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Udder and Teat Shape and the Relationship with Milk Yield in Camels (Camelus Dromedaries)

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Abstract: A total of 72 camels at first and late stage of lactation managed under intensive condition were classified for udder and teat shape using digital images from left side of the mammary gland. Based on visual appraisal udder were classified to: pear, globular and pendulous. Meanwhile, teat classified to: funnel, cylindrical and bottle shape. Globular shape at first and late stage with the percentage of 47.22 %, 46.67 5, followed by pendulous (29.17%, 31.67%) and pear shapes (23.61%, 21.67%), respectively. Cylindrical teat were more frequent 43.06 %, of 61.67 % followed by funnel 36.11 %, 28.33 % and bottle shaped 20.83 %, 10 % at the first and late stage, respectively. A significant p≤ o.o5 difference was observed in total milk yield according to udder shape at first stage of lactation. By cylindrical scale highest milk yield of 5.64 kg was obtained from pear udder shaped followed by globular 4.7±0.28kg and pendulous 4.41±0.036 kg. No significant p≤ o.o5 difference was observed for teat shape and milk yields. Udder depth, length, circumference ranged according to udder shape from 40.14±0.66 to 46.36±0.71cm, 42.05±0.97 to 46.89 ±0.90 and 94.31±1.01 to 97.88±0.64, respectively. Significant difference in length observed between pear against globular and pendulous. Teat length front and rear according to udder shape ranged from3.70±0.25 to 5.80± 0.45 and 4.50±0.22 to5.89±0.51respectively. Teat diameter, distance between teat 2.94±0.18 to4.01±0.45 and 7.88±0.35to9.62±0.39 respectively. Teat length of front and rear, diameter and distance between teats significantly p≤ o.o5 lower in globular shaped from other shapes at first stage. Study showed clear variation in the udder and teat shapes and dimensions and their relationship with milk yield in lactating camels.
Keywords: milk yield, teat shape, teat diameter, udder shape, udder depth

INTRODUCTION

The camel milk dairies have come up as business activity in most camel possessing Nations. Such, the market potential for camel milk could be highly developed in the future [1]. The conformation of udder and teats is one of the key things in the evaluation of lactating camels; udder and teats shape described essential and assistant steps of the development of machine milking in camels [2], good homogenous udder morphology is desirable for good milkability.in this context, the variation in the udder and teat measurement and all the studies which showed a big variability as reported by [3] and the typology of the udder and teat reverse that camels need special milking clusters to improve milk ability [4]. Milk yield and milking time varied among udders and teats shape in dairy cows [5]. Teats are frequently enlarged and deformed and there is significant size and volume change during lactation [6]. Otherwise the associations of common udder infections with udder shape were studied Bhutto *et al* [7] in cows and also stand out through the growth of calf. Udder characteristics need to be included in breeding programs in dairy camel, beside milk production and quality traits. The most important traits of udder are known as shape, size and placement of udder and teats attachment. Therefore, the aim of this study was to determine suitable udder and teat shape assessments during lactation and to evaluate the relationship with milk production for camel milk ability improvement.

MATERIAL AND METHODS

The present study was conducted at AL-Turath Al-Saudi Company, large – scale camel dairy farm (180 km northeast of Jeddah), 22˚.97 ″N and 39˚.91″ E

latitude. The annual rainfall varies between 13.0 – 55.6 mm and the maximum temperature between 28 -38 c˚.

Experimental animals and milking routine

72 lactating camels of the type (AL-Awarik), [8] with different parties and ages were randomly selected from AL-Turath Al- Saudi company herd. Camels are kept in barns all the time in intensive farming system. Each of the experimental selected females was identified by plastic ear tag with numerical No. All calves suckled their dams freely until 40 days of age. Subsequently, they were on partial suckling regime all the night for 15 days when their dam's machine milked once daily. Therefore, all calves allowed to suckling halve of hour after machine milking until they completely weaned at five – month of age together with daily ration consist of 1 kg concentrate and 1.5 kg of alfalfa. The lactating camels are supplemented with 5 kg of commercials concentrate pellets (WAFI®, ARASCO) beside 3 kg of alfalfa per head in addition to continuous water supply. All camels had clinically health udders. Determination of udder performed at the day before a control day at different stage of lactation by CMT. the parlor consist of two rows with 10 camels on each other and equipped with low milk pipeline ,electronic pulsators and listed measurable milk recording system allowing reliable and continues collection of milk yield data of individual camels. The milking machine was set at 45 KPa, 60 pulses min, and 60:40 pulsation ratio. The milking routine included teat cleaning by piece of cloth after iodine dipping.

Data collection

Udder morphology and typology

Multiparous dromedary camels were used to study the evaluation of udder morphology traits through out early (n=72) and late (n=60) stage lactation. All the camels had clinically healthy udders. Udder and teat morphology traits for all camels were measured before morning milking. .Measurement of udder and teat morphology was taken in milking parlor tow times directly before routine pre-milking treatment. Udder depth (UD) measured as the distance from the base to the lowest point of the udder at the place of attachment of the teats. Udder circumference (UC) measured by matching the tape throw around the udder as maximum diameter between four quarters. Udder length (UL) measured as the distance between front and rear attachment of the udder. Teat length (TL) measured between line parallel to bifurcation and teat end. Teat diameter (TD) measured with the caliper at the middle point. Distance between teats (DBT) defined as distance between the rear and front teat from middle point by the right side.

To evaluate the udder and teats shape duplicated images were taken from left side of each camel with the same distance and angle from the udder [4] by digital camera (Sony DSCW530, 14.1MP, compact digital camera), clear images of udders and teats stored directly in a computer to assessment the udder and teats shape as a completion of the data with the udders and teats measurement and milk production for each lactating camel involved in the study. Thus, the shape of the udder was classified as pear shaped; Globular shaped and pendulous shaped, while the teat was classified as funnel shape; cylindrical shape and bottle shape fig (1).

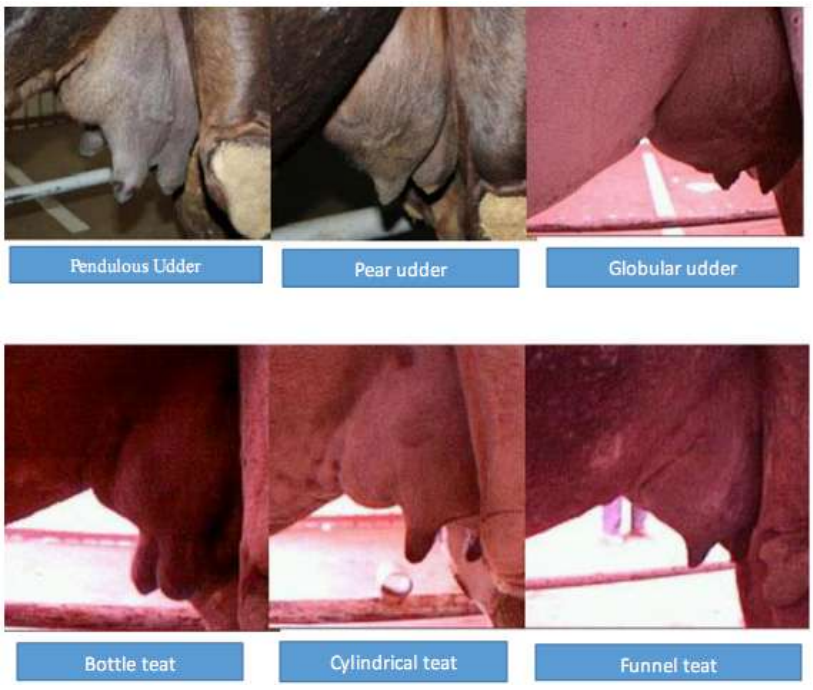

Fig-1: Udder and teat shape of dairy dromedary camels

Daily milk yield

Individual milk yield from morning and evening milking were recorded using cylinders recorders attached with the milking machine for each clusters.

Statistical analysis

Udder measurement and milk yield changes (mean and SD) were studies at early, mid and late stage of lactation. The correlation between different udder and teat parameter were calculated using person correlation. The effect of udder and teat morphology traits and milk yield were examined by ANOVA procedure. The obtained data were analyzed using the statistical analysis System (SAS Inst., Inc., Cary NC, USA).

RESULTS

It may be observed from Table 1 that a great variation existed in the morphology of udders and teats in (AL-Awarik) lactating camels. The results showed among the different udder shapes, globular shape was very common with a percentage of 47.22 %, 46.67% followed by pendulous and pear shapes at the first and late stage of lactation respectively. Similarly among the different shape of teats, cylindrical teats were more frequent than other shapes with a percentage of 43.06 %, 61.67% at the first and late stage of lactation respectively followed by funnel and bottle teat shapes. The percentage occurrence of funnel shape were 36.11%, 28.33% and the bottle shape were 20.83%, 10 at the first and late stage of lactation respectively. Effects of udder and teats shapes on morning, evening and total milk yield were evaluated at first and late stage of lactation. The means of morning, evening and total milk yield with their standard deviation according to udder and teat shapes are given in table 2, 3.Slight difference occurred at early lactation in total milk production according to udder shape (table 2 ($p \leq 0.05$) but no differences was found between morning and evening milk yield ($p \leq 0.05$). Camel with Pear-shaped udder had significantly ($p \leq 0.05$) higher milk yield of 5.64±0.39kg following by globular and pendulous udder shape. Morning, evening and total milk yield were not affected by teat shape ($p \leq 0.05$) at first stage of lactation. However, small and non-significant differences in level of morning and total milk yield existed at late stage of lactation. Otherwise, milk yield and evening milk yield were found roughly similar for pendulous, pear and globular shapes at late stage of lactation. In addition no significant affect ($p \leq 0.05$) was observed between teat shapes and morning milk yield at late stage of lactation.

Table 1: Frequencies and percentage of different udder and teat shapes of dairy dromedary camels at first and late stage of lactation

Parameters	First lactation		Late lactation	
	N	%	N	%
Udder shape				
Globular	34	47.22	28	46.67
Pear	17	23.61	13	21.67
Pendulous	21	29.17	19	31.67
Total	72	100	60	100
Teat shape				
Bottle	15	20.83	6	10
Cylindrical	31	43.06	37	61.67
Funnel	26	36.11	17	28.33
Total	72	100	60	100

Table 2: Daily milk yield (kg) in dairy dromedary camels with various udder and teat shapes at first stage of lactation

Parameters	**AM**	**PM**	**Total milk**	**SEM**
Udder shape				
Globular	2.12±0.14	2.61±0.17	4.71 ± 0.28^{ab}	0.472
Pear	2.35±0.18	3.19±0.28	5.64 ± 0.39^{a}	0.236
Pendulous	2.40±0.20	2.94±0.23	4.41 ± 0.36^{b}	0.291
C.V, %	36.83	36.25	33.12	-
P<	0.472	0.147	0.047	-
Teat shape front				
Bottle	2.37±0.22	2.98±0.25	5.35±0.41	0.048
Cylindrical	2.26±0.15	2.63±0.18	4.80±0.29	0.058
Funnel	2.19±0.17	2.49±0.19	4.58±0.32	0.057
C.V, %	37.13	36.16	36.16	-
P<	0.812	0.296	0.296	-

Table 3: Daily milk yield (kg) in dairy dromedary camels with various udder and teat shapes at late stage of lactation

Parameters	AM	PM	Total milk	SEM
Udder shape				
Globular	2.04±0.15	2.49±0.20	4.16±0.33	0.065
Pear	2.03±0.19	2.40±0.30	4.15±0.49	0.054
Pendulous	1.75 ±0.20	2.48±0.24	4.09±0.41	0.060
C.V, %	36.85	43.48	42.87	-
P<	0.466	0.968	0.988	-
Teat shape front				
Bottle	1.66±0.28	2.33±0.43	4.00±0.40	0.039
Cylindrical	2.14±0.12	2.59±0.17	4.45± 0.28	0.063
Funnel	1.65±0.19	2.25±0.26	3.51 ±0.42	0.059
C.V, %	30.74	40.91	41.25	-
P<	0.060	0. 516	0.103	-

Table 4: Various udder measurements (cm) in dromedary camels according to the udder shape (first and late stage of lactation).

Udder shape	UD		UL		CP	
	Mean+S.E	C.V,%	Mean+S.E	C.V, %	Mean+S.E	C.V, %
Early lactation						
Globular	40.14±0.66	9.60	42.05±0.97	13.45	94.31±1.01	6.23
Pear	42.14±1.13	12.26	44.34±0.72	7.48	95.40±2.52	12.13
Pendulous	41.00±0.80	8.04	43.53±1.08	10.23	97.30±1.58	6.71
Late lactation						
Globular	44.29±0.80	9.58	43.45^{b}±0.80	9.75	96.02±0.67	3.70
Pear	46.36±0.71	6.70	46.89^{a}±0.90	8.41	96.11±1.30	5.90
Pendulous	44.45±1.06	8.94	43.14^{b}±1.67	14.49	97.88±0.64	2.45

Table 5: Variousteat measurements (cm) in dromedary camels according to the udder shapes (first and late stage of lactation)

Teat shape	TLF		TLR		TDF		DT	
	Mean+S.E	C.V,%	Mean+S.E	C.V, %	Mean+S.E	C.V,%	Mean+S.E	C.V, %
First lactation								
Globular	4.32^{b}±0.24	32.85	4.50^{b}±0.22	28.63	2.94^{ab}±0.18	35.01	8.40^{b}±0.32	22.08
Pear	5.80^{a}± 0.45	35.76	5.74^{a}± 0.41	33.05	3.79^{a}± 0.18	21.74	9.62^{a}±0.39	18.77
Pendulous	5.70^{a}± 0.48	34.93	5.86^{a}±0.55	38.45	4.01^{b}±0.45	46.11	8.52^{a}±0.56	27.24
Late lactation								
Globular	3.70±0.25	27.25	4.95^{ab}±0.29	30.56	3.25± 0.12	19.97	8.30^{ab}±0.35	22.31
Pear	5.34±0.48	39.38	5.89^{a}±0.51	37.72	3.53±0.25	30.79	7.88^{b}±0.35	19.27
Pendulous	4.65±0.57	45.91	4.57^{b}± 0.42	34.60	3.70± 0.32	32.12	9.09^{a}±0.44	18.23

Table 6: Correlations between udder and teat measurements and daily milk yield in dairy dromedary camels (first stage of lactation)

	TMY	UD	UL	CP	TLF	TLR	TDF	DT
TMY		0.3982	0.11311	0.17280	0.17834	0.24247	0.19023	0.48496
		0.0255	0.3512	0.1526	0.1397	0.0431	0.1174	0.0453
UD	0.3982		0.30506	0.08054	0.31426	0.26794	0.07935	0.06237
	0.0255		0.0092	0.5012	0.0072	0.0229	0.5107	0.6027
UL	0.11311	0.30506		0.54157	-0.07315	0.04968	0.47255	0.24562
	0.3512	0.0092		<.0001	0.5414	0.6786	<.0001	0.0376
CP	0.17280	0.08054	0.54157		-0.03840	0.12737	0.55981	0.33535
	0.1526	0.5012	<.0001		0.7488	0.2863	<.0001	0.33535
TLF	0.17834	0.31426	-0.07315	-0.03840		0.93716	0.39470	0.08653
	0.1397	0.0072	0.5414	0.7488		<.0001	0.0007	0.4698
TLR	0.24247	0.26794	0.04968	0.12737	0.93716		0.48037	0.14486
	0.0431	0.0229	0.6786	0.2863	<.0001		<.0001	0.2247
TDF	0.19023	0.07935	0.47255	0.55981	0.39470	0.48037		0.40997
	0.1174	0.5107	<.0001	<.0001	0.0007	<.0001		0.0004
DT	0.48496	0.06237	0.24562	0.33535	0.08653	0.14486	0.40997	
	0.0453	0.6027	0.0376	0.0040	0.4698	0.2247	0.0004	

Table 7: Correlations between udder and teat measurements and daily milk yield in dairy dromedary camels (late stage of lactation)

	TMY	UDB	UL	CPB	TLFB	TLRB	TDFB	DTB
TMY		0.42251	0.07361	0.28957	0.21927	0.14830	0.08029	0.6592
		0.0322	0.5697	0.0224	0.0868	0.2500	0.5350	0.03973
UDB	0.42251		0.55115	0.22164	0.29711	0.23174	0.27039	-0.01865
	0.0322		<.0001	0.0834	0.0190	0.0699	0.0335	0.8856
UL	0.07361	0.55115		0.18480	0.06914	0.10504	0.20630	-0.22502
	0.5697	<.0001		0.1505	0.5933	0.4165	0.1077	0.0787
CPB	0.28957	0.22164	0.18480		0.19093	0.29380	0.39211	0.08133
	0.0224	0.0834	0.1505		0.1371	0.0205	0.0016	0.5297
TLFB	0.21927	0.29711	0.06914	0.19093		0.79581	0.61828	0.31591
	0.0868	0.0190	0.5933	0.1371		<.0001	<.0001	0.0124
TLRB	0.14830	0.23174	0.10504	0.29380	0.79581		0.56578	0.13274
	0.2500	0.0699	0.4165	0.0205	<.0001		<.0001	0.3037
TDFB	0.08029	0.27039	0.20630	0.39211	0.61828	0.56578		0.41180
	0.5350	0.0335	0.1077	0.0016	<.0001	<.0001		0.0009
DTB	0.6592	-0.01865	-0.22502	0.08133	0.31591	0.13274	0.41180	
	0.03973	0.8856	0.0787	0.5297	0.0124	0.3037	0.0009	

The means with standard deviation for various udder measurements according to the udder shapes in first and late stage of lactation are presented in table 4. Udder depth, length and circumference in different udder shapes at first and late stage of lactation ranged from 40.14±0.66 to 46.36±0.71cm, 42.05±0.97 to 46.89 ±0.90 and 94.31±1.01 to 97.88±0.64, respectively. Thus, the udder measurement in camels was low in globular shaped udder compared to other shapes. No significant differences were observed between udders shape and udder measurements for first stage of lactation. While, significant differences ($p \leq 0.05$) observed in udder length between pears shaped udders and globular shaped udder and between pear shaped and pendulous shaped udder. On the other hand no significant differences were found between globular and pendulous shaped udders. In addition no statistical significance ($p \leq 0.05$) was observed between udder depth and circumference for udder shaped at late stage of lactation.

Teat measurements according to udder shapes in first and late stage of lactation were presented in table 5. There was a great variation in teat length at first and late stage of lactation in front and rear quarter ranging from 3.70±0.25 to 5.80± 0.45 and 4.50±0.22 to5.89±0.51respectively. While the average of teat diameter and distance of teat with various udder shapes ranging from 2.94±0.18 to4.01±0.45 and 7.88±0.35to9.62±0.39 respectively. At the first stage of lactation teat length, diameter and distance between teats were lower in globular udders shape compared to other types of udders. Nevertheless, there was no significant differences $p \leq o.o5$ between teats measurements in pear and pendulous udders shape except for front distance between teats which was significantly different $p \leq o.o5$.

Furthermore, significant differences $p \leq o.o5$ were observed between teat length rear and distance between teats with various udders shape at late stage of lactation. Teat length was more in pear udder compared to other udders. Otherwise, pendulous udder shaped has highest teats diameters and distances between teats. No significant differences were observed between teat length front and teat diameters front for various udder shapes. Correlation coefficient observed between various udder and teat measurements and total milk yield in first and late stage of lactation are shown in table 6 and 7. Positive and significant $p \leq 0.05$ correlations were observed between udder depth, teat length rear and distance between teats and total milk yield at first stage of lactation. Similarly, udder depth and circumference and distance between teats correlated positively with milk yields at late stage. Significant $p \leq 0.05$ and positive correlation observed among udder measurements Vis .., udder length, depth and circumference. There were great positive correlation observed between various teat measurements viz.., teat length front and rear, teat diameter and distance between teats were also positive and significant ($p \leq o.o5$) to highly significant ($p \leq o.ooo1$) at first and late stage of lactation.

DISCUSSION

Table 1 showed that the most of examined camels had globular udder shape. In contrast the pear udder shape was very little. The results in the present study were in agreement with [4] who also report the majority of the dairy Arabian camels had globular udder shape. The majority and percentage of cylindrical shaped teats observed in the present study were in agreement with [9] in intensive camel milk production in the UAE. Otherwise in agreement of some authors who reported the majority of Murrah buffaloes had cylindrical shaped teats [10-12]. In contrast the percentage of cylindrical shape were more than that reported by [4] who states the funnel shape as the more frequent one with 63.2% and 58.7% for front and rear teats. There were significant $p \leq o.o5$ between various udder shapes and total milk yield clearly shown at first stage of lactation. [13] Reported the udder shape

appeared to have marked effects p≤o.o1 on milk yield in milking time and average milk flow rate in Friesian cows. Otherwise morning and evening milk yield showed no significant, this explained the association of amount of milk production to illustrate udder shape and measurements with the confirmation of no relation was found at late stage of lactation between udder shape and milk yield. Camel with Pear udder shaped yielded more than other shapes. However, [10, 14] reported a higher yield in bowel shaped udders in cows. The low frequency of pendulous udders in camels was probably due to previous infection of mastitis or injuries occurred lately and this is the some of the reasons for camel culling in intensive systems. [4] Reports that pendulous udder was non preferable by the farmer for their non – suitability for machine milking and calf stripping Teat shape

CONCLUSION

In conclusion it's clear that teat and udder shapes and dimensions have relationship and were higher statistically insignificant with milk yield in lactating camels. There for these traits must be considered accordingly while selecting dairy camels.

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