بسم الله الرحمن الرحيم

Sudan university of Science and Technology

College of Agricultural Studies

Department of Food Science and Technology

Evaluation of Nutritional Composition of Yoghurt Supplemented With Sesame Paste (Tahini)

تقييم المكونات التغذوية للزبادي المدعم بالطحينة

A Thesis Submitted to In Partial Fulfillment of the Requirements for The Degree of B.Sc. In the Department of Food Science and Technology (Honor)

By:

Amna Hassan Ahmed Mohammed

Rofida Mohammed Ahmed Soba

Supervisor:

Dr. Salma Elgahli Mustafa

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DEDICATION

To our parents,

Thanks for your great support and continuous care.

To our brothers,

I am really gratefulfor them, they are my inspiration and my soul mates.

To our friends

For their fruitful help, love and encouragement.

To our teachers,

To all those who take the science of a mission to travel to cut through the path of knowledge and tarnished form

With respect

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This thesis was accomplished with the contribution and support of very valuable people. In return, I would like to express my greatest appreciation for each of these people in order to endure their support and assistance.

I extend my sincere appreciation to my supervisor **Dr. Salma El Gahli Mostafa** for her guidance, cooperation and support which brought this study to a successful end. It is inevitable to emphasize the morale and motivation he provided throughout this study.

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ABSTRACT

This study was conducted to evaluate the effect of Sesame paste on the nutritional composition of yoghurt. Sesame paste was added to yoghurt in two concentrations (1% and 2%).Sesame (*Sesamum indicum L.*), which contains monounsaturated and poly-unsaturated fat, high in a variety of helpful antioxidants, good source of proteins, complex carbohydrates and minerals is considered to have both nutritional and medicinal values. Sesame paste (Tahini) is rich in constituents as proteins and lipids. The chemical composition of claim and yoghurt supplemented with Tahini was determined. The yoghurt supplemented with Tahini was subjected to sensory evaluation. The results ofSesame paste(Tahini) analysis was 41.92%, 14.25%, 16.69%, 1.8%, 6.1% and 19.23%for moisture, protein, fat, fiber, ash and carbohydrates respectively, and for the yoghurt (claim and supplemented with Tahini) the protein , fat , fiber, ash and fatty acids percent was increased in sample C (with 2% Tahini concentration). Andthe results for sensory evaluation that included color, flavor, taste, texture and overall acceptability by number of panelists (15), show no significant difference between the samples.Sample C (with 2% Tahini concentration) it has a high degree in overall acceptability compared with other samples. Fromthe result of this study we concluded that, sesame pastehashigh and good nutritional value,it could be added as food supplements to improve the nutritional composition of yoghurt which could be used as functional food.

ملخص الدراسة

أجريت هذه الدراسة لتقييم تأثير معجون السمسم (الطحينة) على التركيبة الغذائية للزبادي. يحتوي السمسم على دهون احادية مشبعة وغير مشبعة ، ومجموعة متنوعة عالية من مضادات الأكسدة المفيدة ويعتبر مصدر جيد للبروتينات والكربوهيدرات المعقدة والمعادن ، ويعتبر له قيمة غذائية وطبية معا.

تمت اضافة معجون السمسم الى الزبادي بتركيزين (1% و 2%) ، ثم أجري التحليل الكيميائي للطحينة ، التقييم الحسي وتحليل التركيب الكيميائي للزبادي (العادي) والزبادي المدعم بالطحينة . أظهرت نتائج تحليل معجون السمسم 41.92%، 14.25%، 16.69%، 1.8%، 6.1% و 19.23% للرطوبة، البروتين، الدهون ، الألياف، الرماد والكربوهيدرات على التوالي.ونجد في نتيجة التحليل الكيميائي للزبادي (العادي) والمدعم بالطحينة أن نسبة البروتين، الألياف، الرماد، والأحماض الدهنية زادت في العينة C (مع تركيز 2% طحينة). ولم تظهر نتائج التقييم الحسي للون، النكهة، الطعم، القوام و القبول العام للمنتج من خلال عدد من المتذوقين (15)، فروقا معنوية بين العينات.العينة C(مع تركيز 2% طحينة) تميزت بدرجة قبول أعلى مقارنة مع العينات الأخرى. ومنهذه الدراسة نخلص الى أن للطحينة قيمة غذائية جيدة جدا. يمكن ان تضاف كمدعم لتحسين القيمة الغذائية للزبادي ويمكن ان يستخدم كغذاء وظيفي.

CHAPTER ONE

INTRODUCTION

Sesame (*Sesamumindicum L.*), otherwise known as sesamum or benni seed member of thefamily Pedaliaceae. Most of the sesame seeds are used for oil extractionand the rest are used for edible purposes (El Khier *et al.,* 2008).

Sesame is considered to have both nutritional and medicinal values. The seeds are usedeither decorticated or whole in sweets such as sesame bars and halva, in baked products,or milled to get high-grade edible oil or sesame paste(Tahini), Sesame paste (Tahini) is defined as a complex colloidal dispersion of oil rich in constituents asproteins and lipids. This paste is obtained by grinding the roasted and shelled seeds, without the additionor removal of any native component. This paste contains a good amount of calcium, iron, potassium, phosphorus and vitamins B, C and E (El Khier *et al.*, 2008).

Fermented milks products are generally made from a mix standardized from whole, partially defatted milk, condensed skim milk, cream and/or non-fat dry milk. Yoghurt is a semi-solid fermented milk product made from a heat-treated standardized milk mix by the activity of a characterizing symbiotic blend of *Streptococcus thermophiles (ST) and Lactobacillus delbrueckii subsp*. *Bulgaricus (LB) cultures.* In addition to mandatory cultures, commercial yogurt contains adjunct cultures, primarily *Lactobacillus acidophilus*, *Lactobacillus casei*, and *Bifidobacterium spp*. Yoghurt is produced from the milk of various animals (cow, water-buffalo, goat, sheep, yak, etc.) in various parts of the world (Panesar, 2011**)**. While sesame paste (Tahini) has high nutritional value its uses are very limited so this study is aimed to use Tahini as supplement to the cow milk yoghurt and to study its effect on chemical composition, sensory properties and nutritional value of yogurt.

The objectives are to:

1- Analyze the physiochemical properties of yogurt and sesame paste.
2- Prepare yogurt with addition of sesame paste by using different concentrations.
3- Study and evaluate the chemical composition and sensory properties of yogurt after addition of sesame paste (Tahini).

CHAPTER TWO

LITERTURE REVIEW

2.1 Probiotic Fermented Milk Products :

The word “probiotic” comes from Greek and means “for life”, Over the years, the term “probiotic” has been given several definitions, Probiotic is used to refer to cultures of live microorganisms which, when administered to humans or animals, improve properties of indigenous macrobiotic. In the food industry, the term is described as “live microbial food ingredients that are beneficial to health. Native inhabitants of the human or animal gastrointestinal tract, such as *lactobacilli* and *bifidobacteria*, are considered to be probiotic, but often display low stress tolerance, which reduces their viability in probiotic applications. Microorganisms traditionally grown in fermented foods, such as *lactic acid bacteria*, *propionibacteria* and yeasts, are also considered for these applications” (Araujo *et al*.,2012).

Fermented milks are widely produced in many countries This type of process is one of the oldest methods used to extend the shelf-life of milk, and has been practiced by human beings for thousands of years. The exact origin(s) of the manufacture of fermented milks is difficult to establish but it is safe to assume that it could date to more than 10000 years agoas the way of life of humans changed gathering to food producing (Tamime, 2002).

The chemical composition of fermented milks provides a useful indication of the potential nutritional value of these products. The main components are protein, fat, carbohydrate, minerals and vitamins. However, the bioactive peptides (e.g. casomorphins, a- and b-lactorphin, immunopeptides, lactoferricin or phosphopeptides), which are claimed to be health-enhancing compoents, should not be overlooked, the beneficial health properties of these products and their use in the treatment of body ailments dates back to few thousand years ago; they have been also mentioned in Biblical scriptures, and some ancient scientists have prescribed them as medicine for curing metabolic disorders of the stomach and the intestine (Tmime, 2002). However, the health aspects of fermented milks including yoghurt became apparent in the late 1800s and the early part of the 1900s; in part, this could be attributed to the scientific observations and\or explanations by panesar, (2011) and then put forward the beneficial effects of lactic acid bacteria (*Bulgarian bacillus,* which was later designated *Lactobacillus bulgaricus* and currently known as *Lb. delbrueckii subsp. bulgaricus*), that were present in 'yahourth', and postulatedthe 'longevity-without-aging' of the Caucasians with highconsumption of such product.

Yoghurt isa fermented milk product obtained from the milk or the milk products by the lactic acid fermentation through the action of *Streptococcus salivarius subsp. thermophilus, Lactobacillus delbrueckii subsp. bulgaricus.*May impart specific sensory properties due to 'post-acidification (Purwandari, 2009).

Yoghurt consumption is also influenced by country, knowledge about yoghurt, as well as socio-demographic factors .It consumed as a snack, popular for young and elderly in Europe, and children in the US **(**Panesar, 2011). .

2.2 Nutritional benefits of fermented dairy products:

The following describes some of the proposed health benefits of consumption of fermented/probiotic dairy products:

2.2.1 Alleviation of Lactose Intolerance

The inability of adults to digest lactose, or milk sugar, is prevalent worldwide. Milk with cells of *L. acidophilus aids* digestion of lactose by such persons. It has been documented that many lactose intolerant individuals are better able to consume fermented dairy products, such as yoghurt, with fewer symptoms than the same amount of unfermented milk. Consumption of lactose by those lacking adequate levels of lactase produced in the small intestine can result in symptoms of diarrhea, bloating abdominal pain and flatulence (Panesar *et al*., 2009).

2.2.2 Protection against Gastrointestinal Infection

Gastrointestinal infections including diarrhea result from a change in the gut micro flora caused by an invading pathogen. It is suggested that viable lactic acid bacteria interfere with the colonization and subsequent proliferation of food borne pathogens, thus preventing the manifestation of infection. *L. bulgaricus, L. acidophilus, S. thermophilus and B. bifidum*have been implicated in this effect. The beneficial effects of lactic acid bacteria and cultured milk products have also been attributed to their ability to suppress the growth of pathogens either directly or through production of antibacterial substances. Antibiotics have been reported to kill normal bacteria as well, often resulting in disruption of the bacterial flora, leading to diarrhea and other intestinal disturbances. Replenishing the flora with normal bacteria during and after antibiotic therapy seems to minimize disruptive effects of antibiotic use. Probiotics have been reported to effective in prevention of various gastrointestinal infections (Panesar *et al*., 2009).

2.2.3 Anti-carcinogenic Effect

It has been reported that fermented milk products can protect against certain types of cancers. Some of epidemiological support is also there. Consumption of yoghurt, Gouda cheese, butter milk protect against breast cancer. Animal studies have shown that lactic acid bacteria exert anti-carcinogenic effect either by prevention of cancer initiation or by suppression of initiated cancer. Anti-carcinogenic effects of yoghurt and milk fermented with *L.acidophilus* have been reported in mice. Different potential mechanisms by which lactic acid bacteria exert antitumor effects have been suggested such as changes in faecal enzymes thought to be involved in colon carcinogenesis, cellular uptake of mutagenic compounds, reducing the mutagenicity of chemical mutagens and suppression of tumors by improved immune response (Panesar, 2011).

2.2.4 Immune System Stimulation

The immune system provides the primary defense against microbial pathogens that have entered our bodies. The immune stimulatory effects of yoghurt are believed to be due to its bacterial components. Animal and some human studies have shown an effect of yoghurt or lactic acid bacteria on enhancing levels of certain immune reactive cells or factors. Milk components such as whey protein, calcium, certain vitamins and trace elements are also capable of influencing immune system. Studies have shown that cytokine production, phagocytic activity, antibody production, T-cell production etc. are increased with yoghurt consumption or with lactic acid bacteria (Panesar, 2011).

2.2.5 Lowering of Serum Cholesterol:

Reports indicate that fermented milk products to havehypocholesteraemic effect. It is suggested that intake of large quantities of fermented milk furnish factors that impair the synthesis of cholesterol. It has been reported that*L. acidophilus* has exhibited the ability to lower serum cholesterol levels. This promotes the potential healthful aspects of dairy products fermented with *L.acidophilus* (or other lactic acid bacteria), since hypercholestermiais considered to be one of the major factors contributing to cardiovascular disease. However, it is likely that some strains may demonstrate this property while others do not (Panesar, 2011).

2.2.6 Alleviation of Constipation

Constipation is common problem in subject'sconsuming the western diet and also in elderly people. Several studies with lactobacillus preparation and fermented milks have been published (Panesar *et al*., 2009).

2.2.7 Antihypertensive Activity

Casein hydrolysate, produced by an extracellular proteinasefrom *L. helveticushas* been reported to show antihypertensive activity in rats. Two antihypertensive peptides have also been purified from sour milk fermented with *L. helveticus*and *Saccharomyces cerevisiae*.These two peptides inhibit angiotensin-convertingenzyme that converts angiotensinogen I to angiotensinogenII, which is a potent vasoconstrictor. It has been reported that consumption of certain lactobacilli, or products made from them, may reduce blood pressure in mildly hypertensive people (Panesar, 2011).

2.2.8 Anti-allergenic Qualities

Probiotics may help prevent allergic reactions in individuals at high risk of allergies, such as food allergies.Probiotic bacteria help to reinforce the barrier function ofthe intestinal wall, thereby possibly preventing the absorption of some antigens (Panesar *et al*., 2009).

2.3 Sesame Seeds:

Sesame (Sesamumindicum L.), otherwise known as sesamum or benniseed, member of the family Pedaliaceae, is one of the most ancient oilseeds crop known to mankind. Most of the sesame seeds are used for oil extraction and the rest are used for edible purposes(El Khier*et al*., 2008).

2.3.1 Composition and Nutritional Quality of Sesame Seeds:

The chemical composition of sesame seed varies with the variety, origin, color, and size of the seed. The fat content of sesame seed was around 50% whereas the protein and ash content were around 25% and 5% respectively. The fiber and carbohydrate contents show large variation. Crude fiber from one variety of Nigerian black sesame was reported to have 19.6%, whereas one variety of Taiwanese black seed contained only 2.81%. The carbohydrate content ranged from 3% to 14% (Mijena, 2015).

Sesame is a rich source of calcium (90 mg per tablespoon for un-hulled seeds, 10 mg for hulled) and phosphorous, iron, magnesium, manganese, copper,and also contains ample amounts of oleic (43%), linoleic (35%), palmitic (11%) and stearic acid (7%) which together comprise 96% of the total fatty acids(Prasad *et al* 2012 and). The oilfraction showed a remarkable stability to oxidation. This could be attributed toendogenous antioxidants (lignin's) together with tocopherols.The seeds are very rich in vitamin B1 (thiamine)and vitamin E (tocopherol). Sesame seeds also contain phytosterols associated with reduced levels of blood cholesterol. The nutrients of sesame seeds are better absorbed if they are ground or pulverized before consumption, as in tahini (El Khier *et al.*, 2008).

2.3.2 Health Benefits of Sesame Seeds:

The seeds are especially rich in mono-unsaturated fatty acid oleic acid which comprise up to 50% fatty acids. Oleic acid helps to lower LDL or "bad cholesterol" and increase HDL or "goodcholesterol" in the blood. The seeds are also very good source of dietary proteins withfine quality amino acids that are essential for growth, especially in children. Sesameseeds contain many health benefiting compounds such as sesamol and sesaminol whichare phenolic antioxidants and help harmful free radicals from the body (Mijena, 2015).

The seeds also contained significant amount of important minerals with the Potassium concentration being the highest, followed by Phosphorus, Magnesium, Calcium and Sodium, Potassium is an essential nutrient and has an important role is the synthesis of amino acids and proteins, Calcium and Magnesium plays a significant rolein photosynthesis, carbohydrate metabolism, nucleic acids and binding agents of cell walls. Calcium assists in teeth development Magnesium is essential mineral for enzyme activity, like calcium and chloride; magnesium also plays a role in regulating the acid-alkaline balance in the body,Phosphorus is needed for bone growth, kidney function and cell growth. It also plays a role in maintaining the body’s acid-alkaline balance. The presence of these minerals also confirms the fat that sesame seed is of high nutritional benefit to its consumers (El Khier*et al.*,2008).

2.3.3 Production Technology of Sesame Paste (Tahini):

Sesame paste (Tahini)is defined as a complex colloidal dispersion of oil rich in constituents as proteins and lipids it is widely consumed in the Middle East and Asian cuisine with the purpose of providing foods with antioxidant compounds, high nutritional value, with regulatory properties and anti-cancer properties,sweetened sesame paste is called tahini and it is used as an additive for bakery products andconfectionery in India and Pakistan, this paste contains a good amount of calcium, iron, potassium, phosphorus and vitamins B, C and EMoreover, sesame oil can resists oxidative deterioration and rancidity due to these antioxidants another benefit of sesame (Armesto *et al*., 2017).

The process of making peanut butter it is shelling and cleaning, roasting, cooling, blanching, grinding and packaging.

I. Soaking and dehulling:

Sesame seed processing is basically done to clean and dehull seed as well as to extract oil from seed. Sesame can be processed to several different stages, such as simply cleaning, or cleaning and dehulling, cleaning /dehulling/drying, cleaning/dehulling/drying/crushing oil, etc. In Nigeria, dehulling is done by soaking in a salt solution overnight. Seeds are rubbed in a mortar to loosen pericarp and then kernel is separated from oat by sedimentation washing, after dehulling seeds are washed and then dried usually with sun-drying. (Mijena, 2015).

Kahyaoglu and Kaya (2006) worked on modeling of moisture, color and texture changes in sesame seeds. Sesame seeds were dehulled as follows; firstly seeds were sieved and then soaked in water (T=18 ± 2° C) for 12 h. The soaked seed were strained off and passed through a mechanical peeler for removing of hulls from seed. The wet dehulled sesame seeds were roasted using a temperature-controlled rotary roasting machine at roasting temperatures of 120, 150 and 180º C, at different time intervals (20–120 min), and they were immediately equilibrated to room temperature (20° C) for prevent further heating, which are used commercially for sesame paste and confectionary productions. Sesame seeds become more fracture and less hard with the effect of roasting that might be evidence of crisp texture.

Dehulling method used for sesame in India is usually done by soaking the seeds overnight in water, followed by drying and rubbing against a rough surface. The separated hulls are removed by winnowing. This method is laborious, time consuming and suitable for processing small quantities. A more convenient dehulling technique has been developed through addition of 3% NaCl (salt) and soaking overnight (Chemonics, 2002).

II. Roasting:

Roasting of sesame seeds is a basic operation for the production of sesame paste. Sesame seeds are roasted in order to promote the flavor, desired color and changes in texture which ultimately increase the overall palatability of the product. Several temperature– time combinations were reported for roasting of sesame seeds during tahini production. The optimum roasting range for production of tahini to obtain the desired color and texture was 155–170° C for 40–60 min (Mijena, 2015).

III. Grinding:

Milling process was carried out to reduce the size of kernel for the production of pistachio paste. This step is critical in the production of nut spread because the particle size and particle distribution are important parameters that influence the overall quality of nut spread (Mijena, 2015).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials:

Cow milk was obtained from the Department of Animal Production farm, College of Sudan University of Science & technology. Skim milk powder from Bahary market. Lactic acid bacteria (starter culture), Daima yoghurt from Ahsan mall. Sesame seeds high purity (Gadarif) from Libya market.

3.2Methodology:

3.2.1 Preparation method of sesame paste:

The methodology for the production of sesame pasta have been used in this research, 500 g of de hulled sesame seeds were cleaned, Then they were dried and roasted at 120°C for 10 mints. Then the roasted seeds were added water and ground in a grain mill. The next flow chart (3.2.1) explain that.

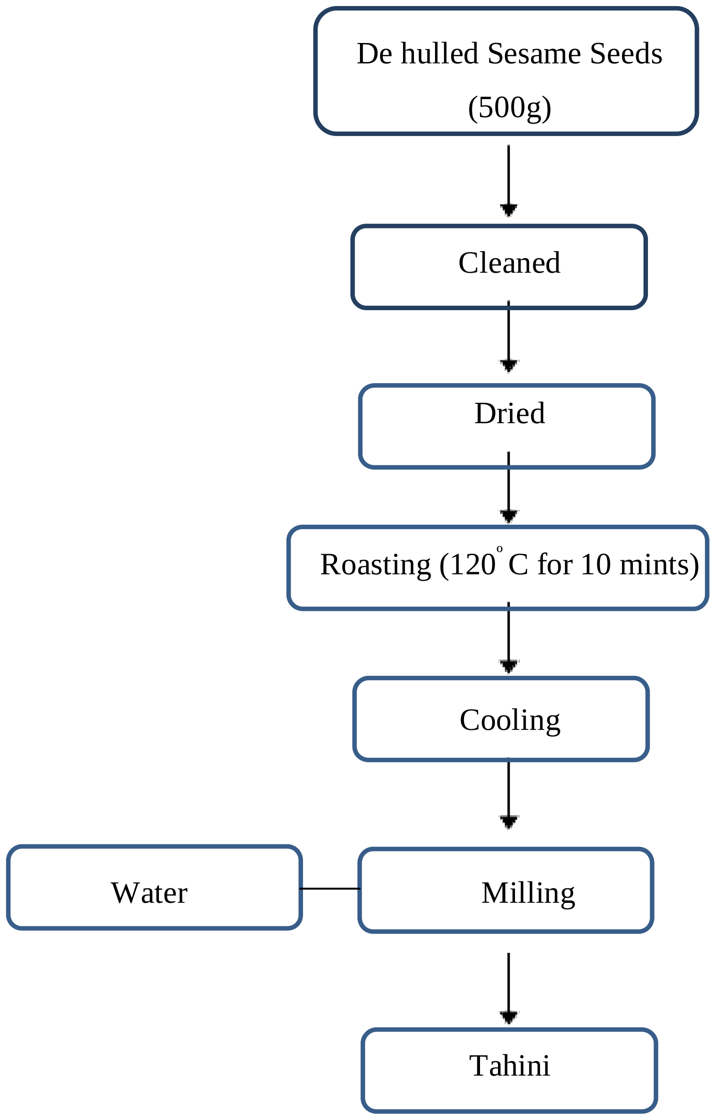

Fig. 3. 1 Process flow chart of sesame paste

3.2.2 Preparation method of yoghurt :

The experiment was conducted at the Dairy lab at the animal production college of Sudan University Science &Technology.

Purchased 3 ½ liters raw cow milk and filtered to remove all impurities, and then pasteurized in a water bath at (85-90.5° C) for 30 mints with homogenized . After pasteurization the milk was cooled (40 to 45° C) and measured the total soluble solids by TSS apparatus and then done raised the total solids by added the skim milk (2-3%), and then cultured with a lactic acid producing culture (Daima yoghurt), with percent (2-3%). After that the quantity was divided into three parts (1 liter to prepared claim yoghurt (control sample), 1 ¼ liter to prepared yoghurt supplemented with 1% Tahini, 1 ¼ liter prepared yoghurt supplemented with 2% Tahini). And then filled in container with 100 g capacity, then incubated at (45° C) for 3-4 hours, after that was removed to the refrigerator. And then the yoghurt was ready to use.The next figure (3.2.2) explain that;

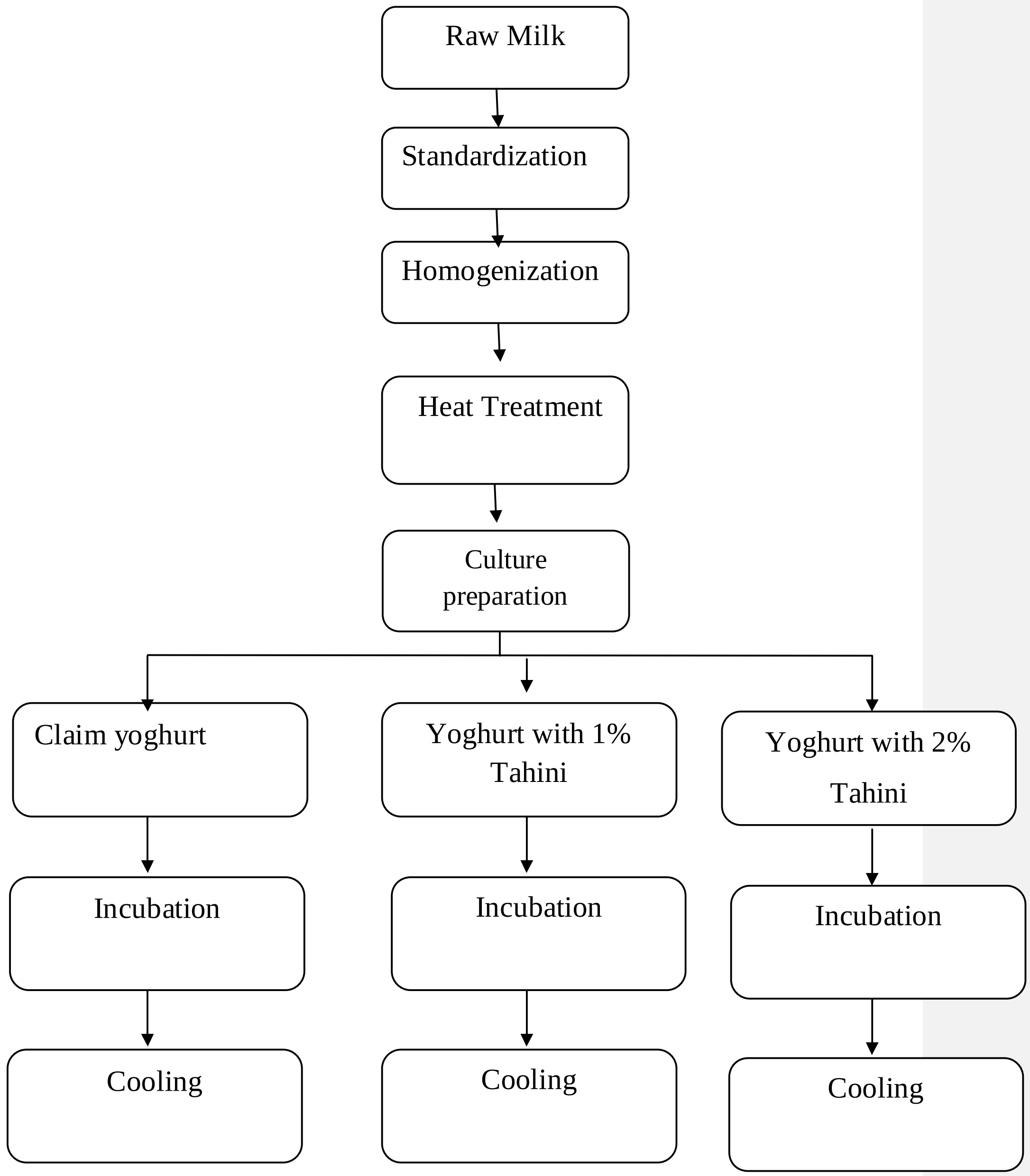

Fig. 3. 2 Process flow chart of yoghurt.

3.3 Chemical Composition :

3.3.1 Moisture content:

Moisture content was determined according to the association of official analytical chemists AOAC (1990) as follows: two grams of each sample were weighed in clean dry and pre-weighed crucible and then placed in oven at 105º C and left over night. The crucible was transferred to desiccators and allowed to cool and then weighted. Moisture content was calculated using the following formula:

$$MC\% = \frac{(W2-W1)-(W3-W1)}{W2-W1} \times 100$$

Where:

MC: moisture content.

W1: weight of empty crucible.

W2: weight of crucible with the sample.

W3: weight after drying.

3.3.2 Protein content:

Crude protein of the sample was determined by using the micro-kjeldahl method according to AOAC (1990) as follow:

I. Digestion:

0.2 grams of sample was weighed and placed in small digestion flask (50 ml). About 0.4 grams catalyst mixture (96% anhydrous sodium sulfate and 3.5% copper sulphate) was added, 3.5 ml of approximately 98% of H_2SO_4 was added. The content of the flask were then heated on an electrical heater for 2 hours till the color changed to blue-green. The tubes were then removed from digester and allowed to cool.

II. Distillation:

The digested sample was transferred to the distillation unit and 20 ml of NaOH (40%) were added. The ammonia was received in 100 ml conical flask containing 10 ml of 2% boric acid plus 3-4 drops of methyl red indicator. The distillation was continued until the volume reached 50 ml.

III. Titration:

The content of the flask were titrated against 0.02 N HCL. The titration reading was recorded. The crude protein was calculated using the following equation:

$$CP\% = \frac{(T-B)*N*14*6.25}{Ws * 1000} \times 100$$

3.3.3 Fat content:

Fat was determined according to the method of AOAC (1990) using soxhlet apparatus follows:

An empty clean and dry exhaustion flask was weighted. About 2 gram of sample was weighted and placed in a clean extraction thimble and covered with cotton wool. The thimble was placed in an extractor. Extraction was carried out for 8 hours with petroleum ether. The heat was regulated to obtain at least 15 siphoningper hour. The residual ether was dried by evaporation. The flask was placed in oven at 105° C till it dried completely and then cooled in a desiccators and weighed. The fat content was calculated using the following equation:

$$FC\% = \frac{W2-W3}{Ws} \times 100$$

Where:

FC: fat content.

W1: weight of extraction flask.

W2: weight of extraction flask with fat.

Ws: weight of sample.

3.3.4 Crude Fiber:

Crude fiber was determined according to AOAC (1990). Two grams of defatted sample were treated successively with boiling solution of H_2SO_4 and KOH (0.26 N and 0.23 N, respectively). The residue was then separated by filtration, washed and transferred into a crucible then placed into an oven adjusted to 105º C for 18-24 hours. The crucible then with the sample was weighted and ached in muffle furnace at 500º C and weighted. The crude fiber was calculated using the following equation:

$$CF \% = \frac{W2-W3}{Ws} \times 100$$

Where:

CF: crude fiber

W1: weight of crucible with sample after ashing

W2: weight of crucible with sample after ashing

Ws: weight of sample

3.3.5 Total ash:

Ash content of the sample was determined according to the method of AOAC (1990) as follows: two grams of sample were placed in a clean dry pre-weighed crucible, and then the crucible with its content ignited in a muffle furnace at about 550º C for 3 hours or more until light gray ash was obtained. The crucible was removed from the furnace to a 13 desiccators to cool and then weighed. The crucible was reignited in the furnace and allowed to cooling until a constant weight was obtained. Ash content was calculated using following equation:

$$AC\% = \frac{W2-W3}{W3} \times 100$$

Where:

AC: ash content.

W1: weight of empty crucible.

W2: weight of crucible with ash.

W3: weight of sample.

3.3.6 Determination of Total Carbohydrates :

Determine total carbohydrateaccording to Rajan, (2015).By difference in infant milk food. Add moisture, fat, protein and ash content and deduct the value from 100 to give carbohydrate content by difference.

3.3.7 Determination of Treatable Acidity:

Determined according to Rajan, (2015).

Reagents:

I. Standard Sodium Hydroxide Solution – 0.1 N.

II. Phenolphthalein Indicator - Dissolve 1.0 g of phenolphthalein in 100 ml of 95% ethanol. Add 0.1 N NaOH solution until one drop gives a faint pink coloration. Dilute with distilled water to 200 ml.

Procedure:

Weigh accurately about 10 g of the material in a suitable dish or basin. Add 30 ml of warm water. Add 1 ml of phenolphthalein indicator.

Shake well and titrate against standard NaOH solution. Complete the titration in 20 seconds. Keep a blank by taking 10 g of material diluted with 30 ml of water in another dish for comparison of color.

Calculation:

$$\text{Treatable acidity as Lactic acid} = \frac{9AN}{W}$$

Where:

A = Volume of standard NaOH required for titration.

N = Normality of Standard NaOH solution.

W = weight of the sample taken for test.

3.3.8 Free fatty acid:

Free fatty acid value of sesame fat spread was determined according to AOAC (1990) test method. About 10 g of sesame fat spread was weighed into an Erlenmeyer flask and 100 ml. neutral alcohol was added in a flask and 2-3 drops of phenolphthalein was added and sample neutralized by drop wise addition of 0.1N Potassium Hydroxide till a faint pink color which persisted for 15 seconds. Expression of result: FFA % as Oleic acid:

$$\text{FFA \% Oleic acid} = (28.2 * N * V) / W$$

Where:

N = normality of NaOH solution;

V = volume of KOH solution used in ml;

W = weigh of sample

3.4 Sensory Analysis:

Sensory evaluation of the yoghurt samples were carried out by 15 panelists on a 5 point hedonic scale for different parameters such as color, flavor, taste, texture and overall acceptability as described by Nadife *et al.,* (2014).

3.5 Statistical analysis:

All experiments were carried out in triplicate unless otherwise specified. Data were evaluated by analysis of variance (ANOVA) by used Minitab 17 program.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 The proximate composition of row materials:

4.1.1Chemical composition of sesame seeds:

The chemical compositions of sesame seeds namely, moisture, protein, fat, fiber, ash, and carbohydrate were analyzed to know the quality of sesame seeds before Tahini production. Results of chemical analyses of sesame seeds are shown in Table 4.1.1 moisture content of seeds was(2.4%) and total of carbohydrate was (15.4%) it is in same range reported by Mijena, (2015). Protein content of seeds was (23.6%). Fat content (46.1%) of seeds was lower than the fat content (%) reported by. Fiber there was (6.3%), which was within the normal range. Ash content was (6.2%).

Table 4. 1: Chemical composition of sesame seeds

Composition%	Value%
Moisture	2.4
Protein	23.6
Crude fat	46.1
Crude fiber	6.3
Ash	6.2
Total Carbohydrates	15.4

4.1.2Chemical composition of sesame paste (Tahini):

The chemical compositions of sesame paste namely, moisture, protein, fat, fiber, ash, and carbohydrate were show in table.

Table 4. 2: Chemical composition of sesame paste (Tahini).

Composition%	Value%
Moisture	41.92
Protein	14.25
Crude fat	16.69
Crude fiber	1.80
Ash	6.10
Total Carbohydrates	19.23

The result for moisture content was been 41.92% recorded to addition water within milling. Also the protein content, fat, fiber 14.25, 16.69, 1.8 respectively, and was less than results reported by Mijena, (2015), and total carbohydrate was 19.23% in range compare with his result.

4.1.3 Proximate composition of plain yoghurt and yoghurt supplemented with Tahini:

Table 4.1.3 shows the results of the chemical composition of the plain yoghurt and yoghurt supplemented with Tahini. There was significant different between samples in parameters (moisture, protein, fat, fiber, ash, acidity and fatty acids) ($p<0.05$).

The moisture content of yoghurt samples A, B and C was 84.90, 83.11 and 81.03 respectively. The moisture content decreased with sample B and C compared with plain yoghurt (sample A). This could be attributed to increased total solids, resolutely to addition of sesame past.The moisture contents of the yoghurt samples fell within the range of most commercial yoghurts (80-86%).

The protein content was between the ranges of 4.55 to 6.90, the highest percent has been recorded for the yoghurt supplemented by Tahini 2% concentration (C), because the sesame paste has a high protein content, and the protein content increase with increase the quantity of sesame paste (Tahini).

The fat content was in range 3.35 to4.80 the fat content increased with increased the concentration of sesame paste, and the highest level was in sample (C) with 2% Tahini.Because sesame paste rich in fats.

The fiber contentfrom 0.00 to 0.036, the highest percent has been recorded for the yoghurt supplemented by Tahini 2% concentration.

The Total Carbohydrates for the samples was inrange 5.48, to 6.41, the percent of carbohydrate increase in sample B & C compared with plain yoghurt (sample A).

The Ash content of yoghurt A, B and C was 0.72, 0.75 and 0.82 respectively. The ash content increase with increase the concentration of Tahini.Agree with results on other plant substituted yoghurt by Ndife *et al.,* (2014).

The Fatty acids content of yoghurt A, B and C was 0.17, 0.20 and 0.22 respectively. Fatty acids increase with increase the Tahini concentration compared with plain yoghurt (sample A).The sesame paste rich in fatty acids.

The Acidity was 1.10 to 0.94 the highest percent has been recorded for the plain yoghurt. The addition of Tahini reduce the acidity percent and that due to the effect of sesame paste on the growth of the lactic acid bacteria.

Table 4. 3: Chemical composition (%) of yoghurt.

Sample	A	B	C
Moisture	85.90±0.20[a]	83.11±0.10[b]	81.03±0.88[c]
Protein	4.55±0.55[c]	5.95±0.05[b]	6.90±0.00[a]
Crude fat	3.35±0.15[c]	3.95±0.15[b]	4.80±0.10[a]
Crude fiber	0.00±0.00[b]	0.05±0.01[a]	0.04±0.025[ab]
Total Carbohydrates	5.48±0.21[a]	6.19±0.28[b]	6.41±0.79[b]
Ash	0.72±0.01[b]	0.75±0.02[b]	0.82±0.02[a]
Acidity	1.10±0.10[a]	0.93±0.02[b]	0.94±0.02[b]
Fatty acids	0.17±0.01[c]	0.20±0.01[b]	0.22±0.01[a]

Where:

A: plain yoghurt (control).

B: yoghurt supplemented with1% sesame paste (Tahini).

C: yoghurt supplemented with 2% sesame paste (Tahini).

4.2 Sensory Evaluation of Yoghurt:

Table 4.2 shows the results of the evaluation of the plain yoghurt and yoghurt supplemented by Tahini. The panel test show no significant difference ($p>0.05$). Between samples in parameters (color, favor, taste, texture and overall acceptability). Sample C (with 2% Tahini concentration) it has a high degree in overall acceptability compared with other samples, and also the degree of flavor acceptable. Color and flavor it is same in all samples. So the degree of acceptable increase with increase the concentration of Tahini.

Table 4. 4: Sensory Evaluation of Yoghurt:

Sample	Composition				
	Color	**Flavor**	**Taste**	**Texture**	**Overall acceptability**
A	4.20±0.68[a]	3.60±0.91[a]	4.07±1.03[a]	3.27±0.96[a]	3.93±0.79[a]
B	4.27±0.79[a]	3.27±0.96[a]	3.60±1.24[a]	3.73±0.96[a]	3.80±1.01
C	4.27±0.70[a]	3.80±0.78[a]	3.87±0.92[a]	4.00±1.00[a]	4.13±0.92

Comment [N1]:

Comment [N2]:

Values in the same column with same superscript letters show no significances differences.

Where:

A: plain yoghurt (control).

B: yoghurt supplemented with 1% sesame paste (Tahini).

C: yoghurt supplemented with 2% sesame paste (Tahini).

And:

1= Unacceptable.

2= Acceptable.

3= Good.

4= Very good.

5= Excellent.

CHAPTER FIVE

CONCLUSIONAND RECOMMENDATIONS

5.1 Conclusion:

From the results we concluded that, sesame paste has high and good nutritional value. According to the nutritional profile, sesame seed is categorized among functional food. However could be added as food supplements to improve the nutritional composition of yoghurt which could be used as functional food.

5.2 Recommendations:

1. Use sesame paste to supplemented yoghurt to improve the nutritional value.
2. More researches are needed to study the effect of sesame past on the storage condition and shelf life, and fatty acids profile of the yoghurt.

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