CHAPTER ONE

Introduction

CHAPTER ONE

1.1Introduction

The camel is the most important animal mentioned in Qura'an as a miracle of God. The animal population in the Sudan was estimated as 141.9 million headsof which 43.4 million heads of goats, 52.1 million heads of sheep. 41.8 million heads of cattle and 4.6 million heads of camels (MARF,2010).

Sudan has a camel population of 4.6 million heads(MARF,2010). This population is quite important while the camel production appears, at least officially very low, with a meat production 49880 tons and a milk production of 120000 tons. The camel production is far away from the potential (Fayeet al, 2011).

With a growing increase of importance of medicinal and nutritional values of camel milk worldwide, there is an urgent need to exploit potentials, as it adapted to harsh conditions.(Amasaib et al, 2013)

The actual camel milk production in Sudan is estimated to be 59,000 tons per year (MARF, 2010). But the potential of camel milk production in Sudan is estimated to be 1,700,000 tons per year. There is a huge gap between actual milk production and the expected potential (1,641,000 tons milk). This could be attributed to social, nutritional, health, labour, capital and lack of governmental policies constraints. It has been documented that camels can produce more milk and for longer period of time than any other species in harsh environment (Farah and Younas,2005). Following the dairy cattle, water buffalo, goat and sheep, camels is the 5th most important dairy animal in the world.

1.2 Objectives of the Study

1.2.1 General objective:

To determine the physical and chemical properties of camel milk in Khartoum State.

1.2.2 Specific objectives:

1) To study the the quality of camel milk produced in Khartoum State.

2) To provide basic data for future research.

CHAPTER TWO

Literature Review

CHAPTER TWO

2.1 Camels Distribution in Sudan

The one-humped camel was domesticated about 3000 B.C.E. in southern Arabia (Bullet, 1975), mainly for its meat and milk (Epstein, 1971) for the desert dwellers (Bedouins) under extremely hostile conditions of temperature and scarcity water and food. Camels are valued as riding, pack and work animals as well as providers of hair and hides (Bayoumi, 1990).

It is known that camel is the animal adapted to the arid lands in the old world, in Africa and in Asia. The camel population in the Sudan is concentrating between approximately isohyets 100 and 300 mm, constituting the "camel belt". This area includes the states of North and South-Darfur, North and South-Kordofan, Khartoum, Gezira, Kassala, Red Sea, River-Nile, Northern Sudan, White Nile, Blue Nile and Sinnar States. North Kordofan state has the highest camel population

which is more than one million heads, representing approximately 5%of the whole world camel population. However, this population is moving and a slight expansion of the camel belt to the South has been observed since a decennial similar to that seen in other countries of Sahel region (Faye 2009).

2.2. Camel breeds:

According to El-Fadil (1986), camels in the Sudan are classifiedas pack (heavy) and riding (light) types according to the function they perform and probably as a result of selection applied for these traits by the various camel-owning tribes. The Sudanese heavy type constitutes the majority of the camels kept by nomads in Sudan. In this group two types can be identified on the basis of conformation and tribal ownership: The Arabi and Rashaidi camels. On the other hand the riding camels are restricted to the north-east of the country between the Nile and Red Sea. Two main types of the riding camel are recognized, namely Anafi and Red Sea Hills (Bishari) camels. Internationally dromedary camels were classified into four major classes named beef, dairy, dual purpose and race camel (Wardeh, 2004).

2.3. Herd size and composition:

Camels Herd structure depends on environmental conditions and family requirement for milk, laborers and breeding animals (Gebrehiwet, 1998). According to Falah (2004), camel herders classify herds into small herds when the number of camels is less than 50, medium herds of 51-200 camels, and large herds of 201 camels and above.

But it is rare to find a herd over 5000 owned by one family. the average herd size owned by one family is estimated to be about 380camels in Saudia, 225 camels in Sudan, 310camels in Somalia, 10-20camels in Algeria and 80camels in India.

This generally depends on method of management, aims of raising camels.

A camel herd of 100 animals is usually composed of 34 pregnant she camels, 10 heifers of 3-4 years of age, 30 newborn 9females, 3breeding males, 20 males for fattening and 3castrated male camels for packing and riding.

A study in the Eastern States of the Sudan (Sakr and Majid, 1998) revealed that the herd size average was about 192heads per herd of which

38%were males, and 62%were females. Sabiel (1999) studied the Kababish camel type and he found that the average herd structure was 41%mature females, 31%males and only 5%stud bulls for natural mating.

2.4. Camel housing:

According to Falah (2004), good husbandry is required to sustain and improve the health and well-being of the animal. This practice includes proper housing instable designed for all age groups of the herd to provide protection from extreme heat, cold and widely weather as well as rain. Camels should be granted good environmental and climatic conditions and adequate accommodation.

Drinking water is arranged in the corners with sufficient numbers. Sufficient feed and water should be offered in a regular practice. Payne and Wilson (1999) added that for camel farms in urban a special accommodation for camels is to be designed. The type of the accommodation depends upon the use of camel.

Adequate space for each camel is essential to avoid over-crowding, the floors should allow the animal to move, lie dawn and rise easily, and the shed must be high enough. Falah (2004) noted that economic fencing should be established for extensive and intensive holding. Steel stakes are recommended since they are easy to transport and install.

Generally1.2meter high fence is enough to keep camels inside the stall.

2.5 Feed Intake:

Camels are known to consume a much wider variety of plants than other domestic animals. They feed by picking up a leaf or two from one plant and moving to the next. This grazing behavior is hailed by the conservation because it reduces destruction of the environment. They can also be fed concentrate and pasture crops (Falah.2004).

Camel can browse different varieties of forages. It can efficiently utilize poor quality forage with higher crude fiber than any other herbivor does. This is done by increasing the retention time of the fiber in the fore stomach for as long as 74hours.

On the other hand, if it is fed on low protein forages it can recycle and utilize its11body urea for microbial protein synthesis much more efficiently than the true ruminant (Schwartz and Dioli 1992). As the dry matter intake per kg of milk produced is much less in the camel than in other milk animals, it would be a suitable species to be used even on marginal and poor grazing lands. According to some reports, the camel needs only 1.9 kg of dry matter to produce 1L of milk, compared with 9.1 kg for cows (Rollefson 2005). The camel usually consumes 25-40 kg of good fodder per day with additional grain supplement for heavy working animals (Falah, 2004), Darling (1938) confirmed the wide variety of plants consumed by the Sudanese camel and he further noted that the camel was slow in adapting to new plants, although animals used to being handled could easily be introduced to strange forages if hand fed by the owner. Ideally camels should be allowed to feed for 6-8hours a day, with a further 6hours being allowed for rumination (Williamson and Payne, 1978; Matharu, 1966).

2.6. Watering of Camels:

The sources of drinking water of the camel are varied. Usually animals are watered from wells dug and maintained by the herders. In desert areas during the rainy season, animals may be watered from the temporary streams, ponds or oases that develop during this time. For housed camels, piped water may occasionally be available.

Due to drinking water shortage, camel's watering frequency from once every 2 to 4 days to once every 15 days was reported by Coppocket.al (1988). Leese (1927) observed that while the large Delta camel of Egypt required water every day, the Somali camel could survive with only one drink in 4days. Mares (1959) also reported the astonishing ability of Somali camels to abstain from water, concluding that they were able to go for 30days without a drink, provided the12grazing was good.

Cole (1975) noted that the Arabian camel drank once a week in the summer, every 7to 10days in autumn and spring and every 4 to 6weeks in the winter. Falah (2004) mentioned that water intake rates per unit live-weight basis in dry season averaged from 29%for camels and goats to74%

for cattle.

2.7. Milking:

Milk let-down is induced by allowing the camel calf to suck his mother for a while and then milking by hand or machine. Sometimes the she-camels refuses to be milked or to induce milk let-down if they are not familiar with the situation or the milker (Falah, 2004).

Generally camels are milked 2 to 4 times a day (Haratly, 1980) but sometimes 6 to 7 times (Knoess, 1977). Falah (2004) reported milking times to be once before dawn or just after sunrise and again at least two hours after sun set. He added that frequencies of milking of camels depend on the customs of the tribe; some tribes milk their camels once a day. He further added that Affair tribes in Ethiopia sometimes milk their camels six times a day and at other times they may leave them the whole day without milking. This practice is expected to hinder milk production in camels.

In Kenya, Spencer (1973) reported that the Rendille tribe herders milk their camels three times in 24 hours.

Two quarters of the udder are usually milked for consumption and the other two quarters are left for maintaining the calf (Ramet, 1987and Ramet, 1994a).

William and Payne (1978) noted that for heavy milking she-camels only one quarter of the udder is left un-milked for the young during the first 3 weeks.

In Somalia, calves are prevented from suckling at pasture by ligating two or more teats depending on the strength of the calf and the milking ability of the dam (Cossins, 1971).

Zayeed et al.(1991) demonstrated that there is a great variation in udder and teat size and length in the she-camel, which may be attributed to variable factors including, camel type, lactation stage, parity number and disease.

2.8. Camel's Milk Productivity:

The milk productivity of camels in Sudan is low. Faye (2004) reported milk production between 820 and 2400 litres/ lactation for 12-18 months lactation. It is known that the farming management has a high impact on the expected productivity. With intensive management (better health care, adding concentrates in the diet, vitamin and mineral supplementation), the total milk production per lactation was 2633 liters in semi-intensive system vs. 1204 litres in traditional system (Bakheit et al. 2008).In Pakistan, Aujla et al (1998) stated that the camel lactation period ranged between 250-270 days, daily milk yield varied from 4-12 liters/day and females were milked twice a day. Mares (1954) noted that the average daily milk yield for Somali camels was 5 kg/day.

2.9. Description of Camel milk:

Camel milk is white in color and tastes sweet and salty depending on the age of the camel and the stage of production and the type of feed and the nature of drinking water and milk is called when the milk directly from the breast with hot milk, a milk that rises above the foam camels milk very hot and drink hot or cold and has foam like milk of cows and sheep, but with a fat called (Jabbujanoubminab), which is lighter than margarine and Bedouine say: that camel milk enters and does not enter it. that is , it enriches other foods that do not need them after eating.

2.10. Physical and Chemical properties of Camels Milk:

The nutritional value of camel milk exceeds the nutritional value cow and goat milk because it contains vitamin C and mineral salts such as Calcium and Sodium. It also contains a high percentage of vitamin A and a level of vitamin C in camel milk three times the milk of cows. It is found that camel milk protein contains several protein compounds, most of which are casein accounts for about 70% of total protein in camel milk. Camel milk differs from that o other mammals in its fat content. Fat pallets are very small and when left to milk or about 24 hours, the fat is distributed in the form o small grains in the milk and does not have a layer of fat as in the case of cows and the ratio of fat to solid material to 31.5% compared to buffalo 41% it is clear that fat in the milk is linked to protein and believes that camel milk easier to digest than the milk of other animals, percentage of low fat, protein breakdown and low casein. The components of camel milk are the mean reason for its difficulty in manufacturing with cow's milk and sheep (Abdel Aziz, 2006). Camel milk contains some natural inhibitors that inhibit the growth of acid bacteria, this is considered an obstacle in the manufacture of camel milk as it affects the growth of pure farms o lactic acid used as the beginning and grade of acid milk camel high the acidity increases and increase the content of acetic acid 6.5-6.7. It is similar to the level of acidity of sheep milk and when leaving the milk period, the acid increases and increases the its content of lactic acid to 0.03% after the milk to 0.14% after 6 hours of the milk and the density of the quality of milk less than the high quality of milk cows and sheep (Abdel Aziz, 2006). Also found the percentage of natural water from 84-90%, lipids average 5.4%, proteins 3%, lactose 4.71%, total solids 13.40%, Ash 0.38% density 1.03-3%.

Factors affecting the composition and bottles of camel milk:

a) Nutrition
b) Breeding
c) Age
d) Nursery period
e) Health condition
f) Condition of thirst and impotence

2.11. Medical Properties and Uses of Camel Milk:

Camel's milk is used in some parts of the world as cure for certain diseases.

Knoess (1982) mentioned that in India camel's milk had been used as a therapy fordropsy, Jaundice, problems of the spleen, tuberculosis, asthma, anaemia and piles. Wernery (2003) reported that recent data suggested that camel's milk contained medicinal properties to treat different ailments such as Auto Immune Disease,Juvenile diabetes, booster of immune system, stress, peptic ulcers and skin cancer. Yagil (1982) added that chronic hepatitis was often being treated with camel'smilk because it was found to improve liver function. Camel's milk was also given to sick elderly and very young people because it is believed to work especially wellin bone formation (Yasin and Walid, 1957).

Yagil (1982) noted that the belief among the Bedouins of the Sinai Peninsula was that an internal disease could be cured by drinking camel's milk. He also reported that the milk is believed to be of such strength and to have such health properties that all the bacteria are driven out of the body; however, this belief isonly for camels that eat certain shrubs and bushes. Benkerroum et al. (2004) found that the camel's milk and colostrum samples had bacteriostatic effect against thepathogenic strains of Escherichia coli and Listeria monocytogenes. Rania (2012)reported that in the Sudan, fermented camel's milk is used to cure LeishmaniasisorKalazar. The patient had to live on "Gariss" alone as food for a long perion after which it was claimed that he would be fully cured. Agrawel et al. (2005) mentioned the utilization of camel's milk for people with type A diabetes. Khalifa(2007) reported that camel's milk can be used for treatment of diabetes and high cholesterol patients.

CHAPTER THREE

Materials and Methods

CHAPTER THREE

3.1. Study Area:

This study was conducted during the period from 19th to 25th March,2017, in Khartoum state.

3.1.1 Geographical location

Omdurman: located between latitudes (31˚:37ˉ-32˚:36.5ˉ) and Longitudes (15˚:11.5ˉ-16˚:39.5ˉ) east, with an area of 740 square kilometers.

Khartoum: located between 6 degrees latitude north, 15 degrees latitude south, longitude 21 degrees west, and 24 degrees longitude east.

Bahri: located between latitudes (8-15) and (16-45) north, and Longitudes (31 -36) and (25-34) east, with an area of 5060 square kilometers.

3.2. Collection of samples:

Six random samples were taken from six different farms in the state.fromBahri (AlwadyAlakhdr and Shambat), Khartoum; (Soba alhila); Omdurman:(Gandahar and Alrdwan). By test tubes kept in preserved and stored in the refrigerator.

3.3 Materials :

a) Samples of camel milk.

b) LAB apparatus are:

- Burning furnace (oven) to estimate the percentage of Ash.
- Drying oven to estimate the humidity ratio.

- Ph meter to estimate acidity

- Girber tube to estimate at percentage.

- Kjeldhal device to estimate protein ration.

- Flame photometer to measure metal elements.

- Burette

- Lactometer to measure density.

- Viscometer to estimate viscosity.

3.4. Chemical Analysis:

3.4.1. Ash content determination

The sample after moisture determination in crucible were then placed in muffle furnace at 550 ˚c until ashes carbon free (3 hours) were obtained, then coded in a dessicator and weighted. The ash content was calculated using the following equation:

$$\text{Ash content } (\%) = \frac{W1}{W0} \times 100$$

Where:

W1 =weight of Ash

W0= weight of sample

3.4.2. Tirable Acidity

Acidity of the samples was determined according to AOAC(1990). Ten milliliters of each milk samples were measured in a conical flask, three drops of phenolphthalein indicator were added. Titration was carried out using 0.1 N NaoH until a faint pink color was reached. The titration figure was divided by ten get the titrable acidity of sample "expressed as % lactic acid".

3.4.3. PH-values:

The pH values were determined using PH meter "Hanna-instrument"

3.4.4. Fat determination:

Fat content was determined using Gerber method according to Bardleget al (1992), as follow: Ten ml of sulfuric acid (density 1.815gm/ml at 20°C) were poured into Gerber tubes, Then 10.94 ml of milk were added followed by addition of one ml of amyl alcohol and distilled water.The contents of the tubes were thoroughly mixed until no white particles were seen. The tubes were then centrifuged at 1100 revolutions per minutes the tubes were transferred to a water bath at65°C for 3 minutes, after which the fat content was immediately read.

3.4.5. Lactose determination:

The Lactose content was determinate using Anthrone method (Richard, 1959). One milliliter of milk pipetted in 500 ml of distilled water. the sample was mixed well. Then 0.5 ml was transferred to boiling test tubes. The samples were put in ice bath and shaken while adding ice-cold anthrone reagent (10 ml). the tubes were steppered, the contents well mixed and placed in a boiling water bath for 6 minutes. Transferred back to ice bath for 30 minutes. The optical density of coloured solution was then read at 625 nm. A blank consisting of distilled water (0.5 ml) and anthrone reagent and standard containing 100 mg/ml of lactose anthrone difference between two successive weighing was less than 0.5 mg. the total solids content was calculated from the following equation:

Total solids (%) $= \frac{W1}{W0} \times 100$

Where:

W1 =weight of sample after drying

W0= weight of sample before drying

3.4.6. Protein content:

The protein content of the samples was determined according to Kjeldahl method as described by A.O.A.C (1990). Ten milliliters of each sample were weighted and poured into a clean dry Kjeldahlflask. A tablet of $CuSo_4$ and conc. sulphuric acid (0.5 ml) were added to the flask. The mixture was then heated until a clear solution was obtained (3 hours). The flask was then removed and allowed to cool. The digested sample was poured into a volumetric flask and 100 ml with distilled water. Then 5 milliliters were taken and neutralized using 10 ml of 40% NaoH. The distillate was received in a conical flask containing 25 ml of 2% boric acid plus 3 drops o indicator (bromocresol green+ Methyl red).

The distillation was continued until the volume in the flask was 75 ml, and then the flask was removed from the distillator. The distillate was then titrated against 0.1 N Hcl until the end point(red color) was obtained protein content was calculated using the following equation:

Nitrogen (%) $= \frac{I \times (0.1) \times 20 \times 0.04}{W} \times 100$

Protein (%) = Nitrogen % × 6.38

3.4.7. Minerals determination:

3.4.7.1. Calcium and Magnesium

Calcium and magnesium were determined according to Chapman and Prah (1982). Calcium was determined by taking1 ml of the extract in the 50 ml conical flask. Twenty milliliters of distilled water were added to the extract .four drops of NaoH were added with small amount of (meroxide indicator (0.5 G) of ammonium purpurate was mixed with 100g potassium sulphate) giving a pink color. The extract was titrated against 0.01 N. EDTA(ethyl diamine tetra acetic acid) until violet color indicating the end point, was reached:

Ca content (mg/L) = $\frac{\boldsymbol{T.R \times N\ of(EDTA) \times 1000}}{\boldsymbol{ml\ taken\ for\ the\ extract}}$

Where:

T.R =Titration reading

N= normality

Calcium and magnesium together were determined by taking 1 ml of extract in 50 ml conical flask, twenty milliliters o distilled water, 10 drops of buffer (6.75 g of NH_4CL in 57 ml concentrated ammonia diluted to 100 ml with distilled water) and 3-4 drops of Erochrome black T (E.B.T) indicator (0.1 erochrome+0.9 g hydroxyl amine hydro chloride dissolved in 20 ml of about 95% ethanol) were added to the extract giving a purple color. The mixture was titrated against 0.01 N EDTA(2g/L) to a blue color indicating the end point.

Ca + Mg Content (mg/l) = $\frac{\boldsymbol{T.R \times N\ of(EDTA) \times 1000}}{\boldsymbol{ml\ taken\ for\ the\ extract}}$

Where:

T.R =Titration reading

N= normality

The magnesium content determined by subtracting the calcium content from calcium and magnesium as follows:

Mg content (mg/l) = (Ca+Mg) content (mg/l) – Ca content (mg/l)

Minerals (mg/100g) = $\frac{(\boldsymbol{Ca\ or\ Mg}\ (\boldsymbol{mg/l}))\ \times \boldsymbol{MW} \times \mathbf{50} \times \mathbf{100}}{\mathbf{1000} \times \boldsymbol{Weight\ of\ sample}}$

Where:

MW= molecular Weight

50 =volume of extract

1000 = to convert from g to mg

3.4.7.2.Sodium and Potassium:

Sodium and potassium were determined according to the A.O.A.C (1984). Using flame photometer as follows:

One milliliter of extract was taken and diluted to 50 ml with distilled water. A standard solution of Nacl was prepared by dissolving 2.54 g Nacl in one litre of distilled water, ten milliliters of solution were taken in 1 liter distilled water giving 10 mg/g concentration. Standard solution of Kcl was prepared by dissolving 1.93 g of Kcl in liter of distilled water. Then 10 ml of solution were taken and diluted with 1 liter distilled water to give 10 mg/g concentration.

The flame photometer was adjusted to zero using distilled water. The sample reading was recorded and the content on minerals (Na or K) was calculated.

Mineral content (mg/100 g) = $\frac{(con\ Na\ or\ K\ (mg/l))\ \times MW \times 50 \times 100}{1000 \times Weight\ of\ sample}$

3.4.7.3.Phosphorus content :

Analysis o phosphorus for each sample was carried according to the method suggested by chopmon and Part (1982). Two ml of mineral extract were pipette into 50 ml volumetric flask. Ten ml of ammonium molybdate and ammonium vandate reagent were mixed and diluted to volume. The density of thecolore was read normally after 30 minutes. Phosphorus was determined from a previously made standard curve calculation:

P (%) = $\frac{curve\ reading \times ash\ dilution \times 100}{oven\ dry\ weight\ of\ sample \times 10}$

CHAPTER FOUR

Results

CHAPTER FOUR

Data analysis:

Results were expressed as mean±SD. The data were statistically analyzed using the statistical program (SPSS Version 16.0). The significant differences between means were calculated by a one-way analysis of variance (ANOVA) using Duncan's multiple-range test at $P<0.05$.

Table(4.1): The chemical components of camel milk in the study area (n=6)

Components /Area	Omdurman	Bahri	Khartoum	Significance
Moiture	88.12 ±0.08	89.15±0.93	88.97±0.12	NS
Ash(%)	0.687 ±0.04	0.759 ±0.14	0.798 ±0.01	NS
Protein(%)	3.27 ±0.26	3.02 ±0.54	2.94 ±0.12	NS
PH/Temp (27.5 c̊)	4.83 ±0.26	5.68 ±0.66	5.34 ±0.19	NS
Acidty	0.42 ±0.14	0.22 ±0.16	0.26 ±0.09	NS
Total solid	11.95 ±0.38	11.10 ±0.55	11.55 ±0.05	NS
Total soluble solid	8.00 ±1.09	8.50 ±0.55	9.25 ±0.27	NS
Lactose(%)	3.20 ±1.42	2.80	2.85 ±0.27	NS
Fats(%)	4.00 ±0.70	3.55 ±1.34	3.60 ±0.14	NS
Mg^{++}	0.09 ±0.03	0.06 ±0.02	0.06 ±0.01	NS
Ca^{++}	0.09 ±0.01	0.11 ±0.04	0.11 ±0.01	NS
P^{+}	0.13 ±0.02	0.11 ±0.01	0.12 ±0.01	NS
Na^{+}	0.07 ±0.03	0.07 ±0.01	0.05 ±0.01	NS
K^{+}	0.22 ±0.04	0.15 ±0.03	0.16 ±0.01	NS

N=6

(*) =significance

NS=No significance Row

A,b,c =within the same Followed with different suppressant are significant different .

The result in table (4-1) showed that the highest moisture value was in Bahri area (89.15±0.93) %, followed byKhartoum area (88.97± 0.12)% and the lowest value registered at Omdurman area (88.12 ± 0.08) .

The highest protein value was in Omdurman area (3.27± 0.26) %, followed by Bahri area (3.02± 0.54) %, and the lowest value registered at Khartoum area (2.94± 0.12) %.

The highest fat value was in Omdurman area (4.00± 0.70) %, followed by Khartoum area (3.60± 0.14)% and the lowest value registered at Bahri area(3.55± 1.34)%.

The highest lactose value was in Omdurman area (3.20± 1.42) %, followed by Khartoum area (2.85 ±0.27) % and the lowest value registered at Bahri area

The highest total solid value was in Omdurman (11.95 ± 0.38)% , followed by Khartoum area (11.55 ±0.05)% and the lowest value registered at Bahri area (11.10± 0.55)% .

The highest soluable solid value was in Khartoum area (9.25± 0.27)%, followed by Bahri area (8.50 ±0.55)% and the lowest value registered at Omdurman area (8.00± 1.09)% .

The highest (Mg^{++}) value was in Omdurman area (0.09 ±0.03)% followed by Bahri area (0.06± 0.02)% and the lowest value registered at Khartoum area (0.06± 0.01)% .

The highest (Ca^{++}) value was in Bahri area (0.11± 0.04)% , followed by Khartoum area (0.11± 0.01)% and the lowest value registered at Omdurman (0.09± 0.03)%

The highest (p^{+}) value was in Omdurman area (0.13 ±0.02)% , then (0.12 ± 0.01)% and the lowest value registered at Bahri area (0.11± 0.01)% .

The highest (Na^{+}) value was in Omdurman area (0.07± 0.03)% , then Bahri area (0.07± 0.01)% and the lowest value registered at Khartoum area (0.05± 0.01)% .

The highest (K^{+}) value was in Omdurman area (0.22± 0.04)% , followed by Khartoum area (0.16± 0.01)% and the lowest value registered at Bahri area (0.15± 0.03)% .

Table(4.2):Physical components of camel milk in the study area:

Components /Area	Omdurman	Bahri	Khartoum	Significance
Viscosity	4.19 ±4.43	1.78 ±1.33	1.16±1.01	NS
Density	1. 02 ±0.002	1.023 ±0.008	1.03 ±0.002	NS

The result in table (4.2) showed that the highest density value was in Khartoum area (1.030± 0.002)%, followed by Bahri area (1.023± 0.008)% and the lowest value registered at Omdurman area(1.020 ±0.002) %.

The highest viscosity value was in Omdurman area (4.19 ±4.43)%, followed by Bahri area (1.78 ±1.33)% ,and the lowest value registered at Khartoum area (1.16 ±1.01)%.

CHAPTER FIVE

Discussion

CHAPTER FIVE

5.1. Discussion:

From table (4.1) the moisture content of milk samples were in the range of (89.15 ±0.93)% to (88.12 ±0.08)% , the highest mean reading registered at Bahri area, while the lowest mean value registered at Omdurman and the medium value at Khartoum. This in line with Rania (2012) who reported that the water content of camel milk was (89 ±0.27) %.

The study revealed that the ash content was in the range of (0.798 ±0.01)% to (0.687±0.04)%, the highest mean reading registered at Khartoum area, while the lowest mean value registered at Omdurman and the medium value at Bahri area. Which is lower than Rania (2012) who reported that the ash content was (0.9 ±0.02) %, this due to feeding.

Concerning Protein content it was in the range of (3.27 ±0.26)% to (2.94 ±0.12)% , the highest mean reading registered at Omdurman area, while the lowest mean value registered at Khartoum and the medium value at Bahri area. Which higher than Rania (2012) who reported that the protein content was (2.5 ±0.08)% this due to feeding .

Lactose was in the range of (3.20 ±1.42)% to (2.80)% , the highest mean reading registered at Omdurman area, while the lowest mean value registered at Bahri area, and the medium value at Khartoum area. Which lower than Rania (2012) who reported that the lactose content was (4.7 ±0.1)%.

Fat content was in the range of (4.00 ±0.70)% to (3.55 ±1.34)%, the highest mean reading registered at Omdurman area, while the lowest mean value registered at Bahri area and the medium value registered at Khartoum. Which higher than Rania

(2012) who reported that the fat content was (3 ±0.2) % this may be to feeding with concentrate.

Viscosity was in the range of (4.19 ±4.43)% to (1.16±1.01)% , the highest mean reading registered at Omdurman area, while the lowest mean value registered at Khartoum area, and the medium value registered at Bahri. Regarding the Density, it was in the range of (1.03 ± 0.002)% to (1.02 ±0.002)% , the highest mean reading registered at Khartoum area, while the lowest mean value registered at Omdurman area, and the medium value registered at Bahri.

PH value was in the range of (5.68 ±0.66)% to (4.83± 0.26)%,the highest mean reading registered at Bahri area, while the lowest mean value registered at Omdurman which is lower than (Gul et.al, 2015) who reported that the pH value was (6.2_6.5)% this may be to the storage was not proper .

Density was in range of (1.030± 0.002)% to (1.020± 0.002)% the highest mean reading registered at Khartoum area , while the lowest mean value registered at Omdurman area which is lower than (Gul et.al ,2015) who reported that the density was (1.26 _ 1.035)%

Minerals :

Ca^{++} was in the range of (0.11 ±0.01)% to(0.09 ±0.01)% , the highest mean reading registered at Khartoum area, while the lowest mean value registered at Omdurman area. The medium value registered at Bahri. Which is lower than Rania (2012) who reported that the Ca^{++} content was (0.5 ±0.08)%.

Phosphor (P^{+})value was in the range of (0.13 ±0.02)% to(0.09 ±0.01)% , the highest mean reading registered at Omdurman, while the lowest mean value registered at Bahri area, The medium value registered at Khartoum. Which is lower than Rania (2012) who reported that the p^{+} content was (0.27 ±0.02)%.

Sodium content(Na^+) was in the range of (0.07 ±0.01)% to(0.09 ±0.01)%, the highest mean reading registered at Bahri, while the lowest mean value registered at Khartoum area. The medium value registered at Omdurman.

This value was lower than Rania (2012) who reported that the Na^+ content was (0.20 ±0.02)%.

Potassium content was in the range of (0.22 ±0.04)% to(0.09 ±0.01)% , the highest mean reading registered at Omdurman, while the lowest mean value registered at Bahri area. The medium reading was at Khartoum area. Which is lower than Rania (2012) who reported that the K^+ content was (0.34 ±0.04)%.

Magnesium value (Mg^{++}) was in the range of (0.09 ±0.03)% to(0.06 ±0.01)% , the highest mean reading registered at Omdurman area, while the lowest mean value registered at Khartoum area. The medium reading was at Bahri area. Which is lower than Rania (2012) who reported that the K^+ content was (0.13 ±0.03)%.

CHAPTER SIX

Conclusion and Recommendations

CHAPTER SIX

6.1. Conclusion

Results of the study showed that the collected sample o camel milk from different area in Khartoum state (Khartoum, Omdurman, Bahri) showed no significant different in chemical and physical components of camel milk.

6.2. Recommendations:

1) Good management to be applied to dairy camel farms.
2) Study more factors that affect camel milk production.
3) Analysis for further minerals content in camel milk.
4) Analysis for more camel milk composition such as vitamins.
5) Analysis of hormones in camel milk.
6) More research must be done in further camel area

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