بسم الله الرحمن الرحيم

Sudan University of Scienceand Technology

College of Graduate Studies

Study on Composition, Properties and Sensory Evaluationof Camel Milk Marketed in Khartoum State

دراسة التركيب والخواص والتقييم الحسي للبن الأبل المسوق في ولاية الخرطوم

By: Sana AbdelguomAlhajAlsanosi

B.Sc. (Hon) in Animal Production

College of Animal Production Science and Technology 2004

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of M.Sc.In Tropical Animal Production

Supervisor:

Dr. Anas Mohamed Osman

2015


بسم الله الرحمن الرحيم

الآية

بسم الله الرحمن الرحيم

قال تعالى :

﴿أَفَلَا يَنظُرُونَ إِلَى الْإِبِلِ كَيْفَ خُلِقَتْ﴾

صدق الله العظيم

(سورة الغاشيه :17)

Dedication

To My Father…

To My Mother …

To My Brother Mohamed , Omer …

To My Sisters …

To My Husband…

To My Colleagues And Friends …

To My Supervisor …

To All Those…

I Dedicate This Work …

Acknowledgement

I would like to express my deepest thanks and sincere appreciation to my supervisor Dr. **Anas Mohamed Osman** for his supervision, assistance, continuous encouragement and valuable advices to carry out this work.

My deep thanks are extended to staff-members of chemistry laboratory of the National Research Center and diary Lab of AnimalProduction College .Sudan University.

Also thanks and appreciations are expressed to my family members, friends, colleagues who encouraged me during the study.

List of contents

Abstract

This research was conducted to study composition, properties and sensory evaluation of camel milk marketed in Khartoum state:Khartoum, Omdurman and Khartoum North areas during the period from 5/9-10/9/2014. Forty five (45) samples of camel milk were purchased from different sale points located in the above mentioned areas, 15 camel milk samples per each area. The samples were then subjected to laboratory analysis forwater,protein,fat,lactose, ash and pH- value, acidity, density and boiling point. Oreganoleptic tests forcolor,taste, smell and consistency were also performed. The results showed that the average water contents, were (87.40 $\pm$ 1.70), (87.90 $\pm$ 0.90) and (87.40 $\pm$ 1.10) % for Khartoum, Omdurman and Khartoum Northtested camel milk samples respectively. The statistical analysis indicated no significant variation were found.The results showed that the protein contents of the camel milk samples are (3.05 $\pm$ 0.45), (3.10 $\pm$ 0.30) and (2.57 $\pm$ 0.20)% for camel milk of Khartoum, Omdurman and Khartoum Northarea respectively.Significant variationswere reportedin the protein contents between (Khartoum - Omdurman) and Khartoum Northcamel milk samples.Average fat % in camel milk samples ofKhartoum, Omdurman and Khartoum North,were (3.40 $\pm$ 6.00), (4.00 $\pm$ 0.70) and (4.20 $\pm$ 0.40) area respectively.A significant variations ($P<0.05$) was noticed in the fat content within Khartoum north and Khartoum, Khartoum North – Omdurman. The highest fat percent (4.20$\pm$ 0.40) was

for Khartoum north while the lowest one (3.40± 0.06)% was for Khartoum area.The average concentration of lactose % of Khartoum, Omdurman and Khartoum Northcamel milk, (5.80 ± 1.20), (4.6 ± 1.30)and (4.80 ± 0.60) respectively. Also a significant different was detected in these samples.The average ash % obtained,were (0.40 ± 0.06), (0.5 ± 0.07) and**(0.50 ± 0.09)**forKhartoum, Omdurman and Khartoum Northcamel milk. A significant variationswere showed between ash% of Khartoum and (Omdurman - Khartoum North) camel milk samples.The pH- value of Khartoum, Omdurman and Khartoum Northcamel milk samples,were (5.70 ± 0.40), (5.90 ± 0.20) and (6.00 ± 0.20) respectively.No significant variation wereshown in these samples. The acidities as lactic acid % of Khartoum, Omdurman and Khartoum Northcamel milk samples were (0.15 ± 0.01),(0.14 ± 0.01) and (0.13 ± 0.01) respectively.Significant variationswerefound in the acidity % of the three milk samples.The densitiesofKhartoum, Omdurman and Khartoum Northcamel milk in average,were, (1.03 ± 0.01), (1.02 ± 0.01) and (1.05 ± 0.09) respectively.No significant difference was detected hereby.In this study the average boiling – points temperaturesobtained,were (100.78 ± 1.70). (100.78 ± 1.60) and (100.78 ± 1.18) C° for Khartoum, Omdurman and Khartoum Northcamel milk respectively.A significant difference was noticed between the average boiling points of (Khartoum – Omdurman) and Khartoum Northcamel milk samples.The color scores of Khartoum, Omdurman and Khartoum Northmilk were normal andshowed mean values of (6.20 ± 1.50), (7.10 ± 0.50) and (7.22 ± 0.70) respectively .Asignificant difference was also recorded in the color of the milk samples.The smell, judged as normal showed mean values of (6.10 ± 10.30) (7.30 ± 1.30), and (5.70 ± 0.90) for Khartoum, Omdurman and Khartoum Northmilks respectively.A high significant difference was noticed in this case.The camel milk of Khartoum, Omdurman and Khartoum Northwas consistent with mean values of (7.32 ± 0.70), (7.10 ± 0.50) and (7.00 ± 1.30) respectively the results indicated that significant variations were found in the smell of the camel milk samples of the three areas, the highest score for the smell (7.30±1.30) was for Omdurman while the lowest scores (5.70± 0.90) was for Khartoum north samples.The results showed that no significant

variations ($p< 0.05$) were recorded in the consistency of the camel milk samples. The consistency scores of the camel milk samples were (7.32 $\pm$ 0.50) (7.10$\pm$ 0.50) and (7.00 $\pm$ 1.30)% for Khartoum and Omdurman and Khartoum North respectively No significant difference detected. The taste of Khartoum and Omdurman tested camel milk samples were evaluated as palatable, while that of Khartoum Northless palatable.The mean values obtained were (5.50 $\pm$ 0.90), (5.10 $\pm$ 1.40) and (4.60 $\pm$ 1.70)for Khartoum, Omdurman and Khartoum Northcamel milk and no significant difference was recorded.

مستخلص البحث

أجري هذا البحث لدراسة التركيب الكيميائي، الخواص والتقييم الحسي لألبان الإبل المسوقة بولاية الخرطوم في كل من منطقة الخرطوم ، أمدرمان والخرطوم شمال. تم شراء عدد خمس وأربعين (45) عينة لبن من نقاط بيع مختلفة في المناطق أعلاه بواقع 15 عينة لكل منطقة . ومن ثم أخضعت لإختبارات تحليلية شملت الماء ، البروتين ، الدهن ، اللاكتوز والرماد . هذا بالإضافة إلي قيمة العدد الأيدروجين ، الحموضة ، الكثافة ونقطة الغليان ، كما أجريت أيضاً إختبارات حسية على اللون، الرائحة ،الطعم والتماسك (القوام) .النتائج المتحصل عليها أظهرت أن متوسط محتوى الماء في العينات المختبرة بلغ (87.40 ± 1.70) ، (87.90 ± 0.90) و (87.10 ± 1.10) % لكل من لبن إبل الخرطوم، أمدرمان والخرطوم شمال على التوالي . كما لم يرصد فرق معنوي بين متوسطات نسبة الماء %.متوسط نسبة البروتين % بلغ (3.05 ± 0.45)،(3.10 ± 0.20) و(0.202.57 ±) لعينات إبل الخرطوم وأمدرمان والخرطوم شمال على التوالي ، أظهر التحليل الإحصائي وجود فرق معنوي بين متوسطات نسبة البروتين لألبان (الخرطوم – أمدرمان) والخرطوم شمال. متوسط نسبة الدهن % المتحصل عليها لعينات إبل مناطق الخرطوم ، أمدرمان والخرطوم شمال بلغت (6.00 ± 3.40)، (4.90 ± 0.70) و (0.40 ± 4.20) على التوالي . كما تم رصد فرق معنوي بين متوسطات نسبة الدهن % لألبان (أمدرمان - بحري) مقارنة مع العينات المختبرة لألبان منطقة الخرطوم . متوسط نسبة اللاكتوز % بلغ (1.20 ± 5.80) ، (1.30 ± 4.60) و (4.80 ± 0.60) في ألبان إبل الخرطوم ، أمدرمان والخرطوم شمال على التوالي . كما تم رصد فروقات معنوية في هذه الحالة. متوسط نسبة الرماد% المتحصل عليها(0.40 ± 0.06) ،(0.02 ± 0.50) و(0.09 ± 0.50) لعينات ألبان الخرطوم ، أمدرمان والخرطوم شمال على التولي ورصد فرق معنوي بين متوسطات لبن إبل الخرطوم و(أمدرمان - الخرطوم شمال) ورصد فرق معنوي بين متوسطات لبن إبل الخرطوم و (أمدرمان - الخرطوم شمال) لنسبة الرماد %. متوسط قيمة الأس الأيدروجيني للعينات

المختبرة لألبان الخرطوم ، أمدرمات والخرطوم شمال بلغت(0.40 ± 5.70)، (5.90 ± 0.20)و (0.20 ± 6.00) على التوالي . ولم يتم رصد فرق معنوي في هذه الحالة . متوسط قيمة الحموضة مقدرة على أساس حامض اللاكتيك % بلغت (0.15 ± 0.01)،(0.14 ± 0.01) و (0.13 ± 0.01)للعينات المختبرة لألبان إبل الخرطوم ، أمدرمان والخرطوم شمال على التوالي . تم رصد فرق معنوي بين متوسطات نسبة الحموضة % لألبان إبل المناطق الثلاث.متوسط كثافة لبن إبل الخرطوم ، أمدرمان و الخرطوم شمال بلغ (1.03 ± 0.01)،(1.05 ± 0.90) على التوالي ولم يرصد يرصد فرق معنوي في هذه الحالة . متوسط نقطة الغليان (درجة مئوية) بلغ (100.78 ± 1.70) ، (100.78 ± 1.60) و (100.75 ± 1.80) م° للبن إبل منطقة الخرطوم وأمدرمان والخرطوم شمال على التوالي .أشار التحليل الإحصائي إلي وجود فرق معنوي بين متوسطات ألبان (الخرطوم – أمدرمان) مقارنة بمنطقة الخرطوم شمال لهذه الخاصية . لون إبل المناطق الثلاث كان طبيعياً وبلغ متوسط القيم المتحصل عليها(1.50 ± 6.20)،(0.50 ± 7.10)و(0.70 ± 7.22) لكل من الخرطوم ، أمدرمان والخرطوم شمال على التوالي . أيضاً تم رصد فرق معنوي في حالة اللون. القيم المتحصل عليها للرائحة والتي قيمت طبيعية بلغت (1.03 ± 6.10) ،(1.30 ± 7.30 و (0.90 ± 5.70)للبن إبل الخرطوم ، أمدرمان والخرطوم شمال على التوالي . أوضح التحليل الإحصائي وجود فرق معنوي عالي بين متوسطات قيم الرائحة .النتائج المتحصل عليها أشارت إلي تماسك لبن العينات المختبرة حيث بلغ متوسط قيم خاصية التماسك (7.32 ± 0.70)، (0.50 ± 7.10)و(1.30 ± 7.00) للخرطوم وأمدرمان والخرطوم شمال على التوالي حيث لم يشير التحليل الإحصائي إلي وجود فرق معنوي . أظهرت النتائج أن طعم لبن إبل الخرطوم وأمدرمان مستساغ بينما لبن الخرطوم شمال أقل إستساغة وبلغ متوسط القيم لهذه الخاصية (0.90 ± 5.50)، (1.90 ± 5.10)و(1.70 ± 4.60)لكل من لبن إبل الخرطوم ، أمدرمان والخرطوم شمال على التوالي ولم يتم رصد فرق معنوي في هذه الحالة .

List of Table

بسم الله الرحمن الرحيم

Chapter One

1- Introduction

The Republic of Sudan is considered at present as one of the largest population of one – humped camels (Camelus dromedarius) world – wide.The estimated camel population of Sudan is about (4.6) million heads according to Ministry of Animal Resources and Fisheries –(MARF, 2010). As given by Al- A ni (2004) , the oldest evidence of introduction to Sudan is a bronze figure of a camel with a saddle found atMeroe and estimated to date between 25- 15 B.C. The distribution areas of camels are found mainlyin the arid andsemi – arid areas of the country (El amin and Wilex, 1992).The camel is amulti- purpose animal. The production of milk by she – camels is counted as one of these purposes.Yet, this potential for milk production has been under estimated, in spiteof the increasing demand for animal protein with increasing population. The camel milk is expected to play a vital role in the prevention of protein shortage in the future, specially at times of global warming, desertsand scarcity of food and water, the camel can be part of a solution tothese problems (Wernery, 2007).

The incorporation of camel milk in the milk consumption cycle may help to a certain extent by minimizing several nutrional problems. Camel rearing for milk productionis gaining more interest now a-days in Sudan. Accordingly, intensive camel farms were established in the last few years, the main objective isto produce milk for man.It is noticed that camel milk isdistributed, marketed and accepted by increasing consumers inKhartoum State.This might be related to the fact, that

camel milk has, beside the high nutritive value, also varioushealth –benefited effects were noted.

The marketed camel milk in Khartoum State may vary in composition, properties and sensory characteristics.The current research studies also if this variation affects the nutritive value of the camel milk and of no harm for consumers.

Objectives:

The main objective of this study is :

- To study the quantitative composition, properties and sensory evaluation of marketed camel milk in Khartoum State.

Chapter Two

2. Literature Review

2.1 Camel milk composition:

Camel milk is composed of different elements including water, fat, protein, sugar, vitamins, enzymes, in addition to sodium, calcium, florine, phosphorus, potassium , manganese, zinc , sulphur, aluminum and jod. (Murad, 2000) .

The variation in the quantitative composition of camel milk is related to different factors. These, might be of genetic, physiological or environmental origin. According to Gera *et.al* (2007) , Omer (2001) Al- Ani (1997) and Mohammed and Hijrot (1993) , type and standard of pasture , season , lactation period , age , feeding conditions and water availability are the main depending factors. Knoess(1977) and Ramet (1987) also noticed seasonal climatic variation of water resources and feeding availability showed similar effects on camel milk composition. Abdelaziz (2001) pointed out that camel milk contains the following components in average : water (86.6%) ,fat (4.33%) , protein (4. 02%) , lactose (4.21%) and ash (0. 80 %) .EL Badawi (2004) gave the following values for the constituents of Sudanese camel milk : Fat (3. 01 %) protein (3. 19%) ,lactose (3. 82 %) and ash (0. 82%) . The quantitative composition of camel milk studied by Ahmed (1988) showed 11.49% total solids, 3.0 % protein 3.45% Fat , 4 .17 % lactose, 0.82 % ash and 84- 88% water.

2.1.1. Water Content:

Water is considered as the important component of camel milk.AL-ani(2004) and Omer (2001) reported the water content of camel milk was (87%) and (88. 31%) respectively. Ahmed (1988) mentioned, the camel milk composition is so similar to cow milk composition and the water content is (87. 3%) for milk of both animals.

In thirsty she – camel the water content increases from (87%) to (91 %) as noticed by Soliman*et.al* (2006). In case of water sufficiency and shortage, the content in the milk was found as (86. 6 %)and (91 %)respectively (Abdelaziz2001). Yagiland Etzion (1980) reported , when examining only the effects of the lack of drinking water on camel milk the diet remains only unchanged throughout the year , but great changes in water content of the milk are found. The water content of fodder would also affect water content of milk , and it would appear that lactating camel loses water in the milkat times of drought , which couldbe a natural adaptation in order to provide not only nutrients , but necessary fluid to the dehyderated calf.

2.1.2 Protein Content:-

The milk protein in Sudanese camel was estimated to range from(3. 3 %) to (4. 7 %) according to Dirar (1993).The concentration of protein content in camel milk was found to range from (2.5 -5.5%) (Sawaya*et.al*, 1984),(Elamin and Wilex, 1992) and (Farah . 1993) . Al–Ani(2004) gave a protein % of (3.5) in camel milk. Milk from dehydrated camel has aseverly decreased protein percentage. (Yagil and Etzion(1980).The protein percentage in camel milk decreased more especially the casein content due to the increase in heat in summer (Soliman*et.al* 2006)

According to Basmail(1997), the casein content in camel is less than that of cow milk. Also, the camel milk casein and their fractions were found to be poor in crude protein when compared with cow milk, as given by Pant and Chandra (1980),Larrson and Mohammed (1986) and Beg *et.al* . (1987), explained,that camel milk was found to contain new kind of protein factors of β -casein and extremely low calcium casein content , which probably behind the state that camel milk does not curdle readily .

2.1. 3 Fat content:

According to Grounda (1996),the concentration of fat in camel milk ranges between (2. 6 %) and (5.5%), and (1.9%) to (5.6%) according to Bayomi (1990). The variation in the fat content is associated with the type of breed, stage of lactation and feeding condition as described by Webb *et.al*. (1980).Basmail(1997) noted, the fat content in camel milk is less than in cowmilk. Cream layer formation of camel milk fat globules is very poor due to deficiency in agglutinin that causes very slow creaming rate at all temperatures as observed byFarah and Ruegg (1991).

The percentages of shortchain fatty acids is lower than long chain fatty acids and accordingly the concentration of long chain fatty acids are relatively high .Hence thephysicalcharacteristics of the triglycerides are characterized by much higher melting and crystallization points than cow's milk.(Abulehia, 1994; Farah and Ruegg 1991; Farah*et.al*. 1989).

2. 1. 4 Lactose content:

The concentration of lactose in camel milk found to range (2.4- 5.3%) as given by Elamin and Wilex (1992) and Wilson (1984).

A remarkable variation between the averages of Lactose % in different areas was noticed , e. g (5.8%) in Pakistan , (4.9 %) in India and (4.4 %) in Saudia Arabia (Abdul Raahman 1996) . The lactose content of camel milk remained unchanged from the first months up to the end of lactation (Sestuzheve, 1958). This indicated that the values did not change (Indra and Evdeneboatr ,1994) . The lactose content of camel milk in case of plentiful –drinking water was (4.6%) and in scarce –drinking water (2.9%) as noticed byYagil andEtizion, (1980).

2. 1. 5 Mineral content:

The concentration of the major mineralsin camel milk showed a wide range of variation as reported by many investigators according to Omer (2001).

Due to this variation, theash contentalso varieswidely. the ash content of camel milk was (0. 7%) , (0. 79%) , and (0. 26- 0. 64%) as given by Gaber and Naiem(2006) , Gindeel (2009) and Gihad (1995) respectively. In thirsty camels the ash content decreases to 0.35 % (Abdelaziz 2006).

However, various studies suggested the variation of minerals in camel milk is linked with genetic and environmental effects(Sawaya*et.al*. 1984).

2.1.6 Vitamin content:

Gihad (1995) explained, the camel milk contains following vitamins:Vit. C, A, D, B_1,B_2,B_{12},$B_{6,}$ and H.Camel milk contains high levels of Vit: C (Thiagarajan, 2001), the levels of VitCin camel milk are 3 times higher, when compared with

cow's milk (Abdelaziz 2001) and one and a half that of human milk (Gast*et.al*. 1969).

According to Gadry(1983),one liter of camel milk contains 0. 343 – 0. 487 ml of Vit A, 0.85ml of Vit B_1, 0. 66- 1.75 mlof Vit B_2 and 574- 79. O ml of Vit C.Basmail(1997) noticed, camel milk contains less Vit. A and H, but higher amounts of Vit C and Niacine ,compared with cow's milk.

The following tables show:

1. Chemical composition of camel milk in different parts of the world.

2. Comparison between composition of camel and Other animals milk

Table (1): Average chemical composition of camel milk in different countries:

Source	Total- solids%	Protein%	Fat%	Lactose%	Ash%
Saudi Arabia	10.1-11.4	2.4-2.9	2.5-3.2	4.4-4.5	0.76-0.81
Sudan	10-14	3.6-4.7	4.0-5.5	_	0.8-1.0
Somalia	13.70	3.00	5.40	3.30	0.70
Pakistan	13.01	3.67	2.90	5.78	0.66
Egypt	12.36	3.10	3.90	4.47	0.80
Ethiopia	14.40	4.50	5.50	3.40	0.90
India	13.06	3.76	3.08	5.43	0.73
Kenya	12.20	3.11	3.15	5.24	0.80

Source: Mehia*et.al*.(1995)

Table :(2): Comparison between camel and otheranimals milk

Species	water	T.s%	Fat%	Protein%	Lactose%	Ash%	Reference
Camel	86.6	13.36	4.33	4.02%	4.12	0.79	Mukasa-Magerwa(1981)
Cow	86.2	13.8	4.4	3.8	4.9	0.7	Ensminger (1969)
Goat	87.0	12.9	4.1	3.7	4.2	0.8	Ensminger(1969)
Ewe	82.2	18.0	6.4	5.6	4.7	0.9	Ensminger (1969)
Buffalo	83.56	16.4	6.85	4.25	5.1	0.82	Salash (1982)

2.2 Properties of camel milk

2.2.1 The pH-value and acidity:

The average pH-value of camel milk was (6.65) as given by Al-Ani(2004).According to Sawaya*et.al*.(1984), the pH ranges from 6.2 to 6.5, which agreed with that reported by Ohri and Joshi (1961). Salash(1979) also mentioned, the pH of camel milk between (6.5) and (6.7), which is similar to the pH of sheepmilk. All Inpladairy (2010) stated, the acidity of fresh camel milk and milk diluted with water (1:1) and stored at room temperature was 0.12±0.03%.Also.Sawaya.*et.al*.(1984) noticed an acidity of o.13% in camel milk. Since camel milk contains antimicrobial and protective effects compounds of protein- nature, the growth ofbacteria in milkcan be inhibited and as a result the developed acidity,this allows camel milk can be kept for longer periods compared withother milks .(Wernery, 2007, Elias, 1995).

Dukwal*et.al*.(2007), pointed out, camel milk remains quite stable at room temperature and takes a comparatively longer time to become sour.The rate of developed acidity is lowered, especially at pH (5.2), while the naturalacidity of

camelmilk is maintained for 13 days, when the milk is kept at 10 ℃ (Zaid*et.al*. 1991).

2.2.2 Specificgravity:

A wide range was observed in the specific gravity of camel milk .Khan (2014) estimated the density of camel milk to range between 1.014 – 1.017 at 20 ℃ .According to Takele(2014),the specificgravity of camel milk ranged 1. 020–1.022 at 20 ℃ . The specific gravity of camel milk is lower than that of cow, sheep or buffalo (Salash,1979).

2.2.3 Boiling point:

The boiling point of camel milk is estimated to be 100.6°c (Mehia and Alknhal , 1992) . Compared to that of cow's milk (100. 17 ℃), it is higher. The boiling point is influenced by the water content in the milk, the dissolved substances in it and the pressure under which the milk is boiled(Osman, 2007).

2.2.4 Freezing point:

The freezing point of camel milkranges between -0.57 and -0.61 ℃ according to Wangoh(1997).Salash(1982) explained , camel milk hasgreater freezing point depression (-0.576 ℃) and this might be related to the comparatively high chloride content in camel milk .

2.3 Sensorycharacteristics:

2.3.1Color:

Camel milk is generally Opaque white in colour (Basmail, 1997;Farah, 1993) . The colour tends to be slightly yellowish, when animals are fed on big lots of green fodders (Zaid*et.al*., 1991).

2.3.2Taste:

The taste of camel milk isnormally sweet,but sometimesit issalty and at times ittastes watery as noticed by Rao*et.al*(1970) and Gihad(1995). AL-Ani(2004) explained, the taste of camel milk variesduring the lactation period;at thefirst months the taste is sweet, but salty at late lactationperiod. The change in taste is caused by type of fodder and availabilityof drinking water.

2.3.3Smell:

Like other milks, camel milk has no distinctive or particular smell. But milk has high capability to absorb different smells from thesurrounding environment, specially chemicals as noticed by Zidan(2004). The smell of animal, sheds or that of certain feeds e.g. Silage, onion can also enter the milk (Osman 2007).

2.3.4Consistency:

Camel milk is generally light consistent and varies very little in texture compared to that of cow's milk (Basmil, 1997). In order to obtain high quality milk,it should be produced by healthy animals given controlled diet,the milking procedure should be carried outunder hygienic conditions with properly maintained machines and free of potential human pathogenic bacteria, antibiotics and chemical residues as suggested by Nagy*et.al.* (2007).

2.4 The nutritive value of camel milk:

According to Wernery (2003), camel milk is a rich source of protein with potential anti- microbial and protective activities,e.g.&– lacto albumin, which are absent or found in minor amounts in cattle milk .It was noticed by Basmail and Hussien (1987) and Khan(2014), that 1.8 kilogram of camel milk may provide the human body with its all protein requirements .The proteins and carbohydrates contents of camel milk were significantly higher as compared to cattle milk (Dukwal*et.al*. 2007).Wernery(2007) reported, lactose intolerance against camel milk does not exist. Schwartz (1992) noted, camel milk contains high amounts of vitamin C (2.9ml/100 ml) compared with milks of otheranimals. Thiagarajan (2001) also noted, camel milk has , beside the high quantities of Vit. C, also considerable amounts of Vit .A and B.Gihad (1995) mentioned , the nutritive valueof camel milk is higher than that of cattle milk , since it contains higherquantities of elements , such as Fe, Na , Ca , P , Mn, K and Mg . The energy content of camel milk ranges between 900- 1000 k-calori/liter, which is considerably higher than of cow's milk (700- 750 k-cal / liter) as pointed out by Gindeel (2003).

CHAPTER THEE

3. Materials& Methods

3.1Samples collection:

Forty five (45) sample of camel milk were collected from different sales points in Khartoum, Omdurman and Khartoum North (Khartoum state), 15 sample per each area at the period from 5/9 to 10/9/2014. The camel milk samples were than tested for water, protein, fat, lactose and ash. Tests for pH – value, acidity,

density and boiling point were also carried out. Organoleptic tests on colour, taste, smell and consistency were done by panelists.

3.2 Chemical Analysis:

3.2.1 Determination of fat %:

Fat content was determined using Gerber Method, Marshal (1993).Ten ml of sulfuric acid (specific gravity 1.815 at 15.5c°) was measured into clean dry Gerber butyrometer tube, and then 11 ml of sample were added carefully. Then one ml of amyl alcohol (specific gravity 0.814 at 15.5c°) was added. The content of the tube were thoroughly mixed till no white particles were seen (until the curd was completely digested). The tubes were then centrifuged at 1100 revolution per minutes (rpm) for five minutes. The tubes were transferred to a water bath at 65c°for three minutes. Direct reading of fat contents was recorded from measures on the tubes.

3. 2.2 Determination of protein:

The protein contents of milk were determined according to AOAC (1990) using kjeldahl method. 10 ml amounts of milk samples were weighed then transferred to kjeldahl flasks. Twenty five ml of concentrated sulfuric acid free nitrogen which had 1.86 density, were added to milk, then they were digested on a heater until clean solutions were obtained. The flasks were removed and left to cool. Each digested sample was poured in a 100 ml volumetric flask, diluted to 100 ml with distilled water and allowed to cool. Five ml of each diluted sample was transferred

to a distillator followed by 10 ml of 40% NaOH. The distillate sample received in a conical flask of 100 ml capacity containing 25 ml of 2% boric acid and three drops of bromo-cresol green plus methyl red indicator then the distillation continued until the volume in the flak reached 75 ml. The flasks were removed then titrated against 0.1 N HCl until the end points were reached (red colour). The milk protein contents were then calculated as follows:

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

Protein %= Nitrogen % X 6.38

Where:

T = Titration figure

0.1 N = Normality of HCl

0.014 = The atomic weight of nitrogen/1000

3.2.3 Determination of ash:

The ash content of camel milk sample was determined according to AOAC (1990). Ten ml of milk sample were weighed and placed in clean dry pre-weighed crucibles. The crucibles were put on a water bath for 30 minutes and place in a muffle furnace at 550^{o}C for 1½-2 hours. They were then removed, placed in a desicator and left to cool, re-weighed and the ash content of sample determined as follows:

$$\text{Ash\%} = \frac{W_1}{W_2} \times 100$$

Where: W_1=Weight of ash.

W_2=Weight of sample.

3.2.4 Determination of lactose:

10 ml milk is poured in volumetric flask and then 40 ml distilledwater, l0 ml sulfuric acid and 5 ml Na % 10 were added. To complete the volume of mixture to l00 ml distilled water is added. The mixture is left for(5-10) minutes in another flask and the volume completed to100 ml with distilled water. In glass cup 25 ml Benedict solution and 5g sodium carbonate and (50-75) ml distilled water were added. The contents were placed on heaterunit boiling. The contents of cup with mixture in burette are titrated until the color changes to white and of blue color of residual disappeared.

Calculation Of Lactose Content:

25 ml of Benedict solution equivalent 0.067 g lactose

$$\% \text{ lactose} = \frac{0.067 * ¿}{R \quad ¿} 10 * 1$$

R = amount of residual to reach to final point.

3.2.5Determination ofmoisture (water):

Calculation method:

- 100- (protein + lactose + fat + ash) = water **%**
- 100- total solids % = water %

3.2.6 Acidity of milk

Titrimetric method

Procedure:

-Measure or weigh suitable amount (10ml) milksample into dish and add 3 point indicator and titrate with NaOH concentrate 0.l ml to 1st persistent pink.

-If measured volume sample was used, determineits weight from specific gravityof sample resultsmay also be expressed as ml 0.1 NaOH / 100gsample.

3.2.7. pH – value

Apparatus and reagents :-

- Milk
- pH meter
- Beaker

Procedure:-

Put milk in beaker and into pH meter and read the H ion by poter – tiometer.

3.2.8 Determination of specific gravity:

Specific gravity was determined using lactometer method according to Pakistan Society (2012). Camel milk sample was poured into a glass measuring cylinder (250ml). Then the lactometer is slowly lowered into the milk until it floats. The lactometer must not be allowed to touch the sides of cylinder or its

bottom.Then reading lactometer and added 0.5 degree.Specific gravity of milk can be calculated by the following formula (for all type of lactometer):

$$\text{Specific gravity} = \frac{\text{Corrected lactometer reading}}{1000} + 1$$

3.2.9 Boiling point:

The boiling point was determined by heating 250 ml camel milk using a heater. The boiling point temperature is followed by using standard thermometer (Chemistry Laboratory of National Resource Center).

3.3 Sensory evaluation:

Ten (10) panelists were chosen to evaluate, colour taste, smell and consistency of the collected camel milk simples giving acertain degree(out of 9)for the testedproperty of each sample. The average of the degrees attained is then calculated to the final score. The evaluation is given in appendix.

3 .4 Statistical Analyses:

The obtained date is analyzedStatistically by using Analysis of Variance (ANOVA)-SPSS program (Version 15). The least Significant Different (LSD) was used for mean separation between the different areas. The level if significance of (0.05) was used.

CHAPTER FOUR
Results and Discussion

4.1 Results: Obtained results are given in the following tables:

Table :(6) Quantitative composition of camel milk(%)

Area	Chemical Composition Mean ± (SD)				
KhartoumState	Protein	lactose	Fat	Ash	Moisture
Khartoum	(a) 3.05 ±0.45	(a) 5.8 ± 1.2	(b) 3.4 ± 0.6	(b) 0.4± 0.05	87. 4±1.7
Omdurman	(a) 3.1± 0.3+	(a) 4.6 ± 1.3	(a) 4.9 ± 0.7	(a) 0.5± 0.07	87. 9± 0.9

Khartoum North	(b) 2.574± 0.2	(b) 4.8± 0.6	(a) 4.2± 0.4	(a) 0.5 ± 0. 9	87. 1± 1.1
Significance (Sig)	*	*	*	*	NS

NS: NotSignificant

*: Significant (P ≤ O.5)

**: High significant (p ≥ o.o1)

- Mean + SD values having different superscript letters in the same raw are significantly different (p ≤ 0.05) .
- Mean + Sde values having same superscript letters in the same ℃ raw are not significantly different(p ≤ 0.05)
- Number of samples:45; 15 samples per each area inKhartoum State.

Table :(7) Physical Properties of camel milk

Area	**Properties Mean ±(SD)**			
Khartoum State	PH.Value	Acidity %	Density	Boiling point ℃
Khartoum	5.7 ±0.4	(a) 0.15± 0.01	1.03± 0.01	(a) 100.78± 1.7
Omdurman	5.9± 0.2	(b) 0.14± 0.01	1.02± 0.01	(a) 100.78± 1.06
Khartoum North	6.0± 0.2	(c) 0.13± 0.01	1.05± 0.09	(b) 100.75± 1.8

Sig	Ns	*	Ns	*

NS: Not significant

*: Significant(P $\leq$ 0.5)

**: High significant (p $\geq$ 0.01)

- Maen+SD. Values having different superscript letters in thesame raw are significantlydifferent (P $\leq$ 0.5)
- Maen+ SD values having same superscript letters in thesame raw

Are not significantly different (p $\geq$ 0.05)

- NO. Ofsamples: 45: 15 samples per each area in Khartoum State.

Table:(8) Sensory Evaluation Of camel milk:

Area	Characteristics Mean ±SD			
Khartoum State	Color	Smell	Consistency	Taste
Khartoum	(a) 6.2 ± 1.5	(b) 6.1±1.03	7.32±0.7	5.52± 0.9
Omdurman	(a) 7.1 ± 0.5	(a) 7.3± 1.3	7.1± 0.5.	5.1± 1.4
Khartoum North	(a) 7.22± 0.7	(c) 5.7± 0.9	7.0±1.3	4.6± 1.7
Sig.	*	**	NS	NS

NS: Not significant

*: Significant(P $\leq$ O.5)

**: High significant (p ≥ o.o1)

- Mean +SD values having different superscript letters in The same raw are significantly different (p ≤ 0.05)
- Mean+ SD values having same superscript letters in the same raw are not significantly different (p ≥ 0.01)
- No of Samples:45. 15 samples per each area Khartoum state.

4.2Discussion:

The abstained results for composition, properties and sensory evaluation of camel milkmarketed in Khartoum State indicate the following (Refer to tables 6, 7, 8. Respectively):

4.2.1 Composition:

4.2.1.1 Watercontent:

The obtained average water % of camel milk samplesof Khartoum, Omdurman and Khartoum North areas was (87.4± 1.7). (87.9±09) and (87.1 ± 1.1) respectively. The values are similar to those given by AL-Ani(2004) , Ahmed (1988) but lower than that of Abdalaziz (2001) in case of scarce water. The variation in water content in camel milk may be related to lack of drinking water and type of fodder given to animals (Abdalaziz , 2001;Yagil and Etzion , 1980).The statistical analysis showed no significant variation between the averages % of water content in the milk of the different areas of Khartoum State.

4.2.1.2 Protein Content:

For Khartoum , Omdurman and Khartoum North , the average % of proteincontent in camel milk , was (3. 05± 0.45) , (3.1 ± 0.3) and (2. 57± 0.2) respectively . Khartoum North Samples of camel milkshowed the lowest protein content.The values obtained were similar with those indicated by Farah (1993), Elamin and Wilex (1992), Sawaya*et.al*. (1984) and AL- Ani(2004).The value of Bahri camel milk contradictedthe lowest limit for protein % in Sudanese camel milk pointed out by Dirar(1993). The variation in protein content of camel milk may be related togenetic,physiological and environmental factors previously mentioned by Gera*et.al*.(2007), Omer (2001) and knoess(1979).The statistical analysis showed a significant difference between the average of protein percent in (Khartoum- Omdurman) camel milk with that of Khartoum North area.

4.2.1.3 Fat Content:

The average fat % in camel milk samples of Khartoum, Omdurman and Khartoum North, was (3.4 $^{\pm}$ 0.6), (4.9 $^{\pm}$ 0.7) and (4.2 $^{\pm}$ 0.4) respectively. This was in agreement with the different levels of fat in camel milk given by Grounda(1996) and Ahmed (1988). The fat content of Khartoum area camel milk is higher than the limit stated by El Badaiwi (2004) for Sudanese camel milk, but lower than of Khartoum North and Omdurman area camel milk samples. The variation in the fat content is dependent on type of breed, stage of lactation and feeding condition (Webb *et.al*. 2012). The statistical analysis revealed a significant variation between the average percent of the fat content in (Khartoum North – Omdurman) camel milk compared to that of Khartoum camel milk.

4.2.1.4 Lactose content:

The average concentration of lactose % of camel milk of Khartoum, Omdurman and Khartoum North samples obtained, was (5.8 ± 1. 2),(4.6 ± 1.3) and (4.8 ± 0.6) respectively. Noticed, the milk samples of Khartoum showed the highest concentration. The values obtained were similar to that given by Abdelaziz (2001), Omer (1996) and Abu Lehia (1989). The concentration of lactose in camel milk is dependent on amount of drinking water (plentiful or scarce), as noted by Yagil and Etzion(1980) , and also on stage of lactation period (Abulehia, 1989). The statistical analysis showed a significant difference in this case.

4.2.1.5 Ash content:

Average ash % obtained, was (0. 4± 0 .06),(0. 5± 0. 07) and (0.5± 0. 09) for Khartoum, Omdurman and Khartoum North camel milk samples respectively. The recorded values are identicalwith that indicated by Gabr and Naeim(2006),Gindeel(2003) and Gihad(1995). The variation in the ash content in camel milk is related to the concentration of the major elements in the milk, which them self show a wide variation, (Omer, 2001).It is also linked with the genetic and environmental effects, as various studies suggested (Sawaya*et.al*, 1984). The statistical analysis showed a significant difference between obtained average % of ash in Khartoum and (Omdurman – Khartoum North) camel milk.

4.2.2 PHYSICAL PROPERTIES:

4.2.2.1 pH – value and acidity:

The pH- value obtained, was (5.7 ± 0. 4),(5. 9 ± 0.2) and (6.0± 0.2) for camel milk samples of Khartoum, Omdurman and Khartoum North respectively.

These values are lower than given by Sawaya*et.al*(1984),Ohri and Goshi(1961) Salash (1979). No significant variation was detected hereby. Samples of camel milk of Khartoum, Omdurman and Khartoum North showed an acidity (as lactic acid %) of (0.15± 0. 0 1), (0 .14 ±0.01) and (0.13 ± 0.01) respectively. The average acidity %of camel milk given by All Inpiadairy (2010) and Sawaya *et.al*. (1984) was (0.12± 0 .03) and (0.13) respectively. The rate of expected developed acidity in the camel milk is lowered at pH (5.2) as mentioned by Zaid*et.al*(1991). The statistical analysis indicated a significant difference between average acidity % in the threemilks.

4.2.2.2 Specificgravity:

The density obtained, was (1.03 ± 0.01),(1.02 ±0.01) and (1.05± 0.09) for samples of Khartoum, Omdurman and Khartoum North respectively .The specific gravity ofcamel milk samples of Khartoum and Omdurman were found within the range pointed out by Takele (2014) and Salash(1979) , while that of Khartoum North milk varied . Several factors may affect the density of camel milk e.g. water content, fodder and others. The statistical analysis indicated no significant difference in this case.

4.2.2.3 Boilingpoint:

Result obtained for the boiling point of camel milk samples, was (100.78 ± 1.7), (100.78 ± 1.6) and (100.75 ± 1. 8) ℃ for Khartoum,

Omdurman and Khartoum North samples respectively. These values are slightly higher than the value obtained by Mehia and Alkanhal (1992). The variation may be attributed to the factors influencing the boiling point of milk previously mentioned by Osman (2007). The statistical analysis showed a significant difference between the averages temperatures of boiling point of (Khartoum – Omdurman) compared to that of Khartoum North milk.

4.2.3 Sensory characteristics:

4.2.3.1 Color:

The statisticallyanalyzed mean values for colour, were (6.2 ± 1.5), (7.1 ± 0. 5) and (7.22± 0.7) for Khartoum, Omdurman and Khartoum North camel milk samples respectively, and the colour was considered as normal. The statistical analysisrecorded a significant difference between the mean values of (Omdurman – Khartoum North) and Khartoum camel milk.

4.2.3.2 Smell:

Mean values obtained for the smell, were (6.1 ±1. 03), (7.3±1.3) and (5.7± 0.9) for Khartoum, Omdurman and Khartoum North camel milk respectively, which was also normal. A high significant difference was detected between the mean values for the smell in the milk of thethree different areas.

4.2.3.3 Consistency:

Mean values for consistency, were (7.32 ± 0.7),(7.1± 0.5) and(7. 0 ± 1. 3)for Khartoum, Omdurman and Khartoum North camel milk samplesrespectively, which was considered to be consistent .No significant variation was detected.

4.2.3.4 Taste:

The mean values for the taste of the samples of camel milk recorded, were (5.2 5± 0.9), (5. 1 ± 1.4) and (4.6 ±1.7) for Khartoum, Omdurman and Khartoum North camel milk. Camel milk of Khartoum North was found to be less palatable, compared to that Khartoum and Omdurman. Statistically no significant differencewas recorded in this case. The variation in the sensory characteristics of camel milk is depending on different factors, such as fodders, age of she–camel , length of lactation period and housing conditions, AL – Ani , (2004) , Zidan , (2005) and Basmail(1997).

CHAPTER Five

5. Conclusionand recommendations

5.1Conclusion:

Increasing interest in camel milk consumption inKhartoumState is noticed. Considerable amounts of camel milkare marketed in Khartoum state by different sales point's e.g groceries, super markets and small handlers. Thusit is of vital importance to study composition, properties and sensory characteristics of marketed camel milk to investigate its suitability for consumption, and if it satisfies the standards required for human nutrition.

The current study is dealing with the above mentioned parameters and slight compositional differences were found in the marketed camel milk.This isalso valid for properties and sensory evaluation. Thedifferencesare of no harm on the nutritive valueof the marketed camel milk.

5.2 Recommendations:

- Encouragement of camel milk consumption as an important source of different verities of nutrients.

- Increasing awareness of camel milk consumption and the health – benefiting effects gained through it.

- Incorporation of camel milk in the national milk consumption cycle to coverthe shortage in milk.

- Study the possibilitiesof utilizing camel milk for manufacturingdairy products.

- Further studies should be performed on the vitamins , amino andfatty acid , as well as themicrobial quality of the marketedcamel milk.

References

Abdul Rahman, O. A. (1996). Studieson Mastitis in the camel, Ph.D. Thesis. Uppsala, Sweden.

Abulehia, I.H. (1994). Recombined camel milk powder , comm. cou, Dromedaries . Etchameaux:animauxlaitiers. Nouakchott. Muritantania.

Ahmed, M. M. (1988). The analysis and quality of camel milk.Ph.D thesis. University of Redding, U.K.

All Inpiadairy (2010) . Composition of camel milk (PDF) and milk products of camel. com., http: // www goggle. Com. Gmail.

Al Ani, F.K (2004).Camel management and Diseases.First Edition.Alsharg Printing press.

Association of Official Analytical Chemists.A.O.A.C. (1990) Official methods of Analysis.Washington. D.C .USA.

Bayomi, S. (1990).Studies on composition and rennet coagulation of camel milk .Michwirtschaft, 42: 3- 8.

Beg, O. U.; von Bahr-Linstrom, H; Zaidi, Z.H. and Journal, H. (1987). Characterization of anheterogeneous camel milk whey non- casein pro protein. Fed.Euro.Bioch. Soc. Letters 2: 270 -274.

Dirar, H.A. (1993). Garissdairy products in the indigenous fermented foods of the Sudan and nutrition.A study in African food and nutrition, 1st ed. University press. UNIDO C.A.B International Walling Ford Cambridge, U.K.

Dukwal, V.;Modi, S.andSingh , M. (2007) . A Comparative study onnutrionalcomposition of camel and cow's milk.CamelConf-Book , International Camel Conference. Bikaner, India.

Elamin, F.M. and C. J. Wilex.(1992). Milk composition of Majaheimcamels.J. Of Dairy Science 75; 3155-3157.

El badawi, E.B. (2004).Effect of Parity number Lactation Stage and season on camel milk Composition.M S.cthesisUniversity of Khartoum, Sudan.

Ensminger, M. E. (1969). Animal science.6th ed. Daville, Illinois, International Printers and Publishers.

Farah, Z. Steffi, T. and Bachman, M. R. (1989). Manufacture and characterization of camel milk butter. Mikhwissenschaft, 44:412- 414.

Farah, Z. and Ruegg, M. (1991).The Creaming properties and size distribution of fat globules in camel milk. J. Dairy Sci. 74: 2901- 2904.

Farah , Z. (1993) .Composition and Characteristics of camel milk.J. of Dairy Res. 60: 603- 626.

Gast, M.; Maubios, J. and Add , J. (1969) . Le lait les Produits laiters en Ahaggar Center ResearchParis – France.

Gera. S;Dahur R.S; Vitmani.M; Sharma A; Garg S. A: and Jain V.K. (2007). Studies in camel in Haryan.Camel Conf – book. International camel conference.Bikaner, India.

Grigoryants, N.N. (1954).Composition of milk.www. fao. Org, docrephtt: // www. Google com.

Indra, R. and Evdenboater, B. (1994).Camel milk processing and its consumption pattern in Mongolia.in: proc. Chameanxe, Fromedries, Animarelaitiers, Conf. Nouakchott, Mauritania.

Khan , G. (2014) , Physico – chemical Quality of (PDF) Bactrian camel milk. www. Mongoliajol.Info> MJC.

Knoess, K .H.(1977) .The camelas meat and milk animal.World Animal Review, 22:39 – 44.

Knoess, K.H. (1979). Milkproduction of the dromedary.In: camels IFS. Symposium, 201 -214, Sudan.

Larson – R ,M .andMohammed, M.A. (1986).Analysis of the casein content in camel (camelus dromedaries) milk . Swedish J. Agrie . Res. 16: 13 - 18.

MARF (2010).Ministry of Animal Resources and Fisheries, Sudan.

Marshal, R.T. (1993). Standard methods for the examination of dairy product. American Public Health Association. Washinton. DC, USA.

Mehia.M.A. and Al Kanhal, M .A. (1992).Taurine and other freeamino acids in camel, buffalo and ass milk.Milchwissnschaft 45-47(1).

Mehia, M.A: Abdelrahman, K, M. and El mougy, S. A. (1995). Milk Composition of majaheim, Wadha and Hamra camels in Saudia Arabia.Food Chemistry, 52: 115- 122.

Mohammed, M.A and Hjort,A. (1993). Camel (Camelusdromedarius) milkchemicalcompossition and tradional preservation methods. The multipurpose camel interdisplinary studies on pastoral production in Somalia, 28:77- 85.

Mukasa–Magerwa, F. (1981).The camel (Camelus dromedarius).A bibliographical Review . ILCA Monograph No (5) . International Livestock center to Africa Addis Ababa, Ethiopia.

Nagy, P.; Juhasz, J. and Marko, O. (2007).Production of high quality raw camel milk.Determination of major Control points in a largescale camel milking farm. Camel Conf- book, International Camel Conference, Bikaner, India.

Ohri, S.P. and Joshi, P. K.(1961). Composition of camel milk.India Vet. J. 38: 514 – 516, 604 – 606.

Omer, R. H. (2001). Studies on camel milk determination trend.Ph .D. Thesis-University of Khartoum, Sudan.

Pakistan Society of Animal Scientists (2012). Determination of specific gravity of milk. From. http://paksas.blogspot.com/2012/08/determination-of-specific-gravity-of.html#. VOBnqLG9rrM.

Pant, R. and Chandra, P. (1980) . Composition of cow and camel milk proteins and Industrial casein.Milchwissenschaft 35: 91- 93.

Rao, M. B; Gupta, R. C. and Dastur ,N. N . (1970).Camels milk and milk products.India. J. dairy Sci 23: 71- 78.

Ramet, J. p. (1987). Production defromages and partir de lait de chamella en Tunisi. Mission Report, Rome, FAO 33 pp.

Salash, M. R. (1979). Utilization of camel meat and milk in human nutrition.in: IES – camel Provisional report. 6 workshops on camel.Khartoum, Stockholm (SWE), p. 285 – 306.

Salash, M. R. (1982). Camel. Egypt J. physiol. Sci 8 (1): 73-74.

Sawaya, W. N; J. K. Khalil; A. Al shalhat and H. A. Mohammed.(1984). Chemical composition and nutritional quality of camel milk.J. offood science. 49: 744 – 747.

Schwartz, H. J. (1992). The camel (camelusdromedarius) in East Africa in:the one humped camel in Eastern Africa opictorial to disease, health and management.

Sestuzheve, R. T. (1958). Effect of stage of lactation on camel's milk.Mol. prom 19: 33- 39.

Soliman, A.H; Hayan, A.A. and Elfaki, A. E. (2006).Chemical and microbiological quality of Gariss.Starter fermented camel product. International J. of food Science and Technology Vol. 41, pp 321.

Takela , D. (2014). Effect of sisal foil wrapped (PDF) milk containers on quality parameters of camel milk.Glopal Journals, http: // www. Google.com.

Thiagarajan , T. R. (2001).Ship of the desert.The Hindu on – lineed.Of Indian national News pp1-3.

Wangoh, J. (1997). Chemical and Technological (PDF) properties of camel milk.EtH- E .Collection liprary. 40909 http: // www google. com.

Webb, B.H.; Johnson, A. H. and Alford, J. A. (2012).Fundamental of dairy Chemistry 2nd ed. west – port, AviPublishing Company, USA.

Wernery, V. (2003).Novel observation on camel milk.Proceeding of the 9th Kenya camel forum .

Wernery.V. (2007).Camel milk new observations.Camel Conf- Book.International Camel Conference. Bikaner, India.

Wilson, R. T. (1984). The camel. Long man Publishing , London and New York.

Yagil, R. and Z. Etzion.(1980). Effect of Drought Conditions on the quality of camel milk.J. of dairy Res. 47: 159 -166.

Arabic References

العانى ، فلاح خليل . (1990) . الأبل تربيتها وأمراضها . الطبعة الأولى – بغداد ، العراق.

العانى ، قلاح خليل . (1997) . موسوعة الأبل . الطبعة الأولى ، المكتبة المصرية . الفرقان . للطباعة والنشر

الياس الميوع ، (1995) . نشرة مقارنة حليب النوق مع حليب الأبقار وصناعة اللبن الخاثر . . شبكة بحوث وتطوير الأبل

باسماعيل سعيد ومنصور فارس حسين . (1407هـ - 1987م) . أهم أمراض الأبل والعلم بها . . كتيب إرشادى من إصدارات المهرجان الوطنى للتراث والثقافة مطابع الحرس الوطنى : ص 37

باسماعيل سعيد . (1997م – 1417هـ) . التربية الحديثة لأبل إنتاج الألبان . نشرة إرشادية رقم 39 . مركز الإرشاد الزراعى – كلية الزراعة - جامعة الملك سعود – المملكة العربية . السعودية

جبر ، أحمد عبدالرازق واحمد فتحى نعيم . (2006م) .رعاية الابل المكتبة المصرية للنشروالتوزيع . مصر

جروانداا ، ت . أ . (1996) . الأهمية الإقتصادية للبن الأبل . تقرير تخريج . مدرسة الطب البيطرى – جامعة البعث - سوريا .

جهاد ، السيد أحمد . (1995) . الأبل العربية . إنتاج وتراث . الطبعة الأولى . الشركة العربية لنشر والتوزيع .

زائد عبدالله ، غسان غادرى وعاشور شريحة . (1991) . الابل فى الوطن العربى – مطبوعات جامعة المختار . البيضاء . ليبيا .

زيدان ، ابراهيم عبدالله . (2004م) . المواصفات القياسية لمنتجات الالبان الغذائية بين الواقع والمأمول . مكتبة بستان المعرفة للطبع ونشر وتوزيع الكتب . جمهورية مصر العربية .

سليمان ، صبحى . (2001م) . تربية الأبل والجمال وأنواعها . شبكة تطوير بحوث الأبل .

عبدالعزيز ، حمد أحمد . (2001م) . الجمل العربى ، الطبعة الأولى المكتبة المصرية . الفرقان للطباعة والنشر .

عثمان ، انس محمد . (2007م) مذكرات تكنولوجيا الالبان – كلية الطب البيطرى والإنتاج الحيوانى – جامعة السودان .

غادرى ، احمد غسان . (1983) . الجمال والخيول . كلية الزراعة جامعة حلب ، سوريا .

قنديل ، حمدى محمد (2003م) . تغذية الحيوان ، الابل ، تربية ورعاية وإنتاج . مركز بحوث الصحراء . مكتبة أوزيريس.

مراد ,محمد مصطفى (2000م) ، نظريات وحقائق علمية مدهشة فى الأبل . دار الشوكانى للطباعة والنشر .

Appendices

Appendix I

Table (3):Taste

Quality	Score
V.palatable	9
Palatable	7
Less potable	5
Un palatable	3

Appendix II

Table (4):Consistency

Quality	Score
V.consistent	9
Consistent	7
Less consistent	5
Not consistent	3

Appendix III

Table (5): Color and Smell

Quality	Score
Very normal	9
No normal	7
Less normal	5
ab- normal	3