بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of graduate studies

Effect of Different Levels of Date Paste on the chemical and Sensory properties of Fermented Camel Milk (Gariss)

تأثير مستويات مختلفة من معجون البلح على الخصائص الكيميائية والحسية للبن الإبل المخمر (القارص)

A Thesis submitted for partial fulfillment of the requirements for degree of Master of Science in Animal Production in Tropics

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الإستهلال

قال تعالي : (الله الّذِي جَعَلَ لَكُمُ الأَنْعَامَ لِتَرْكَبُوا مِنْهَا وَمِنْهَا تَأْكُلُونَ)

صدق الله العظيم

سورة غافر الآية (79)

Dedication

:to

My Great mother, father soul

Friends and relationship

Acknowledgment

All thanks and praise to Allah, then deep thanks to my dignified supervisor prof; Omer Ibrahim Ahmed Hamid, for help, advise and guidelines in all interval of research.

Thanks with my love for my mother, family, and all academic staff in the educational phases especially (Omdurman Islamic University) that supported me till this instant.

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Abstract

This study was conducted at Sudan University of Science and Technology, College of Animal Production Science and Technology, Dairy Science and Technology Laboratory during December 2021 AD, using different levels of date paste to study the effect of adding date paste on chemical and sensory properties of fermented camel milk (Gariss).Four liters of camel milk were obtained from a farm in Sharg Al neel , then pasteurized at a temperature of 85° for 1 hour then boiled for one minute and cooled to temperature of 40° and the starter *(Streptococcus thermophilus, Lactobacillus.bulgricus)* was added at 3%, and incubated till coagulation occurred (12 hours). In this study four treatments were carried out the first one is control sample without addition, in the second, third and fourth treatments date paste (concentration of 80%) at the rate of 20%, 30% and 40% were added respectively. The treatments were subjected to chemical analysis (fat, protein, total solids, ash, and acidity) and sensory evaluation for colour, flavour, taste, consistency and general appearance. The obtained results were subjected to statistical analysis using SPSS Programme with ANOVA analysis then least significant difference (LSD) was used to test the difference between the treatments. The results showed significant differences ($P \leq 0.05$) in fat and total solids contents while no significant ($P \geq 0.05$) variations were found in protein, ash and acidity contents of fermented camel milk samples. The high percentage of fat was in the control sample and high percentage of total solids was in the samples with 40% date paste. The results showed high significant differences in all sensory parameters. The highest color scores was secured by the control fermented camel milk sample , while high scores of flavour in sample with 40% date paste , The gariss samples with 40% date paste secures high scores in the taste, also the sample of gariss with 40% date paste showed high scores in consistency while the high overall appearance was better in fermented camel milk sample with 40% date paste .Its concluded that the date paste improve the chemical and sensory characteristics of the fermented camel milk.

مستخلص الدراسة

أجريت هذه الدراسة بجامعة السودان للعلوم والتكنولوجيا , كلية علوم وتكنولوجيا الإنتاج الحيواني , معمل علوم وتكنولوجيا الألبان في ديسمبر2021م, أستخدمت مستويات مختلفة من معجون البلح لدراسة التأثير الكيميائي والخصائص الحسية للبن الإبل المخمر (القارص).

تم الحصول علي أربعة لتر من لبن الإبل من مزرعة بشرق النيل ثم بسترته في درجة حرارة 85° لمدة ساعة ثم الغليان لمدة دقيقة واحدة والتبريد لدرجة 40ºC واضافة البادئ (*Streptococcus thermophilus,* *Lactobacillus .bulgricus*) بنسبة 3 % ، وتم التحضين حتى اكتمال عملية التخثر(12 ساعة). هناك أربع معاملات في هذه الدراسة ،الأولى كانت عينة الشاهد بدون إضافات ، المعاملات الثانية ، الثالثة والرابعة تم إضافة معجون البلح (ذو التركيز 80%) بنسبة 20% , 30 % ،40 % على التوالى .خضعت المعاملات للتحليل الكيميائي(الدهن ,البروتين ،المواد الصلبة ،الرماد والحموضة) والتقييم الحسي لكل من اللون ، النكهة ، الطعم ، القوام والمظهر العام . النتائج المتحصل عليها خضعت للتحليل الإحصائي بإستخدام برنامج SPSS وتحليل التباين ANOVA وكذلك تم استخدام أقل فرق معنوي (LSD) لإختبار الإختلاف بين المعاملات. أظهرت النتائج وجود فرق معنوي في محتوي الدهن والمواد الصلبة بينما لا يوجد أي فرق معنوي في نسبة البروتين ، الرماد والحموضة لعينات لبن الإبل المخمر ، كانت أعلي نسبة للدهن في عينة الشاهد بينما كانت أعلي نسبة للمواد الصلبة في المعاملة التي تحتوي علي 40% معجون البلح .أوضحت النتائج وجود فرق معنوي جداً في كل القياسات الحسيه , الدرجة العالية للون كانت في عينة لبن الإبل المخمر الشاهد بينما الدرجة العالية للنكهة في العينة التي تحتوي علي 40% معجون البلح ، عينة القارص التي تحتوي علي 40% معجون البلح سجلت أعلي درجة في الطعم ، أيضا كانت أعلي درجة للقوام في عينة القارص التي تحتوي علي 40% معجون البلح ، بينما الدرجة العالية للمظهر العام كانت أفضل في عينة لبن الإبل المخمر التي تحتوي علي 40 % معجون البلح . أستخلص من الدراسة أن معجون البلح يحسن الخصائص الكيميائية والحسية للبن الإبل المخمر.

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CHAPTER ONE

Introduction

Sudan Graded as the second country in the world at camel population after Somalia with 4.5 millions heads. This population is quite important while the camel production appears, at least officially, very low. With a meat production of 49,880 tons and a milk production of 120,000 tons, camel production is far away from the potential. Even if these data did not cover the entire reality, it is Apparent that camel production in Sudan is insufficiently valorized. Meat from young camels has been reported to be comparable in taste and texture to beef. The milk consumption under gariss form is popular in rural areas where camel is generally reared, according with FAO statistics. (Faye, *et al*. 2011).

The pastoral communities depending on basic diet of camel milk is one of the main components, which contributes up to 30% of the annual caloric intake. The main component of milk which has a major impact on its nutritional value and technological suitability is protein, it is a good substitute for human milk, also many research findings proved that camel milk is easily digested by lactose-intolerant individuals and is rich in healthy vitamins and minerals, especially, vitamin C, B and iron (Gizachew, *et al*., 2014).(Fawi, and ahmed ,2016).

In traditional social relations camels have an important role such as in payment of a dowry, and in atonements of casualty parties in clan feuds. In the Somali culture, camel ownership (in terms of herd size) is an indication of social status. Also, camels are the main reserve stock, and therefore act as a store of wealth and security against drought, disease and other natural calamities in the Somali traditional economy.(Guliye,*et al*., 2007).

The camel milk is known to have medicinal properties as well. This systematic review is aimed at determining and reporting nutritional values and medicinal characteristics of camel milk in children and The Camel milk contains low sugar and cholesterol, high minerals (sodium, potassium, iron, copper, zinc and magnesium, and vitamin C). (Zibaee ,*et al*., 2015).

Many countries used Camel milk because is a healthy food across the world for different health problems since long years. Fermented camel milk is proved to have some health benefits, proved or not, such as hypocholesterolaemic effect, antimicrobial activity, antioxidant activity, angiotensin I-converting enzyme (ACE) inhibitory activity, activity against diarrhea, anticancer activity. Camel milk originated lactic cultures also tested for probiotic potential and showed exciting results through in vitro experiments. Nowadays, researchers analyzing these properties with an aim to identify the unknown health benefits and emphasizing on the in vitro, in vivo and in silico experiments to bring out novelty in the market for the public (Solonki, and Hati,2018).

Objective of the study is;-

To evaluate the effect of different levels of date paste on the chemical and sensory characteristics of fermented camel milk (Gariss).

CHAPTER TWO

Literature Review

2.1. Camels

In rural populations, The dromedary camel (Camelus dromedarius) Play an important socioeconomic role and its milk is regarded as an important component of their staple diet (Osman,*et al*,2016).The camels is affords high temperature differences and scanty precipitation. In the course of evolution, camels have adapted to conditions of such environment. They can store up to 36 kg of fat in their humps which serves as a source of water and energy when nutrients are not available. These humps enable the camel to travel up to 160 km without consuming water. Camels rarely sweat, even at a temperature up to 49 °C. The desert plants may hold enough water to enable camels to survive without water for a few weeks during winter. A camel may endure considerable dehydration. In warm surroundings it may tolerate a loss of water of at least 27 % of its body weight (Faye, et *al.*, 2010).

The camel population in north of Sudan is widely included in arid areas of African continent ,This area includes the states of North and South-Darfur, North and South-Kordofan, Khartoum, Gezira, Kassala, Red Sea, River-Nile, Northern Sudan, White Nile, Blue Nile and Sennar State. North Kordofan state only has the highest camel population with more than one million heads, representing approximately 5% of the whole world camel population. However, this population is moving and a slight expansion of the camel belt to the South is observed since one decennial as in other countries of Sahel region (Faye, 2009).

In Sudan also the use of camel for riding and racing common. The Sudanese breeds are appreciated by the racing lover from Gulf countries. For riding the traditional saddle is

placed on the hump contrary to nomads from Niger as Tuareg having a saddle in front of the hump and to Bedouins having a saddle behind the hump. For wedding, a special palanquin is implemented on the camel. The use of camel for agricultural work is also common: for water extraction, sesame oil-press or packing.(Faye, *et al*,2011).

In Sudan breed tribal group's distinctive types of camels, the well-known among these are the Anafi and Bishareen. Camels are the backbone of the Rashaida pastoralists' economy and are also central part of their culture. Cash is received at town markets for male camels sold for slaughter at the age of six to seven years. (Mason and Maule, 1960)

2.2. Milk

Milk is known to be secreted fluid of the mammary glands of female mammals. It includes nearly all the nutrients necessary to sustain life (Wernery, 2008). Milk is the product of mammary gland secretion containing water, protein, fat, carbohydrate mainly lactose, mineral and vitamins. Among all foods, milk is the most complete and balanced nutritional contents, also including calcium, B group vitamin (particularly riboflavin, B12 and niacin, B6), vitamin A, iodine , magnesium, phosphorous, potassium and zinc (Anita, 2001).

In the rural areas of Africa, Asia and the Middle East the Camel milk and camel milk products have always been highly esteemed playing even today an important role in the diet of the population, with scarce agricultural areas, high temperatures and small amount of precipitation (Brezovecki, *et al.2015*).

Camel milk is one of the main components of the pastoral community's basic diet, which contributes up to 30% of the annual caloric intake. The main component of milk which has a major impact on its nutritional value and technological suitability is protein, it is a good substitute for human milk , also many research findings proved that camel

milk is easily digested by lactose-intolerant individuals and is rich in healthy vitamins and minerals, especially B vitamins, vitamin C and iron. (Gizachew, et *al.*, 2014).

Wide range of Camel milk products that include the following: Fresh raw or pasteurized milk. few countries in the world is only Pasteurized camel milk; Fermented milk generally called Susa in North Eastern Africa (including Kenya); yoghurt, cheese, butter: made through centrifugation since camel milk does not cream up, ice creams, puddings and chocolates of different flavors' in addition to beauty products: anti-wrinkles creams; camel milk cleansing soap bars etc. (Musinga, *et al*., 2008 and FAO, 2010).

2.3. Camel milk

The main objectives of the camel producers are the milk production. Under traditional manner the camel milk in Sudan is consumed fresh or fermented (gariss). (Faye, *et al*. 2011)

The lactation period in the Camel's contrast from 9 to 18 month, the annual milk yield range from 800 to 3600 liters and from 2 to 6 liters under desert condition in the average daily milk production range (Farah, 1993).The camels in Sudan are low of the milk productivity: between 820 and 2400 liters/ lactation for 12-18 months lactation (Faye, 2004). These noticing are not in accordance with the official statistics. It is known that the farming management has a high impact on the expected productivity. With intensive management (better health care, adding concentrates in the diet, vitamin and mineral supplementation), the total milk production per lactation was 2633 liters in semi-intensive system vs. 1204 liters only in traditional system i.e. on average 6.9 vs 3.1 liters per day. (Bakheit, *et al*. 2008) .

2.4. Camel milk Composition

The distinctness of contents of camel milk may be attributed to several factors such as analytical methods, geographical area, nutrition conditions, breed, lactation stage, age and number of calvings. they contains on average camel milk : 81.4-87 % water, 10.4 % dry matter, 1.2-6.4 % milk fat, 2.15-4.90 % protein, 1.63-2.76 % casein, 0.65-0.80 % whey protein, 2.90-5.80 % lactose and 0.60-0.90 % ash.(Brezovecki et al ,2015) .
The camel's milk has different properties have been reported in comparison with milk from other animal species. For example camel milk was found to have ten times more iron than cow's milk. Vitamin C content is three to five times more than cow's milk. It is a rich source of B vitamins, imunoglobins, It has a higher level of protein and lower content of fat and cholesterol when compared to cow's milk and it contains insulin like proteins, (Sulieman .et al, 2014) (Gansaikhan, et *al*.2011).

The bactrian camel milk has a protein content varies from 3 to 5% and moisture from 86 to 91%. Amino acid content declines with increasing milk yield. High vitamin, C content (5.7 to 9.8 mg/ml) which is considered important for the people living in arid areas. The vitamin B2 content varies between 2.30 and 3.90 ug/ml, while vitamin A and carotene contents are 7.57 ug/ml and 9.40 ug/ml respectively (Gahlot, 2000).

The mean values of different constituents of camel milk were: 3.01 %, 3.06 %, 0.69 %, 4.33 %, and 11.06 %, for protein, fat, ash, lactose and total solids respectively (Abdalla, *et al*. 2015). Greater part as free water is the water in the milk, while the remaining part is in form of bound water. Lactose, α-lactalbumin and a part of salt are represent milk ingredients soluble in water, while the insoluble ingredients are milk fat, casein and β-lactoglobuline. . (Brezovecki, *et al* ,2015) .The greatest influence on the content of water in camel milk is animal feed and consumption of water. The production of camel milk is

reduced in the dry period and increases in the rainy period. In warmer climate zones the milk of one-humped camels which dwell less fat and more water (Werner, 2006).

In camel milk the dry matter (average 15.06 %); the main ingredients are protein (4.9 %), milk fat (5.60 %), lactose (5.85 %), mineral substances (0.99 %). The one-humped camel milk has the highest lactose content, while the bactrian camel milk has the greatest content of fat and dry matter; the milk of hybrids has the greatest amount of proteins (Konuspayeva, 2007).The milk fat is found in the form of fat globules dispersed in milk serum. The diameter of fat globules varies between1.2-4.2 micron. The ranges of amount fat in camel milk between 1.8 and 5.0 per 100 g (Khaskheli , *et al*. 2005),. Camel milk also contains a higher concentration of long-chain fatty acids compared to cow milk (Konuspayeva, *et al*., 2008)

Two main fractions of proteins camel milk:casein and whey protein. The total amount of proteins varies from 2.15 to 4.90 %), resp. 3.1 % in average (Konuspayeva ,*et al.* 2009.).The main camel milk protein is casein(CN) and its share in the milk of one-humped camels is 1.63-2.76 %, which represents about 52-87 % of total protein (Khaskheli et al., 2005).The fractions of Casein camel milk are αs1-casein (22 %), αs2-casein (9.5 %), β-casein (65 %) and κ-casein (3.5 %). αs2-casein contains 11 phosphoserine residue which provides casein with a strong affinity towards calcium, magnesium and oligo elements. κ -casein differs from other caseins with its sensitivity to chymosin, low affinity to calcium and the presence of carbohydrates within the structure. Camel milk hydrolysis κ-CN takes place on peptide Connection Phe97-Ile98 by cymosine action, while in the cow milk it takes place on Phe105-Met106 (Kappeler ,*et al*. 1998).

In cow β-casein is higher Concentration of essential amino acids comparison with β-casein in dairy camel breeds, with exceptions like lysine, threonine, methionine and

isoleucine,Concentration of non-essential amino acids in κ-casein in cow milk is higher in comparison with camel milk, except arginin (Salmen, *et al*., 2012).

In camel milk the whey proteins found are α-lactalbumin, serum albumin, lysozyme, lactoferrin, peptidoglycan recognition proteins, lacto-peroxidase and immunoglobulins. Camel milk whey proteins constitute 20-25 % of all proteins. Variation the amount of whey proteins in the milk of one-humped camels between 0.63 and 0.80 % (Khaskheli ,et al.,2005).

β-lactoglobuline is basic whey protein in cow milk(50 %), while in the camel milk it is α-lactalbumin Whey, The coagulation is obtained after camel milkis white in comparison with the greenish whey obtained from cow milk .Therefore the whey from camel milk contains ahigher concentration of smaller casein micelles and fat globules, as well as low concentration of riboflavin. (El –Zubeir, and jabreel, 2008).

2.5. The Nutritive and therapeutic value of Camel milk

The camel is stated in the Quran as a prodigy of the God (Deurasech, 2005). Camel milk is very useful for treating malaria, jaundice, gastro intestinal disorder and strong cough (pneumonia)(Tezera ,1998). The medical value of camel milk in the treatment of several diseases including tuberculosis research by Indian scientists (Ilse, 2004).The people use camel milk for medicinal properties such as : anti infectious, anti cancerous and anti diabetic. It is regarded as an energy given product for convalescent. It is treat infectious diseases such as tuberculosis in humans. Also used in Kazakhstan as an adjunct to chemotherapy for some form of cancers, those of the digestive tract,the insulin demand decreased in diabetic patients and glyceamia is better balanced (Guakhar and Faye, 2004).

In Somali, camel milk is demander because to have a remedial effect for at least 13 different kinds of diseases, including hyperacidity, hypertension, pneumonia and respiratory diseases and also to be an aphrodisiac, (Kurtu ,2004).

2.5.1. Anti-Diabetic Properties of Camel Milk

The insulin of camel is contained within micelles and thus protected from digestion and proteolysis in the upper gastrointestinal tract; it is encapsulated in nanoparticles that facilitate its absorption and easy passing to the blood stream; it is again plausible that the antioxidant action of camel milk prevents metabolic syndrome, including hyperglycaemia, hyperlipidaemia, and insulin resistance (Gader and abulgader., 2016).

2.5.2. Camel milk as a therapy for Milk allergies

Another pertinent fact is that the components of camel milk include immunoglobulins similar to those in mothers' milk, which reduce children's allergic reactions and strengthen their future response to foods. (Shabo, *et al*, 2005).

2.5.3. Anti-Bacterial and Antiviral Properties

Camel milk contains antimicrobial enzymes (lactofferin and Lactoperoxidase) protective protein like caseins, stronger immune system and smaller immunoglobulins than other ruminants. Camel milk has higher concentrations of lactoferrin and lysozyme than bovine milk (Konuspayeva, et al. 2005).

2.5.4. Camel Milk for Treatment of Crohn's Disease

Crohn‟s disease is a condition that causes inflammation of the digestive system or guts that boosts with autoimmune disease. There powerful bactericidal properties in camel milk and can rehabilitate the immune system. It was observed that drinking non-

pasteurized camel milk is beneficial to people with all the variety of symptoms associated with an infection of the alimentary canal (Shabo, *et al*., 2008)

2.5.5. Camel Milk for Treatment Autism

The consumption of camel milk in children suffering from autism showed reduction in autism symptoms and improved motor skills, language, cognition, amazing improvements in their behavior and diets, joint coordination and skin health.
The camel milk could play an important role in decreasing oxidative stress by alteration of antioxidant enzymes and nonenzymatic antioxidant molecules levels, as well as the improvement of autistic behaviour as demonstrated by the improved Childhood Autism Rating Scale (CARS) (Laila and Nadra, 2013).

2.5.6 Therapeutic Effects of Camel Milk on Cancer, Tumor

It has been confirmed that lactoferrin have potency to inhibit the proliferation of cancer cell in vitro, and repair of DNA damage (Hosam, *et al*. 2013). Tumors can be cured with camel milk; very active antibodies bind onto the tumors, killing the tumor cells without damaging healthy tissue. But human antibodies are too big to do this (Avi ,*et al.,* 2013).

2.5.7. Therapeutic Effect of Camel Milk on Hepatitis

The Scientific publications explained camel milk cures both hepatitis B and hepatitis C. in camel milk the special fat soothes the liver and has beneficial action on chronic liver patients (Saltanat,2009). Camel milk contains high concentrations of ascorbic acid helps in improving liver function (Gul ,et al., 2015).

2.5.8. Camel Milk for Treatment of Arthr

Camel milk has higher amount of iron chelating protein known as lactoferrin. This protein removes free iron from joints of arthritic patients thereby improves arthritic. (Rohit and Panwar, 2015)

2.5.9. Camel milk as a therapy for tuberculosis: protective proteins in camel milk may have a possible role for enhancing the immune defenses mechanism. Antibacterial properties of these camel milk proteins destroy mycobacterium tuberculosis.(Mal ,*et al*.2006)

2.6. Fermentation

Fermentation is olden manner to produce and preserve food. Microbial Fermentations is one of methods preserve food, to make a safe product, to destroy undesirable factors, to reduce the energy required for cooking, to improve the appearance and taste of some foods (Lopez, 1992). Lactic acid is novel product of fermentation, has been proved to preserve important constituents present in milk, in a relatively more stable (Mehaia, 1993). It affects the physical properties of casein and finally enhance the digestibility in human by reduces the pH. Lactic acid ameliorate the utiilization of minerals like calcium and check the development of potentially injurious bacteria (McBean, 1999). Increases therapeutic values of milk by fermentation (Svanberg and Lorri, 1997; Steinkraus, 2002)

Fermentation in food processing is the process of converting carbohydrates to alcohol or organic acids using microorganisms—yeasts or bacteria—under anaerobic conditions. Fermentation is the action of microorganisms is desired. The science of fermentation is known as zymology or zymurgy. The term fermentation sometimes refers specifically to the chemical conversion of sugars into ethanol, producing alcoholic drinks such as wine, beer, and cider. the preservation of sour foods with the production of lactic acid, such as in yogurt.(Wikipedia)

Fermentation is metabolic process that produces chemical changes in organic substrates through the action of enzymes. In biochemistry, it is narrowly defined as the extraction of energy from carbohydrates in the absence of oxygen. In food production it may more broadly refer to any process in which the activity of microorganisms brings about a

desirable change to a foodstuff or beverage. The science of fermentation is known as zymology.(Hui,2004)

Fermentation is progress: bubbles of CO2 froth on top of the fermentation mixture. In microorganisms, fermentation is the primary means of producing adenosine triphosphate (ATP) by the degragation of organic nutrients anaerobically . (Bowen ,2018) Lactic acid bacteria are known as Gram-positive cocci or rods with low-GC (guanine-cytosine) content. These are acid- appeasable, generally non-spore forming bacteria and associated by their common physiological and metabolic characteristics. lactic acid produced by LAB as the main metabolic end-product at the end of the carbohydrate fermentation. many health benefits and industrial importance of LAB. In general, the types that consist from the LAB are: Lactococcus, Streptococcus, Lactobacillus, Leuconostoc, Pediococcus, as well as the more peripheral Lactobacillus, Aerococcus, Enterococcus, Oenococcus, Carnobacterium, Vagococcus, Tetragenococcus, and Weisella; these belong to the order Sporolactobacillus, (Sonomoto and Yokota, 2011).

2.6.1. Kinds of Fermented camel milk

2.6.1.1. Gariss

In the nomads of Sudan Gariss is a special kind of fermented camel milk popular, in large skin bags or si'ins gariss prepared, which contain a large quantity of apreviously soured product. In the absence of a starter from a previous lot, particularly when using a new si'in, first: adding few seeds of black cumin and one onion bulb to the container, and once the first batch of gariss is successfully obtained, following the addition of fresh camel milk to the bag, gariss can be continuously produced for months (Dirar, 1993).

2.6.1.2. Suusac

In the arid and semi-arid regions of Kenya and Somalia;Suusac is fermented camel milk widely consumed by the pastoralist communities that living in this areas. Suusac is a

white, low-viscosity product with a distinct smoky flavour and a stringent taste. prepared by Fresh camel milk was collected into a pre-smoked gourd and left to ferment naturally for 1-2 days at ambient temperature (26-29° C). The top cream layer was skimmed off and the Suusac stirred (Lore, *et al*., 2005).

2.6.1.3. Chal (Shubat)

Chal or shubat is a white caroused that has a sour flavour, the Method of making is very simple; the fresh camel milk isPoured in a skin bag or a ceramic jar, . Previously soured milk is added to the fresh camel milk and mixed well for 3-4 days till the end product has a volume of 3-5 times that of the original chal. Shubat has a snow-white colour, thicker and fatter than kumis, its fat content reaches 8% and it can be preserved for long times without losing its properties. Shubat is used to cure tuberculosis and some gastric and intestinal diseases (Yagil, 1982).

2.6.1.4. Oggtt

It is a dried fermented camel milk product. It is made by cooking or salting cow or camel milk. The salted type is prepared as above and then adding about 10% salt instead of heating, this type of oggtt is common in the northern region of the Arabian Peninsula, Syria, Jordan and Lebanon. The cooked type is produced by allowing the milk to fermented naturally for1-2 days then churning and boiling the residual butter milk while stirring till it thickens. The thick paste is cooled and shaped manually into small cakes or balls which are pressed and tied in acloth and left to dry in direct sunlight for several days. (Al-Ruqaie *et al* ,1987).

2.6.2. Processing Challenges of Camel Dairy Products

Dromedary milk coagulum does not have a desirable curd formation and firmness and the curd is instead fragile and heterogeneous and consists of dispersed

flakes, therefore industry of yoghurt or other fermented products from camel milk is difficult.. (Attia , et al ,2001)

Because of its antibacterial properties mainly due to the presence of protective proteins camel milk has not easily fermentable. Growth of commercial starter cultures in camel milk has been found to be possible. The acidification rate in bovine milk was higher than camel milk (Abu-Tarboush,1996) (Berhe, *et al*,2017].

2.7. Gariss

Garris is fermented camel milk product prepared traditionally from camel's milk,is made by a semi-continuous fed-batch fermentation process (Dirar, 1993).
Whenever part of the product is withdrawn for human consumption, the consumers add an equal amount of fresh camel's milk. The milk is fermented in large leather bags, which are sometimes covered or imbedded in green grass dampened with water and held in large palm rope nets. The process of removal of garris and replacement of fresh milk Continues for months. During most of the time, the jerky walk of the camel's causes shaking of the milk, the main fermenting organisms of garris are lactobacilli and yeasts. (Sulieman ,*et al*,2006)

2.7.1. Laboratory-made garris

After the pasteurization of the fresh milk, garris was prepared in a 1000 mL conical flask container. An inoculum (2.5%) of previously garris batch (brought by the author from Sudan) was mixed with the pasteurized milk. The souring process continued overnight. The resultant sour milk was then shaken using a vortex mixer to remove fats. The finished product obtained after shaking and removal of fats was analysed for pH, titrable acidity and ethanol% at 0, 12, 24, 48, 72 and 96 h of fermentation. Preparing garris in the laboratory at the faculty of Agriculture of Kobe University, Japan.(Sulieman ,*et al*,2006)

2.7.2. The chemical composition of gariss

Fat 2.8–5% and 10–11% total solids (Hassan, et al., 2008; El Zubeir and Ibrahium, 2009), fresh camel milk: 1.8–5% of fat and 7.8–12% of total solids as stated by (Shuiep, *et al*. 2008). The acidity as lactic acid ranged from 2.2–2.3% (Hassan, *et al*., 2008). Protein and ash contents in Gariss were 2.3 to 3.4% and 0.51–1.3%, respectively. the range of pH in Gariss was 3.6–5.9 (Sulieman, *et al.*, 2007; Abdelgadir, *et al.*, 2008; Hassan, *et al.*, 2008 and Ahmed, *et al.*, 2010).

2.7.3. Nutritive and therapeutic value of gariss

Gariss consisting Bifidobacterium lactis (BB-12) experiment in rats in vivo has been exhibited to possess a hypocholesterolaemic effect (Elayan, et al., 2008) ,lowering of plasma and liver cholesterol levels (Ali, *et al*., 2013)., the hypocholesterol regulating mechanism of camel milk is still unclear. Various hypotheses were discussed by researchers (Li and Papadopoulos, 1998; Rao ,et al., 1981; Buonopane ,et al., 1992).
Gariss is ease of digestion of fermented foods and to their flavor, Therefore consumed in very large quantities than fresh milk.(Dirar ,1993).

2.8. Date

The scientific name of date palm is Phoenix dactylifera, they can be found mostly in the North Africa and Middle East region, as is a monocotyledon plant within the palm tree family, that could survive among a few plants ,the harsh arid environment and thus is highly regarded for the nutritional value that the palm tree fruit provides. (Baliga, *et al.* , 2011).
Date palm serves as a good food source as they are rich in carbohydrates in these arid regions where foods are scarce, and they have even become a part of Arabian diet, and food source, it has been regarded that consumption of the fruit is good for health ,date palm fruits have been used traditionally to treat various types of ailments (Mansouri ,*et al.*2005)

2.8.1. Phytochemical compositions of the date palm

Date palm hast several highly beneficial properties such as antiviral, antifungal, antioxidant, antihyperlidimic activity and hepatoprotective activity (Al-Farsi and Lee (2008). Date fruit rich contents of antioxidant such as the coumaric acid and ferulic acid, And it contains flavonoids, sterols, procyanidins, carotenoids, anthocyanins, sugar (glucose, sucrose and fructose) with low GI, dietary fibers, less protein and fats, vitamins such as riboflavin, biotin, thiamine, ascorbic and folic acid, and minerals for example calcium, iron, copper, cobalt magnesium, fluorine, manganese, phosphorus, potassium, sodium, boron, sulfur, zinc and selenium within the date palm itself (Baliga ,*et al*.,2011). (Anjum , *et al*.,2012). (Vayalil ,2012).

the date seed it consists of fatty acids including capric, lauric, myristic, myristoleic, palmitic, stearic, oleic, linoleic, linolenic, arachidic ,The date fruit and date seed may contribute to synergistic effects in the aforementioned bioactivities. (Boukouada and Yousfi ,2009)

2.8.2. Physical benefits of the date palm

Phoenix dactylifera purveys a physical benefit to the brain, called the neuroprotective or cerebroprotective effect. In general, this neuroprotective effect protects the brain from the destructive activity of the reactive oxygen species (ROS) (Steinbrenner and Sies ,2009). Date palm has high concentrations of phenolic compounds, flavonoids and anthocyanins as well as the presence of selenoproteins, thus an excellent antioxidant agent (Baliga, *et al*.,2011).

CHAPTER THREE

Materials and Methods

This study was conducted during December 2021 at the laboratories of College of Animal Production Sciences and Technology, Sudan University of Sciences and Technology.

3.1. Materials

3.1.1. Source of milk

Camel milk from farm in Sharq Al neel

3.1.2. Source date

Kingdom Saudi Arabia (Basqat , Alqassim)

3.2. Design of the study

Yonder four treatments in this study (A, B, C, D) .The first treatment is the control of fermented camel milk (100%) gariss. In the second, third and four treatments, 20% and 30% and 40% and of date paste and gariss were mixed respectively.

3.3. Methods

3.3.1. Date paste preparation

Date paste was prepared by mixing 800 g dates into 200 ml distill water.

3.3.2. Gariss making process

According to(Sulieman ,*et al*,(2006) gariss were prepared , four liters of camel milk were pasteurized at 85º C for one hour then boiled for one minute and cooled to temperature of 40° and the starter (*Streptococcus thermophilus, Lactobacillus.bulgricus*) was added at 3%, and incubated at (40°C) till souring process occurred(12 hours).

In this study four treatments were carried out the first one was control sample without addition, in the second, third and fourth treatments date paste (concentration of 80%) at the rate of 20%, 30% and 40% were added respectively.

3.3.3. Chemical analysis

3.3.3.1. Fat content

The fat content was determined by Gerber methods described by AOAC (1990) as follows:

In a clean dry Gerber tube, 10 ml of sulphuric acid (density 1.815 gm / ml at 20 °C) were poured, and then 10.94 ml of gariss sample were added, amyle alcohol (1-2ml) was added to tube, followed by addition of distilled water. The contents were thoroughly mixed till become the color brown. The Gerber tubes were centrifuged at 1100 revolution per minute (rpm) for 4-5 minutes, and the tube were then transferred to a wter bath adjusted at 65°C for three minutes. The fat percent was then read forthwith.

3.3.3.2. Protein determination

Protein content was determined by Kjeldahl method according to the AOAC (1990) as follows:

10 ml of each sample were weighed and poured into clean dry kjeldahl flask. Two tablets of Kjeldahl catalyst and concentrated H_2SO_4 (25 ml) were added to the sample. The flask were heated until clean solutions were obtained (2-3 hours) and left for another 30 min. the flasks were then removed and allowed to cool .

The digested milk sample were poured into volumetric flasks (100 ml) and diluted to 100 ml with distilled water. Then five ml of each diluted sample was transferred to distillatory followed by 10 ml of 40% NaOH was added to flask. the distillate were received in conical flasks (100 ml) containing 25 ml of 2% boric acid plus three drops of indicator (bromo-cresol green + phenolphthalein red) . the distillation was continued until the volume in the flasks was 75 ml .the flasks were removed from distillator. The

distillate was then titrated with 0.1 HCL until the end point (red color) was obtained. The protein content was calculated as follows:

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

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

3.3.3.3. Total solids content

The total solids content was determined according to the modified methods of AOAC (1990). Three grams of sample were weighed into a dry oven flat bottomed aluminum dish, and heated on steam bath for 10-15 minutes. The dish was placed in an oven at 105°C for three hours, and then cooled in desiccators and weighted quickly . Weighting were repeated until the difference between the two readings was < 0.1 mg. The total solids content was calculated from the following equation.

$T.S\% = W_1 / W_0 \times 100$

Where: W_1 = Weight of sample after drying

W_0 = Weight of sample before drying

3.3.3.4. Ash content

The ash content was determined according to AOAC (2003). Five grams of the samples were weighed in porcelain crucibles, and then placed in a muffle furnace at 550-

600°C for 3 hrs until ashes were carbon free. The porcelain crucibles were then cooled in desiccators and weighed. The ash content was calculated using the following equation:

$$\text{Ash (\%)} = W_1 \div W_2 \times 100$$

Where:

W_1= Weight of ash

W_2=Weight of sample before ashing

3.3.3.5. Titratable acidity

Titratable acidity was determined according to AOAC (1990). Ten ml of sample were placed into a clean porcelain dish and 3 ml of phenolphthalein indicator was added. The sample was titrated against 0.1 N NaOH till a faint color lasted for at least 30 seconds.

Then the titratable acidity of each sample was calculated as follows:

$$T \times 0.009 \times 100 \div \text{Weight of sample}$$

Where: T= Titration figures

W=Weight of samples

0.009= lactic acid per 1 ml of 0.1 NaOH

3.3.4. Sensory evaluation

Ten panelists were selected among the staff and students of the College of Animal Production Science and Technology. The panelists were given a questionnaire to test, color, taste, texture, flavor, and overall acceptability of coded samples of different treatments. (Larmond , 1977).

3.3.5. Statistical analysis

Statistical analysis was using (SPSS .version 16.2007) , Least significance different (LSD) was used for separation between the treatment mean. In this study was used level of significance (0.05).

CHAPTER FOUR

Results

4.1. Table (1) Analysis of date

Compounds	
Energy	274 cal
Protein	1.59 %
Raw fiber	11.5-6.5 %
Calcium	.75 %
Phosphorus	13 mg
Irons	15.2 %
Potassium	5.9 %
Fat	.93 %
Vit A	A
Vit C	C

Basqat -Alqassim – kingdom saudi Arabia

4.2. Effect of different levels of date paste on chemical composition of Gariss

Table (2) showed the effect of different levels of date paste on physicochemical composition of gariss

The results indicated that there is significant difference ($p<0.05$) in fat and total solid contents within treatments.

The data explained that highest protein content (4.42±1.32%) was in control sample, whereas the lowest one (3.56±.19%) was in gariss was treated with 40% date paste.

Fat sample of control recorded highest content of fat (6.50±.007%) while the lowest one (4.01±.26%) was in gariss with 40% date paste.

Total solids was found higher in gariss samples with 40% date paste (26.37±4.63%) and the lower one was in control sample (10.16±1.16%).

Ash content of control sample was higher (1.34±.64%) while those of sample with 40% date paste were lower (.95±.77%)

The data showed that the acidity was not significantly different among all treatments. However the higher acidity was in control sample (.42±.32%) and the lower one was in that with 40%date paste (.44±.30%).

Table (2) the effect of different levels of date paste on chemical composition of Gariss

	Protein	Fat	Total solids	Ash	Acidity
A	4.42±1.32	6.50±.007[a]	10.16±1.16[c]	1.34±.64	.42±.32
B	4.03±.75	6.28±.30[ab]	18.41±.01[abc]	1.17±.74	.43±.33
C	3.90±.007	5.57±.32[b]	23.02±4.12[ab]	1.11±83	.43±.30
D	3.56±.19	4.01±.26[c]	26.37±4.63[a]	.95±.77	.44±.30
Level of sig	NS	**	*	NS	NS

Mean values with different superscript within column were significantly different ($p<0.05$)

A= pure fermented camel milk (gariss)

B= gariss with 20% date paste

C= gariss with 30% date paste

D= gariss with 40% date paste

*= significant at 0.05%

**= Significant at 0.01%

NS= not significant

4.3. Effect of different levels of date paste on sensory characteristics of Gariss:

Table (3) expounded the different level of date paste on sensory characteristics of gariss. Significant different ($p<0.05$) were found in color, flavour, consistency, taste, overall within treatment.

Data showed that highest color scores was in control sample (8.50±1.10%) while the lowest ones were in sample with 40% date paste (5.80±2.37%).

The results showed that the flavour fermented camel milk sample with 40% date paste was highest (7.70±2.53%) scores whereas lower (5.20±2.41%) scores were in control sample.

The data explained that the consistency of fermented camel milk samples with 40% date paste was highest (8.50±1.43%) scores in comparison with those of control sample (5.00±2.51%).

The fermented milk sample with 40% date paste had highest (8.20±1.76%) scores in the taste while the lowest one (4.60±2.72%) were in control sample.

Data revealed that highest scores of overall (8.50±1.43%) were in those with 40% date paste while the lowest one in control (4.70±2.17%) sample.

Table (3) the different level of date paste on sensory characteristics of Gariss.

	Color	Flavor	consistency	Taste	Overall
A	8.50 ± 1.10^{a}	5.20 ± 2.41^{c}	5.00 ± 2.51^{c}	4.60 ± 2.72^{c}	4.70 ± 2.17^{d}
B	6.90 ± 1.51^{b}	5.90 ± 1.65^{b}	5.80 ± 1.36^{c}	6.10 ± 2.10^{b}	6.10 ± 1.65^{c}
C	6.40 ± 1.46^{bc}	7.20 ± 1.82^{ab}	7.50 ± 1.57^{ab}	7.30 ± 1.49^{ab}	7.50 ± 1.10^{ab}
D	5.80 ± 2.37^{c}	7.70 ± 2.53^{a}	8.50 ± 1.43^{a}	8.20 ± 1.76^{a}	8.50 ± 1.43^{a}
Level of sig	***	**	***	***	***

Mean values with different superscript within column were significantly different ($p<0.05$)

A= pure fermented camel milk (gariss)

B= gariss with 20% date paste

C= gariss with 30% date paste

D= gariss with 40% date paste

*= significant at 0.05%

**= Significant at 0.01%

NS= not significant

CHAPTER FIVE

Discussion

5.1. Effect of different levels of date paste on chemical composition of Gariss

Result in table (2) showed the change in fat content among treatments of gariss samples, the high fat was in control sample could be due to the high fat of the fresh camel milk however, the others treatments were lower in fat is probably due to the low fat content in these samples different levels from date paste ,this decrease could be due to the date fruits that has and anti antioxidant (Maqsood,*et al*,2020) and date syrup extracts has been inhibit lipid peroxidation (Allaith,2008), the date were a high source of Antioxidants , Anthocyanins , carotenoids ,and phenolics(Al farsi ,*et al* ,2005) ,phenolics were considers effective inhibitors of lipid per oxidation (Mansouri *et al* ,2005) ,therefore this properties that decrease of fat content and fat hydrolysis in samples was treated with date paste .

Results in table (2) showed different percent of protein content among treatments , however the high protein content was in gariss without date paste ,this higher value of protein might be due to aqueous date extract which has been shown to inhibit protein content in a dose-dependent manner (Allaith,2008).

The high total Solids contents in gariss samples with 40% date paste probably due to the high total solids content in the date paste as compared to the control, these result was in accordance with that found by Shahein, *et al*. (2022).

The ash content of control gariss sample was slightly higher in comparison with the other treatments this might be due to the fact that the camel milk has high ash content while the aqueous date paste may decrease the ash content in those samples with added date paste

No variations were found in the titratable acidity of the different gariss samples this could be due to the alkaline effect of the date paste.

5.2. Effect of different levels of date paste on sensory characteristics of Gariss:

Data in table (3) showed high significant different in all sensory parameters among the treatments.

The high colour scores (table 3) in the control graiss sample might be due to the fact that the untrained panelists preferred the natural colour of the griss samples than those with added date paste. These results were in line with those presented by(Alotaibi and Eldemerdash (2013).

The high flavour scores of the gariss samples with 40% date paste could be due to the fact that date pastes progressively improve the flavour of the graiss samples because the high palatability of the date is the main reason for this improvement.

The high consistency scores for the gariss samples with 40 % date paste probably due to the high consistency of the date paste in texture with high total solids content these results were agreed with those of (Aljutaily, *et al*. (2022).

The high taste scores for gariss samples with 40%date paste could be due to high content of sugar on date paste, therefore more acceptability for panelists.

The high overall scores for gariss samples with 40% date paste might be due to high scores in flavour ,taste ,texture that make it acceptance than other samples .

CHAPTER SIX

Conclusion and Recommendation

6.1. Conclusion:

Its concluded that the addition of date paste to the fermented camel milk significantly improve the quality Fat and Total solids content of the fermented camel milk samples while no significant variations were observed in the protein, ash and titratable acidity of the fermented camel milk samples. The sensory characteristics of the fermented camel milk samples were found to be affected significantly by the addition of the date paste, the colour of the fermented camel milk samples were adversely affected by the addition of date paste however, the other sensory parameters (flavour ,taste, consistency and overall acceptability were positively affected by addition of date paste.

6.2. Recommendation:

According to the results of the study the followings are recommended:

- Culture awareness for the advantages of fermented camel milk (Gariss) among the consumers
- Further research will be carried out in the fermented camel milk during storage period
- More study about the vitamins and amino acids contents of fermented camel milk with flavoured date juices.

References

Abdelgadir, S.W.,Nielsen, D., Hamad, H.S. and Jakobsen, M. (2008). A traditional Sudanese fermented camel's milk product, Gariss, as a habitat of Streptococcus infantarius subsp. infantarius. Inter J Food Microbiol., 127: 215-219.

Abdalla, E.B., Ashmawy, A.E.H.A., Farouk, M.H., Salama, O.A.R., Khalil, F.A.and Seioudy, A.F.(2015). Milk production potential in Maghrebi she-camels, Small Ruminant Research, , 123 (1), 129-135;

Abu-Tarboush , H. M., (1996). Comparison of Associative Growth and Proteolytic Activity of Yogurt Starters in Whole Milk from Camels and Cows," Journal of Dairy Science, vol. 79, no. 3, pp. 366–371,

Ahmed A.I., Mohammed, A . A., Faye, B., Blanchard, B. and Bakheit, S.A. (2010). Assessment of quality of camel milk and Gariss, North Kordofan State, Sudan. Re s J Animal and Vet Sci., 5: 18-22

Allaith, A.A.A. (2008). Antioxidant activity of Bahraini date palm (Phoenix dactylifera L.) fruit of various cultivars. Int. J. Food Sci. Technol., 43, 1033–1040.

Alotaibi and El-Demerdash,.(2013) , Nutritive Value and Characterization Properties of Fermented Camel Milk Fortified with some Date Palm Products Chemical, Bacteriological and Sensory Properties. International Journal of Nutrition and Food Sciences. Vol. 2, No. 4, , pp. 174-180.

Al-Ruqaie, I.M., El-Nakhal, H.M. and Wahdan, A.N. (1987). Improvement in the quality of the dried fermented milk product, *Oggtt*, Journal of Dairy Research. 54 (3): 429-435.

Ali, A. A., Alyan A. A. and Bahobail, A. S.(2013).. Effect of fermented camel milk and cow milk containing (*Bifidobacteria*) enriched diet in rats fed on cholesterol level. Agric. Sci. Res. J. 3: 342-346.

Al-Farsi, M. A. and Lee, C. Y. (2008). Nutritional and functional properties of dates: a review. Crit Rev Food Sci Nutr 48: 877-887.

Al-Farsi, M ., Alaslvar,A.Morris,M.Baron and shahidi ,F. (2005). comparison of Antioxidant activity ,anthocyanins , carotenodis and phenolics of three native

fresh and sun dried date (phoenix dactylifea.L) varieties grown in oman .j.agric food chem.,53:7592-7599.

Aljutaily, T., Barakat, H., Moustafa, M.M.A. and Rehan, M.(2022). Incorporation of Sukkari Date in Probiotic-Enriched Fermented Camel Milk Improves the Nutritional, Physicochemical, and Organoleptical Characteristics. https://doi.org/10.3390/fermentation8010005

Anjum, F. M., Bukhat, S. I., El-Ghorab, A. H., Khan, M. I. and Nadeem, M. (2012). Phytochemical characteristics of date palm (Phoenix dactylifera) fruit extracts. Pak J Food Sci 22: 117-127.

Anita ,S.W.(2001).the role of milk in the british diet .international journal of dairy technology , 54-130

AOAC (1990). Association of Official Analytical Chemists Methods of Analysis. Washington, D.C., USA.

.

AOAC (2003). Official Methods of Analysis, Association of Official Analytical Chemists, Washington, D. C., USA.

Attia, H., Kherouatou, N. and Dhouib, A.(2001). Dromedarymilk lacticacid fermentation: Microbiological and rheological characteristics,"Journal of Industrial Microbiology and Biotechnology,vol. 26, no. 5, pp. 263–270.

Avi , L., Steiner, L, and Yagil R. (2013): "Camel milk: disease control and dietary laws." Journal of Health Science 1.1 48-53.

Bakheit , S.A, Abu –Nikheila , A.M., kijora ,C and Fay ,B , (2008). The impact of forming system on Sudanese camel milk production , proceedings of WBC /ICAR 2008satellit meeting on camelid reproduction, Budapest (hungary),12-13 july 2008,p.Nagy and G huscenicza (Eds) pp.88-95.

Baliga ,M. S., Baliga ,B.. R. .V., Kandathil , S. M., Bhat, H .P., and Vayalil, P. K. (2011) A review of the chemistry and pharmacology of the date fruits (Phoenix dactylifera L.). Food Research International 44: 1812-1822.

Berhe, T., Ipsen ,R., Seifu E., Kurtu, M. Y., Eshetu, M., and Hansen, E. B., (2017). "Comparison of the acidification activities of commercial starter cultures in camel and bovine milk," LWTFood Sceince Technol,.

Boukouada, M. and Yousfi, M. (2009). Phytochemical study of date seeds lipids of three fruits (Phoenix dactylifera L) produced in Ouargla region. Annales de la Faculté des Sciences et Sciemces de I'Ingénieur 1: 66-74.

Bowen,R.(2018).Microbial fermentation hypertexts for biological sciences .colorado state university .retrieved 29 April

Brezovecki, A , Cagalj ,M , Dermit, Z .F, Mikulec ,N , liojic D. B, and Antunac N. (2015),camel milk mijekarstro ,65(2) , page 81-90

Buonopane, G. J., Kilara A., Smith ,J. S. and Carthy R. D. M.c.(1992) . Effect of skim milk supplementation on blood cholesterol concentration, blood pressure, and triglycerides in a free-living human population. J. Am. Coll. Nutr. 11: 56-67.

Deuraseh, N. (2005). The urine of camels. Treatment of diseases in AL-Tibb Al-Nabawi. Int. Med. J., 4 (1): 25-28.

Dirar, H.A. (1993). The Indigenous Fermented Foods of the Sudan: astudy in African food and nutrition.C.A.B.International,Waillingford, U.K. pp. 303-344

Elayan, A. A., Sulieman ,A. E. and Saleh, F. A. (2008). The hypocholesterolemic effect of Gariss and Gariss containing *Bifidobacteria* in rats fed on a cholesterol-enriched diet. Asian J. Biochem. 3: 43-47.

El-Zubeir, I.E.M. and Jabreel, M.S.O. (2008): Fresh cheesefrom camel milk coagulated with Camifloc, International Journal of Dairy Technology 61, 90-95. doi: dx.doi.org/10.1111/j.1471-0307.2008.00360.x

El Zubeir, I .E.M and Ibrahium ,M .I. (2009). Effect of pasteurization of milk on the keeping quality of fermented camel milk (Gariss) in Sudan. Livestock Res Rural Development 21 (2).

FAO (2010). Food and Agriculture Organization. Animal Production and Health Reports, pp 85-86.

Farah, Z.(1993).composition and characteristics of camel milk .journal of dairy Research, 60:603-626.

Fawi , N.M.T. and Ahmed , H ,M.A.,(2016)., Creating Sustainable Food Markets (Case study of Urban Consumers Camel milk Consumption in Khartoum – sudan . U of Khartoum Vet med Anim – vol 7 p(50-56).

Faye, B. (2004)., Dairy productivity potential of camels proc .of the 34th meeting FAO / ICAR (international committee for Animal Recording) session on camelieds 28may-3 June 2004 ,sousse (Tunisie) pp93-105

Faye, B.(2009).,L Elevage des grands camelides; vers un changement de para digme rene . Rech Ruminants ; 16:345-348

Faye, B., Abdelhadi , O .M .A., Ahmed ,A. I. and Bakheit, S. A, (2011), Camel in sudan : future prospects , Livestock Research of rural development – vol 23 (10).

Faye, B., Konuspayeva, G., and Loisean, G. (2010): Variability of urea concentration in camel milk in Kazakhstan, Dairy Science and Technology 90, 707-713. doi: dx.doi.org/10.1051/dst/2010025

Gader, A. M. A. and Abdulqader, A. A. (2016). "The unique medicinal properties of camel products: A review of the scientific evidence." *Journal of Taibah University Medical Sciences*

Gahlot, T.K. (Ed). (2000). Selected Topics on Came lids.Camel House 67, Gandhi Nagar West, Near LalgarhPalace, Bikaner, India

Gansaikhan, O, Batsukh ,T.S. and Ichinhorloo, Z. M .(2011) Journal of Chemistry,12, 50.

Gizachew, A., Tehe, J. and Birhanu,T (2014). Review on medicinal and nutritional values of camel milk. Nature and Science J., 12(12): 35- 40.

Guakhar, K. and Faye, B. (2004). A better knowledge of milk quality parameters: A preliminary step for improving the camel milk market opportunity in a transition economy- the case of Kazakhstan. Saving the Camel and Peoples 'Livelihoods Building a Multi stockholder Platform for the Conservation of the Camelin Rajasthan, International conference, 23-25, Sadri, Rajasthan, India. pp. 28-36.

Guliye A.Y., Noor, I .M., Bebe ,B .O. and Koskey, I .S. (2007). Role of camels (Camelusdromedarius) in the traditional lifestyle of Somali pastoralists in northern Kenya. Outlook on Agriculture 36(1): 29–34.

Gul, W., Farooq N., Anees ,D., Khan, U. and, Rehan, F. (2015). "Camel Milk: A Boon to Mankind." International Journal of Research Studies in Biosciences (IJRSB) 3.1123-29

Hassan, R. A., El Zubeir, I .M.E and Babiker ,S.A. (2008). Chemical and microbial measurements of fermented camel milk ''Garris'' from transhumance and nomadic herds in Sudan. Australian J Basic Applied Sci., 2: 800- 804.

Hosam, H.M., Wissam , I.H.,Schneider-Stock , R. and Hassan, **H.M. (2013)** Camel milk lactoferrin reduces the proliferation of colorectal cancer cells and exerts antioxidant and DNA damage inhibitory activities, Food Chemistry 141 148-152

Hui,Y.h(2004) , handbook of vegetable preservation and processing . new York :m. dekker .p.108.isbn 978-0-8247-4301-7.7.oclc52942889

Ilse, K.R. (2004). The camel in Rajasthan: Agricultural diversity under threat. Saving the Camel and Peoples' Livelihoods Building a Multi stockholder Platform for the Conservation of the Camel in Rajasthan, International conference,23-25 November, Sadri, Rajasthan, India. pp.6-18.

Kappeler, S., Farah, Z., Puhan, Z. (1998): Sequence analysis of Camelus dromedaries milk caseins, Journal of Dairy Research 65, 209-222.doi: dx.doi.org/10.1017/S0022029997002847

Khaskheli , M., Arain, M. A., Chaudhry ,S., Soomro, A.H. and Qureshi T.A.. (2005). Physico-Chemical Quality of Camel Milk. Journal of agriculture and social sciences. Departments of Dairy Technology, and Pharmacology, Sindh Agriculture University Tandojam–Pakistan.

Konuspayeva, G. (2007): Variabilite physico-chimiqueet biochimique du lait des grands camelide's (Camelusbactrianus, Camelus dromedarius et hybrides) au Kazakhstan. Universite Montpellier II, France, 255.

Konuspayeva, G., Faye, B. and Loiseau, G. (2009): TheComposition of camel milk: a meta-analysis of the literaturedana, Journal of Food Composition and Analysis 2295-101.

Konuspayeva, G., Serikbayeva, A., Loiseau, G., Narmuratova, M. and Faye, B.(2005.) Lactoferrin of Camel Milk of Kazakhstan. NATO Series, I: Life and behavioural Science. Vol. 362, 158-167, 2005.

Konuspayeva ,G., Lemarie , E., Faye, B,. Loiseau ,G, and Montet D.,(2008). Fatty acid and cholesterol composition of camel's (Camelusbactrianus, Camelusdromedarius and hybrids) milk in KazakhstanDairy Science and Technology, 88 (2008), pp. 327–340

Kurtu, M.Y. (2004). An assessment of the productivity for meat and carcass yield of camels (Camelus dromedaries) and the Consumption of camel meat in the eastern region of Ethiopia. Trop. Ani. Health and Prod., 36 :65-76.

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

Laila,Y. and Nadra, E. (2013). Camel Milk as a Potential Therapy as an Antioxidant in Autism Spectrum Disorder (ASD). In: Evidence-Based Complementary and Alternative Medicine Pp8.

Li, H. and Papadopoulos, V. (1998). Peripheral-type benzodiazepine receptor function in cholesterol transport. Identification of a putative cholesterol recognition /interaction amino acid sequence and consensus pattern. Endocrinology. 139: 4991-4997.

Lopez, U. P. (1992). Nutrition and safety consideration. In: Applications of Biotechnology to Traditional Fermented Foods, National Academic Press, Washington, DC, pp. 153-158.

Lore, T.A., Mbugua, S.K. and Wangoh, J. (2005): Enumeration and identification of microflora in *Suusac*, a Kenyan traditionalfermented camel milk product; Lebensmittel- Wisseschaft andTechnologie. 38, (2): 125-130

Mal, G., Sena, D. S., Jain ,V.K and Sahani ,M.S. (2006). Therapeutic value of camel milk as a nutritional supplement for
multiple drug resistant (MDR) tuberculosis patients. *Israel J. Vet. Med.,* 61(3-4): 88-94

Mansouri, A., Embarek ,G., Kokkalou ,E and Kefalas, P. (2005) ,Phenolic profile and antioxidant activity of the Algerian ripe date palm fruit (Phoenix dactylifera). Food Chemistry 89: 411-420

Maqsood, S., Adiamo, O., Ahmad, M.,and Mudgil, P.(2020) Bioactive compounds from date fruit and seed as potential nutraceutical and functional food ingredients. Food Chem., 308, 125522.

.

Mason, I. L. and Maule, J. P (1960). he Indigenous Livestock of Eastern and Southern Africa. Technical Communication No. 14 of the Commonwealth Bureau of Animal Breeding and Genetics, Edinburgh.

McBean, L. D. (1999). Emerging dietary benefits of dairy foods. Nutrition. 34: 47-53.

Mehaia, M. A. (1993). Fresh soft white cheese (Domiati-type) from camel milk: Composition, yield and sensory evaluation. J. Dairy Sci. 76: 2845-2850.

Musinga, M., David, K. and Peter, K. (2008). The camel milk industry in Kenya. Report by Resource Mobilization Center (RMC).

Osman, I. A. , Elnasri ,H. A., Almofti, y. A. ,and Salman, A .M ,(2016),physico – chemical properties of Sudanese camel milk. scholors Research libarary ,annals of Biological research ; 7(5):1-4

Rao, D. R., Chawan ,C. B. and Pulusani.S. R. (1981). Influence of milk and thermophilus milk on plasma cholesterol levels and hepatic cholesterogenesis in rats. J. Food Sci. 46: 1339-1341

Rohit , and Panwar. "(2015) "Camel milk: Natural medicine-Boon to dairy industry

Salmen, S.H., Abu-Tarboush, H.M., Al-Saleh, A.A. and Metwalli, A.A. (2012): Amino acids content and electrophoretic profile of camel milk casein from different camel breeds in Saudi Arabia, Saudi Journal of Biological Science 19, 177-183.

Saltanat, H .(2009). The influences of camel milk on the immune response of chronic hepatitis B patients, Chinese J. Cellular Mol. Immunol; 25: 431-433.

Shabo, Y and Yagil, R. (2005). Etiology of autism and camel milk as therapy. Int. J. of Disab. and Hum. Dev., 4: 67-70.

Shabo, Y., Barzel, R. and Yagil. R. (2008)"Etiology of Crohn's disease and camel milk treatment."Journal of Camel Practice and Research 15.1: 55-59

Shahein, M.R., Atwaa, E.S.H., Elkot, W.F., Hijazy, H.H.A., Kassab, R.B., Alblihed, M.A., and Elmahallawy, E.K. (2022) The Impact of Date Syrup on the Physicochemical, Microbiological, and Sensory Properties, and Antioxidant Activity of Bio-Fermented Camel Milk. Fermentation, 8, 192.

Shuiep, E.S., El Zubeir, I.E.M., El Owni ,O.A.O and Musa ,H.H.(2008). Influence of season and management on composition of raw camel (Camelus dromedarius) milk in Khartoum state, Sudan. Tropical and Subtropical Agro-ecosystems 8: 101-106.

Sonomoto, K. and Yokota, A.(2011). Lactic Acid Bacteria and Bifidobacteria: Current Progress in Advanced Research, Caister Academic Press, Japan.

Solonki , D. and Hati, S.(2018),fermented camel milk :Areview on its bio functional properties ,emirates journal of food and agriculture 30(4):268-274 doi :10.9755/ejfa.v30.i4.1661

SPSS,Version 16. (2007). Software package for Social Science For windows SPSS package.

Steinkraus, K. H. (2002). Fermentations in world food processing. Compr. Rev. Food Sci. Food Saf. 1: 23-30.

Steinbrenner ,H. and Sies, H. (2009) Protection against reactive oxygen species by selenoproteins. Biochim Biophys Acta 1790: 1478-1485.

Sulieman ,A E., Elamin ,O. M., Elamin ,A. E. and Laleye , L. (2014), International Journal of Food Science and Nutrition Engineering. 4, 15.

Sulieman ,A .E., Ilayan ,A .A and El Faki ,A .E, (2006), Chemical and microbiological quality of Garris, Sudanesefermented camel's milk product, International Journal of Food Science and Technology, 41, 321–328

Sulieman, A.E., Osawa, R. and Tsenkova, R. (2007). Isolation and identificationof lactobacilli from Gariss, a Sudanese fermented camel's milk product. Res.J. Microbiol., 2: 125–132.

Svanberg, U. and Lorri , W.(1997). Fermentation and nutrient availability. Food Control. 8: 319-327.

Tezera, G. (1998). Characterization of camel husbandry practices and camel milk and meat utilization in Jijiga and Shnlie zone, Somali region. An M.Sc. Thesis Presented to theSchool of Graduate Studies of AlemayaUniversity. 145p.

Vayalil, P .K (2012), Date fruits (Phoenix dactylifera Linn): an emerging medicinal food. Crit Rev Food Sci Nutr 52: 249-271

Werner, U. (2006): Camel milk, the white gold of thedesert, Journal of Camel Practice and Research 13 (1),15-26.

Wernery, G. December (2008): Milk and Dairy Products German Research Centre for Food Chemistry DOI: 10.1007/978-3-540-69934-7_11

https://en.wikipedia.org/wiki/fermentation-in-food-processing.1/5/2017 2:30pm

Yagil, R. (1982): Camels and camel milk. FAO AnimalProduction and Health. Paper No. 26. Food and Agriculture Organization, Rome, Italy

Zibaee , S ., Hosseini, S .M .A., yousefi , M., taghipour , A., kiani, M. A . and Novas , R . (2015) ,Nutritional and therapeutic characteristic of camel milk in children .november vol 7 issue 7 , pages :1523 -1528.

Sensory Evaluation

Sample	Colour	Flavour	Consistency	Taste	overall
A					
B					
C					
D					

Taste	Scores
Highly palatable	9
Palatable	7
mediocrity palatable	5
less palatable	3
Un palatable	1

Colour	Scores
Very acceptable	9
acceptable	7
mediocrity acceptable	5
Slightly acceptable	3
not acceptable	1

overall acceptability	Scores
Very acceptable	9
Acceptable	7
mediocrity acceptable	5
Slightly acceptable	3
not acceptable	1

Flavour	Scores
Extremely intense	9
Intense	7
mediocrity intense	5
Slightly intense	3
Poor	1

Consistency	Scores
Extremely coherent	9
coherent	7
mediocrity coherent	5
Slightly coherent	3
Not coherent	1