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Influence of community machine milking system on milking temperament and teat condition of crossbred cows

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Abstract
The present study was carried out to evaluate two milking methods—hand milking system (HMS) and community machine milking system (CMS) in the jurisdiction of the Kolar-Chikkaballapura Milk Union Ltd. In order to compare the efficiency of different milking systems, 3 villages having functioning community milking stations were randomly selected from each district, giving a total of 6 villages. In each village, 12 dairy farmers, 6 using hand milking system and 6 using community milking system, were randomly selected. The milking temperament and teat condition score of 216 lactating cows belonging to the respondents was studied. The Milking Temperament score was better in CMS (1.18±0.041) as compared to HMS (1.62±0.063) due to better and hygienic milking surroundings and half of the milking time as compared to HMS. HMS had better Teat Condition Score (1.50±0.093) and Teat End Callosity (1.40±0.056) as compared to CMS (2.26±0.065 and 2.18±0.077, respectively) due to fluctuations in vacuum pressure causing deformation of teat tissues, teat sinus injuries and excessive deposition of keratin at the external teat orifice. It can be concluded that while Community Machine Milking System is an innovative solution to reduce labour requirement for milking at small dairy farms and leads to a better milking temperament score, the inferior teat condition score and teat end callosity needs to be addressed by way of regular maintenance of milking machines, frequent inspection and replacement of liners, and adequate training of staff handling machines.

Keywords: Community machine milking, hand milking, milking temperament, teat condition, crossbred cows

Introduction
Milk is the single largest agricultural commodity contributing 5 per cent of the national economy and employing more than 8 crore farmers directly. Milking operation is the major activity of every dairy farm affecting the quantity, quality and the cost of the milk produced. The milking performance, milking behaviour, udder health and milk quality are all greatly affected by the method of milking. Further, milking is a time-consuming exercise which requires lot of manpower and energy. Good milking practices also enhance productivity, assist in keeping teat and udder in healthier condition and contribute significantly in clean milk production (Sabapara *et al.*, 2015) [10]. Hand milking is the common milking method in our country, with almost 90 per cent of dairy animals being milked by hand. Out of total time spent on various operations, milking operation alone takes more than half of the man-minutes/animal/day (Sreedhar and Ranganadham, 2009) [11]. The labour required for milk harvest may account for as much as 80% of annual milking costs and over 50% of routine operational requirements on a dairy farm.

The Kolar-Chikkaballapura District Co-operative Milk Producers' Union Ltd. (KOMUL) has started installing 'Community Milking Machines' on a pilot basis at the Society level from the year 2001 onwards to get the quality milk required for ultra-high temperature (UHT) milk processing at Kolar dairy under the brand name of 'Nandini Good Life' (Mohan Kumar *et al.*, 2015) [6].

Hygienic milking practices are one of the first and foremost steps in clean milk production. With the ever-increasing cost of agricultural labour, it has become imperative to mechanize

various aspects of dairy farming; the most important being hand-milking operations which involve the most skill and drudgery. Small-scale alternatives to hand-milking, though popular, have associated drawbacks in the form of purchase cost of milking machine, time and money required for daily and periodic maintenance, irregular supply of spares, lack of timely repair in case of breakdown, investment in backup power systems, high operating costs etc. This study aims to compare the two milking systems – hand milking and community machine milking, in terms of their effect on the milking temperament and teat condition of crossbred cows.

Materials and Methods

The study was carried out in the jurisdiction of the Kolar-Chikkaballapura Milk Union Ltd. (KOMUL), Karnataka during July-August 2022. Kolar District is situated at 13.1770°N Longitude, 78.2020°E Latitude, at an altitude of 849 metres (2,785 ft) above the mean sea level, and Chikkaballapura District is situated at 13.5229° N Longitude, 77.8367° E Latitude, at an altitude of 915 m (3,002 ft) above the mean sea level. Kolar and Chikkaballapura districts consist of 119 and 56 community milking machine parlours, respectively, comprising either 4, 6, 8 or 10 bucket units (DeLaval). In order to compare the efficiency of different milking systems, 3 villages having functioning community milking stations were randomly selected from each district, giving a total of 6 villages. In each village, 12 dairy farmers, 6 using hand milking system and 6 using community milking system, were randomly selected for the study. A total of 216 HF crossbred cows were evaluated. Parameters studied were milking temperament score (MTS), teat condition score (TCS) and teat end callosity (TEC).

Fig: Community machine milking system

The milking temperament was recorded as per the five-point scale given by Tulloh (1961) [13] with modification as per Ritu (2019) [9]. The scale assigns numerical scores to milking temperament – Docile (1), Slightly restless (2), Restless (3), Nervous (4), Aggressive (5).

Teat condition scoring was done based on visual and tactile observations. TCS scoring was done as per the five-point scale given by Neijenhuis (2004) [7] as shown below:

- 1: normal, soft teats without any anomalies
- 2: a white ring around the teat canal opening, more or less pronounced
- 3: a well-defined (sometimes even slightly raised) redness on the teat skin
- 4: straight chap in the teat skin, either longitudinal or horizontal in direction
- 5: severe skin damages with deep chaps and open ulcerative lesions or scab

Teat end callosity was assessed by physical observation and evaluation of the teat end orifice for roughness/hyperkeratosis. Scoring was done based on visual and tactile observations as per Neijenhuis *et al*. (2004) [7]. The thickness of the callosity ring was placed into five classes: None (1), Slight (2), Moderate (3), Thick (4), and Extreme (5). Average TEC of each cow was calculated by using the unit scores from 1 to 5.

Results and Discussion

Milk Temperament Score (MTS)

The data on Milking Temperament Score in 216 crossbred cows under different milking systems and districts is presented in Table 1. The mean TS in hand milking and community machine milking systems were 1.62±0.063 and 1.18±0.041, respectively with overall mean of 1.40±0.040. CMS had significantly (p<0.01) lower TS than HMS. There was no significant (p<0.05) difference in the TS in Chikkaballapura (1.50±0.065) and Kolar (1.30±0.046) districts. While there was no significant (p<0.05) difference with regard to TS in HMS among the districts, Kolar district had significantly (p<0.05) lower TS under CMS. Further, CMS had significantly (p<0.01) lower TS than HMS in Chikkaballapura and Kolar district.

The results are in agreement with Pathak (2002) [8] who reported significantly (p<0.05) inferior TS in Sahiwal cows under hand milking (2.85) as compared to machine milking (2.55). In contrast, Ritu (2019) [9] reported that overall mean temperament score was significantly inferior (p<0.05) in the cows milked in Herringbone milking parlour (2.21±0.11) as compared to pipeline (1.89±0.12) and hand milking (1.73±0.13) systems. The better temperament score in CMS may be due to more hygienic surroundings and less distraction from the flies in the milking parlour and half of the milking time in CMS as compared to HMS. Milking temperament scores have been found to be correlated with better milk yield and flow rate. (Ajit Kumar, 2019) [1].

Teat Condition Score (TCS)

The data on Teat Condition Score of crossbred cows under different milking systems and districts is presented in Table 2. The TCS in hand milking and community machine milking systems was 1.50±0.093 and 2.26±0.065, respectively with overall mean of 1.88±0.062. HMS had significantly (p<0.01) lower TCS than CMS. There was no significant (p<0.05) difference in the TCS in Chikkaballapura (1.91±0.089) and Kolar (1.85±0.087) districts. Further, there were no significant (p<0.05) differences between Chikkaballapura and Kolar districts with regard to the TCS in HMS and CMS. However, within each district, TCS was significantly (p<0.01) lower in HMS as compared to CMS.

The results are in agreement with Stojnovic and Alagic (2012) [14] who reported that vacuum and pulsation during milking process put teat tissue under constant stress which cause changes in the teat tissue such as congestion of the teat end, changes in the teat dimension and colour, formation of callus ring on the top of teats and teat texture that are best noticeable within 30-60 seconds after removal of milking cluster in machine milking. Similar findings were reported by Hamann and Mein (1990) [4]. Hillerton *et al*. (2000) [5] reported that immediately after the use of machine milking many changes occur in teat tissue such as teats feel soft and compliant,

swollen or firm or, in extreme cases, hard and unresponsive to touch. The significant changes in teat condition in machine milking system may be due to vacuum fluctuations resulting in decrease in the intramammary pressure which alters the distribution of interstitial fluids and changes in the deformability of teat tissue (Neijenhuis, 2004) [7].

Teat End Callosity (TEC)

The data on Teat End Callosity (TEC) of crossbred cows under different milking systems and districts is presented in Table 3. The TEC in hand milking and community machine milking systems was 1.40±0.056 and 2.18±0.077, respectively with overall mean of 1.79±0.054. HMS had significantly (p<0.01) lower TEC than CMS. There was no significant (p<0.05) difference in the TEC in Chikkaballapura (1.80±0.078) and Kolar (1.78±0.076) districts. Further, there were no significant (p<0.05) differences between Chikkaballapura and Kolar districts with regard to the TEC in HMS and CMS. However, within each district, TEC was significantly (p<0.01) lower in HMS as compared to CMS.

The results are in agreement with Alekish and Simon (2006) [2] who reported changes in the dimensions of the teat and its structures, physiological changes such as congestion and oedema, loss of keratin from the teat canal, and longer-term changes such as hyperkeratosis of the teat-end. Hamann and Stanitzke (1990) [4] reported that after calf suckling and hand milking, teat end thickness was markedly reduced as compared with pre-milking measurements, whereas machine milking caused an increase in teat end thickness by more than 17%. In machine milking, over-milking of teats resulted in an increase of teat sinus injuries and excessive removal of teat canal keratin. During milking, teat tissue gets stretched by the vacuum acting on the teat, stretching causes micro fissures in the skin which is responding with an increased production of keratin and there will be excessive deposition of keratin. It results in a visible thickening of the skin surrounding the external teat orifice. The teat-end callosity can reach different degrees, from smooth and soft skin at the teat canal end to very rough, callused rings, then classified as hyperkeratosis. (Besier *et al.* 2016) [3]

Table 1: Comparison Milking Temperament Score in crossbred cows under hand milking and community machine milking systems in different districts of Karnataka.

Milking System	District		Overall	P-value
	Chikkaballapura	Kolar		
Hand	1.74 ± 0.100^{aX}	1.50 ± 0.074^{aX}	1.62 ± 0.063^{a}	0.054
Community machine	1.26 ± 0.071^{bX}	1.09 ± 0.040^{bY}	1.18 ± 0.041^{b}	0.043
Overall	1.50±0.065	1.30±0.046	1.40±0.040	0.075
P-value	0.000	0.000	0.000	

Note: Means within a column (^{ab}) or row (^{XY}) having different superscripts differ significantly (p<0.05).

Table 2: Comparison of Teat Condition Score in crossbred cows under hand milking and community machine milking systems in different districts of Karnataka.

Milking System	District		Overall	P-value
	Chikkaballapura	Kolar		
Hand	1.56 ± 0.134^{a}	1.44 ± 0.129^{a}	1.50 ± 0.093^{a}	0.551
Community machine	2.26 ± 0.096^{b}	2.26 ± 0.088^{b}	2.26 ± 0.065^{b}	1.000
Overall	1.91±0.089	1.85±0.087	1.88±0.062	0.754
P-value	0.000	0.000	0.000	

Note: Means within a column having different superscripts differ significantly (p<0.05).
There were no significant differences among any of the row-wise means.

Table 3: Comparison of Teat End Callosity in crossbred cows under hand milking and community machine milking systems in different districts of Karnataka.

Milking System	District		Overall	P-value
	Chikkaballapura	Kolar		
Hand	1.39 ± 0.077^{a}	1.41 ± 0.082^{a}	1.40 ± 0.056^{a}	0.869
Community machine	2.20 ± 0.110^{b}	2.15 ± 0.107^{b}	2.18 ± 0.077^{b}	0.718
Overall	1.80±0.078	1.78±0.076	1.79±0.054	0.905
P-value	0.000	0.000	0.000	

Note: Means within a column having different superscripts differ significantly (p<0.05).
There were no significant differences among any of the row-wise means.

Conclusion

Based on the findings of the present study, it can be concluded that Community Machine Milking System can serve as a valuable method of promoting dairy farming and exploiting its full potential, especially among small farmers. While CMS had substantially better milking temperament score as compared to HMS, some adverse effects like inferior teat condition score and teat end callosity can be reduced by regular maintenance of milking machines; frequent inspection and replacement of liners, and adequate training of staff in maintenance of the milking machine.

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