁰C for 16 hours. At the end of the distillation period, the flask was disconnected from.

3.2.3.4.Fiber content:

The crude fiber content in the different samples was estimated according to the method of the **(AOAC, 2000)**.

The crude fiber is the organic residues which remained after the food sample is digested in a chemical solution. The weighed of the residue after digestion is then corrected for ash content and is considered as a crude fiber. About 1 g ±1mg from the defatted sample was weighed in conical flask follow by addition of 200 ml of [0.255N] H₂SO₄. Then the flask was connected to a digestion unit (Electro mantle ME, Britain) and the sample was boiled exactly for 30 minutes.

At the end of the digestion period, the flask was removed and the digest was filtered, the precipitate was repeatedly washed with distilled boiling water, following by second

digestion in 200ml of sodium hydroxide (0.313N) under the reflux condenser for 30 min.

After that, the precipitate was filtrated through a Gooch crucible and washed with hot distilled water followed by 15 ml of ethyl alcohol .finally, the crucible was dried at 105⁰C to constant weighed, cooled (in a desiccator), weighed and ashed in a muffle furnace (No.20-30178,carbolate ,England) at 550-600 ⁰C until a constant weighed was obtained and difference in weighed was considered as crude fiber.

Crud fiber %=

$$\frac{[\text{Dry residue crucible (g)}]-[\text{ignited residue +crucible(g)}]\times 100}{\text{Samplewt (g)}\times [100\%-\text{sample moisture (\%)}]}$$

3.2.3.5.Ash content:

The sample (2g) was weighed into porcelain crucible .This was transferred into the muffle furnace set at 550⁰c and left for about 4 hours. About this time it had turned to white ash .The crucible and its content were cooled to about 100⁰c in air, then room temperature in (AOAC, 2000).desiccators and weighed

Ash content (%) =

$$\frac{\text{Weight of Ash}\times 100}{\text{Original weight of sample}}$$

3.2.3.6. Available carbohydrates content:

The available carbohydrates content of the different samples was calculated by subtracting the total sum of protein, ash, fat, and moisture and crud fibers percentages from 100% as it was describe by (AOAC, 2000).

Carbohydrates content=100-(moisture % +crude protein% +crude fat% +ash % + crude fiber %).

3.2.3.7. Minerals content:

Dry ash can be used for sample preparation in the determination of calcium and iron in plant tissue. It may also be applicable to other elements. If the concentration of the element of interest is too low, the metal can be complexed and extraction into an organic solvent such as MIBK to increase its concentration (10).

One gram of sample was weighed into a porcelain crucible. Then placed in a cool muffle furnace and ashed at 500 °C overnight. The ash was cooled and dissolved in 5-ml of 20%HCL. Then warmed the solution, if necessary to dissolve the residue. The solution was filtered through an acid-washed filter paper into a 50-ml volumetric flask. The solution was diluted to volume with de ionized water and mixed well. (AAS, 1994).

3.2.4. Chemical determination of baobab Yoghurt :

3.2.4.1. Determination of fat, protein and total solids:

The fat, protein and total solids determined by using calibrated food scan S/N 3187671061, FOSS analytical.

3.2.4.2 .Determination of ash:

The sample (2g) was weighed into porcelain crucible .This was transferred into the muffle furnace at 550⁰C and left for about 4 hours. About this time it had turned to white ash .The crucible and its content were cooled to about 100⁰c in air, then room temperature in desiccators and weighed (AOAC, 2000).

The percentage ash was calculated from the formula below:

$$\text{Ash content (\%)} = \frac{\text{Weight of ash} \times 100}{\text{Original weight of sample}}$$

3.2.5..Physicochemical determination:

3.2.5.1.Determination of pH:

The pH of samples was determined by electronic pH meter (JENWAY 3510 pH meter, designed and manufactured in the UK by Bibby Scientific Stone LTD, model 33510, serial no.51030).

3.2.5.2. Determination of Titrable Acidity of baobabyoghurt:

The baobabyoghurt was mixed well and accurately transferred 10ml of baobabYoghurt to beaker by graduated pipette. Then 3 drops of phenolphthalein indicator solution was added by plastic dropper bottle and then titrated with 0.1N sodium hydroxide until the first pink end point was reached by automatic burette and recorded the volume of sodium hydroxide used (AOAC,2000).

Acidity% =

$$\frac{\text{VolNaOH (ml) Normality of NaoHx0.09}}{\text{Ml of sample}} \times 100$$

3.2.5.3 Acidity of baobab pulp:

The mixture is mixed well and accurately transferred 5ml of juice to beaker by graduated pipette. Then 3 drops of phenolphthalein indicator solution was added by plastic dropper bottle and then titrated with 0.1N sodium hydroxide until the

first pink end point was reached by automatic burette and recorded the volume of sodium hydroxide used (**AOAC,2000**).

$$\text{Total acidity/100 ml} = \frac{T \times N \times A \times 100}{V \times 1000}$$

$$\text{Total acidity/100 ml} = T \times 0.128$$

Were T=ml NoaH used .N=Normality of NaoH used (0.1)

A=Acid factor

V=Volume of the sample

3.2.6. Determination of viscosity of baobabyoghurt:

Viscosity was determined by Anton paar viscometer, made in Austria, Reolab QC P/N 18318, S/N 81811601, DC.15V, 1.5 A.

3.2.7. Sensory evaluation method:

Sensory evaluation test determined according to 5-point hedonic scale designed by (Ihekoronye and Ngoddy, 1985). A hedonic rating is a technique to measure the degree of liking for a product by untrained assessors. A 5-point hedonic scale designed was employed to elucidate panelist's acceptance of appearance, flavor, texture, and overall acceptability of the control and the three experiments. Every panelist received the four types of formulation to be judged side-by-side and water for rinsing. Before tasting the products, panelists ,were asked to evaluate the sample`s appearance using a 5-point hedonic scale ranging from "5-excellent, 4-very good, Good, 2-acceptable, 1-poor" After judging appearance, the panelists were then allowed to taste the samples and evaluate their flavor, texture, and overall acceptability using a 5-point hedonic scale, once again ranging from "5-excellent, 4-very good, Good, 2-acceptable, 1-poor".

Panel Table 3: test form:

Directions: rate each of the following: color, flavor, consistency, taste and overall acceptability for the following samples of yoghurt.

Sample code	Control	A	B	C
Attributes				
Color				
Flavor				
Consistency				
Taste				
After taste				
Overall acceptability				

Excellent≡5, Very good≡4, Good≡3, Acceptable≡2, Poor≡1 (Ihekoronye and Ngoddy, 1985).

A≡ Yoghurt treated with Baobab concentration 15%.

B ≡Yoghurt treated with Baobab concentration 10%.

C ≡Yoghurt treated with Baobab concentration 5%.

C ≡ control

3.2.8. Statistical analysis:

The results were analyzed using the Minitab(14) Systems (ms). Results on physicochemical, chemical, microbiological, minerals and sensory profiles were analyzed by one-way analysis of variance (ANOVA). Mean separation was done by Duncan multiple range tests at $P \leq 0.05$.

CHAPTER FOUR

4.RESULTS AND DISSCITION

4.1. Proximate composition (%) and energy content of yoghurt treated with baobab fruit pulp:-

Table (1) show the proximate compision (%) and energy content of yoghurt treated with baobab fruit pulp.

From the results it is obvious that the addition of baobab fruit pulp in did not increases the chemical properties of yoghurt in comparison with control except fibers which increased.

The lowest fat content was in C and lowest moisture content was in B, and A. Highest levels were protein and carbohydrates in A.

The whole treatments show ash content increases with addition of differences percentages of baobab fruit plup in comparison with control (D).

The content of energy is lowest in control than (A, B and C) may be refer to the addition of differences amounts of baobab fruit pulp.

4.1. Table (4) proximate composition of yoghurt treated with baobab fruit plup:

Sample% Content	A	B	C	CONTROL
Moisture	86.5	86.0	82.311	87.69
Protein	6.8	5.9	3.6	3.5
Fat	3.67	2.59	3.28	4.0
carbohydrates	4.26	4.06	3.87	3.69
Ash	0.816	0.822	0.85	0.860
Fiber	7.1	6.95	6.36	0.01
Ascorbic acid	17.62	11.75	5.875	0.07

A=yoghurtreated with addition baobab fruit pulp concentration 15%

B=yoghurt treated with baobab fruit pulp concentration 10%

C= yoghurt treated with baobab fruit pulp concentration 5%

Control

4.2. Physochemicalproperties of yoghurt treated with baobob fruit pulp :

Table(2) and fig (2)show the phsiochemicalpreorties of yoghurtreated with baobobfruit pulp we were found the addition of differences amounts of baobob fruit pulp to yoghurt increases parameters analysis especiallytitrable acidity and the total solids ,After we comparison with control, while pH parameter is no increases on control (D).

In pH samples show, there is no significant differences between Band C, but there is significantdifferences between A and control (D) also may be due to addition of baobab pulp.

The results show that is significant differences between A, B, C and control (D).

The titrable acidity increases in A, B and C than control (D).

4.2. Table (5) physicochemical properties of yoghurt treated with baobab fruit pulp:

Samples	A	B	C	control	S.ER
Physiochemical properties					
Titration acidity	0.850 ^{CD} ±0.007	0.775 ^{BC} ±0.007	0.755 ^{BC} ±0.007	0.730 ^{AB} ±0.028	0.000
pH	3.855 ^A ±0.007	3.795 ^C ±0.007	3.515 ^A ±0.002	4.02 ^D ±0.028	0.001
T.s.s	7.500 ^{BCD} ±0.707	7.000 ^{BC} ±0.00	7.500 ^{BCD} ±0.707	6.000 ^{AB} ±0.000	1.0
Total solids	20.03 ^C ±0.021	13.05 ^A ±0.636	22.75 ^B ±0.071	13.15 ^A ±1.202	1.85

A= yoghurt treated with addition baobab fruitpulp concentration 15%

B=yoghurtreated with baobab fruit pulp concentration 10%

C= yoghurt treated with baobab fruit pulpconcentration 5%

Control.

4.3. Sensory evolution of yoghurt treated with baobab fruit pulp:

Table (3) sensory evaluation of yoghurt treated with baobab fruit pulp.

Person the result of sensory evaluation of yoghurt made different concentration of baobab pulp by untrained panelists on scale of flavor ,color,Appearance,texture,tests and generalacceptable there was significant different (p>0.05).

There is significant different control A,B in flavor and general acceptable which was obtained highest may be due to C has ahigh can contraptions' of baobab fruit pulp the whole sensory panelists show that, there is significant differences between control and B in color and general acceptability .respectively.

4.3. Table (6) of sensory evaluation of yoghurt treated with baobab fruit pulp:

Sensory attributes	A	B	C	CONTROL	SE
Color	3.000 ^{ab} ±1.673	2.833 ^{ab} ±1.329	3.833 ^{abc} ±1.835	3.333 ^{ab} ±2.338	67.00
Flavor	2.833 ^{ab} ±1.472	3.500 ^{abc} ±1.472	3.667 ^{abc} ±0.816	4.167 ^{abc} ±0.816	26.50
Taste	3.833 ^{ab} ±1.941	3.000 ^{ab} ±2.000	3.500 ^{ab} ±0.837	3.833 ^{ab} ±1.602	55.17
Texture	3.333 ^{ab} ±2.251	3.167 ^{ab} ±1.722	2.833 ^{ab} ±1.941	2.667 ^{ab} ±2.251	84.33
Appearance	3.167 ^{ab} ±1.602	2.167 ^{ab} ±2.401	3.333 ^{abc} ±1.506	3.500 ^{abc} ±2.429	13.82
General acceptability	2.333 ^{ab} ±0.816	2.333 ^{ab} ±1.862	3.667 ^{bc} ±1.366	2.667 ^{ab} ±1.211	37.33

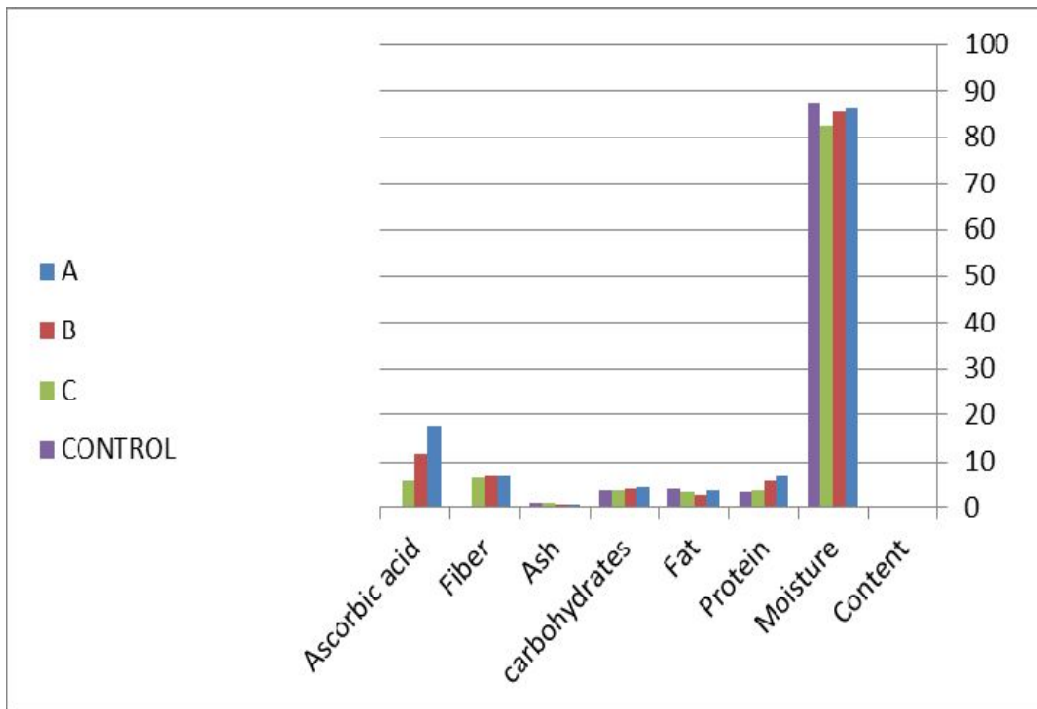
Mean ±StDev

A≡Yoghurt treated with baobab fruit pulp concentration 15%.

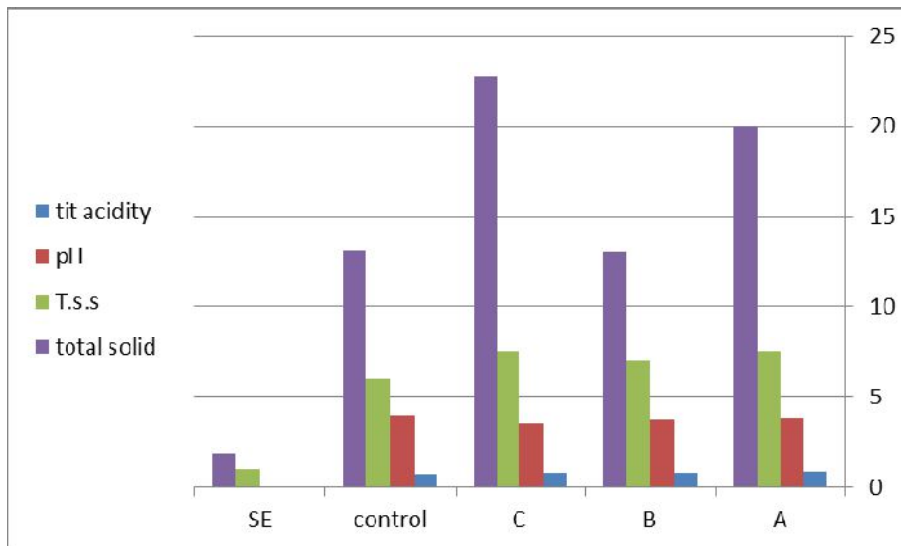
B≡ Yoghurt treated with baobab fruit pulp concentration 10%.

C≡Yoghurt treated with baobab fruit pulp concentration 5%.

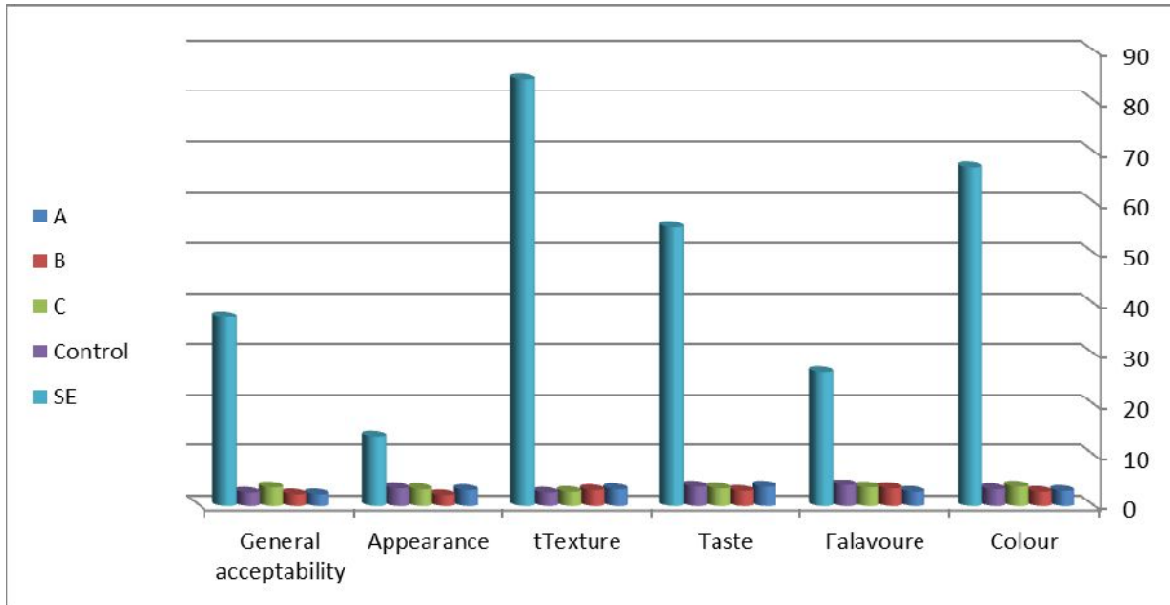
4.1.Fig (2) proximate composition of yoghurt treated with baobab fruit plup



4.2 Fig (3) physicochemical properties of yoghurt treated with baobab fruit pulp:



4.3 Fig (4) of sensory evaluation of yoghurt treated with baobab fruit pulp:



CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions:

1. From the results obtained in this study, it can be concluded that baobab fruit has found high nutritional value.
2. Yoghurt made from this fruit was comparable with control especially in terms of sensory and physicochemical characteristics probably because of the concentrations used (5%, 10%, and 15%).
3. Ascorbic acid or vitamin (C) was found high in A, B and C.
4. The general acceptability was high in B.
5. theyoghurt is treated with baobab fruit pulp has a long period of shelf-life.

5.2 Recommendations:

1. Using of baobab fruit pulp in production of yoghurt with higher nutritional value an acceptable to consumer.
2. The product has high levels of ascorbic acid, for that recommends it for people who suffer from lack of vitamin especially vitamin (C) and high levels of cholesterol.
3. Awareness of consumers about medical and nutritional benefits of baobab
4. Using of baobab fruit powder as alternative for some chemical preservatives especially milk product e.g. yoghurt, cheese and ice-cream.
5. Further studies are needed.

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