PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 8 (12): 1868-1872, 2009
ISSN 1680-5194

Variations in Milk Yield and Composition Between Fore and Rear Udder-Halves in She-Camel (*Camelus Dromedarius*)

M.O. Eisa[1] and A.A. Hassabo[2]*
[1]Department of Animal Production, Faculty of Agriculture, Islamic University of Omdurman
[2]School of Animal Production, Faculty of Agricultural Technology and Fish Science, University of Al Neelain, Khartoum, Sudan

Abstract: Total number of Sixteen she-camels were chosen from a large herd of camel belonging to the Lahween tribe in Eastern Sudan. The breed is known locally as Arabi-Lahwee. The fore and rear udder-halves measurements including, depth and height of the udder, distances, diameter and length of the teats. The results revealed that the depth of fore quarters was 20.9+0.75 cm and which was significantly ($p<0.01$) deeper than the rear quarters (13.1+0.75 cm), the results also indicated significant differences ($p<0.05$) between the height of fore and rear udder halves, (110.9+0.36 versus 110.2+0.36 cm, respectively). The distance between teats in the fore quarters (13.2+0.36 cm) which was significantly ($p<0.01$) longer than rear quarters (9.9+ 0.36 cm), the teats diameter of the rear quarters (2.5+0.1 cm) that was significantly ($p<0.01$) greater than the diameter of the fore quarters (2...1+ 0.1 cm). Teat length on the other hand showed non-significant difference between the udder halves. The data pertaining to milk yield and composition of the fore and rear udder quarters indicated that rear udder half produced 57.5% of the total milk yield, whereas the fore quarters yielded only 42.5% ($p<0.01$). The rear quarters produced milk, which was highly sig. ($p<0.01$) richer in protein% (3.38+0.19) and P% (1.077+0.022) and significantly ($p<0.05$) richer in moisture% (90.42+0.34), K% (1.25+0.032) and pH (6.38+0.043), also scored high but non-significant values in fat% (3.31+0.18) and Ca% (7.169+0.034). While, the fore udder quarters scored highly significant ($p<0.01$) value in lactose% (3.25+0.3), significant ($p<0.05$) value in total solids% (10.44+0.312) and high and non significant, values in Na% (0.64+0.012) and ash% (0.59+0.027). The amount of nutrients contained in milk from rear quarters provided higher amount of nutrients compared to milk of fore quarters.

Key words: She camel, teats, milk

INTRODUCTION

Milk is among the most important products of camel (Schwartz, 1992). Studies on the yield and composition of camels milk indicated a wide range of variations stemming from different factors including breeds, individuality, nutritional, stage of lactation, milking practices, calf suckling, availability of drinking water and frequency of milking (Ramet, 2001).

The camel, like the cows has a four quartered udder (Yagil, 1982). It is firmly suspended from the abdomen, without deep cuts (Sharma and Bhargava, 1963). The four quarters of the udder function independently and it is desirable that any yield or components of the milk from both fore and rear udder halves should be in the ratio of 50:50 for better milk ability (Gawali and Bhatnagar, 1975).

Literature on variations in milk yield and composition from different udder halves is scarce in camels. According to earlier studies, Kulaeva (1979), reported that in the camel, slightly more milk was received from the rear-quarters, (56.4%) compared to (43.6%) from the fore quarters. Ohari and Joshi (1961) demonstrate that, the milk of all quarters appears to have the same composition.

The present study was initiated to investigate milk yield and composition of the fore and rear udder halves in 16 she-camel at different lactations and to testify the indigenous belief among camel herders that calves reared by the rear quarters show better performance than their counterparts maintained on milk from fore quarters.

MATERIALS AND METHODS

Study area: The present study was conducted at Al-Khalefa Hawa Alnabi rain-fed mechanized scheme (30 km. North West of Al-Showak). Which is located in Al-Gadaref state, with the 14°3 N and 35°8 E latitudes. The area is surrounded by the rain-fed mechanized sorghum and sesame fields. The vegetation of the area is comprised of annual grasses, acacias, euphorbias and dwarf bushes. The annual rainfall varies between 400-600 mm and the maximum temp. between 40-45°C. during the dry season (December-June). Al-Showak is dominantly inhabited by two camel owning tribes Rashaida and Lahween. Both tribes are ancient camel breeders and have maintained pastoralist life for centuries. In Al-Showak area camel serve primarily as milk producers, but are also used as pack and meat animals.

Experimental animals: 16 lactating she-camels of type (Arabi-Lahwai), with different parities, stage of lactations and age (Table 1), were randomly selected from the village herd. They all represent the typical features of the Arabi camel such as heavy weight, big hump, long neck, big head with long hair on the hump and shoulder and sandy gray or fawn colour.

Identification: Each of the experimental selected females was identified by a plastic tag with a numerical No. placed round the neck. A record for each she-camel contains age, parity order, calving date, chest girth and daily milk yield were compiled.

Herd managements: The camel herds are managed by husbandry system deeply rooted in the society based on superstition and practices that were founded down by father to son over the ages.

The herds are managed in a pastoral system (Transhumant) dictated by the prevailing ecological habitat. The area is characterized by a long dry season (December-June), fluctuation in rainfall and scarcity of pasture especially during the dry season created a practice of transhumont mode of range utilization where nomad move with their herd from one area to another following certain migratory routes. The herd spends the dry season at Al-Khalefa scheme grazing sorghum residues (Table 2, 3) and some Acacia sp. They move to Alfeel forest to spend the rainy season. The herd is driven to hafeers (constructed water reservoirs) once every three days. The young calves were allowed to run freely with the mothers and were only separated at milking time, which was practiced three times a day.

Milking practice: Because of the height of the udder the milking process is done in standing position with one knee raised to support the plastic pail. The milker stands on one leg and balancing the plastic pail in his bent other leg and uses both hands for milking.

Data collections

Body weight estimation: Estimation of body weight was calculated according to Wilson (1984): Formula for linear regression of chest girth

$$Y = 5.071X-457$$

Where:

Y = Body weight in kg.

X = Animal chest girth in cm.

Udder measurements: Each measurements in the present study was taken twice and the average of the two readings was then adopted as the base of calculations.

Table 1: Details of the She-camels used for the study

She Camel ID.	Type	Age/yr	Parity order	Body wt. kg
188	A.L	13	5	471.0
128	,,	11	4	491.0
107	,,	10	3	552.1
119	,,	10	3	481.1
139	,,	12	5	521.7
130	,,	10	3	445.6
118	,,	9	3	775.3
155	,,	11	4	486.2
109	,,	9	3	465.9
127	,,	12	5	531.8
161	,,	11	4	506.5
187	,,	10	3	481.1
186	,,	13	5	582.6
182	,,	12	5	516.6
162	,,	10	3	516.6
199	,,	10	3	460.9

A-L: Arabi-Lahwee

Table 2: The composition of sorghum residuals

Moisture	Dry mater	Ash	C.P.	E.E	C.F
3.4	96.6	5.1	16.0	3.6	9.2

Table 3: Minerals contents of sorghum residuals

Na%	K%	P%	Ca%
0.039	0.5	0.6	0.3

Udder half depth: Was considered as the distance between the abdominal wall at the base of the udder and the base of the teat. Two such measurements were taken for fore and similarly for rear half and the averaged represent the depth of udder half.

Udder half height: Defined as the distance from the ground to the base of the teats and was measured as the distance from the ground to udder floor at the points directly in front of the fore and rear teats.

Distance between teats: Were estimated by measuring the distance between the fore teats and that between the rear teats, from the middle point of every two teats.

Teat length: Was measured as the distance between the bases of the teats to the tip of the teat, by stretching the tape along the teat.

Teat diameter: Measured with a vernier caliper at the middle point of the teat.

Milk yield determinations: First of all to be noted here, the calves with their dam during the experimental periods and the teats of the dams not tied up, the calves are allowed to suckle their dams to stimulate milk secretion, until the milk start to flow, then the calves are removed.

For milk yield determination two plastic pails in different colour and two milker were used. The milking is done

standing. The milker stands on two legs, hold the pail by his left hand and use the right hand to evacuated the udder half as quickly as possible in to the pails. Every udder half milked in different plastic pail and then the milk yield per udder half was estimated using two measuring Cylinders (each of 500 ml).

Milk composition determinations: A representive sample from fore and rear udder halves of individual she-camel was collected (30 ml). And each sample given the number of the animal plus a sign of the udder half (F = fore; R = Rear). The samples were stored in an insulated container using freeze packs. All milk samples were transferred to the central laboratory (suba).

Statistical analysis: The collected data was subjected to statistical analysis program, Minitab 12.1 (1997), paired t. test was used to find out the variation between fore and rear udder halve in measurements, milk yield and composition.

RESULTS

Udder measurements: The data in Table 4 showed that the mean depth of the fore quarters was 20.9±0.75 cm and which was significantly ($p<0.01$) deeper than the rear quarters (13.1±0.75 cm). The results also indicated significant differences ($p<0.05$) between the heights of fore and rear udder halves (110.9±0.36 versus 110.2± 0.36 cm, respectively). The arrangement of teats as measured by the distance between teats in the fore and rear quarters also varied significantly ($p<0.01$). The distance between teats in the fore quarters was13.2± 0.36 compared to 9.9±0.36 cm, in the rear quarters. The teat diameter was also found to be significantly different ($p<0.01$). The teat diameter of the rear teats was significantly ($p<0.01$) greater than the diameter of the fore teats (2.5±0.1 and 2.1±0.1 cm, respectively). Teat length on the other hand showed non-significant differences between the tow halves.

Milk yield and composition: The data pertaining to milk yield and composition of the fore and rear udder quarters is presented in Tables 5, 6 and 7. The result clearly indicated that the rear quarters out yielded significantly ($p<0.01$) more than the fore quarters. The udder rear half produced 57.5% of the total milk yield, whereas the fore quarters yielded only 42.5%.

The quality of milk produced by the tow udder halves, also seem to differ. The rear quarters produced milk, which was significantly ($p<0.01$) richer in proteins compared to fore quarter's milk (3.38±0.02 versus 3.31 ±0.02%). The lactose content on the other hand of the fore-quarter milk was significantly higher ($p<0.010$) than the rear quarter's milk (3.25±0.3 versus 2.43±0.3%). The fat content in rear quarter's milk was also higher than milk from fore quarters but with non-significant variation (3.31±0.02 versus 3.28±0.02%). Similarly, both the Na^{+} and Ca^{++} content of the milk from fore and rear quarters were not significantly different, however milk obtained from rear quarters contained significantly higher values of K^{+} and P^{++} which were 1.25±0.03 and 7.17±0.03%, respectively, compared to 1.17±0.03 and 7.15±0.03%, respectively obtained from fore quarters milk. Furtherly, the milk pH of the rear quarter was significantly higher ($p<0.05$) than the fore quarter (6.38±0.04 versus 6.28 ±0.04).

The amount of nutrients contained in the milk from fore and rear quarter is tabulated in Table 8, the data indicated that milk from rear quarter provided higher amount of nutrients compared to milk of fore quarters.

DISCUSSION

In the present study the rear quarters produced more milk than the fore quarters. The rear quarter's milk yield was calculated to be 15% more and which was significantly ($p<0.01$) higher than the milk yield of the fore quarters. These result comply with the data reported by Johanson and Korkman (1952) who testified that rear quarters produced significantly more milk than fore quarters. The finding of Kulaeva (1979) that, rear quarters produced 56.4% of the total milk yield compared to 43.6% by the fore quarters is in line with the present study.

Comparative studies in cattle by a number of authors confirmed that rear quarters produced greater yields of milk than fore quarters (Ilieva and Ivanov, 1971; Zakharyan, 1972; Baumgariner and Kalberer, 1972 and Ruegesegger,1972; 1973). Others workers, however reported contradicting data that fore quarters excelled the rear quarters in milk yield. Patel and Patel (1963) stated that the fore quarters produced 58% in Kankerj cow. Other authors postulated non significant differences in milk yield from rear or fore quarters (Mannar *et al*., 1956).

Concerning the milk composition the analysis of milk samples from rear and fore quarters revealed that rear quarters milk is significantly higher in protein, K^{+} and P^{++} while the fore quarters is significantly higher in lactose percentage.

The current result does not comply with the data reported by Ohari and Joshi (1961) who stated no differences in milk composition of the different udder halves. On the other hand some researchers pointed out that slight but non-significant fluctuation in milk constituents existed between fore and rear milk (Turner, 1934 and Mannar *et al*., 1956).

The differences in percentage milk composition between the two udder halves documented in the present study could not be readily extrapolated to variation in udder measurements.

The causes of variation of milk yield and composition is of a very complex nature. This might be due to either

Table 4: Paired t. test for fore and rear udder halves measurement

	Mean					
Measurements (cm)	fore	rear	d.f	±S.E	t. value	level of sig.
Depth	20.9	13.1	15	0.754	10.31	**
Height	110.9	110.2	15	0.359	2.09	*
Distance bet. teat	13.2	9.9	15	0.356	9.04	**
Teat length	4.3	4.4	15	0.182	0.31	n.s
Teat diameter	2.1	2.5	15	0.094	4.26	**

n.s = non sig.; *sig. (p<0.05); ** sig. (p<0.01)

Table 5: Paired t. test for milk yield, portion, fat and lactose

	Mean					
Parameters	fore	rear	d.f	±S.E	t. value	level of sig.
Milk yield (ml)	387.6	524.6	15	48.8	2.80	**
Protein %	3.31	3.38	15	0.0191	3.66	**
Fat %	3.28	3.31	15	0.0186	1.31	n.s
Lactose %	3.25	2.43	15	0.3	2.72	**

n.s = non sig.; *sig. (p<0.05); ** sig. (p<0.01)

Table 6: Paired t. test for moisture, T.S, ash and pH

	Mean					
Parameters	fore	rear	d.f	±S.E	t. value	level of sig.
Moisture %	89.65	90.42	15	0.343	2.24	*
Total solid %	10.44	9.67	15	0.312	2.47	*
Ash %	0.59	0.55	15	0.0268	1.68	n.s
PH	6.28	6.38	15	0.0433	2.17	*

n.s = non sig.; *sig. (p<0.05); ** sig. (p<0.01)

Table 7: Paired t. test for Na^{+}, K^{+}, P^{++} and Ca^{++}

	Mean					
Minerals	fore	rear	d.f	±S.E	t. value	level of sig.
Na %	0.643	0.639	15	0.0116	0.38	n.s
K %	1.169	1.246	15	0.0318	2.44	*
P %	1.016	1.077	15	0.0215	2.85	**
Ca %	7.153	7.169	15	0.034	0.48	n.s

n.s = non sig.; *sig. (p<0.05); ** sig. (p<0.01)

Table 8: Total nutrients supplied by milk of the fore and rear quarters

Nutrient	Amount in fore quarter milk (g/kg)	Amount in rear quarter milk (g/kg)
Protein	1.28	1.77
Fat	1.27	1.73
Lactose	1.26	1.27
Na^{+}	0.25	0.34
K^{+}	0.45	0.65
P^{++}	0.39	0.57
Ca^{++}	2.77	3.76

increased growth and number of secretory cells, or increased secretory activity of the mammary tissue of the rear quarters (Mannar *et al*., 1956). Also the results of this study can be justificated by the finding of Zayeed *et al*. (1991) who reported that, each quarters of she-camel udder consist of two mammary glands and some time the rear quarters might have three glands.

The differences in total amounts of nutrients supply between the rear and fore quarters milk may emphasis the indigenous belief among camel herder, that, calves that rear the rear quarters perform better than their counterparts that rear the fore quarters. This however warrants a furthers detailed study on calves rearing and the anatomy of she-camel udder to strengthen the indigenous belief on a scientific base.

Conclusion: It is very interesting to note that in camel, milk yield, protein%, fat%, moisture%, pH, K%, P% and Ca% of rear half excelled the fore half. Where as the lactose%, total solids%, ash% and Na% of fore half more than the rear half. On the other hand, the amount of nutrients contained in the milk from rear quarters provided higher amount of nutrients compared to milk of fore quarters. Which may emphasis the indigenous belief among camel herders.

ACKNOWLEDGMENT

Thanks are due to Dr. Ali H. Taha (Head of Camel Research Center -Al-Showak), Al-Khalefa Hawa Al-Nabi and his sons for kind permission and facilities offered for collection of data.

REFERENCES

Baumgariner, R. and J. Kalberer, 1972. Report on ease of milking tests. Anim. Breed. Abstr., 41: 2997.

Gawali, S.R. and D.S. Bhatnagar, 1975. Variations in individual quarter yields in dairy cows. In. J. Dairy. Sci., 28: 225-227.

Ilieva, P. and P. Ivanov, 1971. Stripping of machine-milked cows. Dairy. Sci. Abstr., 34: 2994.

Johanson, I. and N. Korkman, 1952. Heritability of the udder proportions in dairy cows. Dairy Sci. Abst., 14: 904.

Kulaeva, V., 1979. Konevodstvo I koayis port. Konavodetova, 34: 5-9.

Mannar, M.C., D. Venkayya, D. Narayan and M.C. Rangaswami, 1956. Functional individuality of the quarters of the udder of the dairy cows. In. J. Dairy Sci., 9: 186-192.

Ohari, S.P. and B.K. Joshi, 1961. Composition of camel milk. Ind. Vet. J., 38 (a): 514-516; 38 (b): 604-606.

Patel, R.D. and B.M. Patel, 1963. Int. J. Dairy. Sci., 16: 76 (sited by: Gawali and Bhatnagar, 1975).

Ramet, J.P., 2001. The technology of making cheese from camel milk (*Camelus dromedarius*). FAO. Animal Production and Health Paper; 113. Rome.

Ruegesegger, A., 1972. Results of milkability tests on Simmental cattle. Dairy. Sci. Abstr., 35: 710.

Ruegesegger, A., 1973. Results of milkability tests of Simmental Cattle. Dairy. Sci. Abstr., 35: 3765.

Schwartz, H.J., 1992. Productive performance and productivity of dromedaries (Camelus dromedaries). Anim. Res. Dev., 35: 86-98.

Sharma, V.D. and K.K. Bhargava, 1963. The bikaneri camel. Indian. Vet. J., 40: 639-643.

Turner, C.W., 1934. Mo. Agric. Exp. Sta., Res., Bull. No, 211. (Sited by: Manner *et al*., 1956).

Wilson, R.T., 1984. The camel... London, Longman Group Ltd.

Yagil, R., 1982. Camel and camel milk. FAO-Animal Production and health paper: 26.

Zakharyan, Zh.S., 1972. Duration of over milking and incidence of mastitis. Dairy. Sci. Abstr., 35: 1089.

Zayeed, A.A., A.B. Magdub, A.M. Shareha, A. El-Sheikh and M. Manzally, 1991. Camels in the Arab World. University of Omar El-Mukhtar, Libya. 1st Ed. (Arabic).