# ASSESSING THE INFLUENCE OF FEEDING MANAGEMENT ON MILK PRODUCTION IN CONFINED PERI-URBAN DAIRY CAMELS IN MOGADISHU, SOMALIA

**BY**

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**J56/12586/2018**

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN LIVESTOCK PRODUCTION SYSTEMS IN THE FACULTY OF VETERINARY MEDICINE**

**UNIVERSITY OF NAIROBI**

**May, 2021**

## DECLARATION

This thesis is my original work and it has never been presented for a master's degree in any other university.

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## DEDICATION

This work is dedicated to my inspiring parents for their endless love, support, encouragement, role models, cheerleading squad, and sounding boards I have needed.

## ACKNOWLEDGEMENTS

First and foremost, I have to express all praise due to the “Almighty Allah” who has created us to explore the hidden facts of nature for the benefit of mankind and also thank my parents for their love and lifetime support. Thank you for giving me the courage to touch the stars, and chase my dreams. My sisters, little brother, auntie, and cousins deserve my wholehearted thanks as well.

I would like to sincerely thank my supervisors, **Prof. Raphael Githaiga Wahome** and **Dr. Charles Odhong** for their guidance, encouragement, valuable comments, and support throughout this study, and especially for their confidence in me. I wish to thank Mr. Nur Abdullahi, for his insights and I express my heartfelt gratefulness for his guide and support. I believed I learned from the best.

Without the work done by several enumerators, this study would not have been possible. For their assistance in data collection, I thank Shafie Hilowle (Mr. Kaaran), Abdirahim Malaz, Qadar Hussein, Hussein Buneyste, Jackson Muchiri, Ahmed Hassan (Shafie), Musup Kadar, and Sadam Ibrahim (Germany).

I am grateful to the many camel owners who had the patience to respond to very lengthy and comprehensive questionnaires. Their excellent memory, especially when recalling file history of the individual animals, made the collection of information possible, and that the information was useful for analysis.

Finally, I thank my Mom, Amina Hassan Taha, for her prayers and for giving me valuable encouragement for my study.

# TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

**ACRONYMS AND ABBREVIATION**

| | |
|---|---|
| DMI | Dry Matter Intake |
| DMS | Database Management System |
| FAO | Food and Agriculture Organization |
| GDP | Gross Domestic Product |
| KG | Kilogram |
| KM | Kilometer |
| L | Liter |
| Mm | Millimeter |
| UN | United Nations |
| ASALs | Arid and Semi-Arid Lands |
| CAHWs | Community Animal Health Workers |
| CP | Crude Protein |

**ABSTRACT**

Two studies were done to evaluate feeding management practices, challenges, and coping strategies in confined peri-urban dairy camels in Mogadishu, Somalia, and the types and quantities of feeds on offer and profitability of the peri-urban dairy camels. In the first study, 50 respondents from 10 peri-urban camel dairy farms were interviewed, each from of the ten farms. They were the owner, general manager, finance manager, and the laborers in charge of feeding and milking. Of the respondents, (84%) adopted group feeding and two-thirds of the respondents (64%) fed their camels twice a day. More than two-thirds of respondents (78%) offered their concentrates mixed with other feeds and provided salt to their herds as a mineral supplement. More than half of the respondents (56%) provided free access to tap water as a source of drinking water for camels. The majority of respondents (64 %) milked five times a day and allowed the calf to suckle both before and after milking. Camel milk producers in the peri-urban system were concerned about camel diseases, feed shortage, and lack of market. These problems can overcome with appropriate knowledge for proper disease diagnoses, feed conservation, and hygiene when managing the herd. The second study was to identify the types and quantities of feeds on offer and profitability of peri-urban dairy camels. A purposive sampling of 12 camels from each farm was selected: four camels in each lactation stage (early, middle, and late). Thus, a total of 120 lactating camels from 10 peri-urban dairy farms were recorded. The types of feeds on offer to the lactating dairy camels varied across the farm categories where the large and small-scale farms were using maize corn, sesame oil meal, alfalfa hay, yellow pea seeds, and sorghum straw while the medium scale were using the same feedstuffs in addition to yellow pea seeds. The quantity of feed offered also varied across the farm categories ($P < 0.05$). On average, the large, medium, and small scale farms were offering an average of 13.6kg/d, 10kg/d, and 8.4 kg/d respectively, which translated to 12.3 kg/DM/day, 9.3 kg/DM/day, and 7.7 kg/DM/day for the large, medium and small scale farms, respectively. The average estimated quantity of Metabolizable Energy, crude protein, and digestible protein offered among the large, medium and small scale farms were 121.3 MJ ME, 1983.6 g CP and 1400.6 g DP; 83.8 MJ ME, 1227.7g CP, 821.4 g DP and 73.5MJ ME, 1092.5 g CP, and 749.7 g DP, respectively. The quantity of milk produced also varied across the three categories ($P < 0.05$). On average, the milk production was 4.7 liter in the small-scale farms while the large-scale farms were 5.7liter. Therefore, the medium scale production was quite better than other scales in terms of feeding practice, income and proficiency. it can be used to improve and sustain the milk production of entire peri-urban dairy camel system.

# CHAPTER 1

## 1.0 GENERAL INTRODUCTION

### 1.1Background

In all the world, it is only in the Somali community that the camel has continuously played a significant role in the economy and culture of its people (Farah *et al*., 2017). It is an honor to own a camel in Somalia and it is here that there is the first reported case of domestication of the dromedary camel with the nation having the largest camel population on the planet (Faye, 2015).

The camel and its milk are at the heart of the culture and pastoral life in Somalia. Camel milk is the principal dietary supplement that is a source of vitamin E, zinc, and selenium in the very dry areas of Africa's horn (Haimed, 2011). It has also demonstrated superior medical properties compared to the milk of other livestock species (Fanzo, 2010). Under similar harsh conditions, camels can produce more milk and for longer periods than any other livestock species (Farah et al, 2007). Various factors have an impact on camel milk yield, for instance, inherited characteristics, natural conditions, feeding organization, and number and period of lactation.

Although Camel ruminates, their ingested feeds are subject to microbial digestion and the final metabolic products are similar to those in real ruminants; they are known as pseudo-ruminants, although this distinction is primarily due to significant differences in the structure and function of the camelid digestive system and the true ruminants (Suyub, I, 2014). Camels have mixed feeding habits under agricultural regimes, and their diets can be highly diverse (Dereje M. a., 2005b).

Camel pick relatively good quality vegetation which helps reduce the risks of nutritional deficiencies. However, there is an emerging peri-urban system where camel foraging is restricted in the vicinity of urban market outlets, especially during dry and drought seasons, where pressure on the feed resource base is high (Hussenet al., 2008).

The primary explanation for the differences in food intake observed for camels and other livestock may lead to their lower metabolic rate and nutritional diet (Field, 1995). The amount of feed a camel consumes is dependent on the nature of the forage's water. If a camel consumes 30 – 40 kg of fresh fodder with a water content of 80%, then dry matter intake is only 6-8 kg (Yagil, 1994). Nutrition facts studies in northern Kenya's arid lands have shown that the small-bodied Rendille / Gabbra camels consume 1.67 DM of their live weight every day. Consequently, the measured daily intake of dry matter (DMI) by multiplying this amount by real live mean weight resulted in 5.02 kg per day (Field, 2005). The DMI calculation for camels should be increased by 10 percent to allow production costs, thus giving 5.52 kg per day (Field, 2005).

Free mobility of herds using large rangeland grazing services in conventional pastoral systems is considered a safe way of using ASALs (Sombroek, 1982). The peri-urban camel production system arises from the pastoral subsistence system in urban areas of northern Kenya (Mehari *et al*., 2007). Given this potential for changing livelihoods in the ASALs, little is known about the actions and features of the developing peri-urban camel production system.

Thus, the emerging peri-urban camel production system with grazing limited to feeding services in the vicinity of urban milk and stock market outlets may pose challenges not quite yet understood by camel producers and development agencies interested in facilitating the idea of such a system (Shibia, Owuor, & Bebe, 2013).

### 1.2 Problem statement

Despite the importance of keeping camels closer to the city, there still exist many gaps in information regarding productivity and feeding management practices under peri-urban systems. Inadequate optimization of feeding and management systems for peri-urban camel milk production has been reported recently. Data on types, quantities, and qualities of feeds on offer and feeding management practices are required for decision-making on how to improve productivity. Therefore, the study collected and assessed data on feeding management and assessed its impact on peri-urban dairy camel production in Mogadishu, intending to improve camel productivity.

### 1.3 Justification

The selling of camel milk is an important economic activity in the peri-urban dairy system, owing to the prospect of better returns benefiting from the growing demand for camel milk in urban markets of Mogadishu. That needs, information on feeding practices, feed types, and feed quality to improve camel milk production and sustain the productivity, so that the people of Mogadishu will benefit in the form of an increased supply of milk at more affordable prices. Then the farmers will benefit from improved feeding and management practices that will result in healthier camels improving the efficiency of production.

## 1.4 Objectives

### 1.4.1 Overall objective

To assess the effects of feeding management on milk production in a confined peri-urban dairy camel production system in Mogadishu, Somalia

### 1.4.2 Specific objectives

1. To document the feeding management practices of peri-urban camel production around Mogadishu city.
2. To identify the types, quantities, and cost of feeds consumed by dairy camels within peri-urban areas of Mogadishu city.
3. To assess the challenges to peri-urban camel milk production and the coping strategies adopted by farmers.

## 1.5 Research question

1. What are the feeding management practices of peri-urban camel production around Mogadishu city?
2. What are the types, quantities, and cost of feeds consumed by dairy camels within peri-urban areas of Mogadishu city?
3. What are the challenges to peri-urban camel milk production and the coping strategies adopted by farmers?

# CHAPTER 2

# 2.0 LITERATURE REVIEW

## 2.1 Overview of camel production

Somalia (with over 6 million camels) has the highest camel population in the world, possibly representing one-third of all dromedary camels (Farah *et al*., 2007). They are found chiefly in arid and semi-arid areas wherever the typical rainfall amount is smaller than 350 millimeters annually. The four neighboring countries – Somalia, Sudan, Ethiopia, and Kenya – have a combined camel population comprising 99% of the camels within the Greater Horn of Africa (GHOA), 97% of all camels in Africa, and 75% of all camels within the world (Noor, 2013).

Camels were initially domesticated for milk production (Raziq, 2015). In the Holy Koran, it is written that the desert dwellers once turned to God with their grievances regarding drought and famine, and God heard their pleas and came to their aid; "*He sent them a she-camel so that they may drink her milk and become well*"(Rasiq et al., 2008).

The Dromedary camel (*Camelus dromedarius*) is adapted to warm, arid areas, where it is a very significant farm animal species. It is mostly distributed in Africa's arid regions, especially in the arid plains of eastern Africa, Somalia, Sudan, Ethiopia, Kenya, and Djibouti. Camels are bred in the most inhospitable ecological zones owing to their extra ability to withstand thirst and hunger for long. This artiodactyl mammal's ability to convert the scarce resources of the desert into milk and meat makes them necessary for pastoralists' survival (Gebreyohanes & Mohammed, 2017).

## 2.2 Camel production systems

### 2.2.1 Pastoral system or Nomadic system

Production systems for pastoral camels are primarily geared towards subsistence. The traditional commodity is milk that is consumed primarily by the household. Where it is possible, milk is sold to buy cereals and other important foods (Khan, Arshad, & Riaz, 2003). Slaughtering camels for the provision of meat is rare in the majority of pastoral communities, except when culling old and barren animals (Wilson, 1998) and during cultural celebrations (Guliye *et al*., 2007).

Where milk production is the primary goal of the farmer, male camels are sold to the butchery, thus the number of female camels in the herd will be high. However, where the function of the herd is transportation, extra males will be reserved and as many males as females, form part of the herd (Wilson, 1998). The camel's usual territory is characterized by high day temperatures and water scarcity. These result in seasonal differences in the amount and quality of available forage (Parker *et al*., 2009). However, suitable husbandry and extensive methods of grazing are vital for the accomplishment of camel production in areas characterized by unpredictable rainfall and recurrent droughts (Farah & Fischer, 2004).

### 2.2.2 Peri-urban system

Camel production systems are experiencing adaptive fluctuations and alterations connected with developing demographic, political, environmental, and socio-economic factors (Herrero, 2016). Camel keepers are becoming more and more devoted to semi-permanent settlements.

These emerging short-range administration systems differ from the outdated long-range elasticity designs, which are dependent on the steadiness of the feed resources available for the herds (McDougall, 2019). The development of peri-urban camel production systems is stimulated by the increased commercialization of camel milk production resulting from increased demand from urban populations, more dependable and stable water supplies, improved veterinary services, and demand from export and local markets (Hashi*et al*., 1995).

### 2.3 Uses of camels

Camels are a source of milk, meat, and hide. They are also used in western Asia (dromedary) and in central Asia (Bactrian) to do work and are actively used in the military. In North Africa, the camel was at the top of the transport sector until the introduction of the internal combustion engine in the 20$^{th}$ century (Teka, 1991).

#### 2.3.1 Camel Milk

Camel milk is an essential part of the nutrition of nomadic desert tribes and from the point of view of nutrition physiology, it has a benefit as there are greater fat adsorption and increased milk digestibility. In contrast to that, camel milk fat contains a lower fatty acid concentration than bovine milk. It is mainly consumed in its unprocessed form and it used to be difficult to turn it into butter by churning (Legesse N., 2018). Currently, it can be made into butter if it is initially curdled, assorted, and then added to an expressive agent or roiled at 24-25 °C (Farah *et al*., 1991). The milk can also be made into yogurt. Butter and yogurt are used in Somalia as medicinal products while in Ethiopia, unprocessed milk is used as an aphrodisiac (Kalla, 2017).

### 2.3.2 Camel meat

The male dromedary's carcass can weigh 400kg or more, while a male Bactrian's carcass can weigh up to 650kg. A female camel's carcass weighs less than the male, varying from 200 to 350kg, but it has a fantastic amount of meat. The preferred components are the brisket, ribs, and loin, while the lack of a hump is assessed as slenderness and is most favored. Camel meat is comparable to beef in terms of taste, but older camels can have uneven and less sweetmeat (Kadim & Mahgoub, 2013). For hundreds of years, camel meat has been consumed by humans and can be found in ancient texts such as those of the old Roman Emperor Heliogabalus, who loved the heel and liver of the camel (Kadim*et al.*, 2008).

### 2.3.3 Camel Power

The camel is used as a pack animal, a source of draft power, and in competitions and leisure riding. As a pack animal, it can walk at 4-5km/h with a 150 to 300 kg pack on the back for up to 10 hours. In Pakistan, the pack can weigh 400-500kg. In Niger, the packsaddle weighs 200-250Kg and the camel can carry it for 30 to 35 days, walking 60 km each day (Pacholek *et al.*, 2000). Agrarian systems (furrowing, trucking, and planting) are frequently assigned to the camel just like the pony (Schwartz, 1992). In competitions, the camel can run at a velocity of 10-12km/h for 50to 100 km per day. The most amazing sprinters can reach 34km/h with a 40km/h limit in the brief race(10km/h) (Faye, 2008).

## 2.4 Camel Feeding

The camel is a browser of a complete range of grain plants, trees, bushes, and once in a while hard-prickly and halophytic (salty) plants that grow in the desert and other semi-parched territories (Field, 2003). They commonly select leaves, youthful twigs/shoots, organic products, blossoms, and cases. Under regular conditions, camels feed more on trees than grasses (Field, 1993). Leaves from trees are usually more concentrated in minerals than grasses (Kuria *et al*., 2004). The advantage of camels' browsing nature is that they are not in direct competition with other livestock either as far as the type of feed eaten or height of feet above ground is concerned (Wilson, 1989).

With a few exceptions, camels are adapted to the nomadic or semi-traveling production systems. Nevertheless, these systems are feeling fast versatile changes and adjustments to deal with rising challenges and monetary variables (Hashi, 1995). Numerous herders are getting increasingly more devoted to semi-permanent settlements. This system has notable differences from the nomadic practices used to adapt to challenges by adjusting the feeding management of the camels. These included, for instance, the reduction of the camel's water turnover capacity by decreasing the recurrence of watering during the dry season and the driving of the groups to remote fields. Agro-pastoralism has also become common (Bhattacharya*et al*., 1988).

A related advancement in camel production systems is the expanding commercialization of milk and the development of less moveable camel-dairying enterprises. At times, the farmers separate lactating animals from the primary herd and keep them in settlements close to urban centers where they can consistently advertise the milk and the camels can walk around the urban center (Kadim et al., 2008).

In other cases, the lactating herd can be raised on permanent premises in farms or rural regions (with access to neglected grounds, stubble grazing, and harvest crop residues) in and around urban centers where they are provided with feedstuffs (Gihad*et al*., 1989).

### 2.4.1 Feed Requirement

**Growth**

No efficient investigation of the nourishment necessities of the camel has been set out and there is little data on the rate of growth of camels. The weight of a full-grown camel depends on the breed. Small hill camels weigh less than 457kg; Somali, Arab, and Sudan camels from 457 to 559 kilograms (kg). Since these weights are less than those of large breeds of horses, it would appear that the camel grows more slowly than the horse. However, the growth rate of young camels on milk is better than that of the foal and roughly the same as that of the cow (Banerjee, 2018)**.**

**Reproduction**

Camels reach puberty at the age of 3 years and are allowed to breed from 4 to 6 years old. This delay (compared to cattle) has been attributed to the harsh conditions in which they live. Gestation takes roughly a year for the dromedary type and 13½ months for the Bactrian. Camel populations have a slow growth rate because the age at first service can be up to 7 years (Gherissi*et al*., 2020). Female camels living close to the equator have regular estrous cycles due to the favorable climatic conditions (and the resultant feed availability) while those further away come on heat occasionally. Male camels become sexually active (rut) during specific occasions of the year when there is a lot of feed and a favorable climate (Abdallah E., 2016).

The rut is when mature males show a sharp interest in females and are typically hard to control since they fight over females until the dominant male wins. During the rut, the males lose the interest to eat and this reduces their ability to work (Abdussamad et al., 2008).

**Lactation**

Typically, most of the milk produced by camels is from low-input, low-yield schemes, and five liters per day are considered a good yield. The lactation period is between 8–18 months. The length of lactation depends on when the lactating dam is remated. Lactating camels generate between 1, 000 and 2, 700 liters per lactation in Africa, but camels in South Asia supply up to 12, 000 liters per lactation. Camels achieve the highest milk yield in the second or third month of lactation and produce milk for eight to eighteen months in a lactation phase. During the wet season, the daily milk yield is often twice that of the dry season (Abdalla*et al*., 2015). The lactation curve for camels resembles that of beef cows (FAO, 2005).

# CHAPTER 3

## 3.0 EVALUATION OF FEEDING MANAGEMENT PRACTICES, CHALLENGES AND COPING STRATEGIES OF CONFINED PERI-URBAN DAIRY CAMELS IN MOGADISHU


### Abstract

A study was done to evaluate the feeding management practices, challenges, and coping strategies of confined peri-urban dairy camel farms in Mogadishu. All pertinent primary data was collected in small herd farms (less than 30 camels); medium herd farms (31- 50 camels); and large herd farms (over 50 camels), using a census survey which was based on interviews using questionnaires. A total of 50 respondents from 10 peri-urban camel dairy farms were interviewed. The 5 respondents of each of the farms were the owner, general manager, finance manager, and the laborers in charge of feeding and milking. Of the respondents (84%) adopted group feeding and two-thirds of the respondents (64%) fed their camels twice a day. More than two-thirds of respondents (78%) offered their concentrates mixed with other feeds and provided salt to their herds as a mineral supplement. More than half of the respondents (56%) provided free access to tap water as a source of drinking water for camels. The majority of respondents (64 %) milked five times and allowed the calf to suckle both before and after milking. Camel milk producers in the peri-urban system were very concerned about problems like camel diseases, feed shortage, and lack of market. These problems can be overcome with proper disease diagnoses, feed conservation, and observing herd hygiene.

## 3.1 Introduction

More than 60 percent of the dromedary camel population is concentrated in the four North East African countries of Somalia, Sudan, Kenya, and Ethiopia (FAO 2004). Somalia has the largest herd in the world, with over 6 million heads. The camels produce more milk than any other milk animal kept under the same harsh conditions, and for longer periods. *Camelus dromedarius* is of economic importance in northern eastern Africa, particularly in Sudan and Somalia, as well as in the Arab and Indian subcontinents (Jaji et al., 2017).

Camel is the most productive animal in the production of milk, based on the consumption of feed per unit. Research indicates that a cow in rangeland conditions needs 9.1 kg of dry matter feed to produce one liter of milk whereas camels produce one liter of milk by consuming just 1.9 kg of dry matter under the same conditions (Sarwar, 2002). During dry seasons and drought, camel milk plays a very important role in the nutrition of people from East Africa (Farah et al. 2007).

In urban areas, camel milk is becoming rapidly commercialized and consumed. Recent market-oriented smallholder dairy studies in peri-urban areas in East Africa suggest that the benefits of dairy significantly outweigh those of alternative conventional agricultural activities (Farah, Mollet, Younan, & Dahir, 2007). In Somalia's northeastern region, the commercialization of camel milk is an increasingly important aspect of the strategy for improving livelihood options among pastoralists (Nori, 2010).

In some countries, camel farming evolves from traditional extensive forms to modern semi-intensive or even intensive forms. This could result in lowering the existing image of camel farming as an environmentally sustainable production system (Faye, 2013). The feed is the most important input into commercial milk production. Food preparation and housing play a very important role in harnessing the true potential of dairy animals as described by (Sinha *et al*., 2009). Therefore, the objective of this is to evaluate the feeding management practices that affect the peri-urban dairy camel in Mogadishu Somalia.

## 3.2 Materials and Methods

### 3.2.1 Study area

This study was carried out in Mogadishu located along the coast and located in the coastal Benadir region lying at latitude 2°2'13.6"N, and longitude 45°20'37.5"E in southern Somalia. The city is the most populous in Somalia having a population of more than 2.5 million residents. It is arid to semi-arid with precipitation of between 50-150 mm. Recently, the peri-urban raising of camels for milk production started. The peri-urban dairy camels, were zero grazed, milked and their milk sold to Mogadishu dwellers. Milk is often the most important camel product availed to the people of Mogadishu city.

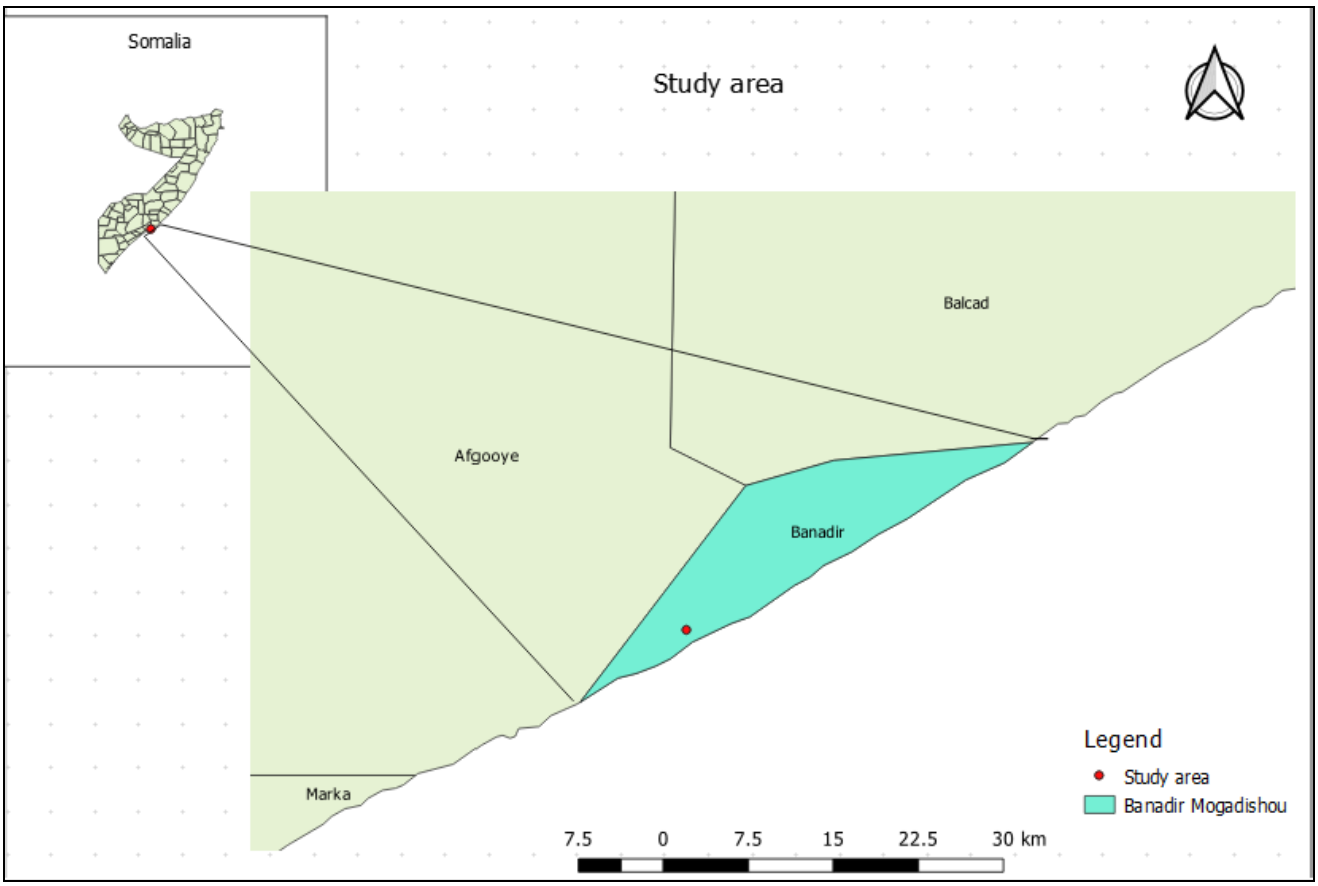


**Figure 3. 1 Map of Mogadishu, Benadir southern part of Somalia**

### 3.2.2 Data Collection

The entire target population of this study was 10 farms whose owners and workers were interviewed. There was no sampling as a census of the farms survey was done using questionnaires. A total of 50 respondents from 10 peri-urban camel dairy farms were interviewed. The 5 respondents on each of the farms were the owner, general manager, finance manager, and the laborers in charge of feeding and milking. The data collected included: Demographics of respondents, characteristics, production objectives, feeding practices, and milking management.

### 3.2.3 Data Analysis

The Questionnaires were checked for completeness and obvious errors. Data were cleaned, sorted, and entered into a Microsoft Excel spreadsheet, and then exported to Statistical Package for Social Sciences (SPSS), version 21.0. For analysis, descriptive statistics were obtained and the results were expressed in frequency and percentage of the results from the questionnaire.

## 3.3 Results and discussions

### 3.3.1 Respondent characteristics:

The demographics of the respondents are shown in Table 3.3.1. Most (72%) of the respondents were male. Of the youth respondents, aged less than 35 years (24%), 41% were illiterate, while 59 % had some formal education. The main occupation of the illiterate was camel keeping while the others were involved in business and formal employment. The middle-aged group between 36-45 years comprised 32% of the respondents, half of whom were illiterate and only looked after camels. The other half were employed in business and formal employment. The aged (over 45 years) comprised 16%, 75% of them illiterates who only looked after camels. The remainder were occupied in business and formal employment. There were fourteen (28%) female respondents. They were either middle aged (36-45) or aged (> 45) and were all either involved in business or formal employment irrespective of level of education. A similar study was done by Noor (2013) showed that the majority of the camel owners of the peri-urban system were illiterate males and had no form of employment.

**Table 3.3. 1 Respondent characteristics of peri-urban dairy camels**

| Gender | Age | Education | Occupation | Number | (%) |
|---|---|---|---|---|---|
| Male | Less than 35 | Illiterate | Livestock keeping | 5 | 10 |
| | | Primary | Business | 1 | 2 |
| | | Secondary | Formal Employment | 1 | 2 |
| | | University | Formal Employment | 5 | 10 |
| | Total | | | 12 | 24 |
| | 36-45 | Illiterate | Livestock keeping | 8 | 16 |
| | | Primary | Business | 2 | 4 |
| | | Secondary | Formal Employment | 5 | 10 |
| | | University | Formal Employment | 1 | 2 |
| | Total | | | 16 | 32 |
| | Over 45 | Illiterate | Business | 6 | 12 |
| | | Primary | Formal Employment | 1 | 2 |
| | | University | Formal Employment | 1 | 2 |
| | Total | | | 8 | 16 |
| Total (Male) | | | | 36 | 72 |
| Total (Female) | 36-45 | Illiterate | Business | 2 | 4 |
| | | Primary | Business | 6 | 12 |
| | | Secondary | Business | 1 | 2 |
| | | | Formal Employment | 1 | 2 |
| | | University | Formal Employment | 1 | 2 |
| | Total | | | 11 | 22 |
| | Over 45 | Primary | Business | 2 | 4 |
| | | University | Formal Employment | 1 | 2 |
| | Total | | | 3 | 6 |
| | | | | 14 | 28 |
| Grand Total | | | | 50 | 100 |

### 3.3.2 Characteristics of peri-urban confined dairy camel farms in Mogadishu

Data (Table 3.3.2) revealed the characteristics of peri-urban confined dairy camel farms in Mogadishu. Farms that had owners with personal camel keeping experience of more than 10 years were categorized into two categories, the large scale (over 50 camels) (20% of farms) and small scale (less than 30 camels) represented 10% of farms. These farms had the highest and lowest average number of employees (7 and 3) on an average pay of 120 and 80 USD, respectively. Those farms that had 5-10 years' experience had herd sizes of 31-50 camels (20% of farms) and less than 30 camels (10% of farms). These farms had 5 and 4 employees earning 100 and 85 USD, respectively. About 40% of farms interviewed had a camel-keeping experience of fewer than 5 years had an average of 3 employees paid an average of 90 USD.

The settlement of peri-urban dairy camels near towns was reported to occur rapidly throughout East Africa, in response to drought-induced livestock losses and increased market involvement (Fratkin, 2001). Besides, many Somali refugees with camel keeping background moved from the southern region to the capital city of Mogadishu and were searching for employment opportunities. Some ended up engaging in peri-urban rearing of dairy camels (Simpkin et al.1996). Peri-urban dairy camels rearing has also contributed to the development of the camel milk industry thus encouraging camel-keeping communities, who have a strong tradition of drinking camel milk, to become involved.

**Table 3.3. 2 Characteristics of peri-urban confined dairy camel farms in Mogadishu**

| Camel keeping Experience, (Y) | lactating camels herd size | Number of farms(N) | Number of farms (%) | Number of employees and their pay | |
|---|---|---|---|---|---|
| | | | | Average number | Average pay, USD |
| More than 10 | Over 50 | 2 | 20 | 7 | 120 |
| | Less than 30 | 1 | 10 | 3 | 80 |
| 5-10years | 31-50 | 2 | 20 | 5 | 100 |
| | Less than 30 | 1 | 10 | 4 | 85 |
| Less than 5 years | Less than 30 | 4 | 40 | 3 | 90 |
| | Total | 10 | 100 | | |

### 3.3.4 Production objectives of the peri-urban confined dairy camel herds in Mogadishu

There are many objectives of setting up confined peri-urban dairy camel farms, some of which are shown in Table 3.3.4 below. The source of the foundation camel herds for peri-urban confined dairy camel production was mainly through purchase (40%), while a combination of inheritance and purchase was reported by 36% of the respondents and inheritance only was the least at 24%. The reasons for adopting this system of camel production were mainly due to the suitability of the system under urban conditions (68%) while 32% of the respondents were influenced by extension officers and other promoters. This result agrees with previous studies (Wilson, 1998; Baars, 2000; Dereje and Uden, 2005b; Farah et al., 2007) who reported high proportions of Somali camel herds as being breeding females that produce milk.

The major factor that encouraged the rearing of camels around Mogadishu was the availability of feed and water as identified by 43.3% of the respondents. Easy access to the urban market for camel milk and improved security were also given by 36.1% and 20.3% of the respondents respectively. This finding is in agreement with the results of several previous camel studies (Mahmoud, 2010). With increasing sedentarization, in urban areas, camel milk is being rapidly commercialized and consumed. In Mogadishu, the confined peri-urban camel milk systems of production are encouraged by increased commercialization of camel milk resulting from increased demands by urban populations, particularly members of pastoral communities who have migrated to urban centers in search of business and employment opportunities. Purposes for keeping peri-urban dairy camels included producing milk for sale (40.4%), producing calves for sale to sustain the farm (36.2%), and building personal livestock wealth (23.4%). Similar findings were reported by Noor, (2013) that the main purpose of keeping camels producing milk for sale ($P<0.01$) with contrast that in pastoral system camels are valued more for progenies to sell ($P<0.01$).

**Table 3.3. 3 Production objectives of the peri-urban confined dairy camel herds in Mogadishu**

| Questions | Variables | Frequency | Percentage (%) |
|---|---|---|---|
| The foundation of peri-urban confined dairy camel herds was | Inherited | 12 | 24.0 |
| | Purchased | 20 | 40.0 |
| | Both inherited and Purchased | 18 | 36.0 |
| Total | | 50 | 100 |
| Reasons for adopting the present system of camel keeping | Extension officers and other promoters influence | 16 | 32.0 |
| | Found the system more suiting to urban conditions | 34 | 68.0 |
| Total | | 63 | 100 |
| Factors that encouraged camel rearing around Mogadishu | Feed and water available | 42 | 43.3 |
| | Easy access to the urban market for camel milk | 35 | 36.1 |
| | Improved security | 20 | 20.3 |
| Total | | 97 | 99.7 |
| The purpose for keeping peri-urban camels | Produce milk for sale | 38 | 40.4 |
| | Produce calves for sale | 34 | 36.2 |
| | Build personal livestock wealth | 22 | 23.4 |
| Total | | 94 | 100 |

### 3.3.4 Feeding practices of confined peri-urban dairy camels

Different feeding practices among the confined peri-urban dairy camel herds are shown in Table 3.3.4. This data showed that most respondents (84 %) adopted group feeding while only (16 %) adopted individual feeding to protect docile animals during feeding from cruel animals. Similar findings were reported by Modi, (2003). Two-thirds (64 %) of respondents fed their camels twice a day followed three or more times by (36 %).

This finding contrasts with that of Sinha et al. (2009), who stated that most farmers in semi-urban areas fed their animals three or more times. More than two-thirds of the respondents (78%) offered their camel's concentrates mixed with roughages while only 22% offered them separately. The majority of the respondents (80%) provided salt to their camel herds as a mineral supplement while 20% did not provide salt as a mineral supplement. The majority of the farms (56%) used tap water on their farms while the rest used water from wells (40%) and boreholes (4%). Two-third of the respondents (60%) had free access to water followed by those provided with water thrice a day (32%) and twice a day (8%). Similar findings were reported Chowdhury et al., (2006) who found that more than half of the respondents (56%) relied on tap water followed by well (40%) and finally borehole water (4%) as sources of drinking water.

**Table 3.3. 4 Feeding practices of confined peri-urban dairy camels**

| Feeding Strategy | Frequency | Percentage (%) |
|---|---|---|
| Individual feeding, % | 8 | 16 |
| Grouping feeding, % | 42 | 84 |
| Total | 50 | 100 |
| Frequency of feeding | | |
| Twice a day | 32 | 64 |
| Thrice or more a day | 18 | 36 |
| Total | 50 | 100 |
| Method feeding concentrates | | |
| Mixing with fodder | 39 | 78 |
| Separate | 11 | 22 |
| Total | 50 | 100 |
| Feeding supplement/ minerals | | |
| Salt | 40 | 80 |
| Both | 6 | 12 |
| Total | 50 | 100 |
| Source of water | | |
| Well | 20 | 40 |
| Tap water | 28 | 56 |
| Borehole | 2 | 4 |
| Total | 50 | 100 |
| Frequency of watering | | |
| Twice a day | 3 | 6 |
| Thrice a day | 16 | 32 |
| Free access to water | 30 | 60 |
| Total | 50 | 100 |

### 3.3.5 Milking Management in confined peri-urban dairy camels

According to Table 3.3.5, the majority of respondents (64%) were milking five times daily, by (20%) milked less than four times and (16 %) milked more than five times a day. More than two-thirds of the respondents (64 %) allowed suckling of the calf before and after milking followed by (24%) and (14%) who allowed suckling of calf only before and after milking respectively. This has similar findings by Jadav et al. (2014) that half of the peri-urban dairy farmers were milked several times and allowed the calf to suckle.

**Table 3.3. 5 Milking Management in confined peri-urban dairy camels**

| **Frequency of milking** | **Frequency** | **Percentage, %** |
|---|---|---|
| Less than four times a day | 10 | 20 |
| Five times a day | 32 | 64 |
| More than five times a day | 8 | 16 |
| Total | 50 | 100 |
| Allowing calf to suckle | | |
| Before milking | 7 | 14 |
| After milking | 12 | 24 |
| Both | 31 | 62 |
| Total | 50 | 100 |

### 3.3.6 The challenges of peri-urban camel milk production and coping strategies

The key constraints faced by camel milk producers in Mogadishu City, ranked by FGD participants in order of importance were: camel diseases, insufficient feed resources, and lack of market. Regarding the strategies suggested by the participants to address those challenges, Simpkin (1993) observed that very few veterinary doctors were familiar with camel diseases and medicines while some were reported to prescribe drugs that killed camels.

A recent study (Swai and Masaaza, 2012) revealed that CAHWs are effective and can contribute to the provision of animal health services in unserved (marginal) areas if properly trained and supervised.

The CAWHs could reduce possible cases of misuse/abuse drugs due to self-prescribed and administered veterinary drugs. Mogadishu's camel production systems are similar to those in neighboring Ethiopia (Baars, 2000), and use cultivated forages, crop residues, and commercial feed supplementation, but are not sufficiently well planned to cater for adequate and affordable feeding of camels. Camel milk producers in the peri-urban system are concerned about the problem of lack of market because it reflects significant economic losses for farmers as well as for the camel traders. Camel milk traders buy only fresh milk from farmers since camel milk consumers prefer fresh and unfermented milk (Matofari *et al.*, 2013).

**Table 3.3. 6 The challenges of peri-urban camel milk production and coping strategies**

| Challenges | Coping strategies |
|---|---|
| - Camel disease (mainly mastitis, mange trypanosomiasis, and hemorrhagic septicemia) | - Usage of conventional therapies, and also the use of veterinary self-prescribed medications.<br>- Occasional diagnosis of disease by examination of blood samples conducted in private laboratories, e.g., in Mogadishu.<br>- National NGOs such as BENALPA occasionally vaccinated<br>- Use of Community Animal Health Workers (CAHWs), due to insufficient availability of animal health professionals. |
| - Inadequate feed resources | - Splitting of the herd (non-lactating camels carried too far pastures).<br>- Maintenance techniques: like purchasing bulky feeds when the feed is available and inexpensive on the market and processed.<br>- Introducing new feed types during a shortage of feed or allowing camels to sometimes browse near the confined farms. |
| - Lack of market for the camel milk | - To reduce the selling price of milk due to competition in the milk market.<br>- To reduce the frequency of milking to avoid milk spoilage and as well as reduce the quantity of feeding |
| Inadequate transportation means | - The best strategy they used to bring the milk to the city was by renting several motorbikes to avoid blockage of the roads. |

### 3.4 Conclusions

This study concluded that the majority of the respondents (the owner, general manager, finance manager, the laborers in charge of feeding and milking) adopted group feeding, and two-thirds of the respondents fed their camels twice a day. More than two-thirds of respondents offered their concentrate mixed with other feeds and provided salt with their herds as a mineral supplement. More than half of the respondents provided free access to water depending on tap water as a source of drinking water camels. The camels were fed and milked five times a day and two-thirds of them allowed the calf to suckle both before and after milking. Feed shortage, camel diseases (e.g., trypanosomiasis and hemorrhagic septicemia), and poor market access occasioned by blockage of the roads, were the major challenges that hampered the growth of the Mogadishu peri-urban camel milk value chain.

# CHAPTER 4

# THE TYPES AND QUANTITIES OF FEEDS ON OFFER AND PROFITABILITY OF PERI-URBAN DAIRY CAMELS OF MOGADISHU


## Abstract

A study was done to identify the types and quantities of feeds on offer and profitability of peri-urban dairy camels. A total of 120 lactating camels from 10 peri-urban dairy farms were recorded. A purposive sampling of 12 camels within each farm with four camels in each lactation stage (early, middle, and late) was done. Whenever possible, the selected camels were of almost similar parities and weights. The types of feeds on offer to lactating dairy camels varied across the farm categories where the large and small-scale farms were using maize corn, sesame oil meal, alfalfa hay, yellow pea seeds, and sorghum straw while the medium scale was using the same feedstuffs except for yellow pea seeds. The quantity of feed offered also varied across the farm categories ($P < 0.05$). On average, the large, medium, and small scale farms were offering an average of 13.6kg/d, 10kg/d, and 8.4 kg/d respectively, which translated to 12.3 kg/DM/day, 9.3 kg/DM/day, and 7.7 kg/DM/day for the large, medium and small scale farms, respectively. The average estimated quantity of Metabolizable Energy, crude protein, and digestible protein offered among the large, medium and small scale farms were 121.3 MJ ME, 1983.6 g CP and 1400.6 g DP; 83.8 MJ ME, 1227.7g CP, 821.4 g DP and 73.5MJ ME, 1092.5 g CP, and 749.7 g DP, respectively. The quantity of milk produced also varied across the three categories ($P < 0.05$). On average, the milk production was 4.7 liter in the small-scale farms while the large-scale farms were 5.7liter. Therefore, the medium scale production was quite better than other scales in terms of feeding practice, income and proficiency. it can be used to improve and sustain the milk production of entire peri-urban dairy camel system.

## 4.1 Introduction

It is estimated that the annual world production of camel milk is 2.9 million liters. Somalia is the leading producer of 1.1million liters followed by Kenya, Mali, Saudi Arabia, Niger, Sudan, the UAE, Mauritania, and Chad. The total worldwide production of camel milk increased 4.6 times between 1996 and 2013, from 629 to 2928 thousand liters, mainly due to increasing demand in Africa. (FAOSTAT, 2015). Camels' basal diet consists of a wide variety of vegetation and different parts of browse which differ in quality (Wilson, 1989; Hashi et al., 1995). Ingestion levels can be rapid where preferred or selected browse is abundant but much slower on thorny species with small leaves (Kassilly, 2010)

The quantity of feed eaten by a camel depends on the water content of the forage. If a camel eats 30-40 kg of the fresh fodder which has a water content of 80% then the intake is only 6-8 kg dry matter (Yagil, 1994). Detailed nutritional studies in the arid lands of northern Kenya have shown that the small bodied Rendile / Gabra camels eat 1.67% of their live weight daily. The daily dry matter intake DDMI determined by multiplying this amount by actual live weight resulted in 5.02 kg per day (Field, 2005).

Energy and protein are the most limiting nutritional factors. Both are required for maintenance and production. In terms of energy, the demands for milk production are high. The required amount of one liter of milk is approximately 10 percent of the maintenance requirement. In terms of protein, milk is much more demanding in nutrients and one liter requires about 20 percent of a 400 kg female camel's maintenance requirement (Wilson, 1989).

Under peri-urban (sedentary) camel production systems, the once desirable mixed exposure and intake of feed are lost with consequences of reduced camel performance (Dereje & Uden, 2005a). Camels were brought to Mogadishu to produce milk to meet growing demand in the city of Mogadishu. However, no systematic documentation of their feeding systems or assessment of their efficacy for feeding was not been done. In this paper, we report documentation of the feeds offered to peri-urban dairy camels and an assessment of their ability to meet nutritional requirements for milking camels.

## 4.2 Materials and methods

### 4.2.1 Study farms

These farms are located at the entrance of Mogadishu city for almost 5km. It is a semi-arid area that has a bimodal rainfall pattern, with an unpredictable and irregular distribution. The average rainfall in the area according to the Rainfall Estimate was 25-150 mm. Long rains come in late March through May and short rains in November to December, with most parts of the Country having mean annual temperatures between 24°C and 30°C.

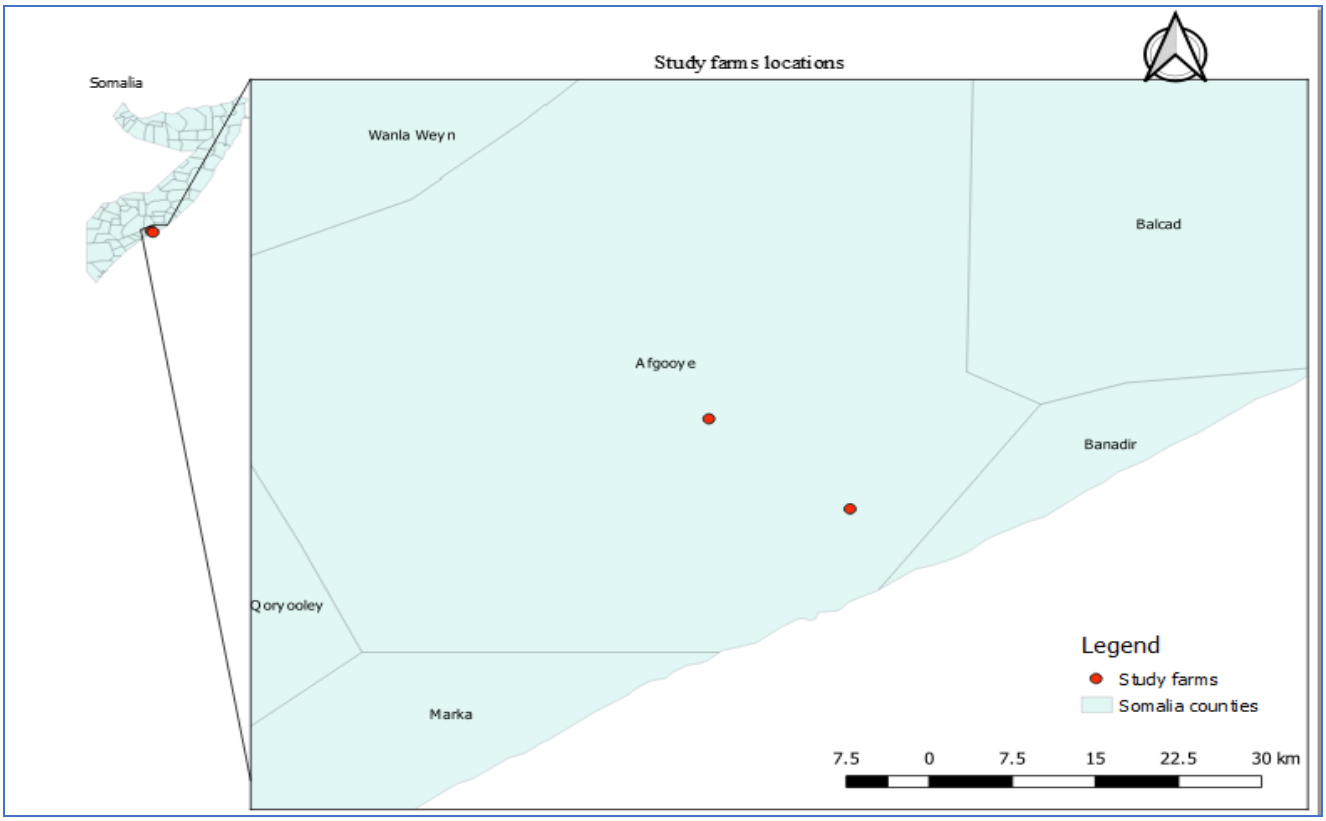


**Figure 4. 1 Map of study farms which are peri-urban dairy farms**

### 4.2.2 Data Collection

The data was collected from 10 farms which were categorized in small herd farms (less than 30 camels); medium herd farms (31- 50 camels); and large herd farms (over 50 camels), A purposive sampling of 12 camels within each farm with four camels in each lactation stage (early, middle, and late) was done. Whenever possible, the selected camels were of almost similar parities and weights. The types and amounts of feeds offered were recorded twice a week for twelve weeks while the milk yield was recorded daily on each farm.

### 4.2.3 Data Analysis

The recorded data were cleaned, sorted, and entered into a Microsoft Excel spreadsheet. This was exported to Statistical Package for Social Sciences (SPSS), version 21.0. For analysis, descriptive statistics were obtained using t-tests and cross-tabulation.

## 4.3 Result and Discussion

### 4.3.1 Types and amounts of Feeds on Offer to Lactating Dairy Camels and Estimated Composition from Feed Tables

The different types and amounts of feeds offered to lactating dairy camels and their estimated composition from feed tables are shown in Table 4.3.1. The large and small scale farmers used to feed their camel herds with the same feedstuffs, such as maize, sesame oil meal, yellow peas seed, Alfalfa hay, and sorghum straw while the medium scale farmers used only maize, sesame oil meal, sorghum straw, and alfalfa hay. On average, the large, medium, and small scale farms were offering an average of 13.6 kg/d, 10 kg/d, and 8.4 kg/d, respectively, which translated to 12.3 kg/DM/day, 9.3 kg/DM/day, and 7.7 kg/DM/day for the large, medium and small scale farms, respectively. The average estimated quantity of metabolizable energy, crude protein, and digestible protein offered among the large, medium and small scale farms were calculated at 121.3 MJME, 1983.6 g CP and 1400.6 g DP; 83.8 MJME, 1227.7 g CP, 821.4 g DP and 73.5 MJME, 1092.5 g CP, and 749.7 g DP, respectively. Similar findings were reported by Mercha et al. (2020) who used diets containing Lucerne, barley grain, wheat bran, and grown straw which is quite similar to what was recorded in the current study. It has been recorded by Wardeh (2004) that the lactating camels consumed greater quantities of dry matter (9.3 kg/head/day) than dry ones (6.7 kg/head/day). Feeds on offer are calculated at 2.5 percent of the bodyweight at 10.88

MJ ME / kg DM, with 8.39 MJ / kg DM for lactating and dry camels respectively, according to Basmail (1989).

**Table 4.3. 1 The Types of Feeds on Offer to Lactating Dairy Camels and Estimated Nutrient Composition from Feed Tables**

| Scale production | Types of Feedstuff | Ave. Amount of feedstuff in (kg)/d | DMI (kg) | MEMJ | CP (g) | DP (g) |
|---|---|---|---|---|---|---|
| Large | Maize | 3.3 | 2.8 | 38.7 | 267.7 | 177.5 |
| | Sesame oil meal | 2.0 | 1.9 | 23.2 | 833.3 | 653.3 |
| | Alfalfa hay | 2.0 | 1.8 | 15.0 | 325.4 | 228.4 |
| | Sorghum straw | 5.3 | 4.9 | 32.0 | 182.4 | 41.6 |
| | Yellow Peas seed | 1.0 | 0.9 | 12.3 | 374.7 | 299.8 |
| **Total** | | **13.6** | **12.3** | **121.3** | **1983.6** | **1400.6** |
| Medium | Maize | 2.0 | 1.7 | 23.5 | 162.2 | 107.6 |
| | Sesame oil meal | 1.6 | 15 | 18.6 | 666.7 | 522.7 |
| | Sorghum straw | 5.3 | 4.9 | 32.0 | 187.3 | 42.7 |
| | Alfalfa hay | 1.3 | 1.2 | 9.8 | 211.5 | 148.5 |
| **Total** | | **10.2** | **9.3** | **83.83** | **1227.74** | **821.43** |
| Small | Maize | 2.2 | 1.9 | 25.8 | 178.5 | 118.3 |
| | Sesame oil meal | 1.7 | 1.6 | 19.7 | 708.3 | 555.3 |
| | Alfalfa hay | 0.1 | 0.1 | 0.8 | 16.3 | 11.4 |
| | Sorghum straw | 4.3 | 4.0 | 26.0 | 152.0 | 34.6 |
| | Yellow Peas seed | 0.1 | 0.1 | 1.2 | 37.5 | 30 |
| **Total** | | **8.4** | **7.7** | **73.5** | **1092.52** | **749.7** |

CP= Crude protein, DCP= Digestible crude protein
ME=Metabolizable Energy,
MJ= Megajoules, Kg= kilogram
Percentage of dry matter bases of all feedstuff such as maize, sesame oil meal, alfalfa hay, sorghum straw, yellow peas seed (86.3, 92.8, 89.4, 93, 88.8) respectively

Standard values of ME MJ per kg of DMI in all feedstuffs (13.6, 12.5, 6.5, 8.5, 13.9)
The standard value of CP% per kg in all feedstuffs (9.4, 44.9, 3.8, 18.2, 42.2)
Standard values of DCP% per kg in all feedstuffs (66.3, 78.4, 70.2, 22.8, 80.0)
Source of these values by Heuzé V., Tran G., Lebas F., 2017. Feedipedia**,**

### 4.3.2 Comparison of the nutrient requirement of lactating camel to current feed offered in Peri-urban dairy camel production

The comparison of the nutrient requirements for lactating camel reported in literature to those of peri-urban dairy camel production in Mogadishu is shown in Table 4.3.2. The energy and protein requirement were based on the average body weights for different scales production. In the large-scale production which was under average body weight of 493 kg, the requirement of dry matter intake and metabolizable energy was (13.3 kg/d and 122.7 MJ/day) and the diet offered provided (12.3kg DM/d and 121.3 MJ/day) which means it met 99% of the requirements. This same diet provided 1400.6 g of digestible protein per day. The requirements for digestible protein for the large scale were 845.g per day which means that the diet supplied 66% more than requirement or about 555.6 g more of digestible protein. The medium and small-scale camel herds, had average body weights between 445 kg and 463kg respectively, or approximately 450kg. The dry matter intake and metabolizable energy requirement were 12.5 kg/d and 115.2 MJ/day. They provided 9.3kg DM/d and 83.8.7 MJ/day for medium and 7.7 kg DM/d and 73.5 MJ/day for the small scale production, respectively. The same diet provided 821.4g and 749.7g of digestible protein for medium and small scale production, respectively. The requirement for digestible energy for both scales was 803g per day. Therefore, for the medium scale, the camels met 73% of the metabolizable energy requirements and 102% for digestible protein requirement. The small-scale production provided 64% of metabolizable energy requirement and 93% of digestible protein falling short of requirements. Similar findings were reported by Wardeh (1989), noting that the nutrient requirement for lactating camels depends on different camel body weights. The energy and protein requirement for maintenance and production of 500kg live weight camels are for

example122.7ME MJ, 845 g DP/day while the requirements for 450 kg live body weight camel is 115.2 ME MJ, 803 g DP.

**Table 4.3. 2 Comparison of the nutrient requirement of lactating camel to current feed offered in Peri-urban dairy camel production**

| Scale production | Ave. Bodyweight | As per requirement | | | Current feed offered | | |
|---|---|---|---|---|---|---|---|
| | | DMI (kg) | Energy MJ ME | DP (g) | DMI (kg) | Energy MJ ME | DP (g) |
| Large | 493 | 13.3 | 122.7 | 845 | 12.3 | 121.3 | 1400.6 |
| Medium | 445 | 12.5 | 115.2 | 803 | 9.3 | 83.8 | 821.4 |
| Small | 463 | 12.5 | 115.2 | 803 | 7.7 | 73.5 | 749.7 |

### 4.3.3 The quantity of milk produced and their parity in peri-urban dairy farms

The quantity of milk produced varied with parity across the three farm categories with ($P < 0.05$). On average, the milk production was lowest in the small scale farms while the largescale farms had the highest production. Within each of the farm categories, significant differences were observed between the stages of lactation as shown in table 4.3.3 below. In each of the categories, it was observed that milk production was lowest during the late stage of lactation. Similar finding was reported by Farah (2004) that the average daily milk of Somali breed camels is from 5 to 8 litters meaning only the small scale farmers were below the average in the current study. It was also reported by Field (1979) that daily yields peak between 10-20 weeks after parturition, tailing off to give low yields at the end of lactation in agreement with the current study. It was also observed that within the largescale farms, camels in the $2^{nd}$ parity gave the highest milk yield, followed by those in the $4^{th}$ parity for the medium scale while the $5^{th}$ parity camels within the small scale farms trailed. Babiker & El-Zubeir (2014) reported that she-camels

had the highest milk yield in the second parity (4.06±1.85 L/day) in agreement with camels in the large scale farms in the current study. However, in contrast, (Musaad et al. 2013) showed that the highest recorded average being the eighth parity.

**Table 4.3. 3 The quantity of milk produced by the confined peri-urban dairy camel farms**

| Scale production | Stage of lactation | Mean yield (liters) | Std. error of difference | Parity | p value |
|---|---|---|---|---|---|
| Large | Early | 5.8 | 0.2 | 3 | <0.05 |
| | Late | 4.4 | 0.1 | | |
| | Mid | 5.9 | 0.1 | | |
| Total | | **5.4** | **0.1** | | |
| Medium | Early | 4.7 | 0.1 | 4 | <0.05 |
| | Late | 4.5 | 0.1 | | |
| | Mid | 6.0 | 0.1 | | |
| Total | | **5.0** | **0.1** | | |
| Small | Early | 4.7 | 0.1 | 5 | <0.05 |
| | Late | 4.5 | 0.0 | | |
| | Mid | 4.8 | 0.0 | | |
| Total | | **4.7** | 0.0 | | |

### 4.3.4 The cost of feed, profitability, and milk efficiency of peri-urban dairy camels

The cost of feed, profitability, and milk efficiencies of peri-urban dairy camels are shown in Table 4.3.4. The cost of feeds used in peri-urban dairy varied across the three farm categories (P< 0.05). On average, the feed cost was lowest in the small scale farms and highest in the largescale farms. The profit also varied among the scale production (P< 0.04). On average, the

profit was lowest in small scale farms while the medium scale farm had the highest. The milk efficiency among the scale production differed ($P<0.05$). On average, the milk efficiency was lowest on a large scale while the medium scale farms had the highest.

A similar report was published by Dairexnet (2019) that lower feed intake and feed cost resulted in higher feed efficiency due to lower nutrient excretion as manure. As earlier indicated in table 4.3.2on feed intake, camels in the large scale farms had the highest feed intake and feed cost compared to medium and small scale farms. This therefore the low profitability and milk efficiency of the large scale farms compared to lower scales as shown in Table 4.3.4. The most profitable scale of production was the medium.

**Table 4.3. 4 The cost of feed, profitability, and milk efficiency of peri-urban dairy camels**

| Scale production | Parameters | Means (per day/head) | Std. error of means | p-value |
|---|---|---|---|---|
| Large scale | **Feed cost** | 4.4$ | 0.1 | **< 0.05** |
| | **Profit** | 6.3$ | 0.2 | **<0.04** |
| | **Milk efficiency** | 44.7% | 0.6 | **<0.09** |
| Medium-scale | **Feed cost** | 3.1$ | 0.02 | **<0.05** |
| | **Profit** | 6.9$ | 0.1 | **<0.04** |
| | **Milk efficiency** | 53.8% | 0.8 | **<0.09** |
| Small scale | **Feed cost** | 3.0$ | 0.03 | **<0.05** |
| | **Profit** | 6.2$ | 0.1 | **<0.04** |
| | **Milk efficiency** | 61.4% | 0.5 | **<0.09** |

## 4.4 Conclusion

The study concluded that the types of feed offered in the peri-urban dairy camel production in Mogadishu were maize corn, sesame oil meal, alfalfa hay, yellow pea seeds, and sorghum straw. The highest average amount of feed offered to camels was 13.6kg as fed and equivalent to 12.3kgDM/day in large scale farms while the lowest average amount of feed offered was 8.4kg as fed equivalent to 7.7kgDM in small scale farms. Besides, lactating camels in the medium scale production were fed adequately and met their daily nutrient requirements. Camels in the large scale production were properly covered in terms of dry matter intake and metabolizable energy requirements but exceeded by 66% the required amount of digestible protein for their level of milk production. Camels in the small scale farms were fed less and had lower yields than those in the other categories. Although the large scale camels had the highest milk yields, it was lower than that targeted for the feed offered. The profitability and milk efficiency for the large scale farms were low compared to the medium scale farms which produced approximately at the same level as the large scale farms but at a lower cost. The medium and small scale farms, had higher incomes from good milk production efficiency.

# CHAPTER 5

# 5.0 GENERAL DISCUSSION, CONCLUSION AND RECOMMENDATIONS

## 5.1 General Discussion

Camel production is the predominant pastoralist livelihood choice, and also a very important livelihood tool for agro-pastoralists in the Somali region (Abera, et al. 2019). Feeding management practices is about availing the required quantity of nutrients needed by livestock for maintenance and a certain level of production (growth and milk) and reproduction while minimizing overfeeding in which case, the excess nutrient including nitrogen and phosphorus are excreted in urine and manure. The effective feeding of nutrients helps in improving the net farm earnings. Camel milk is becoming rapidly marketable and consumed in urban areas. Recent market-oriented smallholder dairy studies in peri-urban areas in East Africa show that the advantages of dairy camels greatly outweigh those of traditional alternative farming practices (Farah, 2007). The two studies were therefore done to evaluate feeding Management practices, challenges, and coping strategies and to identify the types and quantities of feeds on offer and profitability of confined peri-urban dairy camels. The first study was done to evaluate the feeding management practices, challenges, and coping strategies of confined peri-urban dairy camels in Mogadishu. Feeding practices and housing play a very important role in exploiting the real potential of dairy animals as described by Sinha et al., (2009). The Peri-urban system is unlike the pastoral system because the pastoral feeding practices are not well documented and the production is low compare to the peri-urban system, for example, the frequency of milking in the pastoral system is twice a day while the per-urban system camels are milked five times a day so the feeding practices influence milk yield.

Noor, et al. (2013) reported that Feeding practices are likely to influence milk yield and composition in small-scale dairy cows and pastoral camel herds. Camel milk producers in the peri-urban system are very concerned about the problems like camel diseases, feed shortage, lack of market which caused milk spoilage. These problems can be overcome with proper disease diagnoses, feed conservation, and observing hygiene when managing the herd.

A longitudinal study was carried out to identify the types and quantities of Feeds on offer and the Profitability of confined Peri-urban Dairy Camels. Despite the improvement in camel and camel production research in the last two to three decades, there is still limited knowledge of camel's nutritional requirements to provide adequate information needed for systematic feeding for efficient and profitable production (Wilson, 1998). This can be explained by the fact that, for a long time, camels have rarely been managed for commercial purposes (Wardeh, 1994). Therefore, this study revealed the types and quantity, estimated nutrient requirement of feed offered peri-urban dairy as shown in table 4.3.1. Similar findings were reported by (Wardeh, M.F., 1989), that the nutrient requirement for lactating camels depends on different camel body weights. like the energy and protein requirement for maintenance and production of 500kg body weight (122.7ME MJ, 845gDP) per day while 450kg of camel body weight, its nutrient requirement for maintenance and production is (115.2MEMJ, 803gDP)

## 5.2 General Conclusions

The study found that the majority of the camel milk producers use commercial feeds, crop and crop residue, and concentrates. The most common feeds in the peri-urban dairy camel production system in Mogadishu were maize corn, sesame oil meal, sorghum straw, yellow pea seed (lentils), and alfalfa hay. They were fed twice a day and the majority milked five times a day.

Due to inadequate knowledge and rains, most farmers don't grow fodder and few grew grass. The camel milk farmers purchased supplements, the main one being mineral licks from Mogadishu from private agro vet retailers for the lactating camels. The study showed that well tap water was the principal source of water for camels and the herds were allowed free access to the water. This study also revealed that medium scale production system was more efficient than the other two scales. Feed scarcity, camel diseases (e.g., trypanosomiasis and hemorrhagic septicemia), and lack of market associated by blockage of roads, and an inadequate feed resource base were the major challenges that affect the growth of the Mogadishu peri-urban camel milk value chain.

### 5.3. General Recommendations

1. To avoid overfeeding and wastage of feeds, farmers should separate and feed the camels based on the lactation stage since the nutrient requirements vary for the different stages of lactation.

2. To overcome the inadequate challenge of feed resources, producers need to be sensitized through training workshops on the practicality of supplementing feed to lactating camels, especially during the shortage of feeds.

3. It is essential for owners to know the nutrient composition to formulate a balanced ration feed suitable for the peri-urban dairy camel in Mogadishu. It is strongly recommended that the farmers seek advice from an animal nutritionist.

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## APPENDICES

**Appendix 1: Form 1A-Registration Form: Census form recording all camels' data (120 camels)**

| No | Camel Name | Date of Birth | Parity | Date of last calving | Calf sex | Size | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Appendix 2: Form 1B- Records of feed offered to camel groups**

**Recording form Date_____ time_____ Farm identity_____**

| Week | Type of feed offered | Amount | Feeding Regime | Feed price per kg |
|---|---|---|---|---|
| 1 | | | | |
| | | | | |
| | | | | |
| | | | | |

**Appendix 3: Camel Daily milk record card**

Farm Identity_____

Camel Identity_____ Date of Calving _____sex of calf_____-

| Week of recording | Date | AM milk yield | PM Milk Yield | Remarks |
|---|---|---|---|---|
| 1 | | | | |
| | | | | |
| 2 | | | | |
| | | | | |

**Appendix 3: Questionnaire**

Questionnaire number _____

Enumerator's Name _____

Date of interview DD _____ MM _____YEAR____ Location_____

**A. Herd owner/respondent characteristics.**

1. What is your Gender?
   1- Male ☐
   2 -Female ☐

2. What is your Age?
   1- Less than 35 ☐
   2- 36-45 ☐
   3- Over 55 ☐

3. What is your education level?
   1 –illiterate ☐
   2 -Primary ☐
   3 -Secondary ☐
   4 –University ☐

4. What is your major occupation?
   1- Livestock keeping ☐
   2 -Business ☐
   3 -Formal employment ☐

**B. Camel ownership and production objectives**

5. Was your first/foundation herd acquired through?

1. Inheritance from family ☐
2. Purchase ☐
3. Both inheritance and purchase ☐

6. Rank the reasons that necessitated you to adopting the present system of camel keeping

| | Rank |
|---|---|
| 1. Extension officers and other promoters influence | |
| 2. Found the system more suitable to urban conditions | |

3 = Highest importance; 2 = Average importance; 1 = Low importance; 0 = Not of any importance

7. What are the total number of lactating camels in most farms currently?

1. Less than -30 ☐
2. in between 31-50 ☐
3. Over 50 ☐

| Factors | Rank |
|---|---|
| 1. feed and water available | |
| 2. Easy access to an urban market for camel milk, meat, and live camels | |
| 3. Improved security | |

8. When did you start practicing the confined peri-urban dairy camel system?

a. before 2010 ☐
b. in between 2011-2014 ☐
c. After 2015 ☐

9. Rank factors that encourage the keeping of camel around Mogadishu City

3 = Highest importance; 2 = Average importance; 1 = Low importance; 0 = Not of any importance

10. How many employees work on your camel dairy farm?

☐

1. Less than three
2. Four-six
3. More than six

11. What do they earn from the camel dairy farm?

1. less than $100
2. In between $101-120
3. Over $120

12. Rank the contribution of camels to your household needs**:**

| | Rank |
|---|---|
| 1. Milk for selling | |
| 2. Progenies (offspring) sale | |
| 4. Form of wealth | |

3 = Highest importance; 2 = Average importance; 1 = Low importance; 0 = No importance

**C- Feeding practices and milk performance**

13) Rank the importance of the following feeds for feeding your camel herd:

| Types of feed resource | Rank |
|---|---|
| 1. Purchased commercial feeds (Alaf) | |
| 2. Crops and crop residues | |
| 3. Cultivated forages | |
| 4. Concentrates | |

3 = Highest importance; 2 = Average importance; 1 = Low importance; 0 = Not of any importance

14. How do you feed your camels?

1. By Individual
2. By grouping

15. How many times do you feed your camel herd per day?

    1. Once
    2. Twice
    3. Thrice or more

16. When did you feed your animal?

    1. During milking
    2. After milking
    3. Before milking

17. How do you feed the concentrates for your camel herds?

    1. Mixed with fodder
    2. Separately

18. What do you give as feed supplements or minerals?

    1- Table salt
    2- Powder milk
    3- Both

19. During the season of the year, when did you face scarcity of feed?

    1- Dry season
    2- Wet season

20. How many times do you milk your camels per day?

    1. Less than 4 times
    2. 5 times
    3. More than 5 times

21. When did you allow your calf for suckling?

    1. Before milking
    2. After milking

3. Both

22. What is your source of water for your camel herds?

1- Well
2- Tap water
3- Borehole
4- River

23. How many times do you give water to your camels?

1. Twice a day
2. Thrice a day
3. Free access to water

24. Rank the following most important constraints influencing camel milk production

| Constraints | Rank |
|---|---|
| 1. Feed shortage | |
| 2. High feed prices | |
| 3. Diseases and parasites | |
| 4. High medicament costs | |
| 5. Inadequate transport means for the camel milk | |
| 6. Inefficient breeding services | |
| 7. lack of market for milk | |

7. Most important 1. Least important