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The Impact of Milking Frequency on Camel Milk Yield and Composition in Khartoum, Sudan

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Abstract

The research was conducted in Omdurman, Bahri, and Khartoum using a semi-intensive system from November 2020 to January 2021. The she-camels were given two kilograms of supplementary feed, Total Mixed Ration (TMR) containing 17% crude protein (CP) and 12% metabolism energy (ME) in group feeding. They were allowed to graze for seven hours a day and rest for an hour inside the gates. The study investigated the composition and milk output of 120 she-camels, focusing on acidity, pH, total solids, protein, fat, moisture, ash, and density, to determine the impact of daily milking frequency on yield and components. The findings revealed that the Bahri area had the highest moisture value (87.88%), followed by the Khartoum area (87.75%), and Omdurman area (87.39%). The highest total solid value was 12.40% in Khartoum, followed by Bahri (11.57%) and the lowest value was in Omdurman (11.53%). The highest pH value was 5.46 in Khartoum, followed by Bahri (4.53%), and the lowest value was 4.53 in Omdurman. The highest protein value was 3.90% in Khartoum, followed by Bahri (3.82%), and the lowest value was 3.46% in Omdurman. The highest density value was 1.03% in Khartoum, and the same value was observed for Bahri and Omdurman (1.02%). The highest acidity value was 0.38% in Omdurman, followed by Bahri (0.38%), and the lowest value was 0.28% in Khartoum. The highest fat value was 3.91% in Bahri, followed by Khartoum (3.63%), and the lowest value was 3.43% in Omdurman. The highest ash value was 0.67% in Khartoum, followed by Omdurman (0.65%), and the lowest value was 0.60% in Bahri.

Keywords: Physiochemical, She-camel, Yield, Semi-intensive, Frequency**.**

Introduction

Camelid milk has numerous health and nutritional advantages. The traditional grazing regions of camels around the world were impacted by climate change **(Wardeh, 2004)**. This was especially true for camel keepers in Sudan, home to 4.8 million camels **(MARF, 2021)**. In Sudan, camels are a promising breed of dairy cow. **Hassabo et al. (2012)**. Tribal wars, drought, and desertion are just a few of the issues that affect camels and reduce their production **(Darosa, 2005)**. For these reasons, scientists conducted studies to raise the milk yield in Sudan and other tropical nations **(Farah et al., 2004)**. To boost their yield, camels receive additional feed **(Salih et al., 2012)**. Previous studies on milk frequency in other nations have produced encouraging results, particularly when milking twice a day **(Abdurrahman et al., 2016)**. Drought in Sudan leaded the owners of camels to migrate nearest towns by small scale herds for dairy **(Bakhit, 2009)**. For their lost income and substituted by selling the milk to gain money and become civilian, although they produce low milk **(Suliman, 2012)**. So, this study aims the increase the milk yield around urban areas Khartoum state by increasing milking time (frequency) and feeding extra ration.

Materials and Methods

The research was conducted around the city of Khartoum in the localities of Khartoum, Bahri and Omdurman in the period from November 2020 to January 2021 on the semi-intensive system. The study was carried out at the Animal Production Department Laboratory, Faculty of Agriculture Technology and Fish Sciences, University of Al-neelain.

Lactating camel feeding

A total of 120 lactating camels were used in the experiment, with some located in Omdurman, some in Bahri, and others in Khartoum. The camel grazed for six hours each day. From 6:30 am to 12:30 pm after grazing, they were fed a concentrate feed mixture containing Total Mixed Ration (TMR) and 17% CP and 12% ME and each camel consuming about 2 Kg of the mixture.

Experimental design

The impact of milking frequency on camel milk yield and composition under condition of Khartoum was conducted in Shanblah in the Bahri, Gharbawi in Omdorman and Al-Kawahili in Khartoum regions from November (2020) to January (2021).

Milk yield and composition

Samples of camel milk were collected at different periods in the morning and evening, and the analysis is being conducted at Al-Nilein University in the College of Agriculture laboratory. The milk samples are placed in small packaging bottles and placed in a large container provided with ice to ensure that the milk is preserved and not contaminated until the samples are analyzed in the laboratory. The percentages were determined for protein, ash, Total solid, moisture, Acidity, Fats, Lactose. Their milk yield and constituency to be recorded and

they milked twice a day in the morning and evening 5:00 am up to 3:00 pm (10 hour interval). Milk yield and constituents to be recorded in each milking.

Statistical Analysis

The obtained data were statistically analyzed according to statistical analysis system **(SAS, 2003)**. Least Significant Difference (LSD) distinguished the differences among means and significant level was set at 5%.

Results and discussion

Table 1 presents the components of camel milk collected in the morning and evening. The results showed that the average moisture content of camel milk samples collected from Khartoum, Bahri, and Omdurman was 87.95±0.49, 87.94±0.48, and 87.95±0.48 in the morning, while the values were 87.39±1.016, 87.38±1.015, and 87.38±1.011 in the evening, respectively. These values were significantly difference ($P<0.01$). The average total solid content of camel milk samples collected during this study from Khartoum, Bahri, and Omdurman were 11.88±0.48, 11.87±0.47, 11.85±0.45 in the morning and 11.79±0.69, 11.78±0.68, 11.79±0.69 in the evening, but there was no significant difference ($P>0.05$).

Similarly, the average density content of camel milk samples collected during this study from Khartoum, Bahri, and Omdurman were the same value (1.02±0.00) in the morning and in the evening, with no significant difference ($P>0.05$). Finally, the average acidity content of camel milk samples collected during this study from Khartoum, Bahri, and Omdurman were 0.35±0.11, 0.34±0.10, 0.35±0.11 in the morning and 0.34±0.09, 0.34±0.8, 0.34±0.09 in the evening, but there was no significant difference ($P>0.05$).

The average pH content of the camel milk samples was 5.11±0.93, 5.10±0.92, and 5.11±0.93 in the morning and 4.70±0.90, 4.71±0.91, and 4.70±0.90 in the evening for Khartoum, Bahri, and Omdurman, respectively. The differences was significant ($P<0.01$). The average protein content of the camel milk samples was 3.73±0.44, 3.72±0.43, and 3.72±0.44 in the morning and 3.73±0.36, 3.71±0.35, and 3.73±0.35 in the evening for Khartoum, Bahri, and Omdurman, respectively. However, there was no significant variation ($P>0.05$) observed in the protein content. The average fat content of the camel milk samples was 3.61±0.45, 3.60±0.44, and 3.60±0.44 in the morning and 3.70±0.33, 3.70±0.32, and 3.70±0.33 in the evening for Khartoum, Bahri, and Omdurman, respectively. The difference was significant ($P<0.01$).

Also, Table 1 showed that the average ash content of camel milk samples collected from Khartoum, Bahri, and Omdurman was found to be 0.65±0.04, 0.64±0.04 and 0.65±0.04 in the morning and 0.64±0.05, 0.63±0.04 and 0.64±0.05 in the evening. These values were significantly difference ($P<0.01$). The values of humidity, pH, fats, and ash were found to be significantly difference in the morning and evening milk samples, while total solid, density, acidity, and protein showed non-significant variations. These variations were attributed to feeding and lactation. These results are consistent with the findings of **Zayed (2012) and Abdarhman et al. (2016)**.

Table 1. The components of camel milk collected in the morning and evening (Means ± Standard deviation (Std)).

Area	*Khartoum*		*Bahri*		*Omdurman*		LS
	Mean±Std		**Mean±Std**		**Mean±Std**		
Components	**Morning**	**Evening**	**Morning**	**Evening**	**Morning**	**Evening**	
Moisture	87.95±0.49	87.39±1.016	87.94±0.48	87.38±1.015	87.95±0.48	87.38±1.011	**
Total solid	11.88±0.48	11.79±0.69	11.87±0.47	11.78±0.68	11.85±0.45	11.79±0.69	NS
Density	1.02±0.00	1.02±0.00	1.02±0.00	1.02±0.00	1.02±0.00	1.02±0.00	NS
Acidity	0.35±0.11	0.34±0.09	0.34±0.10	0.34±0.8	0.35±0.11	0.34±0.09	NS
PH	5.11±0.93,	4.70±0.90	5.10±0.92	4.71±0.91	5.11±0.93	4.70±0.90	**
Protein	3.73±0.44,	3.73±0.36	3.72±0.43	3.71±0.35	3.72±0.44	3.73±0.35	NS
Fats	3.61±0.45,	3.70±0.33	3.60±0.44	3.70±0.32	3.60±0.44	3.70±0.33	**
Ash	0.65±0.04,	0.64±0.05	0.64±0.04	0.63±0.0	0.65±0.04	0.64±0.05	**

LS = Levels of significance.

Protein provides of camel milk: profile of camel milk

Results of Table 1 agree with the studies conducted by **Salih and Hamid (2012)** and **Hasabo et al. (2012)**, which found that the milk protein content of camel milk ranges from 3.45% to 3.90%, respectively. The fat content of the camel milk sample was not significantly difference (P>0.05). However, the highest fat content was reported, and the variation was associated with factors such as breed type, milk frequency, lactation stage, genetic factors, age, parity, and feeding system. Similar results were reported by **Bakhit (2009); Abdarhman et al. (2016); Yagil (2006) and Alobied et al. (2015)**, who found that the fat content of camel milk varies between 2.9 to 5.4%. The ash content of the camel milk samples confirmed the findings of **Salih and Hamid (2012) and Abdelrahman (2016)**, who reported that ash ranged from 0.79% to 0.82% and from 0.35% to 0.95%, respectively.

Chemical composition of camel milk from Khartoum state

Table 2 presents the components of camel milk collected from areas in Khartoum such as Bahri, Omdurman, and Khartoum. The Total Solid (TS) content of the milk samples collected from these areas was significantly difference (P<0.01). The highest TS content was found in the milk samples collected from Bahri, which could be due to the stage of lactation and feeding conditions. These results were similar to those reported by **Alobied (2015)** who

found that the TS content of camel milk ranges between 10.9% and 12.63%. This might be related to an increase in drinking water availability (Anti-Diuretic Hormone - ADH). These results are also in agreement with the findings of **Farah and Fischer (2004) and Abdurrahman et al. (2015)** who reported TS contents of 11.49% and 11.14%, respectively.

The moisture content of milk samples in Table 2 ranged from 87.88 to 87.39, with the highest mean being recorded in Bahri area and the lowest in Omdurman area. This is consistent with the findings of **Suliman (2012) and Zayed (2012)**. The highest mean protein was recorded in Khartoum area (3.90%), while the lowest was in Omdorman area (3.46%) and the middle value was in Bahri area (3.82%). This might be related to the availability of drinking water and factors such as feeding condition and stage of lactation. The results showed that there was no significant variation (P>0.05) in the protein content of camel milk samples, which is in agreement with **Zayed (2012)** and ranged between 3.5 to 4.5%, respectively.

Table 2. The components of camel milk from areas in Khartoum, Bahri and Omdurman (Means±Standard Deviations (Std)).

Area / Components	*Khartoum* Mean± Std	*Bahri* Mean± Std	*Omdurman* Mean ± Std	LS
Moisture	87.75±0.44	87.88±0.68	87.39±1.37	**
Total solid	12.40±0.30	11.57±0.49	11.53±0.52	**
Density	1.03±0.00	1.02±0.00	1.02±0.00	**
Acidity	0.28±0.09	0.38±0.04	0.38±0.12	**
PH	5.46±0.99	4.53±0.82	4.53±0.17	**
Protein	3.90±0.35	3.82±0.47	3.46±0.18	**

LS = Levels of significance.

Table 3 presents a comparison of three areas in Khartoum governorate. The statistical analysis in Table 3 shows significant differences at the 0.05% level between feeding groups, feeding periods, and their interaction. This difference is due to the behavior of the camels and the feeding method, which is influenced by the movement of the herd. These findings confirm the importance of raising camels in the semi-intensive sector as concluded by **Salam (2000)**. Additionally, **Musa et al. (2003)** confirmed that camels have the ability to benefit from poor natural pastures and add concentrated feed to their diet.

Table 3. A comparison of the total solid, protein, fat, ash, and lactose yields in the three areas of Khartoum Governorate.

Area	***Khartoum***		***Bahri***		***Omdurman***		**LS**
	Mean		**Mean**		**Mean**		
Component	**Before feed supply**	**After feed supply**	**Before feed supply**	**After feed supply**	**Before feed supply**	**After feed supply**	
Total solid/ yield, g/ day	2.187	1.160	1.554	0.786	1.923	1.011	**
Protein /yield, g/ day	0.745	0.367	0.395	0.219	0.603	0.292	**
Fat /yield, g/ day	0.703	0.372	0.395	0.223	0.569	0.297	**
Ash /yield, g/ day	0.117	0.0700	0.0489	0.0415	0.095	0.0560	**
Lactose/, yield, g/ day	3.3	3.26	3.57	4.79	4.3	4.4	**

LS = Levels of significance.

The percentage of fat, ash, protein, and solids was affected by difference feeding systems, and this may be due to the difference in the components of milk depending on the number of times milking, the type of feed, and the consumption of trees.

Recommendations

- Providing an extra ration of feed is important for obtaining abundant milk yield from she-camels.
- Good management practices should be applied in dairy camel farming.
- Providing adequate feed to camels during rest time or when in fences is the best way to improve and increase their milk yield, in addition to increasing milking time per day.

Conclusion

The productivity of lactating camels in the studied areas is very low due to insufficient nutrient supply for the pasture under traditional grazing systems. To increase animal productivity and maximize profit in this system, it is necessary to supply nutrients by providing feed for lactating camels. Supplementing lactating camels with a basic ration (CP 17%, ME 12%) can significantly increase milk yield and milk constituent yield. Adding concentrated feed after grazing provides an abundance of nutrients that are converted into milk. This is because the intestine is poor and cannot meet the animals' needs, and the hours of grazing are not enough to cover the animals' needs. The research recommends adopting the semi-intensive system for better milk production and performance.

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