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Factors affecting milking behaviour and milking efficiency in Ongole cattle

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Abstract

The present study was undertaken to assess the effect of lactation number, stage of lactation, milk yield per milking, shape of udder and teats, pregnancy status, sex of calf, shift of milking and identity of milker on speed of calf to reach its dam from calf shed, time taken for initial calf suckling and milk flow rate in Ongole cattle. The mean speed of calf to reach its dam from calf shed, the mean time taken for initial calf suckling and the mean milk flow rate was 76.29 ± 2.03 m/min, 1.00 ± 0.01 min and 0.68 ± 0.01 kg/min, respectively. The speed of calf to reach its dam from calf shed varied significantly with lactation number (P < 0.01), pregnancy status of dam (P < 0.05) and shape of teats (P < 0.05). The initial calf suckling time varied significantly (P < 0.01) with lactation number, pregnancy status of dam, shape of teats and shift of milking. The milk flow rate varied significantly with lactation number (P < 0.01), stage of lactation (P < 0.01), milk yield (P < 0.01), pregnancy status of dam (P < 0.05), shape of udder (P < 0.01), shape of teats (P < 0.01) and identity of milker (P < 0.01). From the results, it is concluded that non-pregnant cows, cows having bowl shaped udder, conical (long) shaped teats, higher milk yield, higher lactation number and cows in early stage of lactation are more efficient for milking.

Keywords: *Speed of calf, lactation number, milk flow rate.*

Milking behaviour and milking efficiency are among the main traits considered by a farmer when selecting dairy cattle. Any aggressive behaviour during milking prolongs the milking time and may reduce the milk yield from animal as the milking operation should be completed within seven minutes due to very low half-life of oxytocin hormone (Kentjonowaty *et al.*, 2021). A higher milking

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efficiency of cattle may lead to a reduction in labour requirement for milking operation and associated costs involved in milk production as milking operation consumes the most labour time spent in a dairy farm (Bhinda *et al.*, 2021), and cost of labour is second only to the cost of feed in the milk production (Beca, 2021).

Most of the studies reported on milking behaviour and milking efficiency, such as those of Hogeveen *et al.* (2001), Samoré *et al.* (2010), Antalík and Strapák (2011), Edwards *et al.* (2014) and Bobić *et al.* (2020), were conducted on high yielding cows under machine milking system. The Ongole cattle breed is a dual-purpose breed with its breeding tract extending all along the coast from Nellore to Vizianagaram in Andhra Pradesh. It shows strong maternal instinct, which makes it difficult to follow weaning of calves. Machine milking may not be suitable for the Ongole cows due to the low yield of milk to be extracted after calf suckling. A significant difference between machine and hand milking systems in terms of milking efficiency was noted by Filipovic and Kokaj (2009). The present study aims to understand the factors influencing behavioural aspects of calf and dam during milking operation and milking efficiency under hand milking system in the Ongole cattle, which may help in proper management of the animals during milking and selection of animals for good milking behaviour and efficiency of milking.

Materials and methods

The present study was conducted on 40 milch animals present at Livestock Research Station, Mahanandi, Nandyal district, Andhra Pradesh for a period of 30 days from 1st to 30th November, 2023. They were maintained under a loose housing system, with their shed consisted of an open paddock and a covered area of cement concrete floor. They were fed with one kg of concentrate per animal before milking in morning and evening, and 25 kg of chaffed green fodder (Super Napier) per animal after the evening milking. They were allowed to graze from 10:00 AM to 1:30 PM daily.

Milking was done by hand method twice daily i.e., morning and evening. Calves were allowed to suckle before and after milking as weaning is not in practice. All the animals under study had all four functional teats. Milking was done in the milking barn which is of tail-to-tail type with 26 standings on each side. Place of standing of an animal in the barn was almost constant. Distance from calf shed to place of standing of a dam was measured with a tape. The average distance from calf shed to place of standing of dam in milking barn is 27.63 metres.

Behavioural aspects of milking that were studied include speed of calf to reach its dam from calf shed and time taken for initial calf suckling. Milking efficiency was measured in terms of milk flow rate. A total of 340 observations (170 each in the morning and evening sessions of milking) were recorded.

The speed of calf to reach its dam from calf shed was arrived by the following formula:

$$\textit{Speed of calf (m/min)} = \frac{\textit{Distance between calf shed and place of dam in milking barn (m)}}{\textit{Time taken by calf to reach its dam from calf shed and start suckling (min.)}}$$

The time taken for initial calf suckling was the time required for milk let-down, which was confirmed by observing signs such as urination of dam. The milk flow rate (MFR) was calculated by the following formula:

$$\textit{MFR (kg/min)} = \frac{\textit{Milk yield per milking (kg)}}{\textit{Actual milking time (min.)}}$$

The actual milking time was the exact time spent by milker in getting the milk from animal.

The various factors that were studied include lactation number, stage of lactation, milk yield per milking, shape of udder and teats (Fig.1-4), pregnancy status, sex of calf, shift of milking and identity of milker. The details of lactation number, stage of lactation and pregnancy status were taken from the records available on the farm, while the remaining factors were recorded during milking. The stages of lactation were classified into early (below 100 days in milking), mid (100-200 days in milking) and late (above 200 days in milking).

Teats: Conical (long) Udder: Trough | Teats: Conical (short) Udder: Bowl | Teats: Cylindrical (long) Udder: Bowl | Cylindrical (short) Udder: Bowl

Fig. 1-4 Different shapes of udder and teats

The shapes of udder and teats were decided by visual examination before milking on the day before beginning of the study. The different shapes of the udder were bowl and trough, and those of the teats were conical (long), conical (short), cylindrical (long) and cylindrical (short).

The data were subjected to One way-ANOVA and t-test to know the effect of various factors on the behavioural aspects of milking and milking efficiency as per the procedure laid down by Snedecor and Cochran (1967).

Results and discussion

The results of analysis of various factors affecting milking behaviour and milk flow rate are presented in Table 1.

Speed of calf to reach its dam from calf shed

The mean speed of calf to reach its dam from calf shed was 76.29 ± 2.03 m/min. The speed of calf varied significantly ($P < 0.01$) among lactation numbers with lowest (61.97 ± 2.94 m/min) in second lactation and highest (89.43 ± 2.69 m/min) in sixth and above lactations which might be due to increase of mothering ability of dam with age which in turn increases the eagerness of calf to reach dam. It also varied significantly ($P < 0.05$) with pregnancy status of dam and shape of teats. The reason for the significantly lower speed in the case of pregnant dams might be due to a decrease in the eagerness of calves with age, as their age increases by the time their dams become pregnant. Stage of lactation, milk yield per milking, shape of udder, sex of calf, shift of milking and identity of milker did not have any effect on the speed of calf.

Time taken for initial calf suckling

The mean time taken for initial calf suckling was 1.00 ± 0.01 min which is similar to that of Sreedhar (1999), who reported that calf suckling took 40-50 seconds in buffaloes. The initial calf suckling time varied significantly ($P < 0.01$) among lactation numbers and it ranged from 0.93 ± 0.04 min. in fourth lactation to 1.24 ± 0.13 min. in second lactation. It was probably due to increase of milk yield with parity as the milk flows faster from alveoli to cisterns in cases of higher milk yields. The finding of the present study is in agreement with Singh *et al.* (2010), who reported that milk let-down time was significantly ($P < 0.01$) effected by parity order in buffaloes. The initial calf suckling time also varied significantly ($P < 0.01$) with pregnancy status of dam, shape of teats and shift of milking. The higher value of time taken for initial calf suckling in pregnant animals might be due to more time required for let-down of milk, and the higher value in morning shift might be due to ambient cold conditions. The reason for significant variation among teat shapes might be due to the varied level of access provided by teats of different shapes for suckling.

Milk flow rate

The mean milk flow rate was 0.68 ± 0.01 kg/minute which is consistent with Upadhyay *et al.* (2015), who observed that the milk flow rate in Tharparkar cows with calf suckling was 0.63 ± 0.01 kg/min. The result

Table 1. Factors affecting milking behaviour and milk flow rate

Factor	Sample size	Speed of calf to reach its dam from calf shed (m/min.)	Time taken for initial calf suckling (min.)	Milk flow rate (kg/min.)
Overall	340	76.29 ± 2.03	1.00 ± 0.01	0.68 ± 0.01
Lactation number		**	**	**
1	110	70.02^{a} ± 1.48	0.98^{a} ± 0.01	0.54^{a} ± 0.01
2	30	61.97^{a} ± 2.94	1.24^{b} ± 0.13	0.58^{a} ± 0.03
3	48	81.77^{ab} ± 12.56	1.05^{a} ± 0.03	0.73^{b} ± 0.02
4	30	73.37^{ab} ± 4.80	0.93^{a} ± 0.04	0.77^{b} ± 0.02
5	58	77.82^{ab} ± 2.62	0.94^{a} ± 0.02	0.84^{b} ± 0.03
6 and above	64	89.43^{b} ± 2.69	1.00^{a} ± 0.02	0.82^{b} ± 0.03
Stage of lactation		NS	NS	**
Early (below 100 days)	132	75.30 ± 1.95	1.00 ± 0.02	0.76^{b} ± 0.02
Mid (100-200 days)	72	78.55 ± 2.74	1.01 ± 0.02	0.66^{a} ± 0.03
Late (above 200 days)	136	76.04 ± 4.50	1.00 ± 0.02	0.60^{a} ± 0.01
Milk yield per milking (kg)		NS	NS	**
0-1	122	71.46 ± 1.82	1.02 ± 0.03	0.52^{a} ± 0.01
1-2	184	78.70 ± 3.33	1.00 ± 0.01	0.72^{b} ± 0.01
2-3	34	81.30 ± 3.61	0.91 ± 0.03	1.10^{c} ± 0.04
Pregnancy status		*	**	*
Pregnant	48	63.96^{a} ± 2.87	1.18^{b} ± 0.07	0.60^{a} ± 0.02
Non-pregnant	292	77.84^{b} ± 2.24	0.98^{a} ± 0.01	0.69^{b} ± 0.01
Shape of udder		NS	NS	**
Bowl	125	78.28 ± 1.86	0.99 ± 0.01	0.73^{b} ± 0.02
Trough	215	77.41 ± 3.29	0.99 ± 0.01	0.66^{a} ± 0.01
Shape of teats		*	**	**
Conical (long)	122	80.91^{b} ± 1.90	0.96^{ab} ± 0.01	0.73^{b} ± 0.02
Conical (short)	43	62.64^{a} ± 3.41	0.93^{a} ± 0.03	0.72^{b} ± 0.04
Cylindrical (long)	112	77.24^{ab} ± 2.01	1.02^{b} ± 0.02	0.70^{b} ± 0.02
Cylindrical (short)	63	83.30^{b} ± 10.53	1.03^{b} ± 0.02	0.55^{a} ± 0.02
Shift of milking		NS	**	NS
Morning	170	74.33 ± 3.72	1.07^{b} ± 0.02	0.66 ± 0.01
Evening	170	78.24 ± 1.64	0.94^{a} ± 0.01	0.69 ± 0.02
Sex of calf		NS	NS	NS
Male	179	73.35 ± 1.62	1.00 ± 0.02	0.66 ± 0.02
Female	161	79.54 ± 3.89	1.00 ± 0.01	0.70 ± 0.01
Identity of milker		NS	NS	**
Milker 1	99	78.49 ± 8.80	0.99 ± 0.02	0.60^{a} ± 0.02
Milker 2	130	74.67 ± 1.70	0.98 ± 0.02	0.72^{b} ± 0.02
Milker 3	111	77.03 ± 1.81	1.04 ± 0.02	0.66^{ab} ± 0.02

NS: Non-significant *P < 0.05 **P < 0.01

Means without a common superscript differ significantly in each factor.

is also similar to that of Filipovic and Kokaj (2009), who reported that mean milk flow rate in Simmental cow farms of central Croatia was 0.61 ± 0.19 litre/min. However, the mean milk flow rate recorded in the present study is higher than values reported by previous studies *viz.,* 0.32, 0.50 and 0.56 kg/min, respectively by Khatri *et al.* (2021) in Jersey cows, Mishra *et al.* (2020) in cows of Nepal, and Tancin *et al.* (2003) in Holstein cows. Omer (2005) reported higher value of mean milk flow rate (1.888 ± 0.262 kg/min) in Sudan cows. The variation might be due to differences in milk yields and abilities of milkers.

The milk flow rate varied significantly with lactation number ($P < 0.01$), stage of lactation ($P < 0.01$), milk yield ($P < 0.01$), pregnancy status of dam ($P < 0.05$), shape of udder ($P < 0.01$), shape of teats ($P < 0.01$) and identity of milker ($P < 0.01$). The results are similar to that of Singh *et al.* (2010), who reported that milk flow rate varies with parity order and stage of lactation. Kumar *et al.* (2004) observed that parity and stage of lactation had a significant effect on actual milking time. The findings of the present study are also in agreement with those reported by Shiralkar and Dave (1975), who reported that the variation in time taken by different milkers was statistically highly significant ($P < 0.01$) and Sreedhar (1999), who reported that there was significant difference in actual milking time among persons.

The present study revealed that the milk flow rate increases with increase in lactation number and milk yield and it decreases with advancement of stage of lactation which is in conformity with Sandrucci *et al.* (2007) and Fahim *et al.* (2017), who observed that milk flow rate increases with lactation number and decreases with advancement of stage of lactation. Juma *et al.* (2007), Edwards *et al.* (2014) and Bobić *et al.* (2020) found that milk flow increases with increase in lactation number. Gupta and Joshi (2010) and Sachan *et al.* (2018) found that the time required to milk one kilogram of milk decreases with increase in milk yield. The significantly lower milk flow rate in pregnant animals was probably due to lower milk yields, as they were mostly in late stages of lactation.

A higher capacity in terms of volume to store the milk after let-down might be the reason for the significantly higher milk flow rate in case of animals with bowl shaped udders. These findings of the present study are similar to those of Juma *et al.* (2007), who found that milk flow rate vary significantly with shape of udder. The milk flow rate in case of conical (long), conical (short) and cylindrical (long) teats was significantly higher than that of cylindrical (short) teats. However, Juma *et al.* (2007) reported that the shape of teats had no significant effect on milk flow rate. This disagreement might be due to use of machine milking in the study of Juma *et al.* (2007).

Conclusion

From the results, it can be concluded that non-pregnant cows show significantly better milking behaviour in terms of higher speed of calf and lower milk let-down time and higher milking efficiency in terms of higher milk flow rate than the pregnant ones, and that cows of higher parity, present in early stage of lactation and with higher milk yield, bowl shaped udder and conical (long) shaped teats exhibit a higher milk flow rate.

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Conflict of interest

The authors declare that they have no conflict of interest.

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