بسم الله الرحمن الرحيم

Effect of Lactation Stages on Physicochemical Characteristics of Damascus (Shami) Cuprus Goats Milk

أثر مراحل إدرار اللبن على الصفات الفيزوكيميائية للبن الماعز الدمشقي الشامي القبرصي

By

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A thesis Submitted In Fulfillment of the Requirements of the Degree of Master of Science in Animal Production Sudan University of science Technology

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September 201

DEDICATION

This Work is dedicated to

My Mother,

My Father,

My brothers,

My sisters,

And my friends

With love and respect.

ACKNOWLEDGEMENT

First and foremost, praise is to Allah the Almighty who give me the health, strength and patience to complete this work.

I offer my sincerest gratitude to my supervisor, Dr, Ahmed Khalil Ahmed who has supported me throughout my thesis with her patience, kind attitude, constant assistance, and valuable suggestion towards the completion of this study and without it this thesis would not have been completed or written. My appreciation is extended to Dr, Abdelmonam Abonkhala

I would like to express the deepest appreciation to Ezzeldeen Abdelrhamn Mohamed for helping in analyzing the data.

I am indebted to farms owners in Zakat farm in Elrodwan complex (Omdurman) who allowed me to get information and research samples from their farms.

I extend my thanks to staff of soil lab University of Khartoum, Elgula Omer (Nutrition lab Sudan University of science Technology) , Animal Production lab Sudan University of science Technology) and Welud Ahmed (dairy lab of University of Khartoum)

Number of friends who through their generosity and knowledge have made important contributions to this dissertation. It would be impossible to list everyone who contributed to resolve this research. My special thanks to our friends and groups Saham Bshair, Rhab Osman,Hsham Elblolla and Galal Khalil for the great time and support me.

My special thanks to Khald Elfka , Eshraga Ebrhum, Esam Abdelrhman, Ministry of Livestock, Fisheries and Rangelands Department of Animal Production

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ABSTRACT

The study was conducted to determine the composition and Physicochemical Characteristics of Damascus (Shami) Cyprus goats in different lactation periods in Sudanese Environment,

The data was collected from the Zakat farm in Elrodwan complex located in Omdurman in Khartoum state Which is located in the semi arid zone. The farm was established as breeding farm Damascus (Shami) Cyprus goats. The goats were milked by hand twice a day (morning and evening). Milk samples were taken separately from the breed groups during the morning in Sterilization labeled bottle and kept in the refrigerator at 4ºC. Samples of milk were immediately collected by using Composition of milk and Physicochemical determine the chemical composition (total solids, non-fat solids, fat, protein, lactose and ash), minerals (Calcium, phosphorus and Iron) and physical characteristics (Specific gravity, titratable acidity, pH, viscosity, Electrical conductivity, refractive index and freezing point).

This study revealed not significant differences ($P<0.001$) in chemical composition (total solids, non-fat solids, fat, protein, lactose and ash), minerals (Calcium, phosphorus and Iron) and physical characteristics (Specific gravity, titratable acidity, pH, viscosity, Electrical conductivity, refractive index and freezing point)

The total solids content of Cyprus shami goat milk for begin, mid and end of lactation production were 12 %, 11.5% and 11.3% respectively. The protein content of Damascus (Shami) Cyprus goats

milk for begin , mid and end lactation production were 3.5 % , 3.4% and 3.2% respectively .The lactose content of Damascus (Shami) Cyprus goats milk for begin , mid and end lactation production were 3.6 % , 3.4% and 3.2% respectively. The fat content of Damascus (Shami) Cyprus goats milk for begin, mid and end lactation production were 4 %, 4% and 4.1% respectively. The protein content of Damascus (Shami) Cyprus goats milk for early, mid and end lactation production were 0.8 %, 0.75% and 0.78% respectively. The Calcium content of Damascus (Shami) Cyprus goats milk for begin, mid and end lactation production were 0.2%. the phosphorus content of Damascus (Shami) Cyprus goats milk for begin , mid and end lactation production were 0.08,0.1 and 0.1 the Iron content of Damascus (Shami) Cyprus goats milk for begin , mid and end lactation production were 0.383, 0.547 and 0.547 respectively .The Titratable acidity of Damascus (Shami) Cyprus goats milk for begin , mid and end lactation production were 0.15 % , 0.16% and 0.17% respectively. The pH of Damascus (Shami) Cyprus goats milk for begin, mid and end lactation production were 6.6 %, 6, 4 % and 6.5 % respectively. The viscosity of Damascus (Shami) Cyprus goats milk for begin , mid and end lactation production were 1.66 , 1.82 and 1.86 respectively .The Electrical conductivity of Damascus (Shami) Cyprus goats milk for early , mid and end lactation production were 0.010 respectively. The refractive index of Cyprus shami goat milk for begin, mid and end lactation production were 1,352, 1.458 and 1.458 respectively. Freezing point of Damascus (Shami) Cyprus goats

milk for begin, mid and end lactation production were -0.54, -0.54 and -0.55 respectively

The physicochemical properties and characteristics of Damascus (Shami) Cyprus goats milk could be use for dairy goat industries as well as for marketing the products .Establishment of a research center for Damascus (Shami) Cyprus goats in Khartoum state to improve local Sudanese goats, because goats play an important role in the economics of some population groups in Khartoum state.

ملخص الأطروحة

أجريت هذه الدراسة لمعرفة الخصائص الفيزيائية والكيمائية لماعز الشامى فى البئة السودانية،تم اخذ العينات من مزرعة الزكاة فى امدرمان التى تحتوى على قطيع من الماعز الشامى النقى.يحلب الماعز مرتين فى اليوم ، صباحا ومساءا، حيث اخذت العينات فى حلبة الصباح

تم تحليل اللبن لتحديد الصفات الكيمائية (الجوامد الكلية للبن،البروتين ، اللاكتوز،الدهن،الرماد،الفسفور،الكاسيوم والحديد). وايضا لتحديد الصفات الفيزيائية (درجة التجمد للبن، درجة الحموضية ،التوصيل الكهربائى، الكثافة).

لتحليل النتائج المعملية اعينات اللبنSSPSاستخدم برنامج التحليل الاحصائى

أظهرت الدراسة عدم وجود فرق معنوي في الصفات الكيمائية (الجوامد الكلية للبن،البروتين ، اللاكتوز،الدهن،الرماد،الفسفور،الكاسيوم والحديد). وايضا الصفات الفيزيائية (درجة التجمد للبن، درجة الحموضية ،التوصيل الكهربائى، الكثافة)

الجوامد الكلية للبن الماعز القبرصى الشامى لبداية ،منتصف ونهاية الادرار على التوالى ، بروتين اللبن الماعز القبرصى الشامى لبداية ،منتصف ونهاية .11.3 و 11.5 , % 12

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-0.55 .

Chapter one

Introduction

Sudan is an agricultural country characterized by variations in climatic conditions and animal resources .The natural grazing land is estimated as 1.886.000 Kl^2 (186.6 Hectar), which is housing about 103.570.493 heads of livestock. The total population of goats in Sudan is 30837.000 heads according to MARFR, 2012.

Goats play a special role in the life of smallholder farmers. Their small size makes it possible for farmers to keep a large herd in small area (Boylan *et al*., 1996). Goat has been referred as the poor man‘s cow due to the great contribution to the health and nutrition of the landless and rural poor (Dresch, 1988).

Milk is the only food of the young mammal during the first period of its life. The substances in milk provide both energy and the building materials necessary for growth. Milk also contains antibodies which protect the young mammal against infection (Bylund, 1995). Milk plays a tremendous role in building a healthy society and can be used as vehicle for rural development, employment and slowing down the migration of the rural population (Sarwar *et al*., 2002).Goat milk differs from cow or human milk in having better digestibility, alkalinity and buffering capacity (Park *et al*, 2007).

Milk composition and quality are important attributes that determine the nutritive value and consumer acceptability. Malau., et al (2001) reported that goat milk yield and composition are affected by breed, age, stage of lactation, season and nutrition. Barnet and Frederick (2000) showed that goat milk contains more fat and ash than cow milk. However, as infant

food it is nearly as high in vitamin B_6 and twice in vitamin B_{12} as human milk. They also reported that vitamin A in goat milk exists exclusively in its true form and not as carotenoid pigments.

It is well known that the composition of goats milk changes throughout lactation. Any changes in milk composition will be reflected in the nutritional, technological and economic values of goats' milk as well as of other dairy products. Therefore, the extent of these changes should be determined in order to ensure standard production of dairy products (Anifantakis, 1980; Kassem, 1988).

Objective of study:

1- To assess and evaluate the physicochemical characteristics of Damascus (Shami) Cyprus goats milk.

2- Physicochemical properties information on composition and characteristics of goat milk is essential for successful development of dairy goat industries as well as for marketing the products

CHAPTER TWO

LITERATURE REVIEW

2-1.Historical background

2-1-1. History of goats:

About 8000 B.C., goat was the first animal species to be domesticated by the Sumerians in Mesopotamia (Laith, 2009). Domestic goats are considered to have descended from the Bezoar goat (Capra hircus aegargus) in south-west Asia, where the wild form still exists. It is quite certain that the goat was one of the first domesticated animals in Western Asia (Fernández *et al*., 2006).

Goat was considered by the time of domestication was before 7000 BC around the borders of the ancient people as a holy entity for worship at the side of gods .Goats seem to have been first domesticated roughly 10,000 years ago in the Zagros Mountains of Iran (Anonymous, 2000). Ancient cultures and tribes began to keep them for easy access to milk, hair, meat, and skins. In modern times, goats play an important economic role in farming, providing food for farmers in mountains, arid and semiarid areas (Hatziminaoglou and Boyazoglu 2004). Goats have spread all over the world adapting very well for diverse environments Laith, 2009). The goat is found under a wide range of climatic conditions. Apart from thriving in arid desert areas it is known to succeed in tropical rain forests, being the domesticated animal with the largest ecological distribution (Payne and Wilson, 1999). As an example, 88% of the world's goat population is located in Asia and Africa and mostly (80%) in the tropics and sub-tropics. Most of the goats are located in arid (38%) and semi-arid (26%) agro-ecological zones. A similar situation is

depicted, showing that goat is the animal best suited to harsh environments (Laith, 2009). Many breeds are represented and herds are distributed over a wide range of systems of production and husbandry conditions. Goat meat is preferred in most African and Arab countries for it is taste and because it has lower fat percentage than beef. In Sudan goats are mainly kept in small number in villages or towns. And it has been shown that an increase in concentrate supplementation is an efficient way to increase dry matter and nutrient intake of animal. The tropical goats are kept for meat production and are rarely milked as most goats in tropical countries (Ohiokpehai, 2003).

2-1-2. Types of goats in Africa:

In Africa goats can be divided into five major types (Mason and Maule, 1960; Rege et al., 1996): (i) The Long lop-eared goats of North-East Africa which includes the Sudanese Nubian and Sudanese Desert found mainly in Northern Sudan, Eritrea , Ethiopia and the Benadir of Somalia; (ii) the Small short eared goats which extend from Ethiopia and Somalia through East Africa up to Zimbabwe and some parts of South Africa; (iii) the Dwarf short-eared goats which are found along the coast of West and Central Africa; (iv) the Sahelian and Intermediate goats found in the Savannah belt and (v) the Southern lop-eared goats found in southern Africa. In between these major types there are many intermediate and less distinguishable subtypes.

2-1-3. Some important types of goats milk in Europe and Asia:

The major effort has been towards grading up to European dairy breeds based on the Saanen breed in Europe, Korea, Germany, Czech Republic and Russia, and the Toggenburg breed in Europe, Germany, Czech

Republic and Russia (Quartermain, 1991). Similarly, the Angora breed that excels in Mohair production has been used for grading-up the Deccani and Gaddi breeds in India, and feral goats in Australia. Damascus goats, which are known the most important goat breed in some Arab countries(Teleb , 2003).

2-1-4 .Types, Characters and population of goats in Sudan:

Goat is well-adapted animal in Sudan; goats play an important integral component in most traditional production systems. They provide milk for children, meat, skin and cash income from sales (Ageeb, 1992), also play a potential role in the subsistence economy of Sudan where they are generally raised by poor farmers and distressed women. It is population in Sudan is estimated by 30,837 million, forming about 29.9% of ruminants in the countries (MARFR, 2012), 18.2% of goats in Africa and 5.3% of the world goat population (FAO, 1999). The large population of goats is mainly composed of Nubian, Desert, Nilotic and mountain (Taggar) breeds (A.O.A.D, 1990).

2-1-5 .Types and Characters of Shami goat :

Damascus goats, which are known as Shami in Arabic, are considered the most important goat breed in some Arab countries (Egypt, Syria) due to their high milk and meat yield. It is more adaptable to the environmental conditions in the previously mentioned countries, compared to other exotic breeds (Teleb , 2003). Shami are widespread worldwide due to their nutritional and environmental adaptability (Cannas *et a*l., 2008). The Technical Consultation of FAO on Animal Genetic Resources, Conservation and Management has prioritized Damascus goat due to its

quality at attributes. It is a popular goat breed in Lebanon, Syria and Cyprus (Mavrogenis et al., 2006).

The Damascus goat has a reddish brown coat colour consisting mostly of long hair. White spots on the body, legs and face, although not very common, may appear on the animal .The black coat colour is extremely rare and may appear as a result of the presence of a recessive gene in the population. The ears are long and pendulous measuring between 27 cm and 32 cm in length. It is a rather large breed measuring 78 cm at withers, with a body circumference of 97 cm to 99 cm and an adult live weight of about 65±5 kg for the female and 75±5 kg for the male. The head is long with a Roman nose and the presence of horns in both sexes is associated with hinter-sexuality (Hancock and Louca, 1975).

The Shami or Damascus goat is a seasonal polyestrous breed. Onset of estrous cycles occurs from May to November and become more consistent during September to November (Hassan and Shaker, 1990; Papachristoforou *et al*., 2000 Epstein and Herz ,1964) . Mahmut, (2004) found that the Lactation yield of shami goat in Turkey ranged between 277.5-458.0, (347.6± 19.05). Total milk production, including milk produced until weaning, ranges between350 kg and 650 kg per goat per lactation (Louca *et al*., 1975). The quantity of milk produced until weaning including that suckled by the kid(s), is 190 kg to 240 kg, depending on the length of the suckling period (35 or 70 days). Milk production for commercial purposes is high (200 kg to350 kg per goat per lactation) depending on the management system and the level of feeding (Louca *et al*., 1975; Hadjipanayiotou and Louca, 1976;

Papachristoforou *et al*., 2000; Mavrogenis, 1983; Mavrogenis., 1985; Constantinou *et al*., 1985; Mavrogenis *et al*., 1989).

2-2 Milk:

Milk which is the secretion of the mammary glands is the only food of the young mammal during the first period of its life. The substances in milk provide both energy and the building materials necessary for growth. Milk also contains antibodies which protect the young mammal against infection (Bylund, 1995). Milk plays a tremendous role in building a healthy society and can be used as vehicle for rural development, employment and slowing down the migration of the rural population (Sarwar *et al*., 2002). Milk is composed of water, fat and solid not fat .Moreover, milk is not a commodity with a uniform composition but is more widely influenced by environmental and genetic factors than any other biological fluid (Harding, 1999).

Goat milk is white in colour similar to sheep and different from cow milk, which is yellowish because of the presence of carotene (Saini and Gill, 1991). Goat milk has a stronger flavour than sheep milk. This might be due to the liberation of short-chain fatty acids during rough handling, which give off a goat smell (Babayan, 1981; Haenlein, 1993). Unlike cow milk, which is slightly acidic, goat milk is alkaline in nature, which is very useful for people with acidity problems. This alkalinity is due to the higher protein content and a different arrangement of phosphates (Saini and Gill, 1991).

Extant literatures have shown that goat milk is rich in basic food nutrients. It has been reported that goat milk contains more β – casein and less α – casein than cow milk, with a higher production of short and

medium chain length fatty acid than cow milk. The fats in goat milk are easily digested, because of their smaller fat globules (Jenness, 1980). Vitamin A levels in goat milk is almost twice that of cow milk. Goat milk has higher medicinal value, high vitamin B content and high digestibility, which makes it helpful in relieving stress and constipation (James, *et al*., 2005).

The protein content of goat milk is higher than that of human milk in terms of total calories. The protein differs in composition and in kind, but the total amino acid profile is similar (Jenness, 1980). The essential amino acids of goat milk are slightly in excess of infant requirement (Ochepo and Momoh, 2010). Goat milk is adequate for infants in essential fatty acids, with linoleic acid providing about 1% of total calories. The milk is rich in minerals (calcium and phosphorus) and vitamins (C and D) which the cow milk lacks (Jenness, 1980). Goat milk has high vitamin A than that of cow milk and they also can convert all carotenes into vitamin A and hence produce whiter milk than cows. Goats have high levels of vitamin B especially riboflavin in their milk. Soft curd of goat milk is suitable for the digestive and dermatological disorders especially in the old age (Syed and Henna, 2010). Hence, goat milk can be used for infants as well as post weaning diets for children (Jenness, 1980). According to Thear and Fraser (1986), children and adults who are allergic to cow milk do not react to goat milk. It has also been reported that many adults suffering from migraine and asthma find the problems alleviated when they used goat milk instead of cow milk.

Milk production from goats is substantial in many countries of Europe such as France (Sigwald and Lequenne 1985; Sopex 1986), Germany

(Geissler 1987), Great Britain (Mowlem 1988), Greece (Hatzimina *et al.* 1982; Katsaounes, 1986) the Netherlands (Boogaert 1982), Norway (Nygaard 1986), and Spain (Ballester 1986). However even in these countries most people who keep dairy goats keep a few for household use; and the commercial producers, while they may have large numbers of goats in their herds, are relatively few in number.

Goats are also kept for milk production in developed countries elsewhere, such as Australia (Rayner 1985), New Zealand (Horton and Dawson 1987) and the United States of America (Haenlein 1986). They have been reported to be a significant source of milk in many developing countries as well, including Brazil (Neto and Baker 1987), India (Saini and Khan 1986), Mexico (Peraza 1986) and Thailand (Sarabol 1985).

2-3. Chemical properties of animal farming milk:

The major chemical components of milk include water, fats, proteins, carbohydrates, minerals, organic acids, enzymes and vitamins. In order to assess the quality of milk (Rodriguez et al., 2000; Simsek et al., 2000; Vavilis et al., 1997; Vander-Ja Louca *et al*., 1975gt et al., 2001). Milk is a complex fluid in which more than 100 separate chemical compounds have been found. Its major components are water, fat, lactose, *casein*, whey proteins, and minerals (or *ash*) in amounts varying with the milk of various species of animals. However, for any given species, the range of values for the constituents of milk is fairly constant (Riel, 1985; Varnum ,1994 and Singh, 1997).

2-3-1. Total solids content of milk:

Elamin (1992) reported that a total solid of goat milk was 10.9. Total solids in goat milk range from 12 to18%, while in sheep the ranged from

15 to 20% (Haeniein, 1992; Haeniein, 1993). Ghada, (2005) found that the total solids content was 12.62 in goat milk in Egypt . Mahmut, (2004) reported that the total solids of milk in shami goat in Turkey ranged between 11.3-12.9, (12.2 ±0.16). Zahraddeen (2007) reported that there was significant effect ($P<0.05$) of goat breed on the total solids it were highest in Sahel (11.67±0.11) followed by West African Dwarf (11.63±0.12) and lowest in Red Sokoto (11.30±0.09). Total solid was in range of 16.99-20.18% in buffalo milk, 11.23-14.26% in cow milk, 12.00-13.73% in goat milk and 17.94-18.53% in sheep milk (Asif and Sumaira , 2010). Nina *et al*, (2009) found that the total solids content of milk increased in stage 3 and slightly decreased in stage 2 with the progress of lactation **(**11.89± 0.22, 11.83± 0.26 and 12.75± 0.30) . Bhosale et al (2009) observed that the total solids content was significantly lowest in first (12.3) lactation which gradually increased up to fourth (13.7) lactation.

2-3-2. protein content of milk:

Proteins ranged between 3 and 4.5% in goat milk and between 5 and 6% in sheep milk (Haeniein, 1992; Haeniein, 1993). The level of proteins in goat milk was (2.90) higher than that in sheep 1.10 but is slightly lower than cow milk 3.23 (Posati and Orr I 976; IDF 1986; Saini and Gill, 199 1). A number of studies have determined the concentration of protein content in goat milk it is ranged from 2.8 % to 3.9 % (Jenness .1980 .,Ensminger and Parker,1986) . Ghada ,(2005) found that the protein content was 3.32 in goat milk in Egypt. Mahmut, (2004) found that the protein content of milk shami goat in Turkey ranged between 3.2-3.9 (3.5± 0.07). Zahraddeen (2007) reported that protein contain was

significantly (P<0.001) affected by breed was highest in Red Sokoto (3.84 ± 0.03%) followed by Sahel (3.45 ± 0.03%) and lowest in West African Dwarf (3.27 ± 0.04%). On the other hand, the crude protein content decreased with advancing lactations. The crude protein values during colostrums period, early, mid and end of lactation were 3.85 ± 0.04, 3.66 ± 0.04, 3.38 ± 0.04 and 3.20 ± 0.04% respectively. Season and parity however had no effect on milk crude protein content. Protein content was in range 4.56-6.21% in buffalo milk, 4.01-5.00% in cow milk, 3.70-4.88% in goat milk and 4.37-5.22% in sheep milk (Asif and Sumaira ,2010). Nina *et al*, (2009) found that the protein content of milk increased with the progress of lactation **(**2.98+ 0.08, 3.12+ 0.09 and 3.66+ 0.11) for three subsequent lactation stages, respectively. Bhosale *et al* (2009) observed that the protein content of goat milk significantly affected due to lactations was lowest in first (3.2) lactation and significantly increased in second (3.5), third (3.8) and fourth (4.1) lactations. Haenlein (2002) reported that the lactation period influenced the fat content of goat milk. Davies (1939) reported that protein content goat milk was3.5

2-3-3. Lactose content of milk:

The carbohydrate fraction of goat milk is lactose (Parkash and Jenness, 1968). The level of lactose in goat milk is 4.08 usually slightly higher than that in sheep 3.7 but is slightly lower than found in cow milk 4.78 (Posati and Orr I 976; IDF 1986; Saini and Gill (199 1). Lactose content of goat milk was found to be in the range from 4 % to 4.6 % (Jenness .1980 .,Mepham, 1983). Ghada (2005) found that the Lactose content was 4.27 in goat milk in Egypt. Mahmut, (2004) found that the lactose

content of milk shami goat in Turkey ranged between 2.3-4.9,(3.6± 0.08). Zahraddeen, (2007) reported that lactose content revealed breed differences (P<0.001) being highest in Red Sokoto (4.90 ± 0.03%) followed by Sahel (4.46 ± 0.04%) and lowest in West African Dwarf goats (4.29±0.004^{c} %). There was also significant (P<0.001) decrease in lactose as lactation progressed. The values of lactose content during colostrums period, early, mid and end of lactation were 5.02 ± 0.04, 4.72 ± 0.04, 4.40 ±0.04 and 4.07 ±0.04% respectively. Conversely, lactose content increased significantly (P<0.001) with increase in the parity number. In addition, there was significant (P<0.001) seasonal effect on lactose content; the values being 4.25 ± 0.03 and 4.85 ± 0.03% for dry and wet seasons respectively. Lactose content in milk found (4.56-6.21% in buffalo milk, 4.01-5.00% in cow milk, 3.70-4.88% in goat milk and 4.37-5.22% in sheep milk (Asif and Sumaira ,2010) . Nina *et al*, (2009) found that the total solids content of milk slightly decreased in stage 2, then increase again in stage 3, with the progress of lactation **(**4.42± 0.04 4.29± 0.04 4.40± 0.05). Bhosale *et al* (2009) reported that the highest percentage of lactose was observed in first lactation (4.9) whereas, decrease in second (4.7), third (4.5) and fourth (4.1) lactation. Davies (1939) reported that lactose content goat milk was 4.7.

2-3-4. Fat content of milk:

Goat's milk derives many of its most distinctive properties from its lipid fraction. The average total fat content in the goat milk is similar to that found in other ruminant species, (Mack, 1953; Haeniein, 1993). In California DHIA goat records indicate that the dairy goats on test produced milk with a 3.9% milk fat. The fatty acids in the milk fat are

arranged in the triglycerides in accordance with a pattern that appears to be universal among ruminants. The percent unsaturated fatty acids (oleic and linolenic) do not differ from the average found for cow's milk. Because of this, goat's milk does not appear to offer an advantage over cowls milk in use in diets restricting the intake of saturated fats. A major difference between the milk fat of the goat and the cow is the percentage distribution among specific short chain fatty acids. Goats have an appreciably higher proportion of capric, caprylic and caproic acids. The high amounts of these specific fatty acids are responsible for the characteristic flavor and odor associated with goat's milk (Philips and Jenness, 1965). The level of fat in goat milk was 3.80 slightly higher than that in sheep 3.67 and cow milk 3.67 (Posati and Orr I 976; IDF 1986; Saini and Gill 199 1). Fat content in milk was in the range of 6.99-8.41%in buffalo milk, 3.44-4.96% ,in cow milk, 3.16-4.73% in goat milk and 6.09-6.80% and in sheep milk(Asif and Sumaira ,2010). Ghada (2005) found that the fat content was 4.04 in goat milk in Egypt. Mahmut, (2004) found that the fat content of milk shami goat in Turkey ranged between 3.6-4.9 , (4.3± 0.12). Zahraddeen (2007) reported that the fat content was significantly ($P<0.001$) affected by all the factors (breed, stage of lactation, season and parity) investigated. Fat content was highest in West African Dwarf (5.16 $\pm$ 0.02%) followed by Sahel 4.74±0.03 and lowest in Red Sokoto (4.38 $\pm$ 0.02%). Like crude protein fat content decreased as lactation progressed. The fat contents during the colostrums period, early, mid and end of lactation were 5.35 $\pm$ 0.03, 4.97 $\pm$ 0.03, 4.62 $\pm$ 0.03 and 4.13 $\pm$ 0.03% respectively. Fat content was highest in the third parity (5.54 $\pm$ 0.03%) followed by the second parity

(4.73 ± 0.03%) and least in the first parity (4.39 ± 0.02%). Wet season had higher fat content (5.04 ± 0.02%) than the dry season (4.49 ± 0.12%). Nin *et al* a, (2009) found that the fat content of milk increased in stage 3 and decreased in stage 2 with the progress of lactation **(**3.67± 0.18, 3.38± 0.21 and 3.85± 0.24) for three subsequent lactation stages, respectively. Bhosale et al (2009) found that fat content of goat milk was lowest in first (3.5) lactation and significantly increased in second (3.7), third (4.1) and fourth (4.5) lactations. Davies (1939) reported that fat content goat milk was 4.5.

2-3-5. Ash content of milk:

Davies (1939) reported that ash content goat milk was0.8 The level of ash in goat milk is 0.79 slightly lower than that in sheep 0.90 and cow milk 0.73 (Posati and Orr I 976; IDF 1986; Saini and Gill 1991. Abdulla (1997) reported that the ash content is about 0.66 % of milk of Saanen goat breed in Sudan. while the Nubian goat in Sudan, revealed ash contents of 0.80 % and 0.84 % according to Elnaim (1997). Ghada (2005) found that the ash content was 0.83 in goat milk in Egypt. Zahraddeen (2007) reported that there was significant breed effect ($P<0.05$) on the ash highest in Sahel (1.08±0.19) followed by Red Sokoto (0.84 ±0.16) and lowest in West African Dwarf (0.70 ±0.21). Ash content in milk was in the range of 0.69-0.98% in buffalo milk, 0.40-0.80% in cow milk, 0.56-0.99% in goat milk and 0.78-0.98% in sheep milk (Asif and Sumaira ,2010). Bhosale et al (2009) observed that ash content of local goat milk significantly increased from first to fourth lactations. Highest ash content was noted on fourth (0.9) lactation and lowest on first (0.7) lactation.

2-3-6.Minerals content of milk:

Further chemical study revealed that the ash is complicated mixture , which is known to contain potassium ,sodium, calcium magnesium ,chlorine phosphorous and sulfur in relatively large amounts .small amounts of iron ,copper ,zinc , aluminum ,cobalt and iodine and traces of silicon and boron are present in milk (Clarence *et al* 1982). There are many factors that determine the concentration of minerals in milk. Coni *et al*. (1999) reported that concentration ranges of certain health-related elements in milk were closely dependent upon animal species and feeding, time of year of sample collection, environmental conditions and manufacturing processes. Of importance is the quantity of the minerals in the feed. Calcium and zinc were specially affected by the diet. Dellorto *et al*. (2000) showed that the concentration of calcium and zinc were significantly higher in milk of cows receiving diets high in both minerals. Toxic minerals in milk, such as cadmium, are as well affected by the polluted environment.

2.3.6.1. Calcium (ca) :

About 99% of ca is stored in the animal skeleton as constituent of bones and teeth (Walter ,1965). Calcium is present in the blood mostly in the plasma ,(extracellular)in three states: ionized ca (60%),bond to protein (35%), or complexes with organic acids such as citrate or with inorganic acids such as phosphates (5.7%)(Dsciza and flock ,1973). The most obvious function of ca is its action as structural component of skeleton; controlling the excitability of the nerve and muscle .moreover it is

required for normal blood coagulation (church and pond 1988). Although the upper small intestine is generally considered to be the major site for absorption of ca (Wasserman *et al* ,1984). Ca in milk exists in three forms :free or ionized ca complexed with inorganic anion and bond to casein (Margaretc and Christopherd ,1983). The average value of ca in milk of French alpine goat was 1386 mg /L, in Anglo Nubian goat was 1393 mg/l and 1493 mg/L in cross breed saanen goat (pinto *et al* .1992).the breed of goat as well as number of lactions have no effect on ca concentration in milk (pinto *et al,* 1992). The level of Ca in goat milk is 0.194 slightly higher than that in sheep 0.160 and cow milk 0.184 (Posati and Orr I 976; IDF 1986; Saini and Gill (199 1). Al-wabel (2008) reported that there were significant differences in the concentration of calcium in milk ($p<0.05$) between the four species , Sheep milk had the highest calcium (822.5),followed by goat (751.7), camel (699.3) and lowest in cow (661.0

2-3-6-2. phosphorus (P):

The skeleton contains 8%of the total body p (A .R .C ,1965).The percentage of p in the body and the proportion of total p in the skeleton increase throughout prenatal and postnatal life :as ossification of the skeleton progresses to maturity ,the p in the skeleton is present as part of hydroxyapite crystal ,while that in the soft tissue is present mostly in organic forms (Church and pond ,1988). The most obvious function of is as a component of skeleton and phospholipids which are important in lipid transport, metabolism and cell membranes structure. Moreover the average value of p in milk of British aplhine goat was 747 mg/l Anglo Nubian 821 mg/l (Walter ,1965),cross breed saanen 860 mg/l(pinto et a

1992) and in west goat African dwarf was 1180 mg /l ((Walter ,1965). The level of p in goat milk is 0.270 slightly higher than that in sheep 0.145 and cow milk 0.235 (Posati and Orr I 976; IDF 1986; Saini and Gill (199 1).

2-3-6-3. Iron (Fe):

There was no significant difference in the iron content of goat and human milk. Both minerals are vital in1.07 ,1.30 the component of blood hemoglobin required for oxygen transportation and enzymes system (NRC, 1978). The high concentration of iron in goat milk suggests that the extent of iron binding may be a profitable study. Al-wabel (2008) reported that The lowest concentration of iron in milk was recorded for goats(3.0) compared to cow (4.2) , sheep (5.0) and camels (5.0)

2-3-6-4. Sodium (Na):

The sodium content of goat milk was210.41 higher that of cow 51.92 (Jenness, 1978). The low content of sodium in milk also agreed with the report of Desjeux (1993). The variation is due probably to the breed (Rook, 1961), period of lactation and dietary content (Dawes, 1965). NRC (1978) reported that goat may consume excess of their sodium requirement if provided as free choice. However, the sodium content reported here was lower than 0.63g/kg milk reported by ARC (1965). The low content of sodium in cow milk has been recognized more recently (Gorban, 1997) while the high content of sodium in goat milk confirmed the report of ICAR (1981) that goats secrete a good amount of sodium ion in milk. The salt often helps to tone up the system and may even have some effect in removing worms from the body. Al-wabel (2008) reported that there were significant differences in the

concentration of Na in milk ($p<0.05$) between the four species , camel milk had the highest Na(115.9),followed by goat (101.3), Sheep (95.4) and lowest in cow (91.6) .

2-3-6-5. Potassium:

The Potassium content of goat milk was 0.25 1,0.56 higher than cow milk but similar to that of human milk. Again, the level of potassium can be affected by seasonal heat and water intake (Yagil *et al*., 1980). Al-wabel (2008) reported that there were significant differences in the concentration of K in milk ($p<0.05$) between the four species , camel milk had the highest K(133.8),followed by Sheep (127.4), goat (123.9) and lowest in cow (113.7)

2-3-6-6. Copper:

Goat milk has higher content of copper compared to that of human beings and cow milk but similar to those reported elsewhere (Sawaya *et al*., 1984 and Elamin and Wilcox, 1992). The naturally occurring copper is associated predominantly with the fat phase of the milk (Barestova *et al.,* 1967). Al-wabel (2008) reported that cow (1.8) and camels (1.6) had significantly higher concentration of Cu in milk compared sheep(0.62) and goats(0.57)

2-3-6-7. Zinc:

Zinc ranged between 0.11 and 0.80 contents of goat milk were found to be lower but adequate for human infant (Jenness, 1980). In most species, including human being (Vaughan *et al*., 1979; Cassey *et al.,* 1989) zinc concentration falls as lactation advances. This could probably be due to depletion of maternal zinc stored. Al-wabel (2008) reported that Sheep

milk had the highest Zn(3.1),followed by goat (2.3),cow (2.0) and lowest in camel (1.5)

2-3-6-8. Manganese:

Manganese range between 1.59 and 3.29 contents of goat milk were found to be lower but adequate for human infant (Jenness, 1980). Al-wabel (2008) reported that cow (1.3), goats(1.3) and camels (1.3) had significantly higher concentration of Manganese in milk compared sheep(1.2)

2-4. Physical properties of goat's milk:

physicochemical characteristics of goat's milk (pH, Specific gravity, titratble acidity, freezing point, viscosity, Electrical conductivity and refractive index) which can be of great importance in the fields of dairy and food technology, nutrition science, and food analysis, respectively (Imran *et al* ,2008).

2-4-1. pH:

pH of milk values were in the range of 6.53-7.00 in buffalo milk, 6.59-6.67 in cow milk, 6.48-6.64 in goat milk and 6.55-6.68 in sheep milk (Asif and Sumaira ,2010). Zahraddeen (2007) reported that pH of milk were not significantly influenced by breed, highest in Red Sokoto (6.32±0.08) followed by West African Dwarf (6.21±0.10) and lowest in Sahel (6.21±0.09). Bhosale et al (2009) observed that the pH content of local goat milk decreased from frist(6.5) to fourth(6.3) lactation. It was observed that the pH content of local goat milk was significantly affected due to lactation. Fandialan and Davide (2001) reported that the lactation period influenced the titratable acidity in goat's milk. pH value of goat

milk ranges from 6.5 to 6.9 as against 6.6 and 6.8 in case of cow milk(Syed and Henna,2010)

2-4-2. Specific gravity:

Specific gravity of milk was found in range of 1.030-1.035 in buffalo milk, 1.027-1.031 in cow milk, 1.028-1.032 in goat milk and 1.032-1.037 in sheep milk. Bhosale et al (2009) found that specific gravity of goat milk was lowest in first(1.025) lactation and significantly increased in second(1.027), third (1.028) and fourth(1.029) lactations. Arguello et al. (1998) reported that the lactation period influenced the specific gravity of goat milk. The specific gravity of cow and goat milk is similar was from 1.023 to 1.030 (Syed and Henna,2010). Nina *et al*, (2009) found that the density content of milk slightly increase in stage 3, with the progress of lactation **(**1.025.9± 0.52 1.025.7± 0.62 1.029.8± 0.71)

2-4-3. Titratable acidity:

The values of titratble acidity ranged 0.17-0.26% in buffalo milk, 0.14-0.19% in cow milk, 0.14-0.18% in goat milk and 0.21-0.26% in sheep milk (Asif and Sumaira,2010). Mahmut, (2004) found that the Titratable acidity content of milk shami goat in Turkey ranged between 0.14-0.21 (0.17± 0.007). Nina, (2009) found that the acidity content of milk slightly decreased in stage 2, then increase again in stage 3, with the progress of lactation **(**6.10± 0.55 5.88± 0.66 7.44± 0.7). Bhosale et al (2009) observed that the titratable acidity of goat milk significantly increased from first (0.122) to fourth (0.151) lactations. It was also noted that the lactations had significant effect on titratable acidity content of local goat milk. Fandialan and Davide (2001) reported that the lactation period influenced the titratable acidity in goat's milk. Titrable acidity (expressed

as percentage of lactic acid) is also similar to that of cow'smilk and ranges from 0.11 to 0.18(Syed and Henna,2010)

2-4-4. Freezing point:

The freezing point indicates the temperature at which the milk freezes, this indicator being conditioned by the osmotic pressure of milk, the molecule and ions concentration, especially the whey content of lactose and chloride. The freezing point decreases when cattle present mastitis, when mineral salts are added to milk and the cases in which milk suffers adulteration by adding water. This is the main reason that this parameter was introduced in quality standards for milk (**Yongue,** 2004). Milk has a fairly constant freezing point. On that basis .In the dairy industry and regulatory officials have been using the freezing point of milk to determine the possible presence of added water in milk (Henningson, 1969; Marshal1, 1992). Packard and Ginn ,1990 . Packard and Ginn (1991) reported that freezing point was also an effective gauge of normality o f milk component inter-relationship and levels. Generally, the freezing point of milk is considered a "physiological constant" but there are a number of factors t hat affect the freezing point of individual samples. Several researchers (Freeman, 1972; Unger, 1984) have reported that milk from Holsteins has a higher freezing point than milk from Jerseys. Jalil (1973) pointed out that jersey milk has a higher bound water content which relates to the lower freezing point. Vander, *et a1*, (1984) reported that the freezing point of milk gradually decreased throughout the lactation, while Vander (1980) indicated that there relative contributions of lactose, chloride and phosphates to freezing point depression were constant throughout the whole lactation Freezing

point of milk may also Several researchers (Mitchel1,1986; Packard,1990 ;Zee,1982) have reported that seasonal variations with freezing point were higher in the summer than in winter. Park *et al*. (2007) reported the freezing point for goat milk to range between-0.540 and -0.570°C, while Nina, (2009) found that the freezing point occurred much lower, and amounted to -0.609°C, -0.596°C and-0.625°C for three subsequent lactation stages, respectively

2-4-5. Viscosity:

Bhosale et al (2009) observed that the viscosity was significantly increased from first (1.660) to fourth (1.863) lactations. The highest viscosity was noted in fourth lactation and lowest in first lactation. Davide *et al*, (2001) reported that viscosity of goat milk significant by affected due to lactation. Viscosity at 27°C was marginally lower than that of cow's milk at 13.4mP (Syed and Henna, 2010)

2-4-6. Electrical conductivity:

range of all the milk samples was from (6.55±1.56) ms to (11.0±2.10) mS. In animal milk samples, minimum conductivity was recorded for the buffalo milk [(6.55±1.56) mS], followed by the cow milk [(9.20±1.95) mS] and the highest was measured for the goat milk [(10.8±2.07) mS]. Among the liquid-packed milk samples, the lowest conductivity was found for Dairy Queen milk [(8.20±1.75) mS] and the highest was for the Haleeb milk [(11.0±2.10) mS]. The conductivity of the milk sample is mainly due to the presence of various electrolytes. The variation in conductivity may be due to the different levels of the electrolytes present in the milk samples (Riel, R. 1985; Varnum ,1994; R; Singh, 1997).

2-4-7. The refractive index :

A physical property of a substance that relates to how light is refracted from the material. Usually used to indirectly measure some other property such as concentration. The refraction of light by a solution is a function of the molecular concentration of the solute in solution. Each solute maintains its own refractivity, and the *refractive index* of a mixture is that of the total of the refractive indices of the substances plus that of the solvent. The components of milk contributing to its refractive index in descending order of importance are water, proteins, lactose, and minor constituents. Whey proteins are more important than casein. The refractive index of milk at 20°C is 1.3440–1.3485(Riel, R. 1985; Varnum ,1994; R; Singh, 1997).

2- 5. Vitamins:

Goat and milk supplies adequate amounts of vitamin A, thiamine, riboflavin and pantothenic acid, but it is deficient in vitamins C and D, cyanic balamine and folic acid and maybe deficient in pyridoxine (Jenness, 1980). Several cases of anaemia attributed to goat milk diets were reported to have been cured by the patients being given folic acid (Jenness, 1980)

2- 6. The enzymes:

Each enzyme has a specific site of action on its target molecule, and optimal conditions (pH and temperature). There are a large number of enzymes in milk and the functions of many are not well-defined. It should be noted that the enzymes in milk do not make a major contribution to the digestion of milk in humans, which is accomplished by enzymes in the human stomach and small intestine. The major lipase in milk is lipoprotein lipase. It is associated with the casein micelle.

Agitation during processing may bring the lipase into contact with the milk fat resulting in fat degradation and off-flavors. Pasteurization will inactivate the lipase in milk and increase shelf life. Proteases are enzymes that degrade proteins. The major protease in milk is plasma. Some proteases are inactivated by heat and some are not. Protein degradation can be undesirable and result in bitter off-flavors, or it may provide a desirable texture to cheese during ripening. Proteases are important in cheese manufacture, and a considerable amount of information is available in the cheese literature. Alkaline phosphates is a heat sensitive enzyme in milk that is used as indicator of pasteurization. If milk is properly pasteurized, alkaline phosphatase is inactivated. Lactoperoxidase is one of the most heat-stable enzymes found in milk. Lactoperoxidase, when combined with hydrogen peroxide and thiocyanate, has antibacterial properties. It is suggested that the presence of lactoperoxidase in raw milk inhibits the disease causing microorganisms (pathogens) present in milk. However, since there is no hydrogen peroxide or thiocyanate present in fresh milk, these compounds would have to be added to milk in order to achieve the antibacterial benefits. Lysozyme is another enzyme that has some antibacterial activities, although the amount of lysozyme present in milk is very small (Farkye ,2003; Fox and McSweeney ,1998; Pruitt ,2003 and Whitney,1988).

CHAPTER THREE

MATERIALS AND METHODS

3-1. Experimental animals

The goats were imported to Sudan from Cyprus and kept under intensive system in the farm owned by Government farm (Zakat Chamber). The animals kept in a good condition .The flock was established as a model Damascus (Shami) Cyprus goat farm for producing milk. The study was carried from July to October 2012.

3-2. Feeding of Experimental animals:-

The feeding regime consisted of hay (Medicago Sativa) and concentrate of 250 g consist of (sorghum grain, cotton seed cake, wheat bran, salt, and vitamins) per head /day.

3-3 Milk collection:

The goats were milked by hand twice a day (morning and evening). Milk samples were taken separately from the breed groups during the morning in Sterilization labeled bottle and kept in the refrigerator at 4ºC.

3-4 Milk Analysis:

Milk samples were taken separately from the breed groups during the morning. Samples of milk were chemically and physically tested to determine the chemical composition (total solids, non-fat solids, fat, protein, lactose and ash), and physical characteristics (Specific gravity, Titratable acidity, pH, Viscosity, Electrical conductivity, refractive index and Freezing point). All this parameters were determined by using suitable method to analysis.

4-3-1. Chemical Analysis of Milk composition:

4-3-1-1. Protein: was determined according to AOAC,1995 , 1. Pipette out 10 ml samples of milk into a 50ml volumetric flask
2. Add 0.4ml saturated potassium oxalate solution and add 3 drops phenolphthalein indicator. set aside for 2 minutes.
3. Neutralize the milk by titrating with 0.1N NaOH to the endpoint (pink colour)
4. Add 2 ml of 40% formaldehyde solution disappear of pink colour.
5. Titrate again with 0.1 N NaOH to the same endpoint(pink colour) .
6.run a blank by titrating 2 ml of 40% formaldehyde solution plus 10 ml distilled water with 0.1 N NaOH (three drops of phenolphthalein)
Calculation:- %protein= (Va-Vb)×1.74
Va = volume of 0.1 N NaOH used to titrate sample after addition of formaldehyde
Vb= volume of 0.1N NaOH used to titrate blank
Va-Vb=formaldehyde value

4-3-1-2. Total solids:

Total sold content was determined according to modified method of AOAC (1990) three grams of sample were weighted into dry clean flat – bottomed aluminum dish and heated on a steam bath for 10-15 minutes, the dish was placed in an oven for 3 hours then cooling in desiccators and weight quickly. Heating and weighing were repeated until the different between the two successive weighing was less than .01 mg. The total solids content was calculated as following

$$\text{Total solids \%} = \frac{W1 \times 100}{W2}$$

Where W1 = weight of sample after drying.

W2 = Weight of sample before drying.

4-3-1-3. Solids non-fat:

Milk sample were mixed gentely 4-5 times to avoid any air enclosure in the milk .then 25 ml sample were taken in the sample – holder and put in the sample –holder into the analyzer which catalyzed in the recess position**.** The analyzer sucks the milk, makes the measurement as (fat, protein, lactose, density, S.N.F and added water). Then after the results recorded scanner returns the milk in sample –holder and the digital indicator shows the specified results.

4-3-1-5. fat:

(1) Pour the Gerber tube with 10 ml. of sulfuric acid: H_2SO_4.

(2) Suck and gently release 11 ml. of raw milk into the Gerber tube of sulfuric acid so that milk layer is formed above sulfuric acid.

(3) Add 1 ml. of amyl alcohol into the Gerber.

(4) Tightly seal the Gerber tube with a rubber plug and shake gentely for 2 minutes to digest milk with sulfuric acid.

(5) Hold and balance the Gerber in the centrifuge and rotate at 1100 rpm for 5 minutes.

(6) After rotating for 5 minutes, then immerse the Gerber in the water bath at 57 °C to 60 °C for 5 minutes. Then take the Gerber for reading percentage of milk fat by holding the Gerber in the vertical direction in order that the zero reading is at the lowest level of the fat column the.

Read the thickness of fat column from the top layer to the bottom layer to indicate the percentage of milk fat (Marshal, 1992).

4-3-1-6. Lactose:

Milk sample were mixed gentely 4-5 times to avoid any air enclosure in the milk .then 25 ml sample were taken in the sample – holder and put in the sample –holder into the analyzer in the recess position**.** The analyzer sucks the milk, makes the measuremeat as (fat, protein, lactose, density, S.N.F and added water). Then after the results recorded scanner returns the milk in sample –holder and the digital dicator indicator shows the specified results.

4-3-1-7. Ash:

The ash content was determined according to AOAC (1990). Five grams of the milk samples were weighed into asuitable crucible and evaporated on a steam both to dryness, then placed in to muffle furnace at 550 c for 3hours, cooded in adesiccotor and weighed .The ash content was calculated as following:

$$\text{Ash content \%} = \frac{W_1 - W_2}{\text{Weight of sample}} \quad 100$$

Where W_1 = Weight of sample before drying

W_2 = weight of sample after drying

4-3-1-7. Calcium content of Milk: By titration with E.D**.**T.A concentration 0.01N and the indicator is mexide 50 mg and Naoh4N.7 drops, the color change from bink to laveinder calculated as following:

$$\textbf{Ca meg/l} = \frac{N \times v \times 1000}{\text{sample of volume}} = \text{ppm}$$

Ppm= **meg/l** × total of volume(100) × sample of voulme ×100 = **ca**

100×100 × sample of volume

N=normality of E.D**.**T.A

V= volume of titrate of E.D**.**T.A

4-3-1-7. phosphorus content of Milk: by spectrophotometer in 470 n/m

Absorption:-

$Y = 8.1482X^2 + 42.865X + 0.9267 = ppm$

phosphorus = ppm × 100 × 25 × 100

1000×1000×wight of sample

4-3-1-7. Iron content of Milk:

Amounts of 200, 500, 1000, 2000 were taken from the standard bolution 10mg/l in plastic volumetric flask 10 ml , with micro pipette and were made up to the marks with HCL0.5N of solution to be smeller to the solvent of the sample (to avoid the physical interference),corresponding to 1,2,3 and 7ppm of iron respectively.

4-3-2. physical analysis:

4-3-2-1. pH:

Milk pH can be measured by using the pH meter model 3510. pH meter is an electronic device used for measuring the pH (acidity or alkalinity) of liquid thought special probes are sometimes used to measure the pH of semi-sold substances .Atypical pH meter consists of a special measuring probe (a glass electrode) connected to an electronic meter that measures and displays the reading .

4-3-2-2.Viscosity:

Viscosity measured by using-tube viscometers, a U-shaped glass tube held vertically in a controlled temperature bath. In one arm of the U is a

vertical section of precise narrow bore (the capillary). Above this is a bulb; with it is another bulb lower down on the other arm. In use, liquid is drawn into the upper bulb by suction, then allowed to flow down through the capillary into the lower bulb. Two marks (one above and one below the upper bulb) indicate a known volume. The time taken for the level of the liquid to pass between these marks is proportional to the kinematic viscosity.

4-3-2-3.Specific gravity:

Mix the milk sample gently and pour it gently into a measuring cylinder (300-500). Let the Lactometer (float) slowly into the milk. Read and record the last Lactometer reading just above the surface of the milk. If the temperature of the milk is different from the calibration temperature (Calibration temperature may be=20 c˚) of the lactometer, calculate the temperature correction. For each c˚ above the calibration temperature add 0.5 c˚ for each c˚ below calibration temperature subtract 0.5 c˚ from the recorded lactometer reading.

4-3-2-4. Titratable acidity:

Milk acidity determined by titration method AOAC (1980) as follows: 10 ml of raw milk into the flask and add one drop of 1% phenolphthalein solution and titrate with 0.1 N of sodium hydroxide until milk turn into pink color for 30 s. Then read the amount of sodium hydroxide used in titrate for calculation of milk acidity which can be used as a decision for receiving the raw milk and for further products.

$$TA = \frac{NaOH\ (ml) \times 0.09 \times 100}{\text{Weight of sample}}$$

4-3-2-5. Refractive index:

Use a clean, paper or Styrofoam cup to collect a sample. Take a sample directly from the fluid nozzle. Mark the cup with the date, time and system name.

Let the cup sit undisturbed for several minutes. Poke a hole in the middle of the cup and use this portion as the sample for the test. It is a good practice to record the refract meter readings from any central system or sump operation.

Readings should occasionally be checked against lab tests to verify the accuracy of the refract meter, as the system ages and contaminants accumulate. Acculube has concentration control charts which list acceptable ranges for refract meter readings by product. The refract meter is a good tool, but it is important to remember that it measures the refractive index of the total solution, not the cutting fluid concentrate.

4-3-2-6. freezing point:

Freezing point can be measured by using Check temp which is a high accuracy thermometer. The stainless steel probe is perfect for fast response in liquids, air, frozen and semisolid materials. Thermostats make it possible to obtain extremely high accuracy in a very short period of time.

4-3-2-7. Electrical Conductivity:

EC Ds/m/at 25 c° determined by portable ECe meter model 410 micromoos.

3.3 Data analysis:

The SPSS statistical computer software (SPSS for windows, release 17, 2007) was used to analyze the data. Results are presented mainly in the form of descriptive tabular summaries. Chi-square (c2) or t tests were carried out as appropriate to assess the statistical significance or otherwise of particular comparisons.

Chapter Four

Results and Discussion

4 -1 Effect of different lactation periods on chemical properties of Damascus (Shami) Cyprus goats Milk:

As seen in Table (4-1), there no significant differences (P>0.01) between chemical composition (total solids, protein, lactose fat and ash)

The total solids of Damascus (Shami) Cyprus goats milk for begin, mid and end lactation production were 12 %, 11.5 and 11.3 respectively. These results were agreed with that obtained by Mahmut, (2004), (Haeniein, 1992; Haeniein, 1993) and higher than that obtained by Elamin (1992) who reported that a total solid of goat milk was 10.9. The total solids content of milk was highest in first lactation and gradually decreased from first to mid and end lactation. These results were in disagreement with Bhosale et al (2009) who reported that observed that the total solids content was significantly lowest in first (12.3) lactation which gradually increased up to fourth (13.7) lactation.

Protein of Damascus (Shami) Cyprus goats milk for begin, mid and end lactation production were 3.5 %, 3.4 and 3.2% respectively. These results were agreed with that obtained by Ghada ,(2005) who found that the protein content was 3.32 in goat milk in Egypt, Mahmut, (2004) who found that the protein content of milk Damascus (Shami) Cyprus goats in Turkey ranged between 3.2-3.9 (3.5± 0.07) ,also these results agreed with Davies (1939) who reported that protein content goat milk

was3.5 and disagreed with (Asif and Sumaira ,2010). It was observed that the protein content of goat milk significantly affected due to lactations and the average protein content gradually increased from the crude protein content decreased with advancing lactations. The crude protein values during colostrums period, early, mid and end of lactation were 3.85 $\pm$ 0.04, 3.66 $\pm$ 0.04, 3.38 $\pm$ 0.04 and 3.20 $\pm$ 0.04% respectively. Also the finding of present investigation was in agreement with Haenlein (2002).

Lactose of Damascus (Shami) Cyprus goats milk for begin, mid and end lactation production were 3.6 %, 3.4 and 3.2% respectively. These results were agreed with that obtained by Mahmut, (2004) who found that the lactose content of milk Damascus (Shami) Cyprus goats in Turkey ranged between 2.3-4.9,(3.6± 0.08),also these results agreed with Davies (1939) who reported that lactose content goat milk was 3.5 and disagreed with (Posati and Orr I 976; IDF 1986; Saini and Gill 1991 .,Jenness .1980 .,Mepham, 1983 and Jensen ,1995) .Also agreed with Ghada ,(2005) who found that the Lactose content was 4.27 in goat milk in Egypt. The highest percentage of lactose was observed in early lactation whereas, decrease in mid, and end lactation. The present findings are in agreement with Antunac et al. (2001) who studied the effect of number of lactation on changes in the chemical composition of goat milk. Higher content of lactose were determined at the beginning of lactation in comparison with middle of lactation.

Fat of Damascus (Shami) Cyprus goats milk for begin, mid and end lactation production were 4%, 4 and 4.1% respectively. These results were agreed with that obtained by Ghada (2005) who found that the fat

content was 4.04 in goat milk in Egypt, Mahmut, who (2004) found that the fat content of Damascus (Shami) Cyprus goats in Turkey ranged between 3.6-4.9 , (4.3± 0.12).,also these results agreed with Davies (1939) reported that fat content goat milk was 4.5, and higher than that obtained by (Posati and Orr I 976; IDF 1986; Saini and Gill 1991) , who reported that a fat of goat milk was 3.8 and disagreed with (Asif and Sumaira ,2010).

Ash of Damascus (Shami) Cyprus goats milk for begin, mid and end lactation production were 0.8 %, 0.75 and 0.78% respectively. These results were agreed with that obtained by Ghada ,(2005) who found that the Ash content was 3.32 in goat milk in Egypt, Mahmut, (2004) who found that the Ash content of Cyprus shami goat in Turkey ranged between 3.2-3.9 (3.5± 0.07) ,also these results agreed with Davies (1939) who reported that Ash content goat milk was3.5

Table 4- 1: Effect of different lactation periods on chemical properties of Damascus (Shami) Cyprus goats milk

(Percentage -Means ± SE)

Lactation No.	Fat %	Protein%	Lactose%	Ash%	Total solids%
Begin	$4^{a} \pm 0.0$	$3.5^{a} \pm 0.1$	$3.6^{a} \pm 0.0$	$0.8^{a} \pm 0.0$	$12^{a} \pm 0.2$
Mid	$4^{a} \pm 0.0$	$3.4^{a} \pm 0.1$	$3.4^{a} \pm 0.0$	$0.75^{a} \pm 0.0$	$11.5^{a} \pm 0.2$
End	$4.1^{a} \pm 0.0$	$3.4^{a} \pm 0.1$	$3.4^{a} \pm 0.0$	$0.78^{a} \pm 0.0$	$11.3^{a} \pm 0.2$

a,b,c means with the same letters were insignificantly ($P < 0.05$) different.

4 -2 Effect of different lactation periods on Minerals properties of Damascus (Shami) Cyprus goats Milk:

As shown in Table (4-2), there no significant differences (P>0.01) between Minerals properties (Calcium , phosphorus and Iron) of Damascus (Shami) Cyprus goats

Calcium of Damascus (Shami) Cyprus goats for begin , mid and end lactation production were 0.2%. These results were agreed with that obtained by Ghada (2005) who found that the Calcium content was 0.194 in goat milk in Egypt, Mahmut, who (2004) found that the Calcium content of milk shami goat in Turkey ranged between 3.6-4.9 , (4.3± 0.12).,also these results agreed with Davies (1939) reported that Calcium content goat milk was 4.5 and higher than that obtained by (Posati and Orr I 976; IDF 1986; Saini and Gill 1991) who reported that Calcium of goat milk was 3.8 and disagreed with (Asif and Sumaira ,2010).

Phosphorus of Damascus (Shami) Cyprus goatsfor begin, mid and end lactation production were 0.08, 0.1 and 0.1 .These results were agreed with that obtained by (Posati and Orr (I 976); IDF (1986); Saini and Gill (199 1). who found that the phosphorus content was 0.27 in goat milk in Egypt, Mahmut, who (2004) found that the phosphorus content of Cyprus shami goat in Turkey ranged between 3.6-4.9 , (4.3± 0.12).,also these results agreed with Davies (1939) reported that phosphorus content goat milk (Posati and Orr I 976; IDF 1986; Saini and Gill 199 1) (1992) who reported that phosphorus of goat milk was 3.8 and disagreed with (Asif and Sumaira ,2010).

Iron content of Cyprus shami goat for begin, mid and end lactation production were 0.383, 0.547 and 0.547 These results were agreed with that obtained by Al-wabel (2008).

Table-4- 2: Effect of different lactation periods on Minerals content of Damascus (Shami) Cyprus goats milk

(Percentage Mean ± SE)

Lactation No.	**Ca%**	**P %**	**Fe(g)**
Begin	$0.2^{a} \pm 0.0$	$0.08^{a} \pm 0.0$	$0.383^{a} \pm 0.0$
Mid	$0.2^{a} \pm 0.0$	$0.1^{a} \pm 0.0$	$0.547^{a} \pm 0.0$
End	$0.2^{a} \pm 0.0$	$0.1^{a} \pm 0.0$	$0.547^{a} \pm 0.0$

a,b,c means with the same letters were insignificantly ($P < 0.05$) different.

4 -3 Effect of different lactation periods on physical properties of Damascus (Shami) Cyprus goats milk:

There no significant differences (P>0.01) between physical characteristics (Specific gravity, titratable acidity, pH, viscosity, Electrical conductivity, refractive index and freezing point).

Specific gravity of Damascus (Shami) Cyprus goats for begin, mid and end lactation production were 1.032 %, 1.031 and 1.029% respectively. These results were agreed with that obtained by Asif (2010). Who found that the Specific gravity range between 1.028-1.032 in goat

Titratable acidity of Damascus (Shami) Cyprus goats for begin, mid and end lactation production were 0.15 %, 0.16 and 0.17% respectively. These results were agreed with that obtained by (Asif and Sumaira ,2010) who found that the Titratable acidity range between 0.14-0.18% in goat, also these results were agreed with Mahmut (2004),who found that Titratable acidity content of Cyprus shami goat in Turkey ranged between 0.14-0.21 (0.17± 0.007)

pH of Damascus (Shami) Cyprus goats for begin , mid and end lactation production were 6.6 % , 6,4 % and 6.5 % respectively. These results were agreed with that obtained by Asif (2010), who found that the pH range between 6.48-6.64% in goat and agreed with Syed and Henna (2010), who found that the pH value of goat milk ranges from 6.5 to 6.9

Viscosity of Damascus (Shami) Cyprus goats for begin, mid and end lactation production were 1.66, 1.82 and 1.86 respectively. These results were agreed with that obtained by Bhosale et al (2009), who found that the Viscosity range between 1.660 -1.863 in milk goats.

Electrical conductivity of Damascus (Shami) Cyprus goats for begin, mid and end lactation production were 0.010. These results were agreed with that obtained by Asif (2010), who found that the Electrical conductivity range between 0.14-0.18% in goat, also these results were agreed with Mahmut (2004). who found that the Electrical conductivity content of Cyprus shami goat in Turkey ranged between 0.14-0.21 (0.17± 0.007)

Refractive index of Damascus (Shami) Cyprus goats for early, mid and end lactation production were 1, 352, 1.458 and 1.458 these results were agreed with that obtained by (Asif and Sumaira ,2010) who found that the refractive index range between 0.14-0.18% in goat, also these results were agreed with Mahmut (2004),who found that refractive index content of Damascus (Shami) Cyprus goats in Turkey ranged between 0.14-0.21 (0.17± 0.007)

Freezing point of Damascus (Shami) Cyprus goats for begin , mid and end lactation production were -0.54, -0.54and -0.55these results were agreed with that obtained by (Asif and Sumaira ,2010), who found that the Freezing point range between 0.14-0.18% in goat, also these results were agreed with Mahmut (2004),who found that freezing point content of Cyprus shami goat in Turkey ranged between 0.14-0.21 (0.17± 0.007

Table 4-2: Effect of different lactation periods on physical properties of Damascus (Shami) Cyprus goats milk (Mean ± SE)

Lactation No.	Specific gravity	Titratable acidity	pH	Viscosity	Electrical conductivity	refractive index	Freezing point
Begin	1.032[a]±0.0	0.15 [a]±0.0	6.6 [a]±0.0	1.66 [a]±0.0	0.010 [a]±0.0	1.352 [a]±0.0	-0.54 [a]±0.0
Mid	1.031 [a]±0.0	0.16 [a]±0.0	6,4 [b]±0.0	1.82 [a]±0.0	0.010 [a]±0.0	1.458 [a]±0.0	-0.54 [a]±0.0
End	1.029 [a]±0.0	0.17 [a]±0.0	6.5 [c]±0.0	1.86 [a]±0.0	0.010 [a]±0.0	1.458 [a]±0.0	-0.55 [a]±0.0

a,b,c means with the same letters were insignificantly ($P < 0.05$) different.

Chapter Five

Conclusion and Recommendations

Conclusion:-

The composition and Physicochemical Characteristics of Damascus (Shami) Cyprus goats in different lactation periods in Sudanese Environment could be not significant differences ($P<0.001$) in chemical composition (total solids, non-fat solids, fat, protein, lactose and ash), minerals (Calcium, phosphorus and Iron) and physical characteristics (Specific gravity, titratable acidity, pH, viscosity, Electrical conductivity, refractive index and freezing point)

Recommendations:-

The physic- chemical properties and characteristics of Damascus (Shami) Cyprus goats could be use for dairy goat industries as well as for marketing the products .Establishment of a research center for Damascus (Shami) Cyprus goats in Khartoum state to improve local Sudanese goats, because goats play an important role in the economics of some population groups in Khartoum state.

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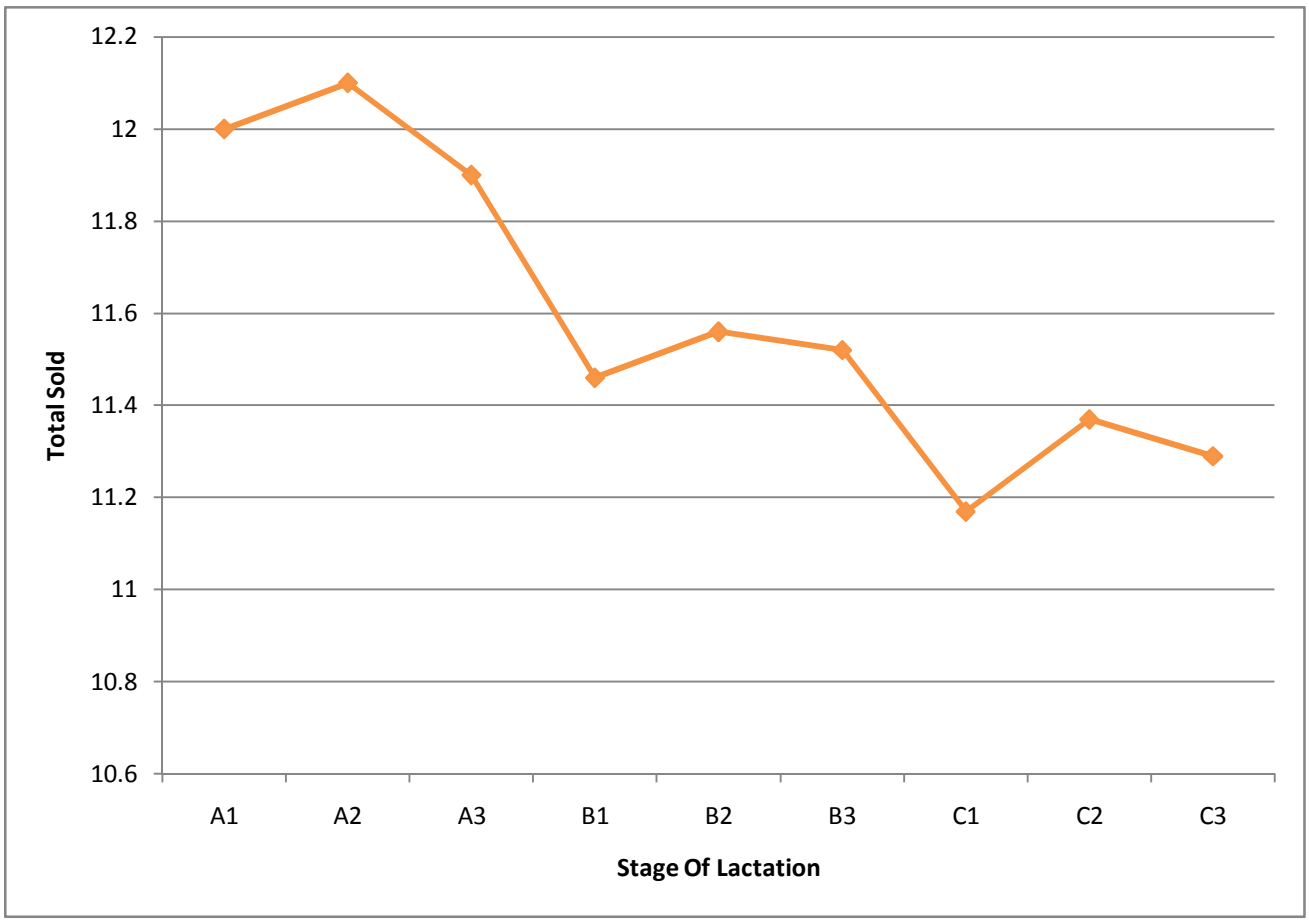
Appendixes

figure 4- 1 – 1 : Effect of different lactation periods on Total Sold content for Cyprus Shami Goat



A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

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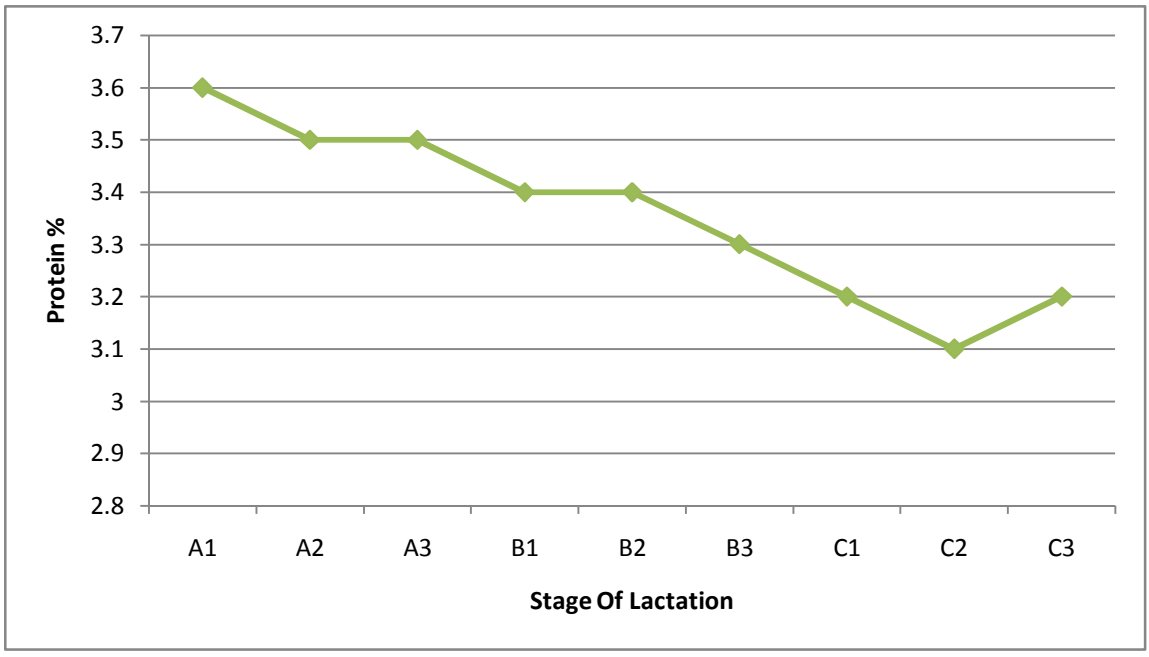
figure 4- 1 – 2 : Effect of different lactation periods on protein content for Cyprus Shami Goat

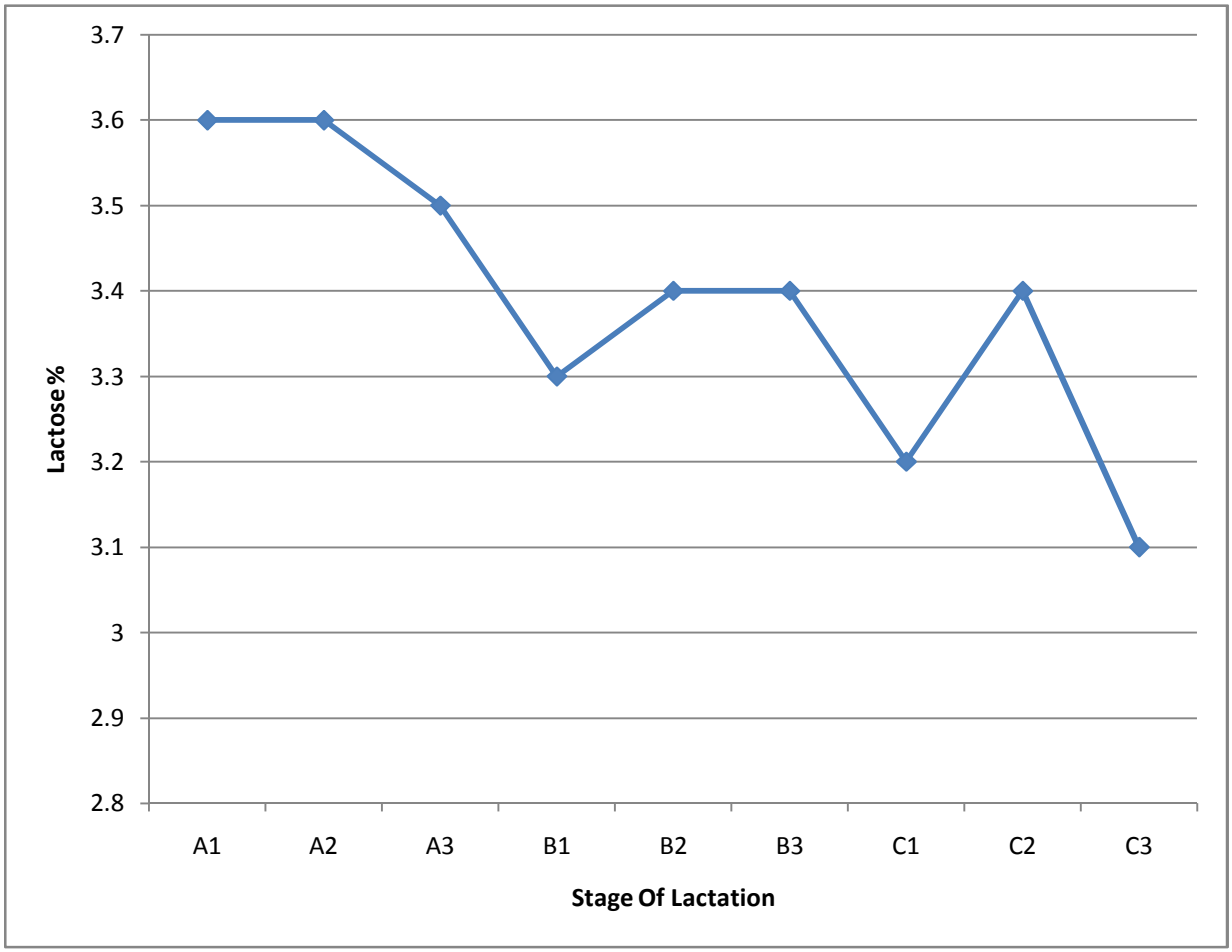


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 1 – 3 :-Effect of different lactation periods on lactose content for Cyprus Shami Goat

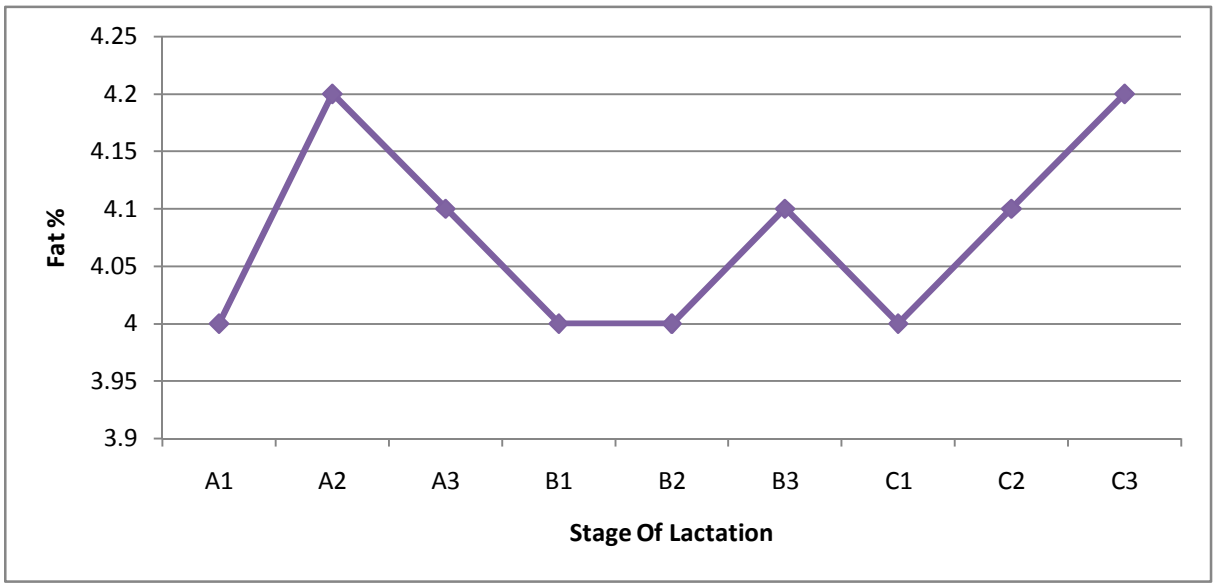


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 1 – 4 -Effect of different lactation periods on Fat content for Cyprus Shami Goat

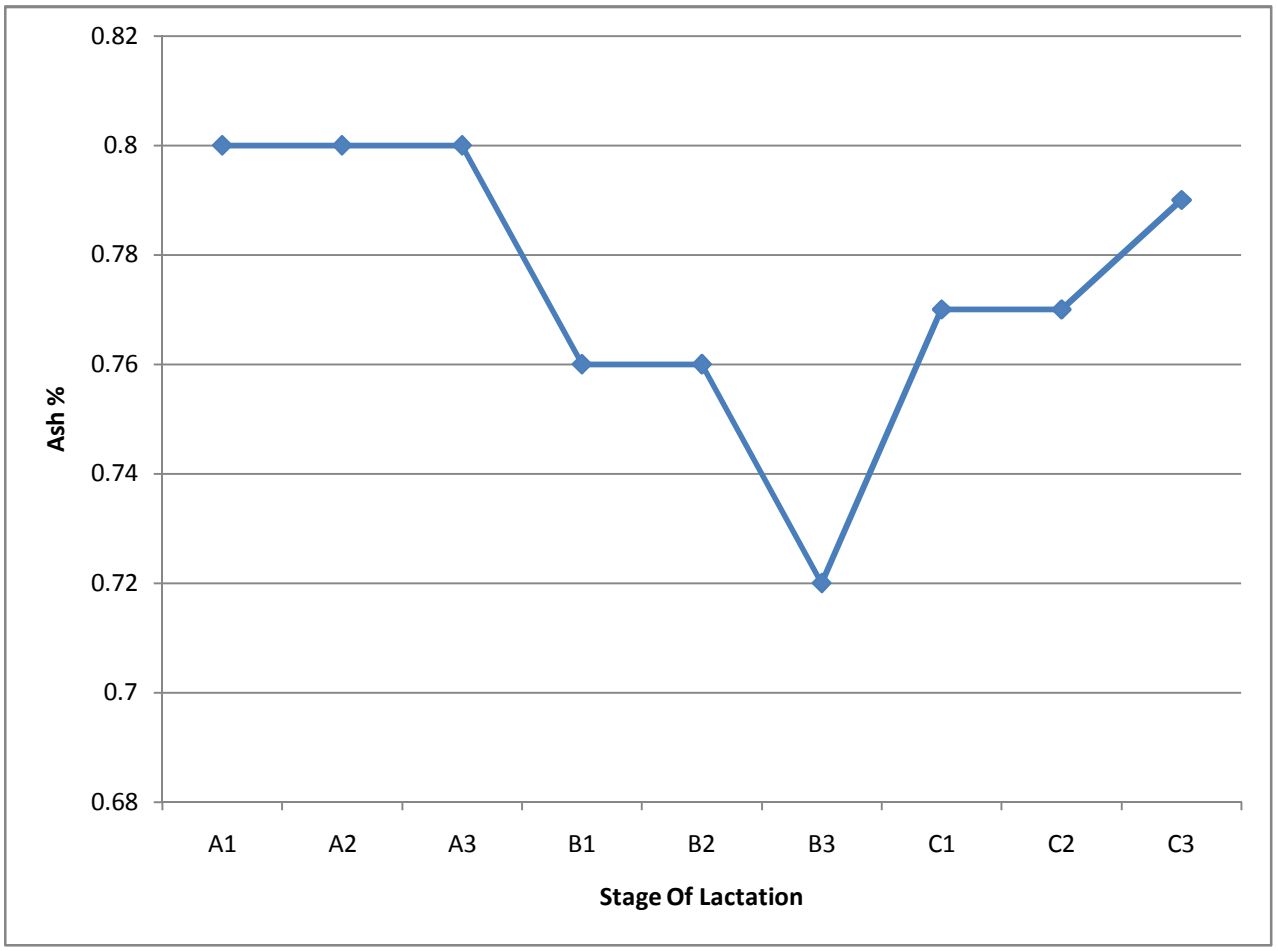


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 1 – 5 :Effect of different lactation periods on Ash content for Cyprus Shami Goat

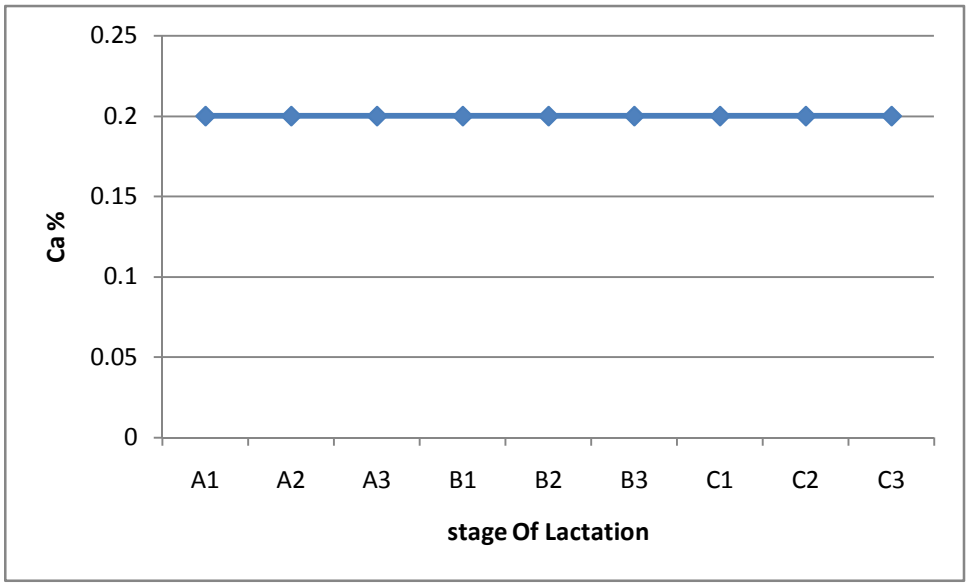


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 1 – 5 -1:Effect of different lactation periods on Ca for Cyprus Shami Goat

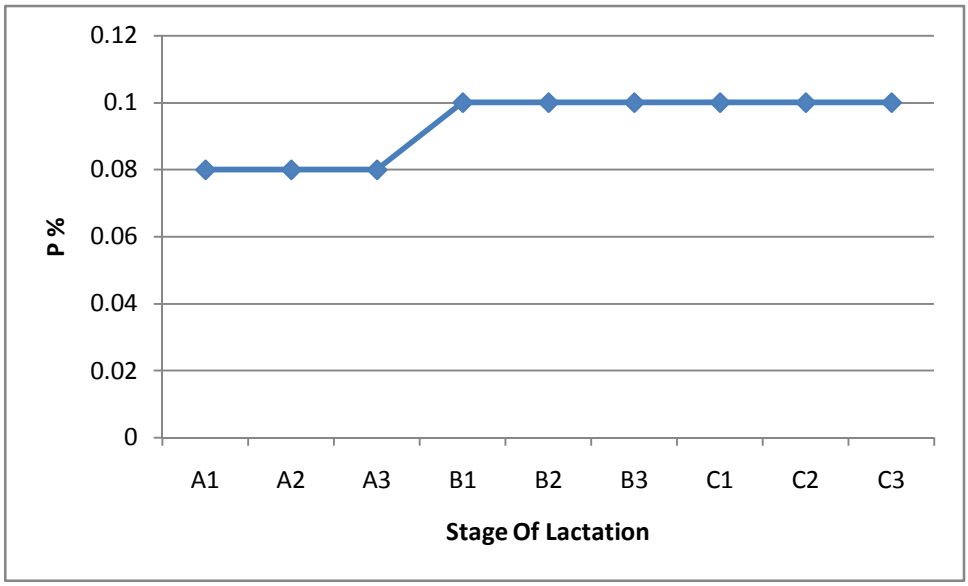


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 1 – 5 -2: Effect of different lactation periods on P for Cyprus Shami Goat

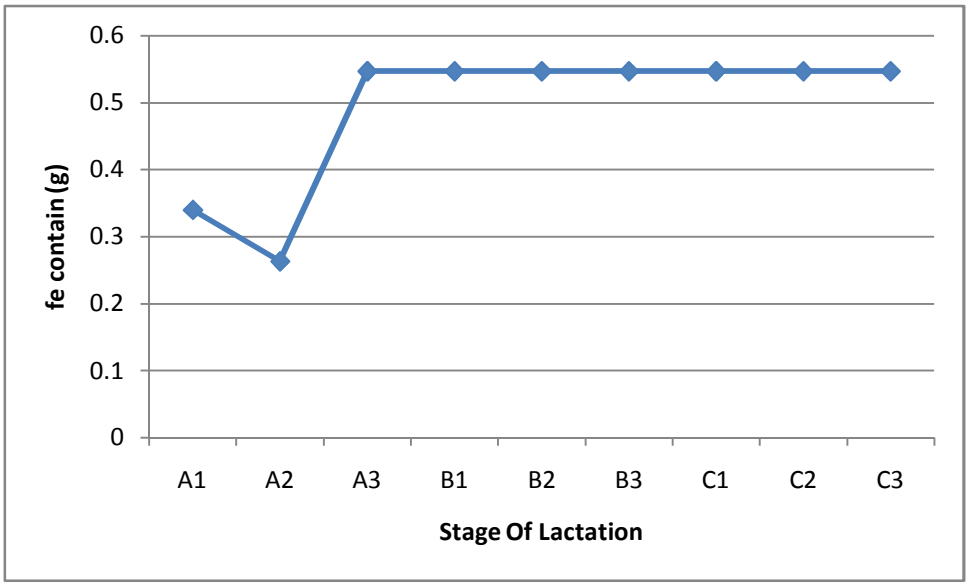


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 1 – 5 -3:Effect of different lactation periods on Fe contain for Cyprus Shami Goat

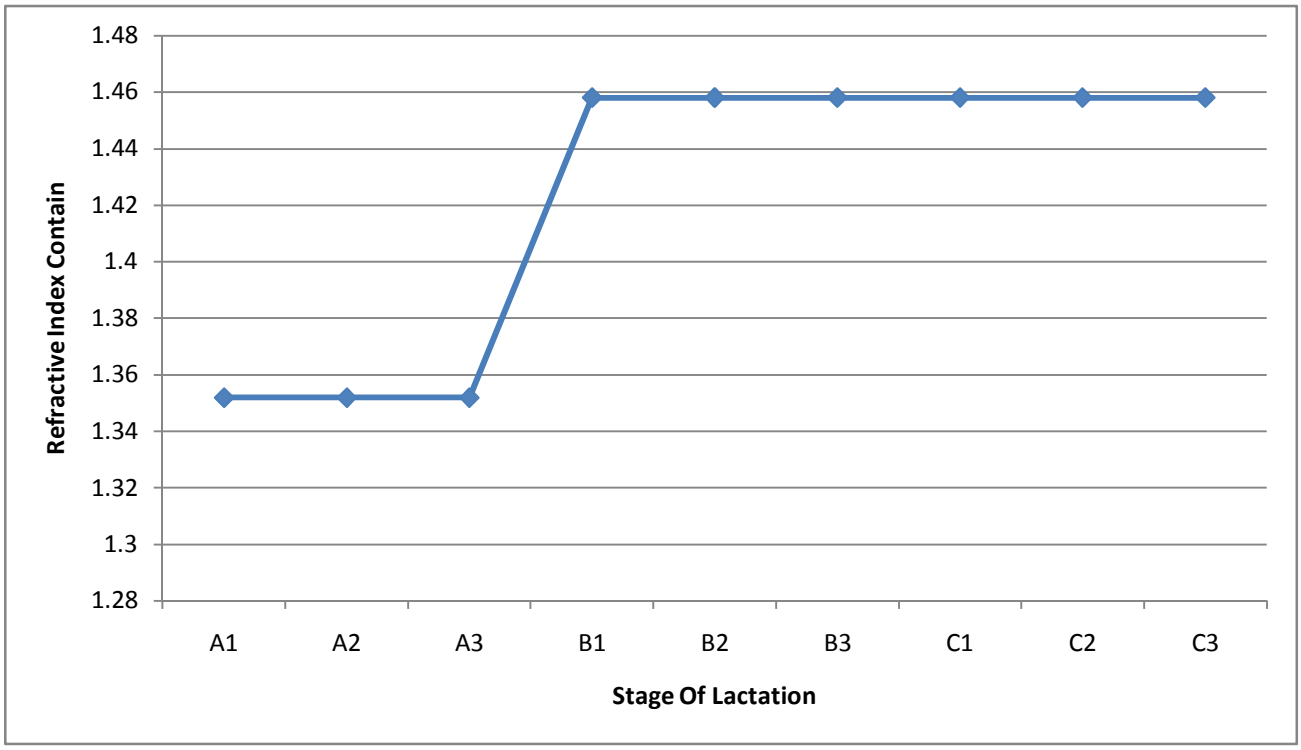


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 2 – 1:Effect of different lactation periods on refractive index for Cyprus Shami Goat

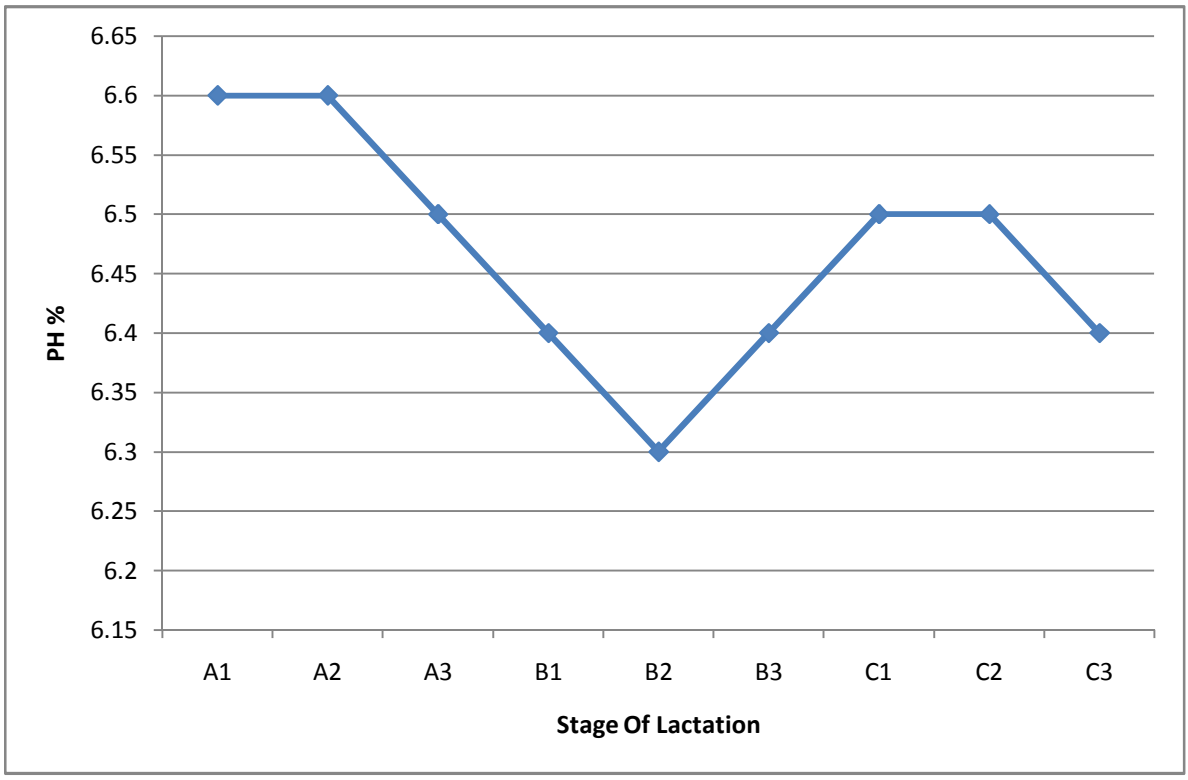


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 2 – 2:Effect of different lactation periods on pH for Cyprus Shami Goat

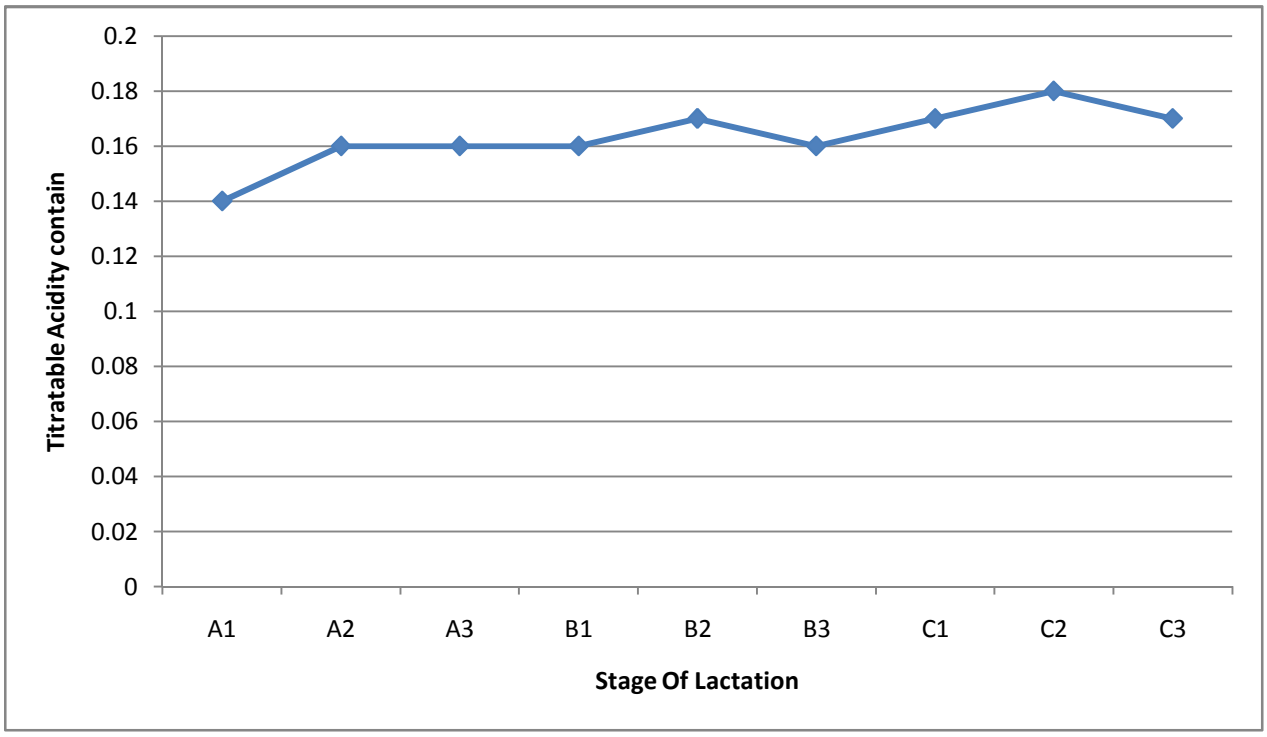


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 2 – 3 : Effect of different lactation periods on Titratable acidity for Cyprus Shami Goat

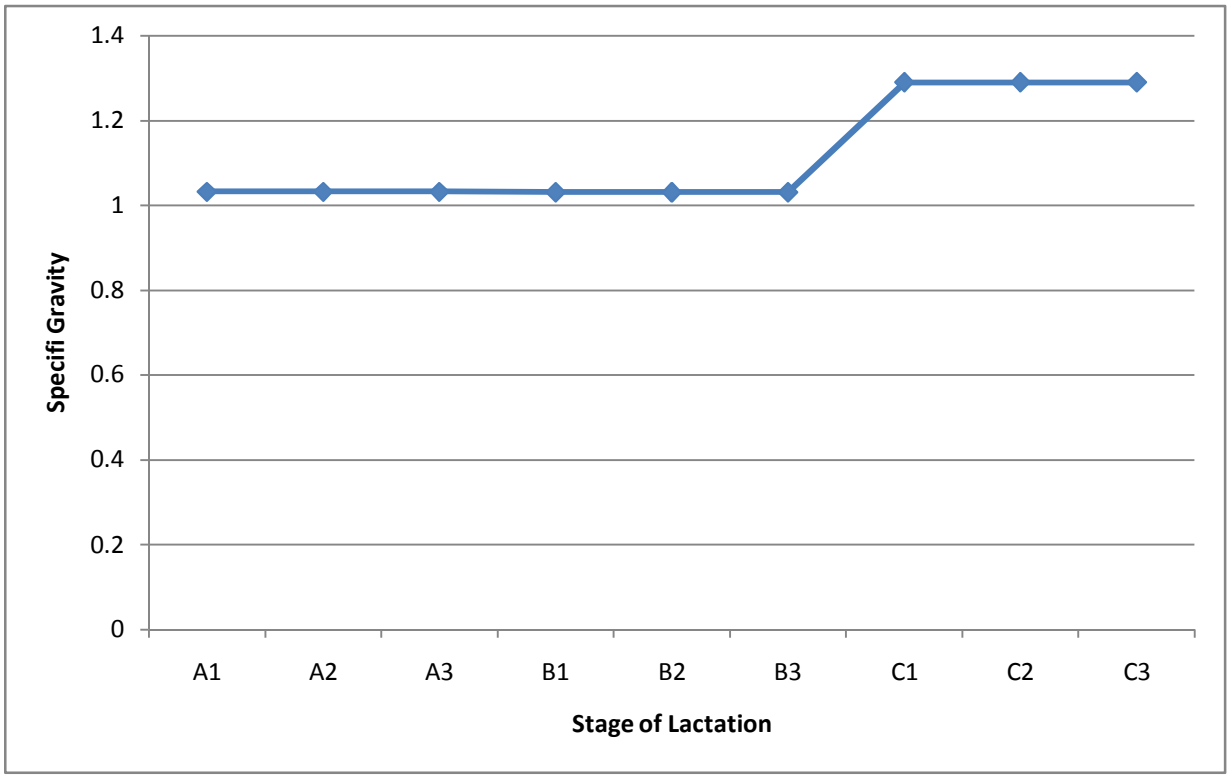


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 2 – 4 : Effect of different lactation periods on Specific Gravity for Cyprus Shami Goat

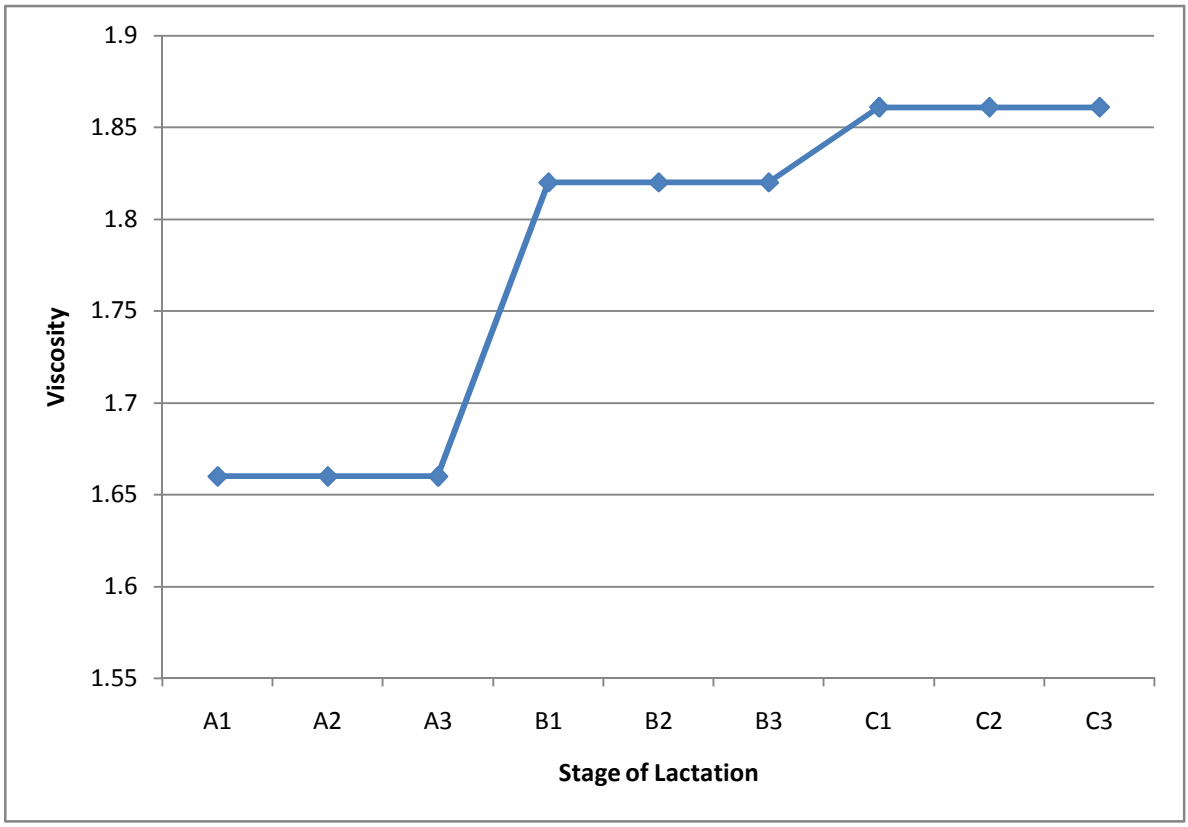


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 2 – 5 : Effect of different lactation periods on Viscosity for Cyprus Shami Goat

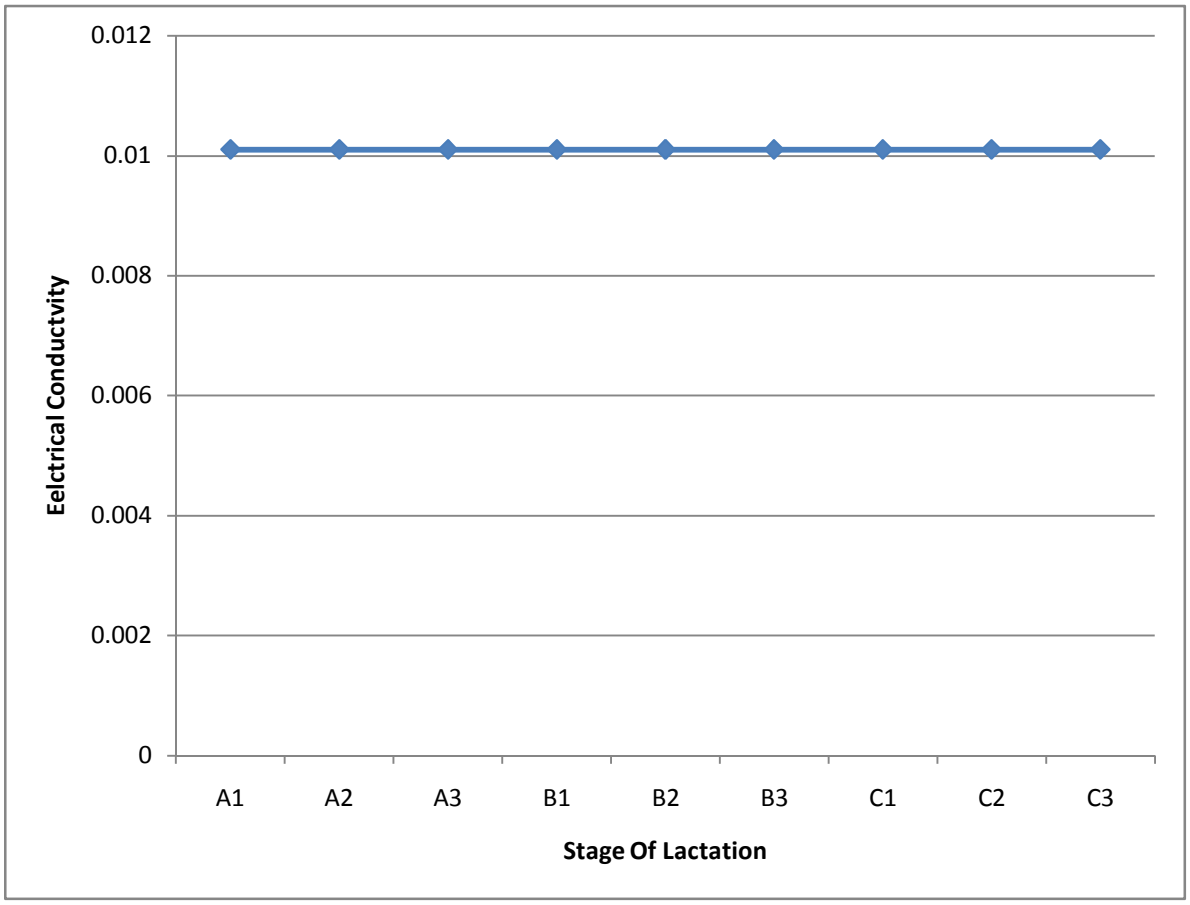


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 2 – 6 : Effect of different lactation periods on electrical conductvity for Cyprus Shami Goat

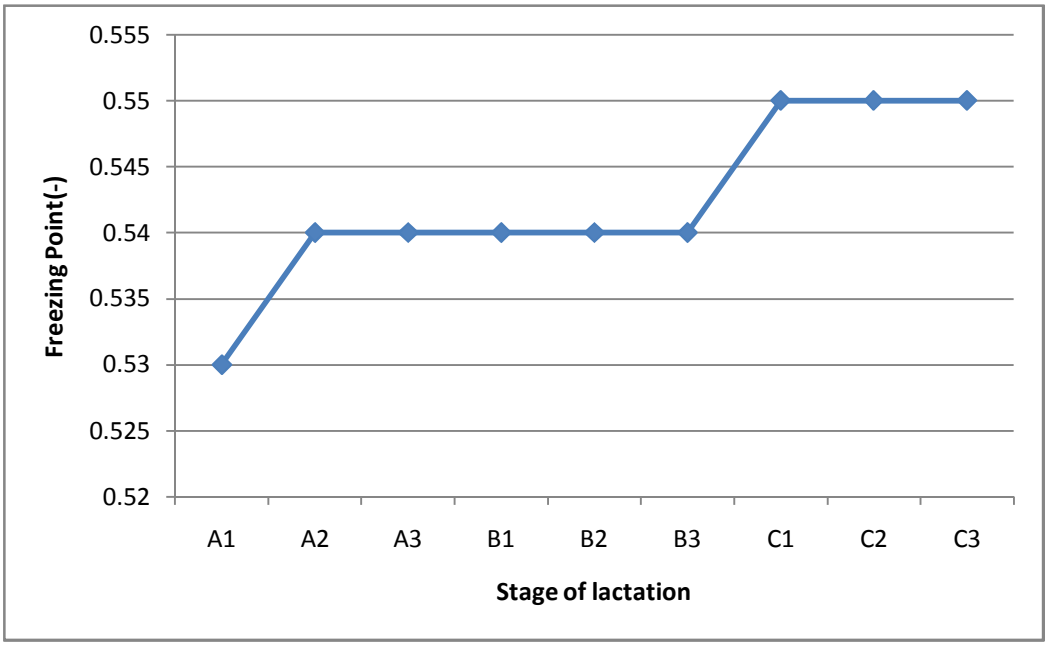


A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end

figure 4- 2 – 7 : Effect of different lactation periods on Freezing point for Cyprus Shami Goat



A1 , A2 ,A3 = Milk samples were taken separately from the breed groups during the early

B1 , B2 , B3 = Milk samples were taken separately from the breed groups during the mid

C1 , C2 . C3 = Milk samples were taken separately from the breed groups during the end