

Effect of parity, lactation stage and udder morphology on milk yield and milk constituents in Jaffarabadi buffaloes

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ABSTRACT

The present study was conducted to know the effect of parity, stage of lactation and udder morphology on milk yield and milk constituents in Jaffarabadi buffaloes. A total of 150 buffaloes selected from private dairy farms located in and around Hyderabad were utilized. The average daily milk yield (ADMY) recorded in buffaloes with different parities were 7.06 ± 0.16 , 8.11 ± 0.11 , 8.86 ± 0.12 and 8.23 ± 0.08 Kg in first, second, third and fourth parity, respectively showing the third parity animals yielded higher ADMY compared to other parities. The ADMY in different lactation stages recorded were 8.55 ± 0.14 , 8.23 ± 0.12 and 8.08 ± 0.13 Kg in early, mid and late stage of lactation, respectively showing there was a decrease in ADMY from early to late stage of lactation. There was a positive and highly significant ($P < 0.01$) correlation between the udder morphology and ADMY. The average milk fat, solids non fat (SNF) and total solids (TS) of different parities ranged from 7.41 ± 0.12 to $8.05 \pm 0.09\%$, 9.67 ± 0.09 to $10.03 \pm 0.12\%$ and 17.44 ± 0.22 to $17.72 \pm 0.15\%$, respectively. The overall average milk fat, SNF and TS were found to be 7.81 ± 0.05 , 9.77 ± 0.05 and $17.58 \pm 0.08\%$, respectively showing there was an increase in milk fat and TS from first parity to fourth parity. The average milk fat, SNF and TS in different stages of lactation ranged from 7.24 ± 0.08 to 8.35 ± 0.08 , 9.67 ± 0.07 to 9.85 ± 0.10 and 16.91 ± 0.12 to $18.20 \pm 0.12\%$, respectively and a significant ($P < 0.05$) increase in milk fat and TS from early to late lactation stage was observed. Similarly, SNF also increased from early to late stage of lactation but was insignificant. It was also observed that there was no significant effect of udder and teat shapes on milk constituents. There was a negative correlation of ADMY with milk fat, SNF and TS and correlation were highly significant ($P < 0.01$) in case of ADMY with fat and TS. The milk fat was positively correlated with SNF and TS but the correlation was significant only with TS. The study concludes that, parity and stage of lactation affect ADMY and milk constituents, while the positive correlation among milk constituents indicating that selection for one trait will also improve other traits in Jaffarabadi buffalo

KEY WORDS: Jaffarabadi buffalo, Lactation stage, Milk Constituents, Milk Yield, Parity.

INTRODUCTION

Buffaloes are a vital source of income and employment especially to the weaker sections of the society, comprising landless labourers,

marginal farmers and small farmers who form the majority in rural India. Buffaloes play a distinct role in improving the rural economy, which is primarily based on agricultural production systems. In fact, these animals can be considered as a financial asset since they serve as an insurance against the risk of crop failure due to natural calamities¹⁰. India had 302.79 million bovine population (cattle and buffalo) in 2019 and the total buffalo population in India is 109.85 million (which shows an increase of 1.1% over the previous census) and contributes around 20.45% of the total livestock population in India⁴.

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Buffaloes contribute for major volume of the total milk produced in India, even though their population is less compared to that of the cattle. India is the highest milk producer country in the world with an estimated quantity of 165.4 million tonnes in the year 2016-17³. It was reported that both morphological and physiological mammary properties affect the milk yield in cattle²⁹. Milk producing ability is the main consideration while selecting the dairy animals for milk constituents. Generally, milk price in India is depend upon milk fat and SNF content, hence its estimation play an important role in improving the cost benefit ratio in dairy farms. Hence, milk auto analyser is used for estimation of milk constituents like SNF and TS²⁶ and these milk constituents play a significant role in maintaining the worth of raw milk, producing best quality milk products and preserving nutritive value for food safety^{19&21}. Milk constituents were affected by several factors such as environmental, nutritional and physiological factors etc²⁶. Apart from that, in a recent study, it was observed that stage of lactation and parity plays a significant effect on milk constituents¹⁵. Further, correlation study among different milk constituents, parity and udder morphology could be helpful for breeders for selection of buffaloes for higher milk constituents. Keeping these in mind, the present study is designed to assess the effect of parity, stage of lactation and udder morphology on milk yield and milk constituents in Jaffarabadi buffalo

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 their 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 to¹³. 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. The milch animals were kept in a closed housing system (tail to tail type) and were provided with sufficient space. The

buffaloes 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 standard². Water pipes were used to wash the under portions including the udder, lateral sides of the belly and the 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) and at the same time samples were analysed for milk constituents such as milk fat, solids non-fat (SNF) and total solids (TS) per cent using "LACTOSCAN" milk analyzer (New Dairy Engineering and Trading Company Pvt. Ltd., Delhi, India). 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 Test¹¹. 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 parity, ADMY and different milk constituents were carried out using Pearson's correlation method.

RESULTS AND DISCUSSION

Effect of parity on milk yield

Perusal of the data revealed that, 3rd parity animals yielded significantly ($P < 0.05$) higher average daily milk yield (ADMY) compared to other parities and the yields were 7.06 ± 0.16 , 8.11 ± 0.11 , 8.86 ± 0.12 and 8.23 ± 0.08 Kg in 1st, 2nd, 3rd and 4th parity, respectively (Table 1).

Table 1. Average daily milk yield (ADMY) and milk composition according to Parity and Stage of lactation in Jaffarabadi buffaloes

Parameter	N	ADMY	Min.	Max.	Milk Fat	SNF	TS
			MY	MY	(%)	(%)	(%)
Kg							
Parity (n=150; Mean ± SE)							
1	20	7.06 ^a ± 0.16	5.98	8.17	7.41 ^a ± 0.12	10.03 ^b ± 0.12	17.44 ^a ± 0.22
2	40	8.11 ^b ± 0.11	7.17	10.43	7.69 ^{ab} ± 0.11	9.80 ^{ab} ± 0.11	17.49 ^a ± 0.17
3	56	8.86 ^c ± 0.12	6.91	11.22	7.88 ^{bc} ± 0.09	9.72 ^a ± 0.06	17.60 ^a ± 0.11
4	34	8.23 ^b ± 0.08	7.60	10.33	8.05 ^c ± 0.09	9.67 ^a ± 0.09	17.72 ^a ± 0.15
Stage of Lactation (n=150; Mean ± SE)							
Early lactation	43	8.55 ^b ± 0.14	6.30	10.49	7.24 ^a ± 0.08	9.67 ^a ± 0.07	16.90 ^a ± 0.12
Mid lactation	63	8.23 ^{ab} ± 0.12	5.98	10.09	7.81 ^b ± 0.06	9.79 ^a ± 0.07	17.60 ^b ± 0.10
Late lactation	44	8.08 ^a ± 0.13	6.44	11.22	8.35 ^c ± 0.08	9.85 ^a ± 0.10	18.20 ^c ± 0.12
Overall Mean ± SEM		8.28 ± 0.08	5.98	11.22	7.81 ± 0.05	9.77 ± 0.05	17.58 ± 0.08

Means with similar superscripts within column do not differ significantly (P<0.05)

The results of the present study showing that there was an increase in ADMY from 1st parity to 3rd parity and these findings are in agreement with the reports of²⁸ who found parity had highly significant (P<0.01) effect on milk yield per milking in Friesian cows and cows in the 3rd parity had the highest milk yield per milking. The results are in agreement with¹, who reported highest milk yield per milking by the dairy cows in the 3rd and greater lactations (10.40 ± 4.67 kg). On the other hand, a researcher¹³ found that the highest (15.70 ± 0.51 Kg/day; 7.11 ± 0.23 Kg/session) milk yield was produced by the dairy cows in their 4th parity and the lowest (11.63 ± 0.54 Kg/day; 5.35 ± 0.24 Kg/session) milk yield was produced in their 1st parity and there was a significant difference (P<0.01) in milk yield among parities. In contrast to the present findings, other workers¹, reported that the highest total milk yield was reached by dairy cows in their 2nd lactation.

Effect of lactation stage on milk yield

The ADMY in different lactation stages ranged from 8.55 ± 0.14 Kg in first stage of lactation to 8.08 ± 0.13 Kg in third stage of lactation. There was a decrease in ADMY from early lactation stage to late

lactation stage in the present study (Table 1). Similar to the results of current study, some workers^{1&18}, found that total milk yield was significantly (P<0.05) higher during the early stages of milk production than in mid and late stages in Mithun cows and Holstein dairy cows, respectively. The other worker¹³ also reported that the total milk/day/animal was significantly (P<0.01) higher during the early stages of milk production (15.45 ± 0.43 Kg/day) than in mid and late stages. Contrary to our findings, some workers^{1&27}, reported that highest values of total milk yield were observed in mid lactation stage than early and late lactation stage in Holstein dairy cows.

Effect of Udder and Teat morphology on milk yield

The ADMY in Jaffarabadi buffaloes with various udder shapes is depicted in Table 2. In the present study, bowl shaped udders yielded higher 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 goat type of udders, respectively. These observations were corroborating the findings of few workers

in cows^{8,9&12}, in Friesian cows²⁸ and in Murrah buffaloes^{5&22}.

The perusal of the data revealing that, the udder with cylindrical shaped teats yielded more ADMY compared to other type of teats and similar findings were reported by several workers in Murrah buffaloes^{5,7,22&24}. In contrary, our findings are not in

agreement with^{9&25}, who reported funnel shaped teats were associated with higher milk yields in cows. From the results of the present study, it may be recommended that buffaloes with bowl shaped udder and cylindrical shaped teats are to be considered in selection and upgrading programmes due to their high milk yielding capacity, compared to other type of udders in Jaffarabadi buffaloes

Table 2. Average daily milk yield (ADMY) and milk composition according to Udder morphology in Jaffarabadi buffaloes

Parameter	N	ADMY	Min.	Max.	Milk Fat	SNF	TS
			MY	MY			
		Kg			%		
Udder shape (n=150; Mean ± SE)							
Bowl	80	8.48 ^a ± 0.11	6.30	10.49	7.68 ^a ± 0.08	9.77 ^a ± 0.07	17.45 ^a ± 0.12
Globular	40	8.12 ^a ± 0.16	5.98	11.22	7.93 ^a ± 0.09	9.71 ^a ± 0.09	17.64 ^a ± 0.12
Pendulous	24	7.97 ^a ± 0.14	6.56	9.93	7.96 ^a ± 0.08	9.88 ^a ± 0.11	17.83 ^a ± 0.15
Goaty	6	7.82 ^a ± 0.13	7.17	8.01	8.09 ^a ± 0.20	9.77 ^a ± 0.20	17.85 ^a ± 0.23
Teat shape (n=150; Mean ± SE)							
Cylindrical	72	8.61 ^b ± 0.12	6.31	11.22	7.81 ^a ± 0.08	9.78 ^a ± 0.06	17.59 ^a ± 0.11
Conical	34	7.67 ^a ± 0.13	5.98	9.05	7.81 ^a ± 0.11	9.83 ^a ± 0.08	17.64 ^a ± 0.14
Funnel	20	8.23 ^{ab} ± 0.15	6.91	9.96	7.70 ^a ± 0.21	9.58 ^a ± 0.20	17.28 ^a ± 0.29
Pear	15	8.08 ^{ab} ± 0.18	7.17	9.93	7.82 ^a ± 0.10	9.96 ^a ± 0.10	17.79 ^a ± 0.16
Bottle	9	8.33 ^b ± 0.27	7.23	9.75	7.95 ^a ± 0.17	9.57 ^a ± 0.16	17.52 ^a ± 0.24
Overall Mean ± SEM		8.28 ± 0.08	5.98	11.22	7.81 ± 0.05	9.77 ± 0.05	17.58 ± 0.08

Means with similar superscripts within column do not differ significantly (P<0.0)

Effect of parity on milk constituents

The mean value of milk fat, solids non-fat (SNF) and total solids (TS) in different parities are presented in Table 1. The average value of milk fat, SNF and TS of different parities ranged from 7.41 ± 0.12 to 8.05 ± 0.09%, 9.67 ± 0.09 to 10.03 ± 0.12% and 17.44 ± 0.22 to 17.72 ± 0.15%, respectively. The overall average milk fat, SNF and TS were found to be 7.81 ± 0.05%, 9.77 ± 0.05% and 17.58 ± 0.08%, respectively. The present study revealed that there was an increase in milk fat and TS from 1st parity to 4th parity. Similar results were reported²⁴ but in contrast, the reports of⁶ revealed that fat and TS per

cent differed significantly (P<0.01) among parities and highest fat, SNF and TS per cent were recorded in first lactation while in second and fourth lactation values did not differ significantly in Murrah buffaloes

Effect of lactation stage on milk constituents

The data presented in Table 2, showing that, the mean value of milk fat, SNF and TS of different lactation stages ranged from 7.24 ± 0.08 (early) to 8.35 ± 0.08% (late), 9.67 ± 0.07 (early) to 9.85 ± 0.10% (late) and 16.91 ± 0.12 (early) to 18.20 ± 0.12% (late), respectively. It was observed that, there was a significant (P<0.05) increase in milk fat and TS from early to late lactation stage. Similarly,

the SNF also increased from early to late stage of lactation but was statistically insignificant. The results of present study were in accordance with the findings in Murrah buffalo⁵ and in Mithun cows¹⁸. In contrary, other worker²³ reported that the fat content of the milk was significantly higher ($P < 0.05$) in early and late than in mid lactation and total SNF was not significantly affected by the stage of lactatio

Effect of udder morphology on milk constituents

The mean values of milk constituents according to the shape of udder and teats are depicted in Table 2. A critical appraisal of results indicated that there was no significant effect of udder morphology on milk fat, SNF and TS. Contrary to our findings, the reports of¹⁶ revealed that the milk fat percentage was highest in goat-type udders followed by round,

bowl-shaped and pendulous types, but SNF did not differ significantly between the udder types in Jersey X Red Sindhi crosses.

Correlation between ADMY and different milk constituents

The correlation coefficient values among ADMY and milk constituents are presented in Table 3. The milk yield was negatively correlated with milk fat, SNF and TS and it was observed that this negative correlation between ADMY with milk fat and TS was highly significant ($P < 0.01$), indicating that selection of animal for higher milk production results in somewhat lesser milk constituents. Similar to these findings, it was reported¹⁷ that the fat percentage was found to be negatively correlated ($P < 0.01$) with milk production.

Table 3. Correlation among Average daily milk yield (ADMY) and milk constituents in Jaffarabadi buffaloes

	ADMY	Milk Fat %	SNF %	TS %
ADMY	1	-0.231**	-0.144	-0.255**
Fat %		1	0.116	0.793**
SNF %			1	0.697**
TS %				1

**Correlation is significant at 0.01 level (2-tailed)

The perusal of Table 3 revealing that, the milk fat was positively correlated with SNF and TS but the correlation was highly significant ($r = 0.793$, $P < 0.01$) only with TS per cent. Similarly, the SNF was also significantly positively correlated ($r = 0.697$, $P < 0.01$) with TS per cent. The results of current study are consistent with the findings of^{14&20}. This positive correlation of fat with other milk constituents indicating that selection of Jaffarabadi buffaloes for fat will automatically improve the other traits of milk.

CONCLUSION

It can be concluded that the parity and stage of lactation had significant effect on average daily milk production and milk constituents in Jaffarabadi buffaloes. In early phase of lactation, the mean milk constituent values were higher, which gradually decreased towards the end phase of lactation. The highly significant, negative correlation of ADMY

with milk constituents indicating that the Jaffarabad buffaloe yielded higher milk, while the positive correlation among milk constituents indicating that selection for one trait will also improve other traits in Jaffarabadi buffaloe

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