بسم الله الرحمن الرحيم

Sudan university of Science and Technology

College of Agricultural Studies

Department of Food Science and Technology

Changes in Physicochemical and Sensory properties of Edam cheese during Ripening

التغيرات الفيزيائية و الكيميائية والحسية لجبن الإيدام أثناء النضج

A dissertation submitted to Sudan university of science and technology in partial fulfillment the requirements of the degree of B.Sc. Honours in food science and technology

By

Afaf Saeed Bakhit Musa

Walaa Babiker Elmubasher Babiker

Huda Ahmed Mohamed Saeed Mohamed Nour

Supervisor:

Randa Abdelmonem Ibrahim

Department of food Science and technology

College of Agriculture Studies

November, 2018

DEDICATION

To our mothers, fathers , brothers

and our sister Aaida Saeed

To our extended family

To all our teachers and friends with great regard and respect

ACKNOWLEDGEMENT

First all we would like to express our thanks to our great almighty Allah for his help in our success to finish this study. Great thanks due to

Randa Ibrahim Abdelmonem

For helpful guidance , Supervision and suggesting the topic of this study.

TABLE OF CONTENTS

LIST OF TABLES

Table No. **Title** **Page No.**

LIST OF APPENDICES

Appendix No. Title Page No.

Abstract

The aim of this study was to evaluate the effect of the ripening period on the edam cheese of the cows and goats by using three samples (100% cow milk, 100% goat milk, 50% milk mixture and 50% goat milk). Used in manufacturing 46 pounds of milk (23 cow's milk and 23 goat milk). And then wrapped in natural wax (beeswax with the addition of a certified food color). The samples of cheeses were stored at room temperature 25 ° C for 30 days and 60 days. The samples were subjected to laboratory analysis to determine chemical composition (protein, fat, moisture, ash), acidity and sensory evaluation (appearance, taste, flavor, texture, general acceptance). Statistical data were analyzed by the Statistical Analysis Program (Mini Tab 17). The statistical analysis showed a mixed effect between the samples and the maturation period. The results of the proximate chemical analysis showed that the period of maturation had a significant effect (P <0.05 on the dietary composition of the Edam cheese. The results of the chemical analysis showed that the storage period (30 days) had a significant effect on humidity, which was higher in the cheese sample made from a mixture of cow's milk and goats (55.80) and the lowest in cheese made from cow milk (53.60) compared to the value of the cheese sample control (43.05).In the protein, the highest percentage was found in the cheese sample made from cow's milk (40:30) and the lowest in the mixed cheese sample (29.93) compared with the lowest value in the control sample (30.80).In fat, the highest percentage was found in the cheese sample of the mixture (26.30) and in cow cheese (24.80) compared to the average of the control sample (25.10). In the ash, the highest percentage was found in the cheese sample made from goat milk (6.10) and in the two types of cheese made from cow's milk and processed from the mixture compared to the low rate of the control

sample (5.10). In the storage period (60 days), the results showed a significant effect on moisture, with the highest percentage in the sample of cheese made from goats' milk (41.09) and the lowest in the processed cheese of the mixture (39.45) compared to the highest value in the cheese sample (41.59) .In protein, the highest percentage was found in the sample of processed milk (26.88) and the lowest in the sample of cheese made from goats (25.37) compared to the lowest value in the cheese sample control (24.53). In the fat, there was no significant difference between the samples of cow cheese and the mixture and the control while the cow cheese sample was the lowest proportion of the amount of fat. In the ash, the highest percentage was found in the sample made from cow's milk (5.53) and the lowest in the processed cheese of goat milk (5.72), while there was no significant difference between the cheese samples made from cow's milk and the control. The result physical analyses showed that the storage period (30 days) had a significant difference in acidity the highest percentage was found in the sample of processed mixture milk (0.20) lowest in the processed cheese of goat milk (0.10) compared to the low rate of the control sample (0.10). In the storage period (60 days), the results showed a difference significant effect in acidity the highest percentage was found in the sample of processed mixture milk (1.46) lowest in the processed cheese of cow milk (1.36) compared to the low rate of the control sample (0.005). The results of sensory evaluation during the storage period (30 days) showed a significant difference in the appearance and texture of cheese while there was no significant difference in taste, flavor and general acceptance. In the storage period (60 days) showed a significant difference in the texture of cheese, while there was no difference in appearance, taste, flavor and general acceptance.

المستخلص

هدفت هذه الدراسة لتقييم أثر فترة الإنضاج على جبنة الإيدام من لبن الابقار والماعز وذلك بأستخدام ثلاث معاملات وهي (لبن الأبقار بنسبة 100 % , ولبن الماعز بنسبة 100 % و خليط بينهما بنسبة 50 % لبن أبقار و 50% لبن ماعز) . استعمل في التصنيع 46 رطل من اللبن (23 لبن بقر و 23 لبن ماعز) . ومن ثم تمت تغليفها بالشمع الطبيعى (شمع العسل مع اضافة لون غذائي مصرح به) وتم تخزين العينات في درجة حرارة الغرفة 25درجة مئوية لمدة 30 يوم و60 يوم. ثم اخضعت العينات (فترة الإنضاج 30 و60 يوم بعد التصنيع) للتحليل المعملي لتحديد التركيب الكيميائي (البروتين, الدهن, الرطوبة, الرماد) والحموضة والتقييم الحسي (المظهر, الطعم , النكهة , القوام , القبول العام). وحللت البيانات احصائية ببرنامج التحليل الاحصائي (الميني تاب 17) . اظهر التحليل الاحصائي تفاعلا معنويا متفاوتا بين العينات وفترة الأنضاج , حيث أوضحت نتائج التحليل الكيميائى التقريبى أن لفترةالإنضاج تأثير معنوي ($P < 0.05$)على التركيبة الغذائية لجبنة الإيدام. اوضحت نتائج التحليل الكيميائي ان فترة التخزين (30 يوم) لها تاثير معنوي على الرطوبة حيث كانت أعلى في عينة الجبنة المصنعة من خليط من لبن البقر والماعز (55.80) واقلها في جبنة الايدام المصنعة من لبن البقر (53.60) مقارنة باعلاها قيمة في عينة الجبنة الكنترول (43.05). وفي البروتين حيث كانت اعلى نسبة في عينة الجبنة المصنعة من لبن البقر (40.30) واقلها في عينة الجبنة الخليط (29.93) مقارنة باقل قيمة لها في العينة الكنترول (30.80). وفي الدهون حيث كانت اعلى نسبة في عينة الجبنة المصنعة من الخليط (26.30) واقلاها في الجبنة المصنعة من لبن البقر (24.80) مقارنة بنسبة متوسطة للعينة الضابطة (25.10). وفي الرماد حيث كانت اعلى نسبة في عينة الجبنة المصنعة من لبن الماعز بنسبة (6.10) واقلاها في نوعي الجبنة المصنعة من لبن البقر والمصنعة من الخليط مقارنة بنسبة متدنية للعينة الضابطة (5.10). اما في فترة التخزين (60 يوم) اظهرت النتائج تاثير معنوي على الرطوبة حيث كانت أعلى نسبة في عينة جبنة الايدام المصنعة من لبن الماعز (41.09) واقلها في جبنة الايدام المصنعة من الخليط (39.45)) مقارنة باعلاها قيمة في عينة الجبنة الكنترول (41.59) .اما في البروتين كانت اعلاها نسبة في العينة المصنعة من اللبن الخليط (26.88) واقلها نسبة في عينة جبنة الايدام المصنعة من الماعز (25.37) مقارنة بأقلها قيمة في عينة الجبنة الكنترول (24.53) . اما في الدهون لم يكن هنالك اختلاف معنوي بين عينات جبنة البقر والخليط والكنترول وبينما كانت عينة جبنة البقر اقلاها نسبة في كمية الدهن .اما في الرماد كانت اعلاها نسبة في العينة المصنعة من لبن البقر (5.53) واقلها في جبنة الايدام

المصنعة من لبن الماعز (5.72) بينما لم يكن هنالك اختلاف معنوي بين عينتي الجبنة المصنعة من لبن البقر والكنترول . اما التحاليل الفيزيائية فقد اظهرت في فترة التخزين (30 يوم) اختلافا معنويا في نسبة الحموضة حيث كانت اعلاها نسبة في عينة الجبنة المصنعة من اللبن الخليط (0.20) واقلها في جبنة الايدام المصنعة من الماعز (0.10) مقارنة بالعينة الكنترول التي كانت اقلها نسبة (0.10). اما في فترة التخزين (60 يوم) فقد ظهر اختلافا معنويا في نسبة الحموضة حيث كانت اعلاها نسبة في عينة الجبنة المصنعة من اللبن الخليط (1.46) واقلها في جبنة الايدام المصنعة من لبن البقر (1.36) مقارنة بالعينة الكنترول التي كانت اقلها نسبة (0.005). اما نتائج التقييم الحسي في فترة التخزين (30 يوم) فقد اظهرت اختلافا معنويا في مظهر وقوام الجبنة بينما لم يكن هنالك اختلافا معنويا في الطعم والنكهة والقبول العام .اما في فترة التخزين (60يوم) قد اظهرت اختلافا معنويا في قوام الجبنة بينما لم يظهر اختلاف في المظهر والطعم والنكهة والقبول العام.

CHAPTER ONE

INTRODUCTION

Milk is a fluid secreted by the female of all mammals, the primary function of which is the complete nutrition of the neonate of the species. Since the nutritional requirements of the young of the different mammalian species differ greatly, it is unsurprising that the compositions of milks of different species vary considerably. The human uses of milk from species like cattle, sheep and goat not only as an aliment for infants, but also for human adults has a long history. (Evershed *et al.* 2008) showed that the first consumption of milk dates to the seventh millennium BC in the Near East and southeastern Europe, approximately 1,000 years after the first domestication of cattle, sheep and goats.

Milk has a high nutritional value since it provides high quality protein, many vitamins and minerals and a wide variety of fatty acids. Especially cow's milk, but also the milk of sheep and goat is one of the most valuable nutrients in many countries all over the world.

Milk protein is a very valuable for the nutrition of human beings. Its composition is very similar to the composition of the human protein. Therefore, it provides all essential amino acids. Milk protein mainly consists of the six main milk proteins, which can be classified into four caseins (αS1-, β-, αS2- and κ-casein) and two whey proteins (α-Lactalbumin and β-Lactoglobulin). Altogether, they account for more than 90 % of the whole milk protein. The remaining 10 % are mainly serum albumin, immune globulins and lactoferrin (Farrell *et al,* 2004).

Milk is the principal starting material for cheese making. Its caseins form the structural matrix of cheese and the fat entrapped contributes to cheese texture and flavor. The minerals of milk (particularly the colloidal calcium phosphate associated with the caseins) are factors that affect cheese texture and lactose the essential fermentation substrate for lactic acid bacteria (Lucey, 2002).The advantages accruing from the ability to convert the principal constituents of milk to cheese would have been apparent from the viewpoints of storage stability, ease of transport and, eventually, as a means of diversifying the human diet.

The differences in composition of milk from different species can influence either the coagulation properties of the milk or the flavour and texture of the cheese made there from. For example, the high levels of short-chain (C6±C10) fatty acids in goat's milk leads to a characteristic flavor in cheese made the re from. Also, caprine milk has very low levels of alpha s1-casein, which results in stronger syneresis, but a more crumbly, or short, texture. Milks of different species also differ in their enzyme activities; for example, sheep’s milk contains very low lipoprotein lipase activity, which influences the flavor of cheese made from that milk. Cheese color can also depend on the source of milk from which it is made, as sheep, goat or buffalo milk yield very white cheese, because of very low levels of Beta-carotene in the milk (Bylund , 2003); cheese color can also be influenced by the diet of the milk-producing animal (Celik, 2003).

A wide range of cheeses and cheese-like products are produced worldwide but from a very limited range of raw materials. Natural cheese is made from cow’s, sheep's, goat's or buffalo's milk, lactic acid bacteria, rennet (in the case of rennet-coagulated varieties) and salt, yet it has been said that there is “a cheese for every taste preference and a taste preference for every cheese”. Cheese has a long history and the collective heritage of certain varieties has been ensured in Europe by Protected Designations of Origin(McSweeney *et al.* 2004) .

Edam is the most common Dutch-type cheeses, similar to Gouda but with a distinctive spherical shape and coated with red wax. Variants of this cheese are made differing in fat content (typically 30, 40 or 45 % fat-in-dry matter) from milk that was standardized appropriately.

Edam belongs to the group of semi-hard cheeses and has undergone maturation for at least 4 weeks when brought to the market.

Objectives

The objectives of this research were:

1. To determine the physic-chemical properties and sensory of Edam cheese from goat milk and cows.
2. To investigate the changes in the flavor of goat Edam cheese during the Ripened period.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition of Milk

Milk is nutrient –rich, white liquid food produced by the mammary glands of mammals. It is the primary source of nutrition for infant mammals before they are able to digest other types of food. (Pehrsson , 2000).

Milk is a major source of dietary energy, protein and fat, contributing on average134 kcal of energy/capita per day, 8 g of protein/capita per day and 7.3 g of fat/capita per day (FAO, 2012).

2.2 Milk Composition

Water is the main component in all milks, ranging from an average of 68 percent in reindeer milk to 91 percent in donkey milk. The main carbohydrate is lactose, which is involved in the intestinal absorption of calcium, magnesium and phosphorus, and the utilization of vitamin D. (Campbell Marshall *et al*, 2007).

Lactose also provides a ready source of energy for the neonate providing 30 percent of the energy in bovine milk, nearly 40 percent in human milk and 53–66 percent in equine milks (Fox, 2008).

Table (2. 1): Proximate composition of cow and goat milks (per 100 g of milk)

Proximate	COW		GOAT	
	Average	Range	Average	Range
Energy (kcal)	62	59-66	66	58-74
Water(g)	87.8	87.3-88.1	87.7	86.4-89.0
Total protein (g)	3.3	3.2-3.4	3.4	2.9-3.8
Total fat (g)	3.3	3.1-3.3	3.9	3.3-4.5
Lactose (g)	4.7	4.5-5.1	4.4	4.2-4.5
Ash	0.7	0.7-0.7	0.8	0.8-0.8

(FAO, 2013)

2.3 Sources of Milk

There are many animal source of milk , these is the various non-bovine species including goats, sheep, buffalo, mare, camel, reindeer, and yak are important for human nutrition and subsistence in many parts of the world. These milks are becoming increasingly profitable and popular as alternatives to bovine milk-based products due to their success in the market and growing consumer interests. The milk of non-bovine dairy species serves 3 types of markets in many parts of the world, such as (i) home consumption (ii) specialty gourmet interests (iii) medical needs (Bornaz *et al*, 2009) besides being the alternative milk nutrient source where dairy cattle do not survive for climatic or geological reasons, and where cow milk is too expensive.

2.3.1 Cow Milk

Cow milk accounted for 83 percent of global milk production in 2010 (FAO 2012). It is contains more protein and minerals, especially calcium and phosphorus, than human milk. The protein in cow milk is of high-quality (defined as amino acids, including lysine. Many human diets are deficient in certain essential protein that supports maximal growth), containing a good balance of all the essential amino acids (FAO, 2012).

2.3.2 Goat Milk

The volume of goat milk production has been dramatically increased in the past two decades (Salem HB, 2010), and worldwide production of goat milk has been risen by approximately 60% between 1993 and 2013 (Resource in tropical Africa ,1991) . The goat is the most versatile domesticated animal and was the first livestock domesticated and its milk was used for human consumption (Ballal, 2008). Certain chemical and nutritional compositions of goat milk, such as non-protein nitrogen and oligosaccharide contents are closer to human milk compared to those of the cow milk. However, large variations can occur in milk composition, depending on different factors such as breeds, diet, stage of lactation, environmental and management conditions in both species.

The economic contribution and nutritional value of goat milk can be observed in developing countries, particularly in the Mediterranean region, the Middle East, Eastern Europe, and South America (Ribeiro and Ribeiro, 2010).

Goat milk is highly digestible and can be consumed by people with cow milk allergies and gastrointestinal disorders; therefore, it can be used as a healthy substitute for cow milk products (Haenlein, 2004; Mituniewicz-Malek et al., 2014). Because of its chemical composition, goat milk has only a low level of, or lacks, αs1-casein, which affects formation of an almost semi liquid coagulum (Seelee *et al.*, 2009); moreover, the intense flavor of goat milk restricts acceptance of its de-rivatives by consumers (Gomes *et al.*, 2013).

2.3.2.1 Nubian Goat

Nubian is a highly productive dairy goat compared to other Sudanese goat breeds. Nubian goats are widely distributed in arid and extreme arid areas (Salem HB, 2010). Besides Sudan, Nubian goats are found widespread in North Eastern Africa and the Mediterranean coastal belt. They have likely their origin in Sudan. These goats are commonly black, but pure brown and multi-colorations of black and white also. (Rahmatalla *et al*, 2017).

2.3.2.2 Sensory Characteristics of Caprine Milk Products

Cheese is the major dairy products produced from goat milk in most goat producing countries in the world especially in the Mediterranean region. Caprine milk cheese first began in Mesopotamia (Kosikowoski and Mistry ,1999) . Goat milk cheese probably started off as soft cheese then turned into hard and ripened cheeses. Goat milk cheeses were developed later in other Mediterranean countries such as Turkey,Greece, Syria, Israel, Iraq, and Iran (Kosikowski ,1986)

Goat milk has a higher proportion of fatty acids including capric, caprylic and caproic acids. The composition of these short chain fatty acids gives goat milk and its cheeses for their unique tangy flavor (Kosikowoski and Mistry ,1999) . When goat milk cheese is aged, the tangy flavor may cause creamy and earthy cheese taste.

The sensory qualities of cheese are influenced by a number of factors including animal genetics, the milk production environment and processing technologies (Fekadua and Soryala *et al*, 2005) andto the chemical and microbiological characteristics of the raw material used (Coulon and Delacroix-Buchet *et al*,(2004) . The quality and composition of raw milk are among the major factors determining yield and quality of cheese.

Texture is of primary importance to the consumer as it is often the first attribute to assess quality or to identify the cheese.

2.4 Cheese

Cheese is a rich source of essential nutrients; in particular, proteins, bioactive peptides, amino acids, fat, fatty acids, vitamins and minerals (Barbara Walther *et al*., 2008).

Nearly 52 percent of the world's cheese is produced in Europe. Although the biggest single producer is the United States. Only 7.7 percent of cheese is produced by Low Income Food Deficit Countries, while less than 2 percent of the world production is from Least Developed Countries, which shows that cheese is not a major source of nutrients in these countries. (Fox and McSweeney, 2004)

The CODEX general standard for cheese (FAO and WHO, 2010g) provides the following definitions and guidelines:

Cheese is the ripened or un ripened soft, semi-hard, hard, or extra-hard product, which may be coated, and in which the whey protein/casein ratio does not exceed that of milk, obtained by:

(a) coagulating wholly or partly the protein of milk, skimmed milk, partly skimmed milk, cream, whey cream or buttermilk, or any combination of these materials, through the action of rennet or other suitable coagulating agents, and by partially draining the whey resulting from the coagulation.(b) processing techniques involving coagulation of the protein of milk and/or products obtained from milk which give an end-product with similar physical, chemical and organoleptic characteristics as the product defined.

The main step in cheese-making, the coagulation of the casein component, is achieved using one of the following methods, or a combination of these methods:

a) Limited proteolysis using enzymes .

b) Acidification by adding acids or a starter culture;

c) Acidification combined with heating to about 90 °C. (Fox and McSweeney, 2004; Henning et al., 2006).

The majority of cheeses are produced byenzymatic (rennet) coagulation; rennet from the stomachs of young calves, kids, lambs and buffalo was traditionally used. (Fox and McSweeney, 2004).

The coagulated milk, the curd, can be separated from the whey in several ways.

In some other cheeses, the curd is cut into cubes while being heated, causing it to float in the whey. The whey is drained off, while the curd is subjected to syneresis (dehydration); this involves cutting the coagulum, cooking, stirring, pressing, salting and other operations that promote gel syneresis. (Fox and McSweeney, 2004).

The final stages are shaping (moulding and pressing) and salting, which contributes to the dehydration process (about 2 kg of water is lost per kg of NaCl taken up). (Fox and McSweeney, 2004).

2.4.1 Steps of Cheese Manufacture

Milk

↓ **Selection**
Pre-treatment
Standardization

Cheese milk

↓ **Addition of :**
Start culture (acidification)
Color (optional)
$CaCl_2$ (optional)
Coagulation (rennet , acid or heat/acid)

Coagulum (gel)

↓ **Cut coagulum**
Stir
Heat
Acidification (rennet-coagulated cheese)
Separation of curds from whey

Curds

↓ **Acidification**
Special operation
(e.g., cheddaring , stretching)
Salting (some varieties)
Molding
Pressing (some varieties)

Fresh Cheese

↓ **Salting (most varietie)**
Ripening (most rennet-coagulated cheese)

Mature cheese

2-4-1-1 Selection of milk

The composition of cheese is strongly influenced by the composition of the cheese milk, especially the content of fat, protein, calcium and pH. The constituents of milk are influenced by several factors, including species, breed, individuality, nutritional status, health and stage of lactation of the producing animal.

2.4.1.2 Standardization of milk composition

Milk for cheese is subjected to a number of pre-treatments, with various objectives. Different cheese varieties have a characteristic fat-in-dry matter content, in effect, a certain fat-to-protein ratio and this situation has legal status in the "Standards of Identity" for many cheese varieties. While the moisture content of cheese, and hence the level of fat plus protein, is determined mainly by the manufacturing protocol, the fat: protein ratio is determined mainly by the fat :casein ratio in the cheese milk. Depending on the ratio required, it can be modified by:

- removing some fat by natural creaming or centrifugation
- adding skim milk
- adding cream
- adding micellar casein (prepared by ultra filtration)
- adding milk powder, evaporated milk or ultra filtration retentate. Such additions also increase the total solids content of the milk and hence cheese yield and will

Calcium plays a major role in the coagulation of milk by rennet and subsequent processing of the coagulum and hence it is common practice to add CaCl2 (e.g., 0.01 %) to cheese milk.

The pH of milk is a critical factor in cheese making. The pH is inadvertently adjusted by the addition of 1.5–2 % starter culture which reduces the pH of the milk immediately by about 0.1 unit. Starter concentrates (sometimes called direct-to-vat starters), which are now used widely, have no immediate acidifying effect.

• The lower pH was more favourable for rennet action and gel formation.

The natural pH of milk is ~6.6–6.7 but varies somewhat (e.g., it increases in late lactation and during mastitic infection).

2.4.1.3 Heat Treatment of Milk

Traditionally, all cheese was made from raw milk, a practice which remained widespreadn until the 1940s. Even today, significant amounts of cheese are made in Europe from raw milk. The use of raw milk may be undesirable due to:

• Public health safety

• The presence of undesirable microorganisms which may cause defects or variability in flavour and/or texture.

A sub-pasteurization temperature, eg., 68–70 °C may be used for cheese

There are four alternatives to pasteurization for reducing the number of microorganisms in milk:

• Treatment with H_2O_2

• Activation of the lactoperoxidase-H_2O_2-thiocyanate system.

• Bactofugation

• Microfiltration

2.4.1.4 Conversion of Milk to Cheese Curd

After the milk has been standardized, pasteurized or otherwise treated, it is transferred to vats (or kettles) which vary in shape (hemi-spherical, rectangular, vertical or horizontal cylindrical), may be open or closed . Here, it is converted to cheese curd, a process that involves three basic operations: acidification, coagulation and dehydration.

- **Acidification**

Acidification is usually achieved by the in situ production of lactic acid through the fermentation of the milk sugar, lactose, by lactic acid bacteria. Initially, the indigenous milk microflora was relied upon to produce acid but since this microflora is variable, the rate and extent of acidification are variable, resulting in cheese of variable quality.

- **Coagulation**

The essential characteristic step in the manufacture of all cheese varieties involves coagulation of the casein component of the milk protein system to form a gel which entraps the fat, if present. Coagulation may be achieved by:

- Limited proteolysis by selected proteinases (rennets);
- Acidification to ~pH 4.6;
- Acidification to a pH value >4.6 in combination with heating to ~90 °C.

2.4.1.5 Removal of Whey, Moulding and Pressing of the Curd

When the desired degree of syneresis has been achieved and in some cases, the desired pH attained also, the curds are separated from the whey by a variety-specific method, e.g., transferring the curds-whey into perforated moulds (common for soft varieties, e.g., Camembert), allowing the curds to settle in the vat and sucking off the supernatant whey (eg., Gouda and Emmental), scooping the curds from the vat using heavy cloths and placing them in moulds (e.g., Parmigiano Reggiano), draining the whey form the curds using perforated screens (e.g., Cheddar and Pizza cheese).

Many cheeses are made into traditional shapes and sizes, eg., small flat cylinders (e.g., Brie and Camembert), taller cylinders, ranging in size from 5 to 40 kg (e.g., Cherddar and Parmesan), large low cylinders (e.g., Emmental), spheres (Edam). In some cases the traditional shapes have been abandoned, e.g., Cheddar and Emmental now frequently made as rectangular or square blocks. In some cases, the size and shape of a cheese are cosmetic and traditional but the size of a cheese has important consequences for the ripening of many varieties. Microflora plays a critical role in ripening.

2.4.1.6 Salting

Salting is the last manufacturing operation. Salting promotes syneresis but it is not a satisfactory method for controlling the moisture content of cheese curd which is best achieved by ensuring that the degree of acidification, heating and stirring in the cheese vat are appropriate to the particular variety.

2.4.1.7 Application of Ultra-filtration in Cheese making

Since cheese manufacture is essentially a dehydration process, it was obvious that ultrafiltration would have applications in cheese manufacture, not only for standardizing cheese milk with respect to fat to casein, but also for the preparation of a concentrate with the composition of the finished cheese, commonly referred to as “pre-cheese”.

2.4.1.8 Ripening

Fresh cheeses constitute a major proportion of the cheese consumed in some countries. Most of these cheeses are produced by acid coagulation.

Although rennet-coagulated cheese varieties may be consumed at the end of manufacture and a little is (e.g., Burgos cheese), most rennet-coagulated cheeses are ripened (cured, matured) for a period ranging from ~3 weeks to >2 years; generally, the duration of ripening is inversely related to the moisture content of the cheese. Many varieties may be consumed at any of several stages of maturity, depending on the flavour preferences of consumers and economic factors.

Although curds for different cheese varieties are recognizably different at the end of manufacture (mainly as a result of compositional and textural differences arising from differences in milk composition and processing factors), the unique characteristics of the individual cheeses develop during ripening as a result of a complex set of biochemical reactions. The changes that occur during ripening, and hence the flavour, aroma and texture of the mature cheese, are largely predetermined by the manufacturing process, i.e., by composition, especially moisture, NaCl and pH, level of residual coagulant activity, the type of starter and in many cases by a secondary inoculum added to, or gaining access to, the milk or curd. The biochemical changes that occur during ripening are caused by one or more of the following agents:

• Coagulant

• Indigenous milk enzymes, especially proteinase and lipase, which are particularlyimportant in cheese made from raw milk

• Starter bacteria and their enzymes

• Secondary microorganisms and their enzymes

• Non-starter lactic acid bacteriaon elucidating the primary reactions.

2.4.1.9 Processed Cheese Products

Depending on culinary traditions, a variable proportion of mature cheese is consumed as such, often referred to as “table cheese”. A considerable amount of natural cheese is used as an ingredient in other foods, e.g., Parmesan or Grana on pasta products, Mozzarella on pizza, Quarg in cheesecake, Ricotta in ravioli. A third major outlet for cheese is in the production of a broad range of processed cheese products which in turn have a range of applications, especially as spreads, sandwich fillers or food ingredients.

2.4.2 Type of cheese

Table (2. 2): Classification of Cheese by Production Method

Psrocessd Cheese	External Mould Cheese	Internl Mould Cheese	Soft Cheese	Semi-hard Cheese	Hard Cheese
Cheese sylices Cheese spreads	Brie	Stilton	Brie Camembert Mozzarella Feta Cottage	Edam Gouda Stilton	Cheddar Emmenthal Parmesan

Cheeses are also classified according to the post-coagulation operations they have undergone. The majority of rennet-coagulated cheeses are subjected to ripening. According to the CODEX general standard for cheese:

“Ripened cheese is cheese which is not ready for consumption shortly after manufacture but which must be held for such time, at such temperature, and under such other conditions as will result in the necessary biochemical and physical changes characterising the cheese in question.

Mould ripened cheese is a ripened cheese in which the ripening has been accomplished primarily by the development of characteristic mould growth throughout the interior and/or on the surface of the cheese.

Un ripened cheese including fresh cheese is cheese which is ready for consumption shortly after manufacture”.

Other examples from CODEX

- Un ripened (fresh) cheese: Mozzarella
- Soft, rind less, un ripened cheese: Cottage cheese .

- Soft surface ripened, primarily mould ripened cheese: Camembert, Coulommiers .
- Soft surface ripened, primarily white mould ripened cheese: Brie
- Ripened firm/semi-hard cheese: Saint-Paulin, Edam, Gouda, Provolone, Tilsiter, Danbo , Havarti .
- Ripened hard cheese: Samso, Emmental, Cheddar.

2.4.3. Nutrient profile of cheese and the impact of cheese-making on nutrient profiles

Cheese contains high levels of essential nutrients relative to its energy content, although the nutritional profile varies with the type of milk, the type of starter culture, the method of manufacture and ripening conditions.

About 10 litres of milk are required to produce 1 kg of cheese, and during the process the water-soluble material (whey proteins and water-soluble vitamins) are separated from the casein, fat and salts. The casein remains in the curd, but caseins are low in sulphur-containing amino acid sand the nutritional value of cheese protein is slightly lower than that of total milk protein. Not more than 75 percent of the total protein in milk is recovered in rennet-coagulated cheeses.

Some whey can remain trapped within the curd, contributing to increased supplies of essential amino acids such as cysteine, isoleucine, leucine, lysine, threonine and tryptophan. Newer methods in cheese-making attempt to increase the nutrient value of cheese by including the whey proteins in the curd.

Methods used to achieve this include heat-treatment to denature the whey proteins (causing them to form protein aggregates with κ-casein), adding the whey proteins at a later stage of the manufacturing process and ultra filtration, especially in the case of semi-hard or soft cheeses, e.g. feta, a soft, white cheese ripened in brine, manufactured from sheep milk, or a mixture of sheep and goat milk .

Most milk used in cheese-making is pasteurized, usually immediately before use. During pasteurization, whey proteins are denatured and the resulting β-lacto globulin–κ casein entraps denatured whey proteins, which may lead to some minor differences in amino acid profiles between lactic cheese and soft cheese.

A progressive breakdown of casein during ripening is reported to increase its digestibility. Moreover, proteolysis induced by fermentation and ripening increases amounts of bioactive peptides and free amino acids present in the cheese. The free amino acids present in goat cheese are glutamic acid, leucine and lysine.

Whey contains up to 94 percent of the lactose, much of which is lost in cheese making.

The remaining lactose is partially transformed into L-lactate or D-lactate, or into glucose and galactose on cheese-making. These residual carbohydrates found in fresh cheeses disappear with increasing ripening time. Lactose content in cheese is generally less than 1 g/100 g, with a few exceptions.

The curd contains almost 95 percent of the fat, and during cheese-making the fat is concentrated between 6- and 12-fold, depending on cheese variety.

Contents of other fat soluble compounds such as β-carotene (for cow milk cheese), xanthophylls and vitamin E have also been shown to depend on the original milk composition, rather than on cheese processing. However, vitamin A content was partially influenced by both the original milk composition and the cheese-making process.

Mineral contents vary with cheese type. The strong decrease in pH occurring early in the production process of some types of cheeses (during coagulation) make calcium, phosphorus and zinc (mainly bound to caseins) soluble and these are therefore lost with the whey during draining. Potassium and magnesium, which are essentially soluble, also decreased as dry matter increased through pressing or aging. All lactic goat cheeses were found to have similar calcium contents, showing an overall similar demineralization. Magnesium concentrations in fresh lactic goat cheeses were reported to be similar to that in goat milk.(FAO, 2013).

2.5 Edam Cheese

Edam cheese originated in Holland in the village of Edam .It is a type of semi hard cheese having a wide distribution among consumers.

Open Country Edam Cheese is a pressed semi-hard to hard cheese, made from pasteurised cow's milk. It is a reduced fat cheese with a smooth body. Mild, clean, with a sweet and nutty flavor, Edam is a washed curd cheese usually consumed young, when the texture is elastic and supple. (Journal of American Science , 2010) .

2.5.1. Applications

Open Country Edam Cheese is suitable for a range of further manufacturing applications including shredding, cheese sauces and cheese spreads. Because of its good melt ability, Edam is not only a good cooking cheese, but is also ideal for cut and wraps applications.

2.5.2. Ingredients

Pasteurised cow’s milk, salt, rennet, cultures. (Open Country ,2014) .

edam cheese as major representatives ,are semi hard ,sliceable ,shreddable cheese .thier typical composition is 40 -52 % fat in dry matter and 55 -63% moisture in un ripened fat –free cheese ,with PH 5.2 -5.4 pasteurized cows milk and mixed-strain mesophilic starter cultures

,minerals are adjusted. Are brine-salted ,coated ,and naturally ripened for 4-6 weeks up to more than 1 year ,or alternativelyfoil-ripened for relatively short periods (rindless cheese). During ripening ,the typical flavor(changing from mild to strong) ,texture (changing from soft and elastic when young to smooth ,shorter ,even brittle after long maturation) ,and appearance (afew small eyes are formed with DL-or L- starters) develop. this is the combined result of lactose and citric acid fermentation ,proteolysis and amino acid conversion ,and alimited exten of lipolysis. the use renneting with achymosin preparation ,and cutting the coagulum at moderate gel strength .bywashing\scalding the curd at moderate temperatures ,while PH is still high ,the contents of moisture ,lactate ,and of adjunct cultures has broadened the diversity of flavor profiles and varieties (e.g ,low fat) .

Table (2. 3): Main nutrient composition of Edam

	Water (G)	**Energy (KCAL)**	**Protein (G)**	**Total fat (G)**	**Lactose (g)**
Average	41.5	353	26.6	27.1	0.8
Range	39.0–43.8	341–360	25.0–28.1	26.0–27.8	0.1–1.4

(FAO, 2013)

2.5.3 Edam Cheese Manufacture

- Fresh milk was standardized to 3.0% milk fat and pasteurized at 71C for 1s.
- Milk was cooled immediately to 32C and placed in a cheese vat.
- Active lactic starter was added at the rate of 1.5%.
- An hour later the titratable acidity had increased by about 0.01 % .

- Annetto yellow color (Mills Laboratory Inc., Elkhart, IN), diluted 30 fold with cold tap water was added at the rate of 30 mL per 455 kg of milk.
- Single strength calf rennet (Chr. Hansen Inc., Milwaukee, WI) was added at the rate of 90 mL per 455 kg milk. Rennet was diluted in the same manner as color.
- After 30 min curd was cut into 1/4 in. cubes. After 5-10 min, agitation was started and the temperature was brought to 38.6C at the rate of 1.1C per 5 min over the next 30 min.
- Cheese was cooked for an hour and 15 min to the correct degree of firmness. This degree of firmness was determined by scooping out a spoonful of curd with a chlorine sanitized spoon, lightly pressing the curd in the palm and later trying to separate the individual curd particles.
- When individual curd particles no longer lost their identity, but maintained their individual curd particle boundaries on hand separation, the correct degree of firmness was attained.
- Curd was packed under whey for 5 min before draining. After draining whey, curd was allowed to mat for 30 min.
- When the titratable acidity reached 0.25%, the cheese was hooped; 1.5 kg curd was placed in a cheese cloth in each hoop, then pressed for 30 min at 1.5 kg/cm2. Cheese was re-dressed by inversion and pressed for another hour at 1.5kg/cm2.
- Cheese was removed from the hoops and the lips were trimmed from the ball (due to pressing of the lid into the cheese).
- These cheese balls were placed for 48 h in saturated salt solution maintained at 4C.

- After removal from the salt solution they were dipped in mold inhibitor, placed in the cooler and allowed to dry for 24 h.
- Edam cheese balls were later waxed, bagged and stored for maturation at 4C. (KAYANUSH J. ARYANA and ZAHUR U. HAQUE', 2000) .

2.6 Previous studies related to the research

In study microstructure of a Jarlsberg type Edam cheeses as influenced by maturation. The microstructure developed during maturation helps us better understand texture related changes taking place over time. This study was conducted with the objectives to elucidate the effect of maturation on the microstructure of Edam cheese. (Kayanush. J.*et al*, 2000)

In study Factors Affecting Sensory Quality of Goat Milk Cheeses Caprine milk reportedly has more fat, protein and ash, and less lactose than cow milk ,there are many factors that influence the flavor and sensory qualities of goat milk cheeses. The flavor of cheese arises from a series of complex reactions involving microbial metabolism and enzymatic reactions which include proteolysis of proteins, lipolysis of fats, and fermentation of carbohydrates. Understanding the complexity of flavors embodied by goat milk and goat milk products further aids in the production of quality products that enhance the consumer acceptability of caprine milk cheese products.

It has been demonstrated that sensory qualities of cheeses are greatly affected by levels of peptides, amino acids, and free fatty acids resulting from proteolysis and lipolysis during storage Sensory and organoleptic properties of different species milk cheeses can be greatly influenced by chemical and biochemical changes that occur during storage of the cheeses. (Dr.Park *et al*., 2017)

In study quality enhancement of Edam like cheese made from goat's milk there was significant different in moisture of experimental Edam the decrease level of moisture along ripping period, it was observed higher slightly fat. as for the protein content of control which contained the lowest protein .

During ripening period it was necessary determine the major branched chain fatty acids which are considered to be responsible irritating flavor (Ibrahim *et al* , 2016) .

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental design

The experiment was conducted at the Animal Production Department, Faculty of Agricultural Studies, Sudan University of Science and Technology. The milk and goat milk were obtained from the farm of the department, where 46 pounds of milk (23 pounds of cow's milk and 23 pounds of goat milk) were used. The experiment began on 20/8/2018 to 20/10/2018.

Table (3. 1): The composition of Row milk from cow and goat :

Different samples of milk (%)	Moisture	Protein	Fat	Ash	T.S	Lactose	PH	Acidity
Cow	89.18	3.16	3.08	0.79	10.83	3.80	6.58	0.19
Goat	88.96	3.6	3.32	3.32	0.82	3.53	6.44	0.19

Material in experiment

- Starter from yogurt.
- Calcium chloride
- rennet
- National honey wax
- Dietary color.

3.2. Method

We were took 3 sample from milk (one of this sample 100% cow , the second sample is 100% goat and the last sample is mixing between 50% cow and 50% coat milk) .

3.2.1. Cheese preparation

We must insure about the safety of raw milk by using liquidating .Hover we pasteurized the milk and mixed-strain mesophlilic starter cultures, minerals are adjusted. Are brine-salted, coated, and naturally ripened for 4-6 weeks up to more than 1 year, or alternatively foil-ripened for relatively short periods (rind less cheese).

During ripening ,the typical flavor(changing from mild to strong) ,texture (changing from soft and elastic when young to smooth ,shorter ,even brittle after long maturation) ,and appearance (a few small eyes are formed with DL-or L- starters) develop .this is the combined result of lactose and citric acid fermentation ,proteolysis and amino acid conversion ,and animated extent of lipolysis .the use renneting with achymosin preparation ,and cutting the coagulum at moderate gel strength by washing scalding the curd at moderate temperatures ,while PH is still high ,the contents of moisture ,lactate ,and of adjunct cultures has broadened the diversity of flavor profiles and varieties (e.g. ,low fat) .

3.3 Analytical methods

The Analytical method was determined according to the standard method of the Association of Official Analytical Chemists (AOAC, 2005).

3.3.1 Moisture content

A sample of 5 gm ± 1 mg was weighed into a pre-dried and tarred dish. Then, the sample was placed into an oven (Kat-NR.2851, Elektrohelios, Sweden) and left to dry at 105±1C° until a constant weight was obtained. After drying, the covered sample was transferred into desiccators and cooled to room temperature before reweighing. Triplicate results were obtained for each sample and the mean value was reported to two decimal points according to the following formula:

Moisture content %

$$\text{Moisture content \%} = \frac{(W1-W2)}{W1} \times 100$$

Where:

W1= Original weight of sample.

W2= Weight of sample after drying.

3.3.2 Crude protein determination

Procedure: 0.5gm ± 1mg sample was accurately weighed and transferred together with 2-3 glass pellets, kjeldahl catalyst (No 33064, BDH, England) and 20ml concentrated sulphuric acid (No 18474420, Mark AG, Germany) into kjeldahl digestion flask. After that, the flask was placed into a kjeldahl digestion unit (Tecator, Sweden) for about 3hours, until a colorless digest was obtained. Following, the flask was left to cool to room temperature. The distillation of ammonia was carried out in 30 ml boric acid (2%) by using 40 ml distilled water and 60 ml sodium hydroxide solution (33 %). Finally, the distillate was titrated with standard solution of 0.1N HCL in the presence of 2-3 drops of indicator (Bromocreasol green and methyl red) until a brown reddish color was observed. The total nitrogen and protein were calculated using the following formula:

$$N\% = \frac{\text{volum of HCL} \times N \times 14}{\text{Weight of S}} \text{x100}$$

P% = N% * 6.38 (factor)

N% = crude nitrogen.

P% = crude protein.

N = normality of HCL.

14 = equivalent weight of nitrogen.

3.3.3 Determination of fat content

Ten milliter of Sulphuric acid (specific gravity 1.820 at 155^{o}C) were measured into Gerber butyrometers, and mixed well, 10.94 mL of sample was slowly added into butyrometers tube. One milliter of amyl alcohol was added and lock stopper was inserted securely with the stoppers end up. Gerber tube was grasped and shacked with precaution until the sample was completed digested, the Gerber tube were centrifuged at 1100 rpm for 4minutes. Butyrometer was then placed in a water bath at 65°C for at least 3 minutes. The fat percent was finally read out directly from the Colum.

3.3.4 Determination of Ash

Five grams of the samples were weighed in crucibles, and then placed in a muffle furnace at 550-600 C^{o} for 3 hrs until ashes were carbon free. The crucibles were then cooled in desiccators and weighed. The ash content was calculated using the following equation:

$$Ash \% = W_{1/}W_2 \text{ x } 100$$

Where:

W_1= Weight of ash

W_2=Weight of sample before ashing.

3.3.5 Titrable acidity

Ten grams of cheese were weighed and placed in a conical flask and distillate water at 40 ^{O}C was added until the volume in the flask was 105 ml. The sample was then vigorously agitated and filtered. 25 ml of the filtrate were pipette into porcelain dish and 3-4 drops of phenolphthalein indicator were added. The sample was titrated against 0.1N NaOH until a faint pink color. The acidity calculated from the following equation:

$$Acidity \% = T \text{ x}4/ W$$

Where:

T= Titration figure.

W=Weight of sample.

3.4 Subjective Sensory Evaluation

Sensory evaluation was conducted in the sensory evaluation facilities of cheese laboratory. Samples for sensory evaluations were presented to a 10 semi-trained panelists for evaluation of Appearance, Taste, Texture , flavor and overall acceptability on an 7-point hedonic scale score ,7 being extremely desirable and 1 being extremely undesirable (Cross *et al.1978*)

CHAPTER FOUR

RESULTS

4.1. Effect of Ripened period (30 and 60 days) on quality characteristics in Edam cheese form cow and Goat milk

4.1.1 Chemical composition

As shown in table (4.1).In the different cheese samples and storage period had a significant ($p<0.05$) effect on chemical composition (moisture, protein, fat and ash). The control showed a significantly ($p<0.05$) highest moisture% compared with the different cheese samples treatments where different cheese samples resulted in a significant ($p>0.05$) increase of the Edam cheese moisture % at the 30 day of ripened period, high moisture in Goat (53.09) and low moisture in Cow (52.09). Increasing the storage period to 60 days resulted in a significant ($p<0.05$) reduction of the moisture% between the control and the different cheese samples where this reduction was significant ($p>0.05$) with different cheese samples, the high moisture in Goat (41.09) and low moisture in Cow (40.09).

The control showed a significantly ($p<0.05$) lowest protein % compared with the different cheese samples treatments where different cheese samples resulted in a significant ($p>0.05$) increase of the Edam cheese protein % at the 30 day of ripened period, high Protein in Cow (40.30) and low protein in mix milk (31.70). Increasing the storage period to 60 days resulted in a significant ($p<0.05$) reduction of the protein % between the control and the different cheese samples where this reduction was significant ($p>0.05$) with different cheese samples, the high protein in mix milk (26.88) and low protein in goat (25.37).

The control showed a non significantly ($p<0.05$) fat % compared with the different cheese samples treatments where different cheese samples resulted in a significant ($p>0.05$) increase of the Edam cheese fat % at the 30 day of ripened period, high fat in goat (26.30) and low fat in cow (24.80). Increasing the storage period to 60 days resulted in a significant ($p<0.05$) increase of the fat % between the control and the different cheese samples where this increase was significant ($p>0.05$) with different cheese samples, the high fat in goat, control and mix milk (27.92 , 27.96 , 27.93) and low fat in cow (27.81).

The control showed a significantly ($p<0.05$) lowest ash % compared with the different cheese samples treatments where different cheese samples resulted in a significant ($p>0.05$) increase of the Edam cheese ash % at the 30 day of ripened period, high ash in goat (6.70) and low ash in cow and mix milk (6.10 5.83). Increasing the storage period to 60 days resulted in a significant ($p<0.05$) reduction of the ash % between the control and the different cheese samples where this reduction was significant ($p>0.05$) with different cheese samples, the high ash in cow and control (5.53, 5.73) and low ash in goat (5.62).

Table 4. 1: Effect of storage period 30 days on chemical composition in Edam cheese from cow and Goat milk

Different cheese samples (%)	Ripened period (days)	Moisture	Protein	Fat	Ash
Control	30	43.05[a] (±0.0)	30.80[d] (±0.10)	25.100[bc] (±0.20)	5.100[c] (±0.20)
Cow	30	53.60[d] (±0.10)	40.30[a] (±0.10)	24.80[c] (±0.10)	6.100[b] (±0.00)
Goat	30	52.90[c] (±0.00)	31.70[b] (±0.100)	26.30[a] (±0.200)	6.700[a] (±0.00)
Mix (Cow and Goat)	30	55.80[b] (±0.100)	29.93[c] (±0.15)	25.30[b] (±0.100)	5.83[b] (±0.115)
SE	30	0.057	0.094	0.129	0.094

Means in the same column within treatment with different superscripts are significant different at ($p<0.05$).
SE: standard error of the mean

Table 4. 2: Effect of storage period 60 days on chemical composition in Edam cheese from cow and Goat milk

Different cheese samples (%)	Ripened period (days)	Moisture	Protein	Fat	Ash
Control	60	41.59[a] (±0.10)	24.53[d] (±0.17)	27.96[a] (±0.00)	5.73[a] (±0.02)
Cow	60	40.09[c] (±0.05)	26.55[b] (±0.05)	27.81[b] (±0.03)	5.53[a] (±0.005)
Goat	60	41.09[b] (±0.02)	25.37[c] (±0.03)	27.92[a] (±0.01)	5.62[c] (±0.01)
Mix (Cow and Goat)	60	39.45[d] (±0.10)	26.88[a] (±0.06)	27.93[a] (±0.02)	5.72[b] (±0.01)
SE	60	0.082	0.082	0.016	0.086

Means in the same column within treatment with different superscripts are significant different at ($p<0.05$).
SE: standard error of the mean

4.1.2 Physical composition

As shown in table (4.2). In the different cheese samples and storage period had a significant ($p<0.05$) effect on physical composition Acidity. The control showed a significantly ($p>0.05$) lowest acidity % compared with the different cheese samples treatments where different cheese samples resulted in a significant ($p<0.05$) increase of the Edam cheese acidity % at the 30 day of ripened period, high acidity in mix milk (0.20) and low acidity in goat (0.10). Increasing the storage period to 60 days resulted in a significant ($p<0.05$) reduction of the acidity % between the control and the different cheese samples where this reduction was significant ($p>0.05$) with different cheese samples, the high acidity in mix milk (1.46) and low acidity in Cow (1.36).

Table 4. 3: Effect of storage period 30 days on physical composition in Edam cheese from cow and goat milk

Different cheese samples (%)	Ripened period (days)	Acidity
Control	30	0.10[c] (±0.00)
Cow	30	0.20[b] (±0.00)
Goat	30	0.10 [d] (±0.00)
Mix (Cow and Goat)	30	0.20[a] (±0.00)
SE	30	0.000

Means in the same column within treatment with different superscripts are significant different at ($p<0.05$).
SE: standard error of the mean

Table 4. 4: Effect of storage period 60 days on physical composition in Edam cheese from cow and goat milk

Different cheese samples (%)	Ripened period (days)	Acidity
Control	60	1.36[c] (±0.005)
Cow	60	1.36[c] (±0.005)
Goat	60	1.42[b] (±0. 01)
Mix (Cow and Goat)	60	1.46[a] (±0.01)
SE	60	0.007

Means in the same column within treatment with different superscripts are significant different at ($p<0.05$).
SE: standard error of the mean

4.1.3 Sensory evaluation

As shown in table (4.3) the control showed a no significantly compared with the different cheese samples treatments in (Flavor, overall acceptability) but there was a significant difference in taste between two period (30 and 60)where improve in 60 days , appearance was improve after end of 60 days and texture also. at the 30 day of ripened period, compared with the storage period to 60 days resulted in a significant difference in taste where improve in 60 days and texture also, but no significantly compared with the different cheese samples treatments in (Appearance, Flavor and overall acceptability).

Table 4. 5:Effect of ripened period 30 days on sensory evaluation in Edam cheese from cow and goat milk:

Different cheese samples (%)	Ripened period (days)	Appearance	Taste	Flavor	Texture	overall acceptability
Control	30	5.50[a] (±1.71)	5.20[a] (±2.15)	4.50[a] (±1.71)	5.80[a] (±1.54)	4.10[a] (±2.33)
Cow	30	5.60[a] (±1.35)	5.00[a] (±1.52)	4.30[a] (±1.05)	4.30[ab] (±1.49)	4.60[a] (±1.57)
Goat	30	3.30[b] (±2.45)	3.10[b] (±1.91)	3.00[a] (±1.70)	2.90[b] (±1.96)	3.10[a] (±1.91)
Mix (Cow and Goat)	30	4.00[ab] (±1.24)	4.00[ab] (±1.77)	4.10[a] (±1.37)	4.00[ab] (±1.41)	4.50[a] (±1.50)
SE	30	0.785	0.829	0.665	0.725	0.832

Means in the same column within treatment with different superscripts are significant different at ($p<0.05$).
SE: standard error of the mean

Table 4. 6:Effect of ripened period 60 days on sensory evaluation in Edam cheese from cow and goat milk:

Different cheese samples (%)	Ripened period (days)	Appearance	Taste	Flavor	Texture	Overall acceptability
Control	60	4.70[a] (±2.62)	4.90[a] (±1.52)	3.60[a] (±1.43)	5.50[a] (±1.65)	3.70[a] (±1.49)
Cow	60	5.50[a] (±1.43)	4.50[a] (±1.78)	4.60[a] (±1.95)	3.70[ab] (±1.33)	4.30[a] (±1.63)
Goat	60	4.80[a] (±1.61)	4.00[a] (±1.88)	4.10[a] (±1.66)	4.20[ab] (±1.87)	4.70[a] (±1.76)
Mix (Cow and Goat)	60	4.90[a] (±1.66)	3.70[a] (±1.95)	3.40[a] (±1.77)	3.10[b] (±1.44)	3.50[a] (±1.90)
SE	60	0.847	0.802	0.768	0.711	0.763

r

CHAPTER FIVE

DISCUSSION

5.1 Chemical composition

In the different cheese samples and storage period had a significant effect on chemical composition (moisture, protein, fat, ash). The control showed a significantly highest moisture compared with the different cheese samples treatments where different cheese samples resulted in a significant increase of the Edam cheese moisture at the 30 day of ripened period, high moisture in Goat and low moisture in Cow. Increasing the storage period to 60 days resulted in a significant reduction of the moisture between the control and the different cheese samples where this reduction was significant with different cheese samples, the high moisture in Goat and low moisture in Cow . the result agree with Kayenush .J Aryana (2000).

The control showed a significantly lowest protein compared with the different cheese samples treatments where different cheese samples resulted in a significant increase of the Edam cheese protein at the 30 day of ripened period, high Protein in Cow and low protein in mix milk. Increasing the storage period to 60 days resulted in a significant reduction of the protein between the control and the different cheese samples where this reduction was significant with different cheese samples, the high protein in mix milk and low protein in goat . the result agree with Kayenush .J Aryana (2000).

The control showed a non significantly fat compared with the different cheese samples treatments where different cheese samples resulted in a significant increase of the Edam cheese fat at the 30 day of ripened period, high fat in goat and low fat in cow. Increasing the storage period to 60 days resulted in a significant increase of the fat between the control and the different cheese samples where this increase was significant with different cheese samples, the high fat in goat, control and mix milk and low fat in cow. the result agree with Kayenush .J Aryana (2000).

The control showed a significantly lowest ash compared with the different cheese samples treatments where different cheese samples resulted in a significant increase of the Edam cheese ash at the 30 day of ripened period, high ash in goat and low ash in cow and mix milk. Increasing the storage period to 60 days resulted in a significant reduction of the ash between the control and the different cheese samples where this reduction was significant with different cheese samples, the high ash in cow and control and low ash in goat . the result agree with Kayenush .J Aryana (2000).

5.2 Physical composition

In the different cheese samples and storage period had a significant effect on physical composition (Acidity and PH). The control showed a significantly lowest acidity compared with the different cheese samples treatments where different cheese samples resulted in a significant increase of the Edam cheese acidity at the 30 day of ripened period, high acidity in mix milk and low acidity in goat. Increasing the storage period to 60 days resulted in a significant reduction of the acidity between the control and the different cheese samples where this reduction was significant with different cheese samples, the high acidity in mix milk and low acidity in cow.

The control showed no significantly PH compared with the different cheese samples treatments of the Edam cheese at the 30 day of ripened period . decreasing the storage period to 60 days resulted in a significant reduction of the PH % between the control and the different cheese samples where this reduction was significant with different cheese samples, the high PH in cow and low ph in goat and mix milk . these results agreed with Kayenush .J Aryana (2000) .

5.3 Sensory evaluation

the control showed a no significantly compared with the different cheese samples treatments in (Taste, Flavor, overall acceptability) but there was a significant difference in cheese Appearance and texture at the 30 day of ripened period, compared with the storage period to 60 days resulted in a significant difference in cheese texture, but no significantly compared with the different cheese samples treatments in (Appearance ,Taste, Flavor and overall acceptability) . these results agreed with Dr.Park et al., (2017) .

CHAPTER SIX

6.1 Conclusion

Based on the results obtained in the present study, the following Conclusions can be drawn:

- The storage of different sample cheese had given better maturation of the cheese in nutritional value by increasing the proportion of protein and ash during the storage period.
- The storage of different sample cheese was found increasing the fat and decrease the moisture.
- The storage of different sample cheese was found increasing the acidity .
- The storage period further improves the sensory evaluation of Edam cheese especially made from goat milk.

6.2 Recommendation

- We recommend advantage of quantities of goat milk in manufacturing cheese nutritional value and acceptance by the consumer.
- We recommend adding aromatic herbs to enhance the taste and flavor (e.g Black cumin and Cinnamon) to made the product more acceptable to consumer.
- Introduce a new product to the local market.
- Increase studies in the field of manufacturing a product with high nutritional value and economic.

References:

AOAD. Arab Organization for Agricultural Development.(1990). Goats resources in Arab states. Sudan, Khartoum.

Ballal, K.M. Mka A, Lma M. (2008).Estimates of phenotypic and genetic parameters of growth traits in the Sudanese Nubian goat. 3:9–14.

Bornaz, S. Sahli. A, Attalah. A. and Hamadi.A (2009). Physicochemical characteristics and renneting properties of camels's milk. International Journal of Dairy Technology , 62(4): 505–513.

Bushara, I. Abu Nikhaila, M.A .(2012). Productivity performance of Taggar female kids under grazing condition.J. Anim Prod Adv, 2:74–9 .

Bylund G. (2003). Dairy processing hand book.

Celik S. (2003) β-Lactoglobulin genetic variants in Brown Swiss breed and its association with compositional properties and rennet clotting time of milk. International Dairy Journa. 13, 727-31.

Coulon, J.B. Delacroix-Buchet, A. Martin ,B and Pirisi, A.(2004) . Relationships between ruminant management and sensory characteristics of cheeses .

Cross, H.R., R.Moen and M.S. Stanfielid . (1978). Traning and Testing of judges for sensory analysis of meat quality . Food Technol .32:48-54.

Cruz-Hernandez, C. Kramer, J.K.G. Kennelly, J.J. Glimm, D.R. .Sorensen, B.M., Okine, E.K., Goonewardene, L.A. and Weselake, R. J.(2007). Evaluating the conjugated linoleic acid and *trans* 18:1 isomers in milk fat of dairy cows fed increasing amounts of sunflower oil and a constant level of fish oil. *J. Dairy Sci* . 90(8): 3786–3801.

El-Naim ,Y.A. (1979). Some reproductive and productive traits of Sudan Nubian goats. University of Khartoum . Sudan.

Epstein, H. Mason, I. L. (1971). The origin of the domestic animals of Africa. New York.

Evershed, R. P. Payne, S. Sherratt, A.G. Copley, M.S. Coolidge, J. Urem-Kotsu, D. Kotsakis, K. Özdoğan, M. Özdoğan, A.E. Nieuwenhuyse, O. Akkermans P.M. Bailey, D. Andeescu , R.R . Campbell, S. Farid S. Hodder, I. Yalman, N. Özbaşaran M . Bıçakcı, E . Garfinkel, Y. Levy, T. and Burton M.M. (2008) . Earliest date for milk use in the Near East and southeastern Europe linked to cattle herding. *e*455, 528.

FAOSTAT. FAO statistical database. (2012).

Farrell, H.M. Jimenez-Flores, J. R . Bleck, G.T. Brown, E.M. Butler, J.E. Creamer, L.K. Hicks, C.L. Hollar ,C.M. Ng-Kwai-Hang, K.F Gomes, J. J. Duarte, A. S. Batista, R. M. de Figueire-do, E. P. de Souza, E. L. de Souza and R. de C. R. do E Queiroga. (2013). Physicochemical and sensory properties of fermented dairy beverages made with goat's milk. Lwt Food Sci. Technol. (Campinas) 54:18–24.

Fekadua, B. Soryala K. Zenga S. Van Hekken D. and Baha, B. (2005). Changes in goat milk composition during lactation and their effect on yield and quality of hard and semi-hard cheeses.

Fox, P.F. (2008). Milk: an overview. In A. Thompson, M. Boland H. and Singh, eds. Milk proteins, from expression to food. San Diego, USA.

Fox, P.F. (2017). Springer New York. Fundamentals of Cheese Science.

Haenlein, G. F. W. (2004). Goat milk in human nutrition. Small Rumin.

Ibbahim, A. A. Abo ayana and El deeb. A. M. (2016). Quality enhancement of edam like cheese made from goat`s milk .American journal of food technology.

Ismail, A. M. Yousif, I. A. Fadlelmoula A. A .(2011). Phenotypic variations in birth and body weights of the Sudanese Desert goats.

Kayanush, J. Aryana and Zahur, U. Haque. (2000) Microstructure of Jarlsberg type and edam cheeses as influenced by maturatron.

Kosikowoski, F.V. Mistry V . (1999) Cheese and fermented milk foods .

Kosikowski, F.V. (1986). Requirements for the acceptance and marketing of goat milk cheese. Dairy Goat Journal.

Lucey, J.A. (2002) .Formation and Physical Properties of Milk Protein Gels. Journal of Dairy Science.

Mason, I.L. Maule JP. (1960). The indigenous livestock of eastern and southern Africa. UK.

McSweeney, P. L. H., Ottogalli G. and Fox P.F. (2004) Diversity of cheese varieties ds.

Pehrsson, P. R. Hayytowitz. D. B. Holdem.J.M. Perry.C.R and Beckler. D.G. (2000). USDA`s National food and nutrient analysis program: food samping.

Ribeiro, A. C., and S. D. A. Ribeiro. (2010). Specialty products made from goat milk. Small Rumin.

Salem, H. B. (2010). Nutritional management to improve sheep and goat performances in semi arid regions, 39:337–47.

Seelee, W.W. Tungjaroenchai, and. Natvaratat, M. (2009). Develop-ment of low fat set-type probiotic yoghurt from goat milk. Asia J. Food kAgro-Indus. 2:771–779.

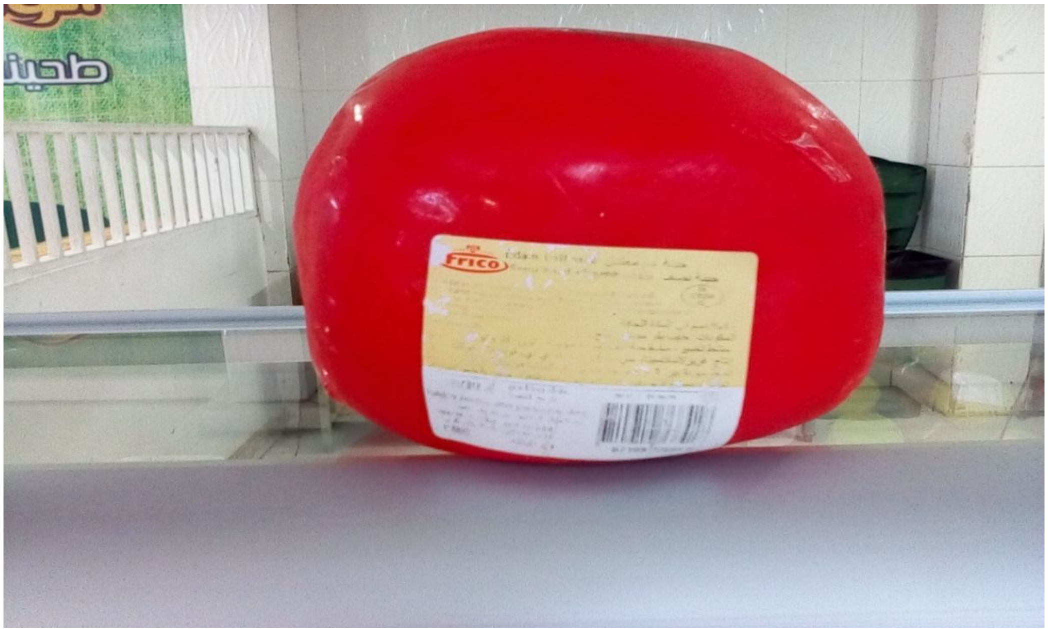
Silanikove, N. (2000). The physiological basis of adaptation in goats to harsh environments. Small Rumin. 35:181–93.

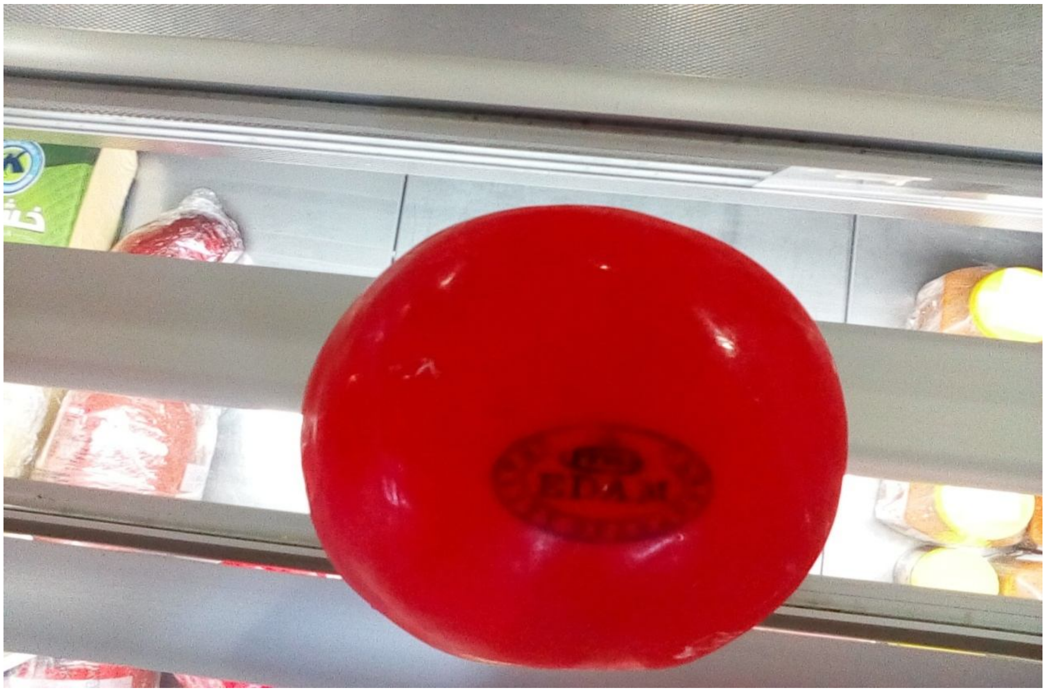
Swaisgood, H. E. (2004). Nomenclature of the Proteins of Cows' Milk—Sixth Revision. Journal of Dairy Science 87.

Wilson, T. (1991). Small ruminant production and the small ruminant genetic resource in tropical Africa.

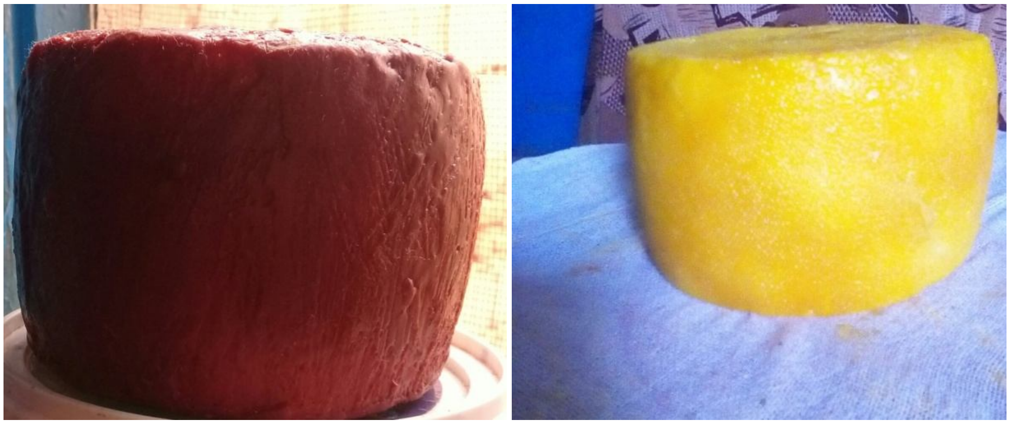
APPENDICES

Appendix 1: Edam cheese blank sample (control)



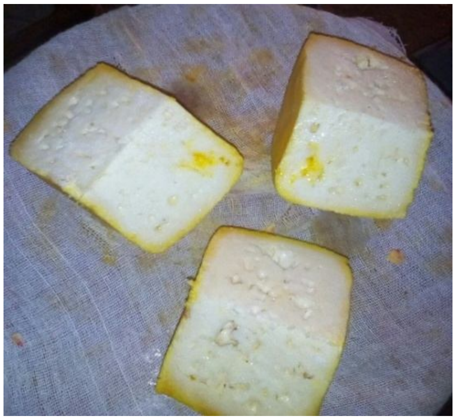


Appendix 2: Edam cheese from cow before and after waxing



Appendix 3: The shape of cheese from interior

A: MIX



B: COW

C: Goat

Appendix 4: Sensory Evaluation Form

Date:…………………………….

Number:………………………..

7= Extremely like

6= Moderately like

5= Like

4= Slightly like

3= Slightly dislike

2= Dislike

1= Extremely dislike

Sample code	**A**	**B**	**C**	**D**
Appearance				
Taste				
Flavor				
Texture				
Overall acceptability				