

MILKABILITY AND MILK FLOW TRAITS AS AFFECTED BY UDDER MORPHOLOGY, PARITY AND LACTATION STAGE IN JAFFARABADI BUFFALOES

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ABSTRACT

A study was undertaken to know the effect of udder and teat shapes, parity and lactation stage on milkability and milk flow traits and their relationship with milk yield in Jaffarabadi buffaloes. A total of 150 animals from private farms located around Hyderabad were selected and grouped according to udder and teat shapes, parity (1st to 4th lactation) and stage of lactation (early, mid and late). Among milkability and milk flow traits, average milk let down time, milking time, stripping time and total milking time, stripping yield and average milk flow rate (AMFR) recorded in Jaffarabadi buffaloes under hand milking were 1.54 ± 0.01 min, 3.49 ± 0.04 min, 1.28 ± 0.01 min, 6.31 ± 0.05 min, 0.19 ± 0.001 kg and 0.65 ± 0.01 (kg/min), respectively. The AMFR in buffaloes with bowl shaped udders was highest ($P < 0.05$) followed by globular, pendulous and goatly shapes and buffaloes with bottle shaped teats was highest ($P < 0.05$) followed by cylindrical, funnel, pear and conical shaped teats. The AMFR was significantly ($P < 0.05$) high in 3rd parity (0.67 ± 0.01) and low in 1st parity (0.60 ± 0.01) buffaloes and significantly ($P < 0.05$) higher AMFR was recorded during early (0.66 ± 0.01 kg/min) and mid (0.64 ± 0.01 kg/min) compared with late (0.63 ± 0.01 kg/min) stages of lactation. Positive and highly significant ($P < 0.01$) correlation was observed between average daily milk yield (ADMY) with milking time ($r = 0.523$), total milking time ($r = 0.489$) and AMFR ($r = 0.624$) and significant correlation ($P < 0.05$) with stripping time ($r = 0.188$) and stripping yield ($r = 0.188$). The total milking time and stripping yield had significant ($P < 0.01$) positive correlation but total milking time was negatively correlated with AMFR ($r = -0.366$, $P < 0.01$). The study concludes that, higher AMFR and higher ADMY were found in buffaloes with bowl shaped udders. Therefore, while selecting buffaloes for milk production, bowl shaped udder should be taken into consideration.

Key words: Jaffarabadi buffalo, Milk flow traits, Milk yield, Parity, Udder morphology

INTRODUCTION

Buffaloes are known to be difficult to milk, hence, it is necessary to understand the

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factors that influence the efficient removal of milk from buffaloes. The selection of animal and also the management practices employed by the farmer play a prominent role in deciding the total yield of the animal. Enormous research work has been done on milking management of dairy cattle, sheep and goats but comparatively little research data is available on the milking management of buffaloes. Hand milking is followed immediately after suckling by the calf. A good milker is thus not only a skilled workman, but should be rapid, efficient, gentle and clean, then only he will get cleaner milk with higher yield from a dairy animal, than a slow, inefficient and careless milker. Thus, it is generally considered that, efficient milking method can save milking time, maintains lactation at higher level and lowers the incidence of mastitis. Therefore, milking requires a relatively more skilled labour as compared to other operations on a dairy farm. Milk producing ability is the main consideration while selecting the dairy animals. The milk producing ability of cows is influenced by various milkability traits viz., milklet down, total milking time and milk flow rate (Trivedi, 2008). The importance of all other characters is in proportion to their influence on milk production. The study of milk flow traits provides useful information for enhancing milking efficiency and also in adapting either machine or hand milking procedures to the physiological requirements of the dairy animals protecting udder health (Prasad and Jayalaxmi, 2014). There were certain reports that udder and teat morphology could be used as a reliable source for selection of buffaloes for milk production (Prasad *et al.*, 2010). Therefore, the present investigation is aimed to study the effect of udder and teat

shapes, parity and lactation stage on milkability and milk flow traits and their relationship with milk yield in Jaffarabadi buffaloes.

MATERIALS AND METHODS

A total of 150 Jaffarabadi buffaloes in different private dairy farms located in and around Hyderabad were selected and grouped according to parity (parity 1 to parity 4), stage of lactation (early stage: up to 100 days in milk, mid stage: from 100 to 200 days in milk and late stage: more than 200 days in milk) according to Fahim *et al.* (2017). Animals were kept in similar enclosures by all the farm owners including infrastructure of farms so that there was no farm effect observed as such. Milch animals were kept in a closed housing system (tail to tail) and were provided with sufficient space. They were fed roughages ad-lib that consisted of mixture of greens available in surrounding areas of dairy farms and concentrates were offered during milking, both at morning and evening to fulfil the nutrient requirement as per ICAR feeding standards (Anonymous, 2013). Water pipes were used to wash under portions including the udder, lateral sides of the belly and posterior part of the body. All buffaloes were stimulated for the let down of milk, either by letting a calf or manually by massaging the udder. Stripping was done at the end and the strip yield was measured and added to the milk to arrive at the total milk yield/day of an animal. The duration of the study was for three months (May to August, 2017). All the buffaloes were hand milked twice a day i.e. in morning (5.00 to 6.00 am) and evening (5.00 to 6.00 pm). Immediately after collection, the milk samples were checked for sub clinical mastitis by California Mastitis Test (CMT).

The udder shapes were classified basing on the visual appraisal as bowl, globular, goaty and pendulous shaped. Similarly, teat shapes were classified as conical, bottle, pear, cylindrical and funnel shaped as followed by Prasad *et al.* (2010).

Milk yield

The total milk yield was recorded by measuring the quantity of milk present in the milking pail after completion of the milking operation.

Milk flow traits

The milk flow traits *viz.*, milk letdown time, milking time, stripping time, total milking time, stripping yield, total milk yield and the total daily milk yield were recorded weekly once in the evening on hand milked buffaloes as suggested by Prasad and Jayalaxmi (2014).

Milk let-down time

Let-down time is the time interval from touching of a teat by calf/hand of the milker to first drop of milk drawn in the pail or bucket. This parameter was measured using the stop watch and expressed in minutes (min).

Stripping time and yield

The time the continuity of milk flow was stopped and the milk that was removed with a little difficulty till its stoppage was taken as stripping time. The farmer's observation was taken to arrive at this time. A stop watch was used to measure the time of stripping and expressed in minutes (min).

Total milking time

Milking time was measured from the moment milker placed his hands on the udder

to begin milking to the moment the last drop of milk was released from the udder, using a stop watch and expressed in minutes (min).

Total milk yield/ milk yield per milking

After milking, the total milk produced by an individual animal was weighed on digital weighing balance. Milk yield was measured in kg/milking/buffalo/day.

Average flow rate

Average flow rate was measured by dividing the total yield with total milking time and expressed as kg/min.

Total daily milk yield

Milk yield (kg) was recorded daily during the morning and evening milking.

Statistical analysis

Analysis of variance was utilized to test the significance of various treatments and the difference between treatment means was tested for significance by Duncan's Multiple Range and F Test (Duncan, 1955). The data obtained on various udder and teat parameters and milk yields were analyzed using SPSS statistical package (version 12.0.1). The correlation between ADMY and Milk flow traits were carried out using Pearson's correlation method.

RESULTS AND DISCUSSION

Effect of udder and teat shapes on milk yield and milk flow rate

The bowl-shaped udder yielded higher average daily milk yield (ADMY) compared

to other types of udders and the yields were 8.48 ± 0.11 , 8.12 ± 0.16 , 7.97 ± 0.14 and 7.82 ± 0.13 kg in bowl, globular, pendulous and goaty shaped udders, respectively (Table 1). These observations were corroborating with the findings of Prasad *et al.* (2010) and Badekar (2016) in Murrah buffaloes. The average milk

flow rate (AMFR) in buffaloes with bowl shaped udders was also highest followed by globular, pendulous and goaty shapes (Table 1). These results were in agreement with the findings of Tag *et al.* (2011), who reported udder shapes are having marked effect ($P < 0.01$) on AMFR and bowl shaped udder has highest AMFR.

Table 1. Milk yield, milk flow rate according to udder and teat shapes in Jaffarabadi buffaloes under hand milking

Parameter	Evening milk yield (kg)	Average daily milk yield (kg)	Average milk flow rate (kg/min.)
Udder shape (n=150; Mean \pm SE)			
Bowl	$4.14^b \pm 0.05$	$8.48^a \pm 0.11$	$0.65^b \pm 0.01$
Globular	$3.96^{ab} \pm 0.06$	$8.12^a \pm 0.16$	$0.64^{ab} \pm 0.01$
Pendulous	$3.91^{ab} \pm 0.07$	$7.97^a \pm 0.14$	$0.64^{ab} \pm 0.01$
Goaty	$3.80^a \pm 0.08$	$7.82^a \pm 0.13$	$0.60^a \pm 0.02$
Teat shape (n=150; Mean \pm SE)			
Cylindrical	$4.20^b \pm 0.05$	$8.61^b \pm 0.12$	$0.66^b \pm 0.01$
Conical	$3.76^a \pm 0.05$	$7.67^a \pm 0.13$	$0.61^a \pm 0.01$
Funnel	$4.00^{ab} \pm 0.07$	$8.23^{ab} \pm 0.15$	$0.65^b \pm 0.01$
Pear	$3.98^{ab} \pm 0.09$	$8.08^{ab} \pm 0.18$	$0.65^b \pm 0.01$
Bottle	$4.02^{ab} \pm 0.12$	$8.33^b \pm 0.27$	$0.69^b \pm 0.02$

^{a,b}Means with similar superscripts within column do not differ significantly ($P < 0.05$)

The perusal of Table 1, also shows that the udder with cylindrical shaped teats yielded significantly higher ($P < 0.05$) ADMY compared to other type of teats and similar findings were reported by several workers (Bharadwaj *et al.*, 2007; Prasad *et al.*, 2010; Badekar, 2016; Rahmatullah *et al.*, 2017) in Murrah buffaloes. The AMFR in Jaffarabadi buffaloes according to the teat shapes are presented in Table 1 showing that, the AMFR in buffaloes with bottle and cylindrical shaped

teats was highest ($P < 0.05$) followed by cylindrical, funnel, pear and conical shapes. To substantiate this observation, review was not available and further studies are suggested in this regard for finding out the relation between teat shapes and milk flow rate in Jaffarabadi buffaloes. The results of the present study, suggests that buffaloes with bowl shaped udder are to be recommended in selection and upgrading programmes due to their high milk yielding capacity.

Effect of parity and stage of lactation on milk yield and milk flow rate

The average daily milk yield and average milk flow rate in Jaffarabadi buffaloes according to the parity are presented in Table 2. The highest (8.83 ± 0.11 kg; $P < 0.05$) ADMY was produced by buffaloes in 3rdparity, whereas, the lowest (7.06 ± 0.16 kg) ADMY was recorded from buffaloes in 1stparity. The average milk flow rate was significantly ($P < 0.05$) higher in 3rdparity (0.67 ± 0.01 kg/min) and lower in 1stparity (0.60 ± 0.01 kg/min). The positive and highly significant ($P < 0.01$) correlation was observed between the ADMY and AMFR. These results were in agreement with Tag *et al.* (2011),

who found parity had highly significant ($P < 0.01$) effect on milk flow rate and cows in the 3rdparity had the highest milk flow rate. Contrary to our results, Bhagat *et al.* (1992) reported that the AMFR was significantly ($P < 0.01$) higher in 2ndlactation as compared to 1st, 3rdand 4thlactation in Murrah buffaloes. Antalík and Strapák (2011) reported that the highest AMFR was found in the 2ndlactation compared to other parities. Fahim *et al.* (2017) reported that the average milk flow rate was significantly ($P < 0.01$) higher in multiparous cows in 4thparity. Antalík and Strapák (2011) reported that no significant correlations were detected between parity and milk flow traits and the highest average and maximal milk flow rates were measured in 2ndlactation.

Table 2. Milk yield, milk flow rate according to parity and lactation stage in Jaffarabadi buffaloes under hand milking

Parameter	Eveningmilk yield (kg)	Average daily milk yield (kg)	Average milk flow rate (kg/min.)
Parity (n=150; Mean \pm SE)			
1	$3.52^a \pm 0.06$	$7.06^a \pm 0.16$	$0.60^a \pm 0.01$
2	$3.92^b \pm 0.05$	$8.11^b \pm 0.11$	$0.63^b \pm 0.01$
3	$4.31^c \pm 0.06$	$8.83^c \pm 0.11$	$0.67^c \pm 0.01$
4	$4.04^b \pm 0.04$	$8.23^b \pm 0.08$	$0.65^{bc} \pm 0.01$
Stage of Lactation (n=150; Mean \pm SE)			
Early lactation	$4.15^b \pm 0.07$	$8.55^b \pm 0.14$	$0.66^b \pm 0.01$
Mid lactation	$4.05^{ab} \pm 0.05$	$8.23^{ab} \pm 0.12$	$0.64^{ab} \pm 0.01$
Late lactation	$3.92^a \pm 0.06$	$8.05^a \pm 0.12$	$0.63^a \pm 0.01$

^{a-c}Means with similar superscripts within column do not differ significantly ($P < 0.05$)

The average daily milk yield and average milk flow rate in Jaffarabadi buffaloes according to the stage of lactation

are presented in Table 2. The AMFR was significantly ($P < 0.05$) higher during early and mid stages (0.66 ± 0.01 and 0.64 ± 0.01 kg/

min), respectively in comparison to late stage of lactation. These findings were in agreement with Bharadwaj *et al.* (1987) in buffaloes, Bhagat *et al.* (1992) in Murrah buffaloes, Roshanfekar *et al.* (2010) in buffaloes and Strapák *et al.* (2011) in Holstein dairy cows. Contrary to our study, Antalík and Strapák (2011) and Fahim *et al.* (2017) reported that highest values of AMFR were observed in mid stage of lactation than early lactation stage in Slovak Simmental dairy cows and CB dairy cows, respectively. Singh and Tomer (1994) reported that the influence of stage of lactation on AMFR was not significant, but the milk yield of the animal had a significant effect on the flow rate.

Milk flow traits

The mean values of various milk flow traits in Jaffarabadi buffaloes under hand milking are presented in Table 3. It was found that, the average milk let-down time, milking time, stripping time and total milking time, stripping yield and average milk flow rate were 1.54 ± 0.01 min., 3.49 ± 0.04 min., 1.28 ± 0.01 min., 6.31 ± 0.05 min., 0.19 ± 0.001 kg and 0.65 ± 0.01 (kg/min.). In the present study, the average milk let-down time was less than those reported by Aulakh and Gupta (1995) in buffaloes, Chaudhary *et al.* (2001) in buffaloes and cows, Roshanfekar *et al.* (2010) in Khuzestan buffaloes and Prasad and Jayalaxmi (2014) in Murrah buffaloes, but more than the findings of Tripathi *et al.* (1991) in desi and CB milch cows and Bhagat *et al.* (1992) in Murrah buffaloes.

Table 3: Mean values of various milk flow traits in Jaffarabadi buffaloes under hand milking

Attributes	Values (Mean \pm SE)
Total no. of animals	150
Milk letdown time (min)	1.54 ± 0.01
Milking time(min)	3.49 ± 0.04
Stripping time (min)	1.28 ± 0.01
Total milking time (min)	6.31 ± 0.05
Stripping yield (kg)	0.19 ± 0.001
Average milk flow rate (kg/min)	0.65 ± 0.01

The variation observed in milk let-down time may be due to different levels of udder preparation. The time from the start of tactile stimulation until the occurrence of milk ejection spans 40 seconds to more than 2 minutes and increased with a decreasing degree of udder filling, and maximal possible reduction of stress has to be targeted and proper udder pre-stimulation must be performed for an optimal milking of the dairy animal by the farmer (Bruckmaier and Wellnitz, 2008). Comfortable surroundings, such as feeding and lighting of the milking parlour can increase the secretion of Oxytocin. Hence, it may be concluded that the animal comfort and good milking environment plays a major role in the induction of milk ejection and milk removal.

The average stripping time in the present study was 1.28 ± 0.01 min and it was less than that reported by Prasad and Jayalaxmi (2014) when hand milking performed in Murrahbuffaloes. Average stripping yield in

the present study was 0.19 ± 0.001 kg and it was greater than that reported by Kijak and Zdunczyk (1976) with hand milking in cows and Prasad and Jayalaxmi(2014) with hand milking in Murrah buffaloes.

The average milk flow rate obtained in the present study was 0.65 ± 0.01 Kg/min (Table 3), and it was less than those reported by Swaid and Sastry (1982) in CB cows under hand milking conditions, Pandey *et al.* (1990) in different CB cows, Trivedi (2008) in triple CB and Kankrej cows and Antalík and Strapák (2011) in Slovak Simmental dairy cows and it was greater than that reported by Prasad and Jayalaxmi (2014) with hand milking in Murrah buffaloes.

Correlation between milk yield and milk flow traits

The milk yield had highly significant ($P < 0.01$) positive correlation with milking time ($r = 0.523$), total milking time ($r = 0.489$) and average milk flow rate ($r = 0.624$) and significant ($P < 0.05$) with stripping time ($r = 0.188$) and stripping yield ($r = 0.188$). Thus, milk yield had a direct effect on milk flow rate and the findings in the present study were similar to those reported by Pander and Chopra (1986) in cross bred dairy cattle and Singh and Tomar (1994) in buffaloes. A non-significant negative correlation was observed between milk yield and milk let-down time (Table 4).

Table 4. Correlation (2-tailed) between milk yield and milk flow traits in Jaffarabadi buffaloes

Attributes	Average daily milk yield (ADMY)	Milk let-down time	Milking time	Stripping time	Total milking time	Stripping yield	Average milk flow rate (AMFR)
ADMY	1	-0.088	0.523**	0.188*	0.489**	0.188*	0.624**
Milk let-down time		1	-0.039	-0.060	0.235**	-0.105	-0.320**
Milking time			1	0.199**	0.930**	0.193*	-0.263**
Stripping time				1	0.412**	0.399**	-0.161*
Total milking time					1	0.242**	-0.366**
Stripping yield						1	-0.004
AMFR							1

*Significant at 0.05 level; **Significant at 0.01 level

The correlation co-efficient of milk let-down time with total milking time was significantly ($r=0.235$; $P<0.01$) positive and milk let-down time was negatively correlated with milking time ($r=-0.039$), stripping time ($r=-0.060$), stripping yield ($r=-0.105$) and average milk flow rate ($r=-0.320$), but statistically highly significant ($P<0.01$) correlation was seen with the average milk flow rate only. In the current study, the milking time has shown a significant ($P<0.05$) positive correlation with stripping time ($r=0.199$), stripping yield ($r=0.193$) and total milking time ($r=0.930$; $P<0.01$), and it was negatively correlated with average milk flow rate ($r=-0.263$; $P<0.01$). Similarly, the stripping time was significantly ($P<0.01$) positively correlated with total milking time ($r=0.412$), stripping yield ($r=0.399$) and negatively correlated with average flow rate ($r=-0.161$; $P<0.05$). The total milking time and stripping yield had significant ($P<0.01$) positive correlation but total milking time was negatively correlated with average flow rate ($r=-0.366$; $P<0.01$). The stripping yield was also negatively correlated with average flow rate ($r=-.004$), but was statistically insignificant. The results of the present study also corroborating with the findings of Prasad and Jayalaxmi (2014).

CONCLUSION

It can be concluded that, higher average milk flow rate and higher average daily milk yields were found in buffaloes with bowl shaped udders with bottle shaped teats. The highly significant positive correlation of ADMY with various milk flow traits like, milking time, total milking time and average

milk flow rate and significant correlation with stripping time and stripping yield indicating that selection for one trait will also improve other traits. Therefore, while selecting Jaffarabadi buffaloes for milk production, animals in their 2nd or 3rd parity, in their early stage of lactation with bowl shaped udder and bottle shaped teats are to be taken into consideration for maximum returns.

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