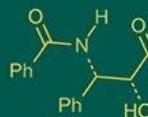


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Phenotypic association of udder measurements with daily milk yield in Jaffarabadi buffaloes

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Abstract

An investigation was carried out named Phenotypic association of udder measurements with daily milk yield in Jaffarabadi Buffaloes. A total of 40 for experimental Jaffarabadi buffaloes from Cattle Breeding Farm, Junagadh Agricultural University, Junagadh, Gujarat were selected. Udder morphology was studied and assessed for each animal. Milk yield per milking was recorded for each animal during evening milking. Duration of experiment was 3 months. All the udder measurements were taken prior to milking at monthly intervals. All milk samples were analyzed at fortnightly intervals. The results showed that among different udder shapes bowl shaped udder was the most common followed by round and pendulous udder with 66 percent, 45 percent and 7.5 percent, respectively. The mean values of udder length, width and depth in Jaffarabadi buffaloes of different udder shapes ranged from 65.20 ± 1.01 to 66.53 ± 1.18 cm, 52.52 ± 0.90 to 55.50 ± 2.62 cm and 11.01 ± 0.45 to 15.61 ± 1.96 cm, respectively. Udder shape had significant ($p < 0.05$) effect on udder depth. The milk yield per milking (kg/milking) in experimental Jaffarabadi buffaloes with various udder shapes observed were 4.18 ± 0.17 , 4.34 ± 0.22 and 4.25 ± 0.13 kg/milking in bowl, round and pendulous type of udders, respectively. Buffaloes having higher udder length, width and depth had significantly ($p < 0.05$) higher milk yield per milking (kg/milking) and total milk yield (kg/day). Udder width was positively and highly significantly ($p < 0.01$) correlated with total daily milk yield. Udder depth was positively and highly significantly ($p < 0.01$) correlated with milk yield per milking (kg/milking) and total milk yield (kg/day). The present study indicated that, experimental Jaffarabadi buffaloes with higher udder length, width and depth were found to produce more milk.

Keywords: Jaffarabadi buffaloes, udder morphology, udder measurements, milk yield

Introduction

In the Indian dairy landscape, buffaloes are preferred over cattle due to their unique physiological advantages, including superior feed conversion efficiency, enhanced disease resistance and higher milk fat content. Buffaloes are popularly known as black diamond due to their abundant contribution to our national economy through milk, meat and draft power. Buffalo contributes major volume of the total milk produced in India (49 percent of the total milk production in India) (Anonymous, 2021) [2]. Morphological characteristics of udder have a direct relationship with milk production potential in dairy animals. Udder characters like shape and size of teats and placement of teats are the points to be considered while judging animals.

Materials and Methods

The present study was carried out at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh, Gujarat. A total of 40 experimental Jaffarabadi buffaloes were selected and isomanagerial practices were followed. Duration of experiment was 3 months. All the udder measurements were taken prior to milking at monthly intervals. All milk samples were analyzed at fortnightly intervals.

Udder

Udder biometry was recorded for each Jaffarabadi buffalo at three distinct intervals during the first, second and third months of lactation. These measurements were udder length, udder width and udder depth respectively. All udder shapes were recorded for three times during the experiment period.

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Udder shape

The shapes of the udders based on the visual assessment were classified into bowl, round and pendulous shapes.

Udder Width (UW)

The udder width (cm) was measured as a distance between two lateral lines of attachment of the udder to abdominal wall, beneath the flank. Measuring tape will be kept in position on one side of the animal, under flank, near the stifle joint and it will be passed over in between fore and rear teats to the other side. All measurements were taken in cm.



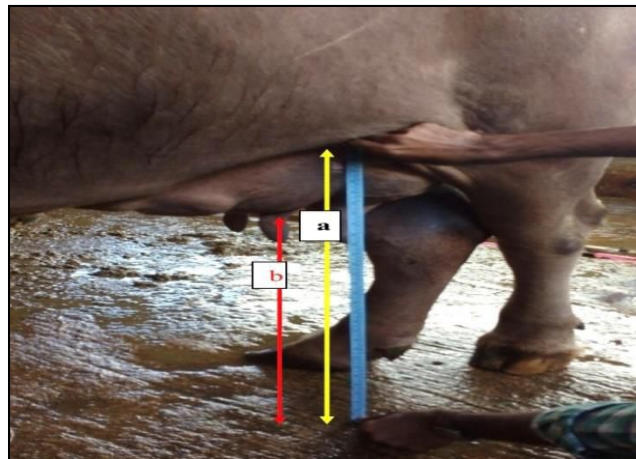
Udder Length (UL)

The udder length (cm) was measured by using the measuring tape from the rear attachment of the udder, near the escutcheon, to the front of the udder, where it blends smoothly with the body (Bhuiyan *et al.*, 2004).



Udder Depth (UD)

Udder depth (cm) was measured by taking the differences of two mentioned measurements; a = distance from ground floor to the base of the udder, b = distance from ground floor to the lowest point of the udder at the place of attachment of teats. Udder depth = a-b



Milk yield

Daily milk yield (kg) was recorded during the morning and evening milking at fortnightly intervals. Milk yield was recorded by a digital weighing machine.

Statistical Analysis

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1994)^[10]. Means among different groups were compared by analysis of variance (One way ANOVA).

Results and Discussion

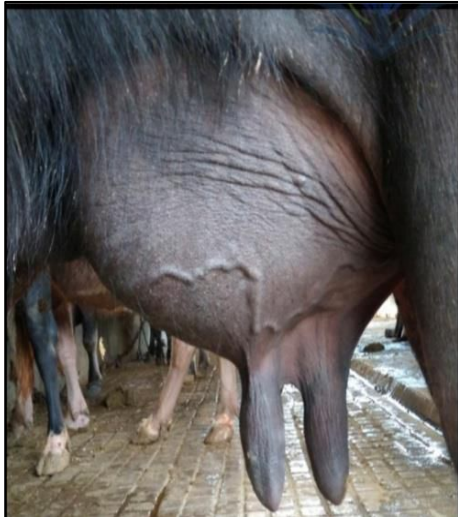
Shape of udder

In the present study, different udder shapes were observed viz., bowl, round and pendulous shaped udder. Occurrence of various udder shapes is presented in Table 1. Among the different shapes of udder in Jaffarabadi buffaloes, the occurrence of bowl shaped udder was the most common followed by round and pendulous udder with percentages 55%, 37.5% and 7.5% respectively. The finding were similar to the results of Prasad *et al.* (2010)^[4] in Murrah buffaloes. Prasad *et al.* (2010)^[4] who reported that udder of this shape was more desirable than other shapes of udders for their higher milking ability. Contrary to the present finding, Singhai (2012)^[9] and Sonwane *et al.* (2016)^[11] reported, round shape udder were predominant over other shape of udder.

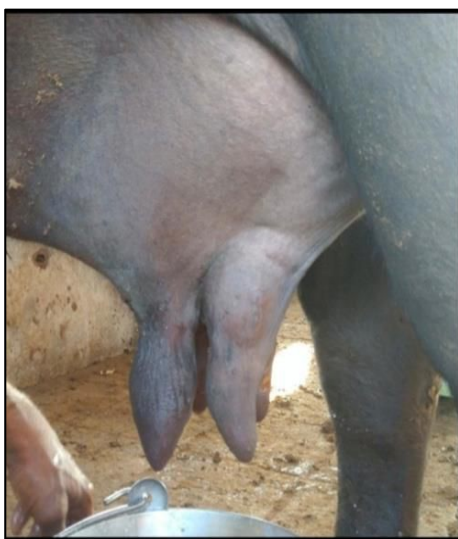
Shapes of udder



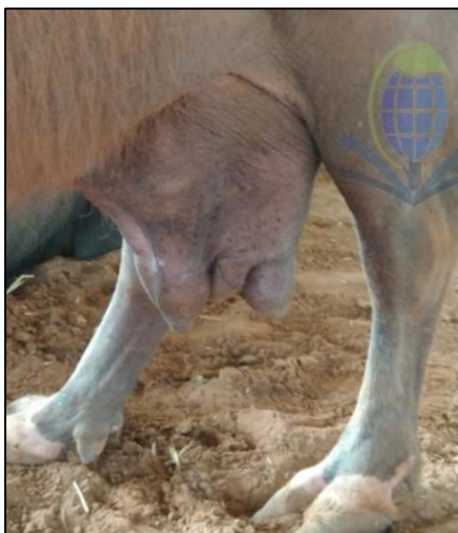
Bowl udder



Round udder



Goaty udder



Pendulous udder

Udder measurements according to the udder shape

The mean values of various udder measurements in different udder shapes are presented in Table 2. According to the udder shapes in Jaffarabadi buffaloes, the mean values of udder length for bowl, round and pendulous shaped udders were 65.20 ± 1.01 cm, 66.53 ± 1.18 cm and 66.50 ± 2.14 cm,

respectively. The mean values of udder width for bowl, round and pendulous shaped udder were 52.52 ± 0.90 cm, 55.41 ± 1.26 cm and 55.50 ± 2.62 cm, respectively. The mean values of udder depth for bowl, round and pendulous shaped udder were 11.01 ± 0.45 cm, 12.99 ± 0.59 cm and 15.61 ± 1.96 cm, respectively. The overall mean values of udder length, udder width and udder depth were 65.80 ± 0.73 cm, 53.83 ± 0.72 cm and 12.10 ± 0.38 cm, respectively. The present study revealed that numerically highest udder length (66.63 ± 1.18 cm) was found in round shaped udder and numerically the highest udder width (55.50 ± 2.62 cm) was found in round shaped udder. However, udder depth (15.61 ± 1.96 cm) was significantly ($p < 0.05$) higher in pendulous shaped udder compared to bowl shaped udder. Statistical analysis revealed that significant difference was found in udder depth compared to other udder measurements. However, udder width and udder length were did not differ significantly regarding udder shapes. Udder depth was significantly ($p < 0.05$) higher in pendulous shape udder compared to bowl shape of udder but at par with round shaped udder. Udder depth was higher in pendulous udder might be due to rear attachment appears to become lax, allowing the udder to swing forward and sometimes causing the rear quarters to occupy a position lower than the front quarters.

Udder morphology relation with milk yields

The milk yield in Jaffarabadi buffaloes with different udder shapes is presented in Table 3. It was observed in the present study that the pendulous shaped udder yielded numerically higher total daily milk yield followed by round and bowl shape of udder. The overall means values total daily milk yield for bowl, round and pendulous shape udder were 7.74 ± 0.33 cm, 7.79 ± 0.44 cm and 7.86 ± 0.81 cm, respectively. The evening milk yield in different shape of udder for bowl, round and pendulous were 4.18 ± 0.17 cm, 4.34 ± 0.22 cm and 4.33 ± 0.76 cm, respectively. This may be because the pendulous udder had higher udder depth as compared to other shape of udder.

No significant difference was found in milk yield regarding udder shape. The observations were corroborating the findings of Ranjitha *et al.* (2021) [7] in Murrah buffaloes observed pendulous shape udders are having high milk yield. Contrary to these findings, Prasad *et al.* (2010) [4] in Murrah buffaloes, observed bowl shape udders are having maximum milk.

Udder biometry relation with milk yield

Various udder measurements viz. udder length, udder depth and udder width were grouped into three categories i.e. small, medium and large. The milk yield in Jaffarabadi buffaloes with different udder length is presented in Table no. 4.

The mean values of milk yield per milking for different udder length group such as ≤ 57 , $58-72$, ≥ 73 were 3.99 ± 0.31 , 4.42 ± 0.16 and 4.00 ± 0.30 cm, respectively. However, mean values of total milk yield for different group such as ≤ 57 , $58-72$, ≥ 73 were 6.76 ± 0.62 , 7.92 ± 0.29 and 8.27 ± 0.63 cm, respectively. Statistical analysis revealed, Buffaloes having higher udder length had significantly ($p < 0.01$) higher total milk yield compared to lower udder length. Effect of higher udder length on milk yield per milking was non-significant. The milk yield in Jaffarabadi buffaloes with different udder width is presented in Table 5. The mean values of milk yield

per milking for different udder width group such as ≤ 46 , 47-60, ≥ 61 were 3.61 ± 0.26 , 4.36 ± 0.17 and 4.44 ± 0.26 cm, respectively. However, mean values of total milk yield for different udder width group such as ≤ 46 , 47-60, ≥ 61 were 6.26 ± 0.57 , 7.87 ± 0.29 and 8.74 ± 0.62 cm, respectively. Statistical analysis revealed, Buffaloes having higher udder width had significantly ($p < 0.01$) higher total milk yield and milk yield per milking compared to lower udder width.

The milk yield in Jaffarabadi buffaloes with different udder depth is presented in Table 6. The mean values of milk yield per milking for different udder depth group such as ≤ 7.9 , 8-16.1, ≥ 16.2 were 3.79 ± 0.22 , 4.18 ± 0.16 and 5.13 ± 0.28 cm, respectively. However, mean values of total milk yield for different udder width group such as ≤ 7.9 , 8-16.1, ≥ 16.2 were 7.20 ± 0.51 , 7.49 ± 0.29 and 9.94 ± 0.42 cm, respectively. Statistical analysis revealed, Buffaloes having higher udder depth had significantly ($p < 0.01$) higher total milk yield and milk yield per milking compared to lower udder depth.

Significant and positive correlation between udder width (0.253) and udder depth (0.287) with total daily milk yield while, udder length was significant ($p < 0.05$) effect on total daily milk yield. Similar results were reported by Rahmarullah *et al.* (2017) [5] in Murrah buffaloes with a conclusion that the total daily milk yield was highly significant ($p < 0.01$) with udder width and udder depth in Murrah buffaloes. Udder length having high milk yield might be attributed to good udder size depended on the existence of milk, where the udder enlarged with milk secretion and shrink after milking. Udder depth having high milk yield because of deep udder have good capacity.

Correlation of Udder Biometry with Milk Parameters

The correlation co-efficient values among the milk yield, total daily milk yield, udder length, udder width and udder depth are presented in Table 7

The udder length was negatively correlated with milk yield per milking, but statistically it was non-significant ($p > 0.05$). The udder length was positively correlated with total daily milk yield, but it was non-significant ($p > 0.05$). However, udder width was positively and highly significantly ($p < 0.01$) correlated with total daily milk yield ($r = 0.253$). Udder depth was positively and highly significantly ($p < 0.01$) correlated with milk yield ($r = 0.209$) and total daily milk yield ($r = 0.287$).

Present finding to similar Ranjeet Singh *et al.* (2010) [8] in Vrindavani cattle observed that, positive and significant correlation ($p < 0.05$) between total milk yield and udder length, width and depth. Abdullah *et al.* (2013) [11] in Nili-Ravi buffaloes, observed that significant and positive ($p < 0.05$) correlation of udder width and milk production. It concluded that voluminous and wide udder produced more milk.

Table 1: Frequencies and percentages of different udder shapes in Jaffarabadi buffaloes

Months	Shape of udder		
	Bowl	Round	Pendulous
I	22 (55 percent)	15 (37.5 percent)	3 (7.5 percent)
II	22 (55 percent)	15 (37.5 percent)	3 (7.5 percent)
III	22 (55 percent)	15 (37.5 percent)	3 (7.5 percent)
Total	66 (55 percent)	45 (37.5 percent)	9 (7.5 percent)

Table 2: Mean udder measurements (cm) in Jaffarabadi buffaloes according to udder shape

Udder shape	No. of animals	Udder length (cm)	Udder width (cm)	Udder depth (cm)
Bowl	66	65.20 ± 1.01	52.52 ± 0.90	$11.01^{a \pm 0.45}$
Round	45	66.53 ± 1.18	55.41 ± 1.26	$12.99^{ab \pm 0.59}$
Pendulous	9	66.50 ± 2.14	55.50 ± 2.62	$15.61^{b \pm 1.96}$
Overall	120	65.80 ± 0.73	53.83 ± 0.72	12.10 ± 0.38

Means with different superscripts within a column (a, b) differ significantly ($p < 0.05$)

Table 3: Total daily milk yield and milk yield per milking in Jaffarabadi buffaloes according to the udder shape

Udder shape	Milk yield (kg/milking)	Total milk yield (kg/day)
Bowl	4.18 ± 0.17	7.74 ± 0.33
Round	4.34 ± 0.22	7.79 ± 0.44
Pendulous	4.33 ± 0.76	7.86 ± 0.81
Overall	4.25 ± 0.13	7.77 ± 0.25

Table 4: Total daily milk yield and milk yield per milking in Jaffarabadi buffaloes according to different udder length

UL (cm)	Milk yield (kg/milking)	Total Milk yield (kg/day)
≤ 57	3.99 ± 0.31	$6.76^{a \pm 0.62}$
58-72	4.42 ± 0.16	$7.92^{ab \pm 0.29}$
≥ 73	4.00 ± 0.30	$8.27^{b \pm 0.63}$
Overall	4.25 ± 0.13	7.77 ± 0.25

Means with different superscripts within a column (a, b) differ significantly ($p < 0.05$)

Table 5: Total daily Milk yield and milk yield per milking in Jaffarabadi buffaloes according to different udder width

UD (cm)	Milk yield (kg/milking)	Total milk yield (kg/day)
≤ 7.9	3.79 ± 0.22	$7.20^{a \pm 0.51}$
8-16.1	$4.18^{ab \pm 0.16}$	$7.49^{a \pm 0.29}$
≥ 16.2	$5.13^{b \pm 0.28}$	$9.94^{b \pm 0.42}$
Overall	4.25 ± 0.13	7.77 ± 0.25

Means with different superscripts within a column (a, b) differ significantly ($p < 0.05$)

Table 6: Total daily Milk yield and milk yield per milking in Jaffarabadi buffaloes according to different udder depth

UW (cm)	Milk yield (kg/milking)	Total milk yield (kg/day)
≤ 46	$3.61^{a \pm 0.26}$	$6.26^{a \pm 0.57}$
47-60	$4.36^{b \pm 0.17}$	$7.87^{ab \pm 0.29}$
≥ 61	$4.44^{b \pm 0.26}$	$8.74^{b \pm 0.62}$
Overall	4.25 ± 0.13	7.77 ± 0.25

Means with different superscripts within a column (a, b) differ significantly ($p < 0.05$)

Table 7: Correlation of udder biometry with milk parameters in experimental Jaffarabadi buffaloes

Parameters	Udder length (UL)	Udder width (UW)	Udder depth (UD)
Milk yield (kg/milking)	-0.059	0.168	0.209**
Total daily milk yield (kg/day)	0.078	0.253**	0.287**

* Significant at 5 percent

** Significant at 1 percent

Conclusions

Majority of experimental Jaffarabadi buffaloes had bowl shaped udder (55 percent) followed by round (37.5 percent) and pendulous (7.5 percent) shaped udder. Udder depth was significantly ($p < 0.05$) higher in pendulous shaped udder followed by round and bowl shaped udder. Experimental Jaffarabadi buffaloes having pendulous udder had numerically higher total daily milk yield (kg/day). Experimental Jaffarabadi buffaloes having higher udder length had significantly ($p < 0.05$) higher daily milk yield (kg/day). In experimental Jaffarabadi buffaloes, higher udder width and depth had significantly ($p < 0.05$) higher milk yield. Specifically, udder width and depth showed a highly significant ($p < 0.01$) positive correlation with total daily yield, suggesting that larger udder measurements are reliable indicators of improved milk productivity in this breed.

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