Sudan University of Science and Technology
College of Animal production Science and Technology

Department of Dairy Science and Technology

Effect of Adding Cinnamon Powder on Chemical Characteristics and Sensory Properties of Yoghurt Produced From Goats Milk

أثر إضافة مسحوق القرفة علي الخواص الكيميائية والصفات الحسية للزبادي

المصنع من حليب الماعز

Dissertation Submitted in Fulfillment for the Requirements of (B.sc) in Dairy Science and Technology

By:

Abazar Mohamed AdamMohamed

Alaa Ahmed Alsanosey Alnafar

AsawerMohamed Ahmed Adam Daoud

Fatima Alfadel Ali Abad- Almajed

Supervisor:

Prof. Omar Ibrahim Ahmed Hamid

October.**2018**

الإستهلال

بسم الله الرحمن الرحيم

قال تعالى:

(وإن لكم في الانعام لعبرة نسقيكم ممافي بطونه من بين فرث ودم لبنا خا لصا سائغا للشاربين).

صدق الله العظيم

سورة النحل ,الاية (66).

Dedication

I dedicate this study

To our father

To our mother

To our brother and sisters

To our Friends

Acknowledgement

Thanks to Allah first and then thank Stour supervisor professor Omer Ibrahim Ahmed Hamid for his valuable supervision and endless advice throughout the conduction of the study. Our appreciation to our parents for their encouragement and patience through our study journey.

Thanks are extended to our sincerely Dr. Rania Hassan Zayed and Teacher

Zawahir Abu Al Bashar for their help. Our Thanks was due to everyone who helped us complete the research and provided us with the necessary information.

Thanks are due to the Sudan University of Science and Technology, College of Animal Production Science and Technology, especially the Department of Dairy Science and Technology.

List of content

List of tables

ABSTRACT

This study was conducted at the College of Animal Production Science and Technology at Sudan University of Science and Technology during the period from11-18April.2018 to find out the effect of adding cinnamon powder on the chemical and sensory properties of the flavouring yoghurt made from milk goat. In this Study four treatments were carried out, the first was the control where the yoghurt was made without cinnamon addition. In the second, third and fourth treatments 0.2%, 0.3% and 0.5% of cinnamon powder were added respectively to the yoghurt milk. In all treatment yoghurt milk was pasteurizes at 80 ºC for 16 scanted then the cooled to 45 º C and processed into yoghurt, chemical and sensory evaluation of the yoghurt samples were carried out after 12 hours at refrigeration temperature. Statistical analysis was performed using SPSS program, the means were separated using the least significant difference method, the results of chemical analysis showed significant differences in fat and total solids while there was no significant differences in protein and acidity of the yoghurt samples. Sensory evaluation showed significances differences in colour and no significant variations in the flavour and Texture.

Key Word: - Fermented milk – Milk standardization – Flavouring- Benefits of cinnamon.

مستخلص البحث

اجريت هذة الدراسه بمعمل علوم وتكنولوجيا الانتاج الحيواني جامعه السودان للعلوم والتكنولوجيا في الفتره مابين 2018/4/11 الي 2018/4/18 .وذلك لمعرفه اثر اضافه مسحوق القرفه علي الخواص الكيمايئه والصفات الحسيه للزبادي المنكهه المصنع من لبن الماعز.

تم شراء 4 لتر من حليب الماعز لاجراء التجربه , اجريت اربعه معاملات في هذا البحث . المعامله الاولي وهي الشاهد حيث تم تصنيع الزبادي من دون اضافه القرفه, اما المعامله التانيه تم اضافه 0.2%من مسحوق القرفه ,اماالمعامله التالته تم تصنيع الزبادي با ضافه 0.3% من مسحوق القرفه ,اما المعامله الرابعه تم فيها تصنيع الزبادي باضافه 0.5% من مسحوق القرفه .

تم بسترة اللبن في كل المعاملات في درجة حرارة 80مº لمدة16ثانية ، وتم تبريدها الي 45مº ، تم اخذ العينات للتحليل الكيميائي والتقيم الحسي بعد 12ساعة من صناعة الزبادي،اجري التحليل الاحصائي باستخدام برنامج SPSS حيث استخدم تحليل التباين . اظهرت نتائج التحليل الاحصائي وجود فروق معنويه في الدهن والمواد الصلبه بينما لاتوجد فروق معنويه في البروتين والحموضه، اوضحت نتايج التحليل الحسي وجود فروق معنويه في اللون وايضا عدم وجود فروق معنويه في النكهه والطعم والقوام.

Chapter one

Introduction

Yoghurt made from cow's milk is widely consumed in the world. On the other hand, there is a desire for alternatives to cow's milk due to problems relating to gastrointestinal intolerance and market demand for the formulation of novel dairy products. Goat's milk is reported to have Higher digestibility and lower allergenic properties compared to cow's milk (Ranadheera *et al*., 2012).

Goat milk has high protein content, higher vitamin A and B contents, a higher content of free amino acid Taurine, and a higher proportion of short to medium chain fatty acids and considerable amount of calcium and phosphorous. However, the average goat milk consumption is not significantly different from cow milk. Goat milk with its low lactose content is more suitable for those who suffer from lactose intolerance often caused by cow's milk (Ahmad and Noor, 2012).

Production of goat milk worldwide has increased in recent years. It has many beneficial effects for human health. The nutritional and healthy values of fermented milk and beverages were well-described (Ribeiro and Ribeiro, 2010).

Goat is considered as the poor man's cow. In the developing world, goat can fulfill the difference between malnourished and healthy sustaining diet (Mowlem, 2005)

1.1. Objective of the study:

To Study the effect of adding cinnamon powder on physicochemical and sensory properties of yoghurt.

Chapter Two

Literature review

2.1. Fermented milk products:

Fermented milks are sour milk products prepared from milk, from partially or fully skimmed concentrated milk or milk substituted from partially or fully skimmed dried milk homogenized or pasteurized or sterilized and fermented by means of specific dairy starter cultures (Gandhi, 2000).

The origin of cultured dairy product is obscure and it is difficult to be precise about the date when they were first made. Fermented by lactic acid bacteria the growth and toxicity of anaerobic, sporefoming bacteria in the large intestine are inhibited (Gandhi, 2000).

Lactic acid is biologically active and capable of suppressing harmful microorganism. Especially putrefactive ones and so has favorable effect on human viral activities. Of longevity considerably influenced the spread of fermented milk products to many countries, particularly in Europe he also promoted extensive studies concerning biochemical and physiological properties of fermented milks. (Gandhi, 2000).

2.2. Culture milk:

These are seeded but unfermented milks which deliver significant doses of probiotics microorganisms. In this case, the growth of the cultureis intentionally avoided in order to preserve the fresh taste of the milk. Accordingly, the product is maintained at refrigeration temperature at all times in the past, acidophilus milk was marketed

By fermenting sterilized milk with *lactobacillus acidophilus* the inoculated base was incubated at 37C (98.6F) for 24hours (Chandan,2002)The plain product developed a titratable acidityof1-22%. Consequently, it had a very harsh, acidic flavor. Its popularity declined rapidly as sweetened yoghurt with fruit flavors began to dominate the market. However, *L.acidophilus*, does have a strong consumer appeal. Most of the yogurts (80%) now sold in the USA contain *L.acidophilus*, which is either added after culturing with yogurt culture or is co cultured with yoghurt culture. Sweet acidophilus milk is an acceptable substitute for acidophilus milk. The product is based on pasteurized and low-fat milk, to which a concentrate of lactobacillus is added (Handan, 1999).

2.3. Yoghurt:-

Yogurt is an ancient food that has gone by many names over the millennia: katyk (Armenia), dahi (India), zabadi (Egypt), mast (Iran), lebenraib (Saudi Arabia), laban (Iraq and Lebanon), iogurte (Brazil), cuajada (Spain), coalhada (Portugal), dovga (Azerbaijan), and matsoni (Georgia, Russia, and Japan). It is believed that milk products were incorporated into the human diet around 10 000–5000 BC, with the domestication of milk producing animals (cows, sheep, and goats, as well as yaks, horses, buffalo, and camels) (Moreno et al., 2013).

Yoghurt and fermented milk products are generally considered as a healthy food and are among dairy products widely consumed around the world (Remaufelal el al, 2003).

Yoghurt mad in a variety of composition either plain or with added substances, fruits, sugar, gelling agents and beverages (Walstra*el et al*, 1999).

2.3.1. Types of yoghurt:-

There are two major types of yoghurt set and stirred ,set yoghurt (which may include fruit on the bottom) is formed in retail pots as lactic acid bacteria ferment lactose into lactic acid giving a continuous gel structure in the consumer container ,therefore in stirred yoghurt ,the acid gel formed during incubation in large fermentation tanks is disrupted by agitation(stirring),and the stirred product is usually pumped through a screen which gives the product a smooth and viscous texture (Tamime and Robinson ,1999).

2.3.2. Varieties of yoghurt:-

Yogurt can be categorized into two different groups namely, standard culture yogurt and bio- or probiotic yogurt. Standard yogurt refers to those made with *L. bulgaricus*and*S. Thermophiles*. These bacteria said to be not actually inhabit gut; however able to stimulate the friendly microflora already present in the gut helping to maintain the general intestinal health(Dowden,2013).This type of yogurts are more popular and have a milder, creamier flavor and less acidic. Further, bio-yogurts are claimed to aid in digestion and promote good health; however, these probiotic strains should remain live at adequate numbers to claim any health effect (Daily Australia, 2013).Because of this reason, a term called “live and active cultures” has been introduced recently which refers to the living microorganisms including standard yogurt cultures and probiotic cultures present in the yogurt at the time of manufacture. In order to identify the yogurt products with adequate amounts of beneficial live microorganisms, the National Yogurt Association recently introduced the live and active cultures seal. Therefore, according to the National Yogurt

Association's guidelines, the refrigerated products should contain at least 100 million live cultures per gram and the frozen products should contain at least 10 million live cultures per gram at the time of manufacture in order to obtain the live and active culture seal (National Yoghurt Association 2013c).

Apart from this classification, the yogurt products available in the market are in a wide variety of flavors, textures and forms that suits a vast array of palates and meal occasions. These can be consumed either as a snack, dessert or a part of a meal. Different varieties of yogurt that can be categorized according to the physical and chemical nature, added flavors and post incubational processes are discussed in this section (FDA, 2013a).

2.3.2.1. Based on the chemical composition of the product

Based on the fat content of yogurt, it can be categorized into three major varieties namely, regular yogurt, low-fat yogurt and non-fat yogurt. Regular yogurt is produced from the full fat milk which should contain at least 3.25% of milk fat (FDA, 2013a).

2.3.2.2. Based on the physical nature of the product

The physical nature of yogurt can be solid, semi-solid or fluid. Yogurts that are solid in nature (jelly-like texture) are called as set yogurt that is incubated and cooled in the final packaging. Whereas yogurts which are in semi-solid state and fluid nature called as stirred yogurt and fluid/drinking yogurt, respectively. Stirred yogurts are produced by incubating the mix in a tank followed by breaking by stirring prior to cooling and packaging (Dairy Consultant, 2013).

2.3.2.3. Based on the flavor of the product: -

Addition of flavors would enhance the consumer appeal while produce a variety of products. Flavors can either be added immediately before homogenization or after the homogenization.Yoghurts can be

categorized into plain-, fruit- and flavored yogurt based on the particular flavor of the yogurt (Dairy UK, 2009).

2.3.2.4. Plain/Natural yoghurt: -

This is the simplest and the least adulterated form of the yogurt made by lactic acid bacterial fermentation of pasteurized milk in order to produce its characteristic texture and flavor. In other words, it can be defined as the plain and unsweetened fermented milk product containing no added color or any other additives (Dairy UK, 2009). Therefore, it is closer to the nutritional value of milk which it is made of, and provides all of the benefits associated with fermentation while supplying fewer amounts of calories. Moreover, plain yogurt gives the pure yogurt taste and contains the richest calcium content among the yogurt products (Daily Australia, 2013).

2.3.2.5. Flavored yoghurt

Yogurts are available in a vast array of flavors including fruit (apple, apricot, black cherry, black currant, blue berry, lemon, mandarin, raspberry, strawberry, peach), cereal, vegetables, chocolate, vanilla, caramel, ginger, etc (Goodness Direct,2013). In general, flavors are added to yogurt during production stage and the addition of flavors not only results a wide array of tastes, but also increases sweetness of the product (Daily Australias, 2013).

2.3.4. Yoghurt related products:-

After the basic incubation process in the yogurt manufacturing, depends on the manufacturing processes employed such as mixing with other mixtures, heat treatment and drying, may results a range of yogurt products namely, pasteurized yogurt, UHT yogurt, dried yogurt, etc(Dairy UK,2009).

2.3.4.1. Pasteurized and UHT yoghurt:-

These types of yogurts are produced after the fermentation by subjecting to heat treatment with different time-temperature combinations (Dairy UK, 2009). Although these types of yogurt products are produced by the manufacturers in order to prolong the shelf life and/or to decrease the natural tartness of yogurt, the heat treatment may destroy considerable numbers of live and active cultures present, which would be a disadvantage when considering the health benefits of yogurt consumption.

2.3.4.2. Frozen yoghurt:-

The Pennsylvania Code defines frozen yogurt as a food which is prepared by freezing while stirring a pasteurized mix consisting of the ingredients permitted for ice cream and should contain not less than 3.25% milk fat, not less than 8.25% milk solids nonfat and has a titratable acidity of at least 0.3% expressed as lactic acid (The Pennsylvania Code 1992a). In order to obtain the National Yogurt Association's Live and Active Cultures seal, frozen yogurt must be a product produced by fermenting pasteurized milk using traditional yogurt cultures until the proper acidity is reached followed by mixing with pasteurized ice cream mix including cream, sugar, stabilizers, etc according to the pre-determined recipes of the manufactures which can then be blended with fruits and then frozen (National Yoghurt Association, 2013a).

2.3.4.3. Dried yoghurt/yoghurt Powder:-

Yogurt powder is produced by fermenting non-fat milk using standard yogurt cultures until attain the desirable pH followed by a step of drying, most probably by freeze-drying. In addition, blended yogurt powder is manufactured by blending cultured non-fat milk, cultured

whey, cultured whey protein concentrate, cultured dairy solids, nonfat dry milk and lactic acid which are similar to the flavor and functionality to that of the traditional yogurt powder (Childsand Drake, 2008).

2.3.4.4. Herbal yoghurt:-

In recent years, there is an increasing trend towards the production of herbal yogurts by incorporating natural food additives and health promoting substances. Addition of name (*Azadirachtaindica*) into yogurt has shown increased acidification, total phenolic compounds, antioxidant activity and inhibition of enzymes related to diabetes and hypertension (Shoriand Baha2011a,). Bioyogurts prepared from cow milk and camel milk with *Cinnamomumverum*reported to inhibit enzymes such as α-amylase and α-glucosidase related to diabetes whereas the higher counts of Lactobacilli was observed in the herbal yogurts prepared with camel milk than that of the plain yogurt (Shori and Baha,2011a,2012).

2.3.5. Health benefits of yoghurt: -

Health benefits of yoghurt include providing immune support for fighting against infections or cancer, providing a healthy replacement with good bacteria in the intestinal tract following antibiotic therapy, reducing occurrence of diarrhea in humans, aiding in lowering cholesterol and improving the symptoms of lactose intolerance (Hara, et al ., 2007).

Some strains of acidophilus have studiedextensively for health effects. The Mayo clinic publishes a list of which has been tested, grafting the evidence for each use from strong evidence of effectiveness, through unclear, down to strong evidence of ineffectiveness.

L. acidophilus or yoghurt enriched with it for the treatment of some vaginal infections, effectiveness for other conditions ranges from

unclear to fair negative evidence some L. acidophilus strains may be able to survive gastrointestinal transit, being resistant to bile, low pH, and digestive enzymes. They may then be able to adhere to human epithelial cell lines and human intestinal mucus (Singh *et al*, 1980). .L. acidophilus led to a significant decrease in levels of toxic amines in the blood of dialysis patients with small bowel bacterial over growth. At adequate daily feeding levels L.acidophilus may facilitate lactose digestion in lactose – intolerant subjects (Singh *et al.*, 1980).

2.3.6. 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 (Tamimeand Robinson, 1999).The generalized process of yogurt making is comprised of modifying the original composition of milk, pasteurizing the yogurt mix, fermentation at thermophilic temperatures (40-45 ºC), cooling and addition of fruits and flavors.

Yoghurt is made with a variety of ingredients including milk, sweeteners, stabilizers, fruits, flavors, and bacterial cultures. Milk is the main ingredient used in yoghurt manufacturing. The type of milk to be used depends on the variety or type of the yoghurt that will be prepared. For instance, whole milk is used for full fat/regular yoghurt, partially skimmed milk is used for low fat yoghurt and skimmed milk is used for nonfat yoghurt. Cream/butter fat is used to adjust the fat content whereas skim milk powder, whey protein concentrate is used to elevate the total solid content of the yogurt mix. Stabilizers are usually added to the mix in order to increase the body and texture

leading to an increase in firmness, prevents whey separation/syneresis, and aids in uniform distribution of ingredients. In addition, sweeteners are added to increase the flavor and consumer appeal (Tamimeand Robinson, 1999).

2.3.6.1. Milk standardization:-

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 andregulations of many countries (Tamimeand Robinson, 1999).In order to achieve this, the FAO/WHO standards specifies that milk should be standardized with the minimum SNF and milk fat content of 8.2% and 3% respectively for yogurt 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 titratable acidity not less than 0.3% expressed as percentage of lactic acid (Codex Alimentarius Commission 2010).

.2.3.6.2. 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 yogurt with high fat content. Consequently, it results no distinct creamy layer on surface of the yogurt and improves consistency of the yogurt (Chandanand Kilara, 2013).

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 (Dairy Consultant, 2013).

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).

2.3.6.3. Heattreatment:-

It is generally considered that the heat treatment of milk is an essential step in yogurt 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 (Leeand Lucey, 2010; Dairy Consultant, 2013).

2.3.6.4. Inoculation and incubation:-

After the heat treatment, the milk base in cooled to the incubation temperature used for growth of The starter culture, an optimum temperature of the *Streptococcus thermophilus*and Lactobacillus delbrueckii sub sp. bulgaricus is around 40-45ºC. the inculcation amounts vary between 0.5-5% but the optimum value is 2% bacterial fermentation converts lactose into lactic acid, which reduces The pH of milk, during acidification of milk, The pH decreases from 6.7 to <4.6.(Lee and Lucey, 2010).

2.3.6.5. Cooling:-

When yoghurt has reached the desired pH, yoghurts are partially cooled (2ºC) before Fruit or Flavoring ingredientsare added. Yoghurt products are often blast chilled to 5ºC in the refrigerated cold store to reduce further acid development (Meso, 2013).

In the manufacture of set-yoghurt, yoghurt is directly transferred to a cold store or blast chilled in cooling tunnels. On the other hand, in the manufacture of stirred-yoghurt, cooling is first performed by agitating the jacketed fermentation vat in order to produce smoothened product before filling to containers (Lee and Lucey 2010).

2.3.7. 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 cultures , storage period of yoghurt and the additives in yoghurt (Deeth and Tammie, 1981).Yoghurt can be easily modified by adding sweeteners with fruits and flavors to make them feel palatable and aromatic .(Bodotv, *el. al.2013)*

2.3.7.1. Flavoring: -

Flavoring are intense preparations which are added to foods in order to impart taste and /or smell. These food flavors are used in small amounts and are not intended to be consents and are not intended to be consumed alone. There are certain natural food flavors which are derived from herbs. Spices and substances having an exclusively sweet, sour or salt taste. These natural food flavors are not included in the definition of flavorings for regulatory purposes.

2.3.7.1.1. Types of food flavoring: -

Flavorings are used as food additives for altering and /or enhancing the flavors of natural food products sometimes, food flavorings are also used to create flavor for food products that do not have desired flavors such as candies and other snacks. There are three major types of food flavorings that are used in foods. The classification of flavorings is done as – Natural flavorings and synthetic flavorings, and nature –identical flavorings (Food Additives, 2013-2018).

2.3.7.1.2. Natural flavoring substances: -

Flavoring substances that are obtained from plant or animal raw materials, by physical, microbiological or enzymatic processes are classified as natural flavoring substances. These natural from or processed from for consumption by human beings. However, they cannot contain any nature –identical or artificial flavoring substances (Food Additives, 2013-2018).

2.3.7.2. Nature –identical flavoring substances: -

Nature identical substances are the flavoring substances that are obtained by synthesis or are isolated through chemical process, which are chemically identical to flavoring substances naturally identical to flavoring substances naturally present in products intended for consumption by human beings, flavoring substances(Food Additives, 2013-2018).

2.3.7.3. Artificial flavoring substances: -

Flavoring substances that are not identified in a natural product intended for consumption by human being. Whether or not the product is processed are artificial flavoring substances. These food flavorings are typically produced by fractional distillation and additional chemical manipulation naturally sourced chemicals or from crude oil or coal tar (Food Additives, 2013-2018).

2.3.8. Cinnamon: -

Cinnamon is spice that comes from the branches of trees of the ‘cinnamomum

family.It is native to the Caribbean, south America, and south Asia. Cinnamon

has been consumed since 2000 BCin Ancient Egypt, where it was highly prized , in medieval times , doctors used cinnamon to treat conditions such as coughing , arthritis ,and sore throats .it is now the second most popular spice ,after black pepper in the U.S and Europe(Nordqrist, 2007).

2.3.8.1. Scientific classification:-

Kingdom: plants.

Supkingdom:Tracheobionta

Superdivision:Spermatophta

Division :Magnoliphyta

Class :Magnoliopsida

Subclass: Magnoliidae

Order :Laurales

Family :Lauraceae

Genus :CinnamomumSchaeff

Species : C, *v*erumJ.presl (USDA, 2018).

2.3.8.2. Types of cinnamon:-

There are two main types of cinnamon:-

2.3.8.2.1.Ceylon cinnamon (*Cinnamon verum*), often considered to be true cinnamon.

2.3.8.2.2.Cassia cinnamon or Chinese cinnamon (*C*innamomum aromaticum)which originates from southern China *Ceylon cinnamon* is very expensive, so most foods in the united states and western

Europe,including sticky buns,breads and other products use the cheaper cassia cinnamon (dried cassia bark)(Nordqrist, 2007).

2.3.8.3. Nutrition of cinnamon:-

According to the U.S.Department of Agriculture(USDA) ateaspoon of ground cinnamon wieighing 2.6 gcontains

Energy: 6calories

Fat: 0.39 %

Carbohydrates: 2.1g

Protein: 0.19

Calcium; 26 milligrams (mg)

Iron: 0.2mg

Magnesium: 2mg

Phosphorus: 2mg

Potassium: 11mg

Vitamin c: 0.1mg

Vitamin A 8 IU

It also contains traces of vitamins Band K (Nordqrist, 2007).

2.3.8.4. The Benefits of cinnamon: -

2.3.8.4.1. Cinnamon has powerful antioxidants:-

Cinnamon is lodged with polyphenols, powerful antioxidants that fight free radicals research has discovered over 41 protective compounds in cinnamon that can benefit you(Tadimalla, 2018)..

2.3.8.4.2. fights in Flammarion in your body:-

The anti-inflammatory properties of cinnamon can help ease different knits of swelling.

2.3.8.4.3. Cancer protection: -

Cinnamon is toxic to cancer cells and in dices cancer cell death .it reduces the growth of cancer cells and prevents them from prolife rating. One study done on mice showed interesting results the

spiceactivatesenztmes in the colon that detoxify the organ and prevent caner proliferation.

2.3.8.4.4. Boosts heart health:-

Cinnamon reduces bad cholesterol and stabilizes the levels of good cholesterol, by preventing heart attacks this is especially true in patients with type 2 diabetes(Tadimalla, 2018)..

2.3.8.4.5 lowers the blood sugar levels:-

Several small studies have linked cinnamon intake to lowered blood sugerlevels.the spice achieves this by lowering insulin resistance butdon't take cinnamon without talking to your doctor if you also have liver issues .

The antioxidants in cinnamon help in abigway.They reduce oxidative stress, which can otherwise make diabetes worse (Tadimalla, 2018).

2.3.8.4.6. Cinnamon improves the digestive health:-

Oil cinnamon has powerful antimicrobial properties these fight bacteria that cause infection in the digestive tract the antifungal properties of cinnamon even treat candida in the digestive tract (Tadimalla, 2018).

2.3.8.4.7. Improves the dental health:-

Cinnamon can relieve toothache. Research shows how this spice can treat toothaches and oral infections and even eliminate bad breath (Tadimalla, 2018).

2.3.8.4.8.-treats your sore throat:-

Thanks to the antibacterial properties and antioxidants in cinnamon the spice can ease asore throat you can simply add a teaspoon of cinnamon powder to your morning tea that must give you relief (Tadimalla, 2018).

2.3.8.4.9. Cinnamonenhances skin health:-

Cinnamon works great in treating acne.The antibacterial properties of spice help eliminate the bacteria that cause acne. (Tadimalla, 2018)

2.3.9. Effect of too much cinnamon:-

2.3.9.1. Cause liver damage:-

Cassia or regular cinnamon is arich source of coumarin. It contains approximately 5 mg of coumarin per teaspoon (2 grams), while*Ceylon cinnamon* only contains trace amounts of it (Raman, 2017). .

2.3.9.2. Increase the risk of cancer:-

Animal studies have shown that eating too much coumarinwhich is abundant in cassia cinnamon, may increase the risk of certain cancers (Raman, 2017).

2.3.9.3. Cause mouth sores:-

Cinnamon contains cinnamaldehyde a compound that may triggeran allergic reaction when consumed in large amounts (Raman, 2017).

2.3.9.4. Cause low blood sugar:-

Having chronic high blood sugar is a health problem if left untreated it may lead to diabetes, heart disease and many other health problems (Raman, 2017). .

2.3.9.5. Cause breathing problems: -

Fating too much ground cinnamon in a single sitting may cause breathing problems.This is because the spice has affine texture that can make it easy to inhale, Accidentally it can cause coughing ,gagging and make it hard to catch breath .also ,the cinnamaldehyde in cinnamon is throat irritant and may cause further breathing problems(Raman, 2017).

2.3.9.6. Interact with certain medication:-

Cinnamon is safe to eat in small to moderate amounts with most medication .however,taking too much may be an issue if taking medication for diabetes, heart disease. This is because cinnamon may interact with those medicines,either side effects, forexample, cassia cinnamon contains high amounts of coumatin, which can cause liver toxicity and damage if consumed in high amounts. (Raman, 2017).

Chapter Three

Materials and Methods: -

The present study was conducted during April 2018 at the laboratories of College of Animal Production Science and Technology, Sudan University of Science and Technology.

3.1. Materials:-

Water bath, Thermal thermometer ,four liters of goats row milk samples were purchased from the Bakrey from Alshigla (Shargalneel) , cinnamon was purchased from Hila Kuku and has been refilled , sugar , gauze filter , abowl of aluminum , abladder , yoghurt of Daima , plastic buckets , Genlb Inc

ubator , Refrigerator , Mechanical engine , Sensitive balance ,Centrifuge , Girbertubes, Burette ,Absorbent , Beakers , Drying oven , Burning furnace , Tinfoil , Slender , Volumetric flask , milkos can.

3.2. Methods: -

Four liters of milk were purchased and then filteredby gauze. The milk was tested byMilkoscanfor acidity, fat, density and total solids.

Sugar was added at the rate of 10% and the milk pasteurized at 80 ºC for 16 scanted.Then the milk was cooled to 45. Starter culture was addedat the rateof 2% then mixed well and stirred for 5 min.

The milk was then divided into four treatments, the first treatment was the control with spice addition, the second treatment cinnamon powder was added at the rate of 0.05 %, the third treatment 0.2% of cinnamon powder was added and in the fourth treatment 0.3% cinnamon powder was added to the yoghurt milk the yoghurt milk samples in all treatments was packed into plastic containers with 1000ml capacity. The milk samples in all treatment were placed into the incubator for 3 hours until

complete coagulation occurred. The yoghurt samples were placed outside the incubator for 10 minutes then inserted into the refrigerator and left for 12 hours after which chemical and sensory evaluations were carried out.

3.3. Chemical analysis:

3.3.1. Fat content:

The fat content was determined by Gerber methods according to Bradley et al., (1992) as follows:

In a clean dry Gerber tube, 10 ml of sulphuric acid (density 1.8 gm/ ml at 20) were poured, and then 10.94 ml of yoghurt sample were added, amyl alcohol (1-2ml) was added to tube, followed by the amount of distilled water. The contents were thoroughly mixed till no white particles could be seen. The Gerber tubes were centrifuged at 1100 revolution per minute (rpm) for 4-5 minutes. The fat column was then read immediately.

3.3.2. Protein determination: -

Protein content was determined by kjeldhal method according to the AOAC (2003) as follows:

Ten grams of each sample were weighed in a crucible and transferred to a digestion flask. Two tablets of kjeldhal catalyst (mercury) and 3 ml of concentrated sulphuricacid (sp.g.1.84) were added to the sample. The flask was placed on the digested apparatus, heate

d strongly until the liquid had become clear.

To the digested sample of yoghurt, fifteen ml of NaOH (40%) were added in kjeldhal distillation apparatus. Ten ml of boric acid (2%) and three drops of indicator (bromocresol green and methyl red) were added to a receiving flask. The distillation was continued until the distillate in the receiving flask was 75 ml.

The sample in the receiving flask was titrated against HCL (0.1 N) until the color was changed to a faint pink. The protein content was calculated as flows:

$$N\% = \frac{T \times 0.1 \times 20 \times 0.014 \times 100}{\text{Weight of sample}}$$

Where:-

T: Titration figure

20: dilution factor

0.014: atomic weight of N /1000

Protein (%) = N (%) × 6.38

Where:-

N= nitrogen content

6.38 = conversion factor

3.3.3. Total solids:-

The Total solids content was determined according to the modified method of AOAC (1990).

Three grams of sample were weighted into adry oven flat bottomed crucible and heated steam bath for 10-15 minute the was placed in oven at 105ºC over night and then cooled in desiccators and weighed quickly were repeated and till difference between the two reading was< 0.1mg. The solids content was calculated from the following equation.

T.s% = w1/wo×100

Where =w1 = weigh of sample after drying.

Wo= weigh of sample before drying.

3.3.4. Determination of Titratable acidity: -

Titratable acidity was estimated accordance with the AOAC (1990) method. 9 ml of yoghurt was added and 3 points of phenolphthalein were added and then NaOH was calibrated 0.1% until the color became light pink and reading was taken.

Acidity=T/ W

T= titration figure

W= weight of samples

3.4. Sensory evaluation: -

Sensory profiling of the yoghurt samples was conducted, using conventional profiling, by untrained panelists. Ten panelists were selected among the staff and students of the College of Animal Production Science and Technology. The panelists were given a hedonic questionnaire to test color, taste, texture,flavor, body and overall acceptability of coded samples of different treatments (larmond, 1978).

3.5. Statistical analysis: -

Statistical analysis was carried out with SPSS version 16 by one- way ANOVA model was used for data analysis .Least Significance (LSD) was used for mean separation between thetreatments. The level ofsignificance($p>0.05$), ($p<0.01$) was used in this study.

Chapter Four

Results

4.1. Chemical composition of raw goat's milk: -

Theresults in Table (1) showed the chemical composition of raw goat milk (protein, titratable acidity, fat,density , pH, lactose , ash and Total solids).

4.2. Effect of different levels of cinnamon on the chemical composition of flavor yoghurt: -

The data in Table (2) showed the effect of adding cinnamon powder on the physicochemical composition of the flavor yoghurt.

The results showed that significant ($p<0.01$) differences were observed in the fat contents of the yoghurt samples, the higher value (3.65 ± 0.00^{a} %) was for the yoghurt samples with 0.5% cinnamon while the lower one(3.25 ± 0.07^{b} %)was for the samples without cinnamon, however there were no significant effect among the treatments with the different levels of cinnamon.

The statistical analysis of the yoghurt samples revealed no significant variation ($P>0.05$) in the titratable acidity and proteins contents. The highest titratable acidity (1.60 ± 0.00%) was for the control yoghurt samples while the lowest one (1.00 ± 0.00) was for the yoghurt samples with cinnamon powder.

The data showed that the yoghurt samples with different levels of cinnamon had significantly ($P<0.01$) higher total solids. The higher

total solids (18.55 ± 0.35[a]) was for the yoghurt samples with 0.5% cinnamon while the lower one (16.07± 0.63[b]) was for the control yoghurt samples. However, no significant effect was found among the yoghurt samples treatments with different cinnamon levels.

Table (1) Chemical composition of raw goat milk:-

Chemical composition	%
Temperature	22.4c
Fat	3.29
Density	25.03
Ph	6.96
Protein	2.68
Lactose	4.08
Ash	0.61
Total solids	7.32

Table (2) Effect of different levels of cinnamon on the chemical composition of flavored yoghurt:-

Treatments	Chemical composition %			
	Fat	Acidity	Protein	Total solids
Control	3.25± 0.07[b]	1.60 ± 0.00	3.30 ± 0.00	16.07± 0.63[b]
0.2%	3.40± 0.00[a]	1.00 ± 0.00	3.30 ± 0.00	17.47 ± 0.49[a]
0.3%	3.50± 0.00[a]	1.00 ± 0.00	3.30 ± 0.00	17.60 ± 0.42[a]
0.5%	3.65± 0.00[a]	1.00 ±0.00	3.30 ± 0.00	18.55 ± 0.35[a]
Sig	**	NS	NS	**

Means with different superscript in the same column are significantly ($p<0.05$) different.

Sig = significant different.

** = Significant different at ($p<0.01$).

* = Significant different at ($p<0.05$).

NS = No Significant different ($p>0.05$).

a .b .Means within the same column followed by different superscripts are significantly different ($p<0.05$).

4.3. Sensory analysis flavoring yoghurt samples with cinnamon powder: -

Figure (3) Showed the sensory analysis of the flavoring yoghurt the result showed Significant ($p>0.01$) difference between the samples in the color. The sample showed the best while 0.5%, 0.3%, 0.2% as for taste,flavor andtextures, there are no significant differences.

Table (3) Effect of different levels of cinnamon powder on sensory properties of flavor yoghurt:-

Treatment	Sensory analysis			
	Color	Taste	Flavor	Textures
Control	7.00 ± 0.00^{a}	6.20 ± 1.03	5.08 ± 0.17	4.00 ± 2.16
0.2%	5.40 ± 1.26^{b}	5.40 ± 1.57	5.60 ± 1.64	3.80 ± 1.68
0.3%	5.80 ± 1.39^{b}	5.80 ± 1.39	5.40 ± 1.26	3.80 ± 1.68
0.5%	5.60 ± 1.34^{b}	6.00 ± 1.41	5.60 ± 1.64	4.20 ± 2.14
Sig	*	NS	NS	NS

* = Significant different at ($p<0.05$).

a. b. .Means within the same column followed by different supers cripts are significantly different ($p<0.05$)

CHAPTER FIVE

Discussion

The addition of different levels of cinnamon powder showed significant difference on the fat and total solids contents of the yoghurt samples (Table 2).

The high fat contents of the yoghurt samples with cinnamon levels might be due to the inhibition effect of the cinnamon powder on the activities of the lipolytic bacteria which might be degraded the fat of the yoghurt samples without cinnamon. This result was in line with that by Musa (2011).

The highest total solids content of the yoghurt samples with cinnamon powder could be attributed to the high crude fiber and minerals contents ofcinnamon.These findings were in accordance with the work of Musa (2011) and Felfoul*et al.* (2017).

The result demonstrated no significant effect of cinnamon powder addition on the protein and the acidity of yoghurt samples in different treatments.This result was not in agreement with that by Felfoul*et al.* (2017) and Musa (2011).

The difference in color indicates that yoghurt with cinnamon powder is darker(light brown) than that of the control, this color may be due to darker color of cinnamon powder that may be negatively affected the color of the yoghurt samples.This finding was in accordance with those previously reported by Felfoul*et al.* (2017).

Chapter Six

6.1. Conclusion

- **ItWould be concluded of cinnamon totheyoghurt significantly increased the fat content and total solids of the yoghurt samples while titratable acidity and the protein content were not significantly affected.**
- **The color of the yoghurt significantly affected by the addition of cinnamon powder. However, taste, flavorand texture of the yoghurt were not affected.**

6.2. Recommendations: -

These recommendations weredrawn from this study: -

- Further work is needed on the effect of cinnamon on the microbiology of yoghurt samples.
- Vitamins, minerals and amino acids contents of yoghurt samples with cinnamon powder required elaboration.
- Effect of storage period of yoghurt samples with cinnamon powder needs further study.

References

AOAC ,(2003). Official Methods of Analysis , Association of official Analytical chemists , Washington , D C , U S A .

AOAC.(1990). Association of official Analytical chemists methods of Analysis . Washington , D C , U S A .

Bradley , R. L.J : Arnold , E . J .R :Barbano , D. M :Semerad , R.G .: Smith ,D ,E. and Viries , B. K .(1992). Chemical and physical methods in : Marshall, R . T.(Ed) Standard Methods for the Examination of Dairy products. American public Health Association Washington O C. USA.

Bodot, V., Soustre, Y. and, Reverend, B. (2013).Best of Yogurt Special. French National Dairy Council (CNIEL): Scientific and TechnicalAffairsDivision;2013.http://www.idfdairynutrition.org/Files/media/FactSheetsHP/EXEEN_BofYogu

pdf. Accessed October 11, 2014.

Chandan, R. C., and Kilara, A. (Eds.). (2013).*Manufacturing yogurt and fermented milks*. Wiley Blackwell Publishers.

Chandan,R.C. (2002).Symposium .Benefits of live fermented milks :presentdiversity of products. proceeding of international Dairy congress,paris,France . CD-ROM.

Chandan, R. C.(1999). Enhancing market value of milk by adding cultures.J.Dairy Sci.82:2245-2256.

Childs, J.; and Drake, M. 2008. Sensory properties of yogurt powders. Poster presentation, IFT Annual Meeting, June 2008. Abstract 048-09.

Chye, S.J., Ahmad, R. and Noor Aziah, A.A. (2012). Studies on the physicochemical and sensory characteristics of goat's milk dadih incorporated with tropical- fruit purees. International Food Research Journal,19, 1387-1392.

Codex Alimentarius Commission. (2010). Codex standard for fermented milks. CodexSt 243-2003. [online]. Available: www.codexalimentarius.org/input/download/.../400/CXS_ 243e.pdf> [Accessed 5 December 2013].

Daily Australia, (2013). Types of Yogurt. [online] Available at: <http://www.dairyaustralia.com.au/Dairy-food-and-recipes/Dairy-Products/Yogurt/Types-of-Yogurt.aspx> [Accessed 2 December 2013].

Dairy Consultant, (2013). Dairy Science Information. [online] Available at: <http://www.dairyconsultant.co.uk/si-yoghurt.php#> [Accessed 5 December 2013).

Dairy UK, 2009. Code of practice for the composition and labeling of yogurt. London: W1U 6QQ

Dowden, A., (2013). The good yoghurt guide. Daily Mail, [online] 4 December. Available at: <http://www.dailymail.co.uk/health/article-19005/The-good-yoghurt-guide.html> [Accessed 4 December 2013].

Deeth,C.H. and Tamime,Y.A.(1981). Yoghurt: Nutritive and Therapeutic Aspects Journal of Food protection, 44(1):78-86.

FDA. (2013a). Yogurt. 21 CFR 131.200, Code of Federal Regulations. U. S. Dept. of Health and Human Services, Washington, DC.

Felfoul, M.,Borchani, O., Samet- Bali, H.Attia, M.A.Ayadi (2017), effect of ginger (Zingiberofficalis) addition on fermented bovaine milk Rheological properties ,sensory attributes and antitoxidannd potential , journal of new sciences impacted and in dexed journal , E-ISSN 2286-5314.

Food Additives.(2013).Ameliorating the flavors, Enriching the food. Flavoring,Food flavors <www.Food additives world .com.2018. 23.

Gandhi, D.N.(2000). Fermented Dairy products and Their Role in controlling Food Borne Diseases,,in: S.S.Marwaha and J.K.Arora, Eds., Food processing :Biotechnological Applications, Asiatech publishers Inc., New Delhi.pp.209-220.

Goodness Direct, (2013). Fruit and Flavored yogurt. [online] Available at:<http://www.goodnessdirect.co.uk/cgi-local/frameset/sect/CDYF-Fruit___Flavoured_Yogurt.html >[Accessed 30 November 2013].

Hara,O A M and Shanahan ,F.2007. Mechanism of action of probiotics intestinal diseases , sci world j 2007,7;31- 46.

Joseph, N. (.2007). What are the health beniefits of cinnamon?-Medical News Today- last updated the 30November 2007.< medicine wstoday .com.

Larmond, E. (1977). Laboratory methods for sensory evaluation of food. canadian Department of Agriclture, Ottawa , Canada.

Lee, W. J., andLucey, J. A. (2010). Formation and physical properties of yogurt. Asian-Aust. J. Anim. Science, 23(9), 1127-1136.

Meso , R. O .(2013). Evaluation of mongo fruit yoghurt produced from camel milk supplemented with Gum Arabic .M .Sc. thesis Sudan University of Science and Technology, Sudan .

Moreno A, L, CerveraRal P, Ortega A, R, (.2013). [Scientific evidence about the role of yogurt and other fermented milks in the healthydiet for the Spanish population (Spanish)]. Nutr Hosp2013;28:2039–2089.

Mowlem, A., (2005). Marketing goat dairy produce in the UK. Small Ruminant Research. 60, 207–213.

Musa, N.A.(2011). Effect of adding cinnamon , fenugreek and cardamom to goats milk curd on chemical compostition and sensory properties of white cheese during storage, Sudan University of Science and Technology ,2011.

National Yogurt Association,(2013c). *Live and Active Culture Yogurt*. [online] Available at:<http://www.aboutyogurt.com/Live-Culture> [Accessed 29 November 2013].

Remauf, F:, Mohammed, S:,Sodini,I.and Tissier,J.P.(.2003). preliminary observations on the effects of milk fortification and heating on miceostructure and physical properties of stirred yoghurt. International Dairy Journal, 13:773-782.

Ribeiro, A.C., Ribeiro, S.D.A.,(2010). Specialty products made from goat milk. Small Rumin. Res. 89, 225-233.

Raman, R,M S (N Z). (2017). 6Side Effect of Too Much Cinnamon – Healthline ,November 18,2017.<https:// www:healthine.com.

Ranadheera,S, C., Evans, C. A., Adams, M. C., and Baines, S. K. (2012). Probiotic viability and physico-chemical and sensory properties of plain and stirred fruit yogurts made from goat's milk. *Food Chemistry*, *135*(3), 1411-1418. Retrieved from<http://www.scincedirect.com.

Sheil B F, .(2007), probiotic effects on inflammatory bowel disease , j Nutr 137; 819S- 824S.

Singh , d., Khanna , A . and Chander , H .(1980).Effect of incubation temperature and heat treatment of milk cow and buffalo an acid flavor production by S. thermophilus and L.bulgaricus . Journal of food protection , 43(5): 399—400.

Shori, A. B., and Baba, A. S. (2011a). Antioxidant activity and inhibition of key enzymes linked to type-2 diabetes and hypertension by*Azadirachtaindica*-yogurt. *Journal of Saudi Chemical Society*.

Shori, A. B., and Baba, A. S. (2012). Viability of lactic acid bacteria and sensory evaluation in *Cinnamomumverum*and *Allium sativum*-bio-yogurts made from camel and cow milk. *Journal of the Association of Arab Universities for Basic and Applied Sciences*, *11*(1), 50-55.

Tamime, A. Y., and Robinson, R. K. (1999).*Yoghurt: science and technology*. Woodhead Pub Limited.

Tadimalla,T,R.2018.Cinnamon: 10 potent Health Benefits the Best Types of cinnamon. Stylecraze.com, September 5,2018.<https:// www.google .com.

The Pennsylvania Code, (1992a).*22 Pa.B. 5019 § 39.23*. *Frozen yogurt.* Commonwealth of Pennsylvania [online] Available through: <http://www.pacode.com/secure/data/007/chapter39/s39.23.html> [Accessed 4 D ecember 2013].

USDA (2018), classification for kingdom plantae down to subkingdom , natural resources conservation service (15, 10, 2018).

USDA, (2001). USDA Specifications for Yogurt, Nonfat Yogurt and Lowfat Yogurt. Dairy Programs. Agricultural Marketing Services. United States Department of Agriculture: Washington, DC.

Walstra . p; Geurts , T. J ; Noomen , A ; Jellems , A .and Nan Boekel , M. A .J .S .(1999). Dairy technology principles of milk properties and processes . C R C press Book Marcel Dekker , inc . New York.