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## Effect of different milking systems on the yield and quality of milk from crossbred dairy cows

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#### Abstract

This research work was carried out to compare and evaluate the effect of electrical milking machine (T<sub>1</sub>), hand milking (T<sub>2</sub>) and manual milking machine (T<sub>3</sub>) on the quality and quantity of milk produced by crossbred dairy cows. Fifteen freshly calved crossbred dairy cows were randomly allotted to three treatment groups adopting switch-over design. The milk composition, revealed no significant difference in the fat per cent, but significant ( $P < 0.01$ ) difference in Solid-Not-Fat, Specific Gravity and Protein. There was no significant difference in the average daily milk yield obtained by different milking methods. The Somatic Cell Count was more in the milk obtained by hand milking followed by manual machine and electrical milking machine ( $5.145 \pm 0.080$ ,  $5.791 \pm 0.093$  and  $5.152 \pm 0.094$  somatic cells/ml). The Total Viable Count of milk was significantly ( $P < 0.01$ ) higher in hand milking (T<sub>2</sub>) ( $456.867 \pm 37.838 \times 10^3$ cfu/ml) than in T<sub>1</sub> and T<sub>3</sub> ( $280.70 \pm 30.428$  and  $312.93 \pm 29.705 \times 10^3$ cfu/ml). The study reveals that the quality of milk is considerably reduced by hand milking compared to machine milking.

**Keywords:** Milking methods, milk quality, hand milking, machine milking

#### Introduction

Milking operation is the major activity of every dairy farm affecting the quantity, quality and the cost of the milk produced. According to [5], dairy producers in India are rural based small producers and account for about 70 million of the total population. Although hand milking is still the common milking method in our country, many dairy farms are now a days adopting machine milking due to its practical and ergonomic advantages. Almost 90 per cent of animals in India are still hand milked, as majority of farmers cannot afford the costly electrical milking machine. Nearly 70 per cent of the work force in this sector is contributed by women, which causes back pain, shoulder pain, finger fatigue and allergic reactions to them. Milk which is secreted sterile often gets contaminated during hand milking. Machine milking, ensures clean milk production and welfare of animal at large. But the small holders who are the main stay of Indian milk production cannot afford the costly electrical milking machine. Therefore, the manual milking machines were developed to produce quality milk which was comparatively very cheap. This study was envisaged to compare and evaluate electrical milking machine, hand milking and manual milking machine, on the quality and quantity of milk produced by crossbred dairy cattle.

#### Materials and Methods

The experiment was carried out on fifteen freshly calved crossbred dairy cows of Instructional Livestock Farm Complex (ILFC), Pookode, Kerala, of the same parity and Body Condition Score (BCS). The lactating animals, after five days of colostrum feeding to calves, were randomly selected and allotted to three treatments adopting switch-over design. Where in which, all the three treatments would be studied upon the same animal alternately, with an adaptation period of three days between the treatments. The animals under T<sub>1</sub> were milked with electric machine DE Laval® bucket type milking machine which had a pulsation rate of 60 pulse per minute, pulsation ratio of 60:40 and vacuum level of (-) 50 Kilo Pascal. Animal under T<sub>2</sub> were hand milked and animals under T<sub>3</sub> were milked using manual machine- (Rocker type), Indian Patent No. 5963/CHE/2013. The machine worked on the principle of alternating pulsatile vacuum but no continuous vacuum. This eliminated many costly parts of the electrical milking machine making it comparatively very cheap. The picture of the electrical milking machine and manual milking machine used is presented in Fig. 1. All the animals were milked twice daily at 5.00 A.M and 2.00 P.M and data collected.



**Fig 1:** The electrical milking machine and manual milking machine used for the study

Physico-chemical characteristics of milk in terms of Fat (%), Solid-Not-Fat (SNF) (%), Specific Gravity ( $\text{g}/\text{cm}^3$ ) and Protein (%) were estimated using Eko Milk Ultra® milk Analyser (MILKANA KAM98-2A). Somatic Cell Count (SCC) of the milk was determined weekly using a portable and automated DE Laval® cell counter (DCC) Plate. Pour Plate technique described by [10] was followed for estimation of Total Viable Count (TVC).

### Results and Discussion

The results of the effect of different milking methods on the composition of milk during morning and evening are presented Table 1 & 2. The average daily milk yield was  $11.70 \pm 1.13$ ,  $11.11 \pm 1.25$  and  $11.14 \pm 0.90$  kg, respectively and the difference was statistically insignificant.

The milk fat content in the morning session was  $3.59 \pm 0.16$ ,  $3.42 \pm 0.17$  and  $3.66 \pm 0.19$  per cent, respectively for  $T_1$ ,  $T_2$  and  $T_3$ . In the evening session, it was  $4.96 \pm 0.08$ ,  $5.09 \pm 0.12$  and  $4.89 \pm 0.15$  per cent, respectively. There was no significant difference in the fat per cent of milk both during both sessions of milking. Similar result was reported by [1]. They also stated that changes in milking system will not change the milk fat.

The overall mean SNF per cent was significantly higher ( $P < 0.01$ ) in the milk obtained by electric milking machine ( $T_1$ ) ( $8.47 \pm 0.11$  per cent) and manual milking machine ( $T_3$ ) ( $8.41 \pm 0.07$  per cent), the same trend was observed in the evening session also, with the values of  $8.44 \pm 0.10$  and  $8.52 \pm 0.08$  per cent, in  $T_1$  and  $T_3$  respectively. But the milk obtained by hand milking ( $T_2$ ), was found to have relatively less SNF with  $8.16 \pm 0.11$  and  $8.17 \pm 0.09$  per cent in the morning and evening milking sessions. This might be due to the stress induced on the teat tissue and consequential damage

followed by reduced synthesis of casein and lactose due to hand milking as reported by [7].

The overall mean Specific Gravity (SG) of milk ( $\text{g}/\text{cm}^3$ ) obtained using electrical ( $T_1$ ) and manual ( $T_3$ ) milking machine were found to be significantly ( $P < 0.01$ ) higher ( $1.029 \pm 0.000 \text{ g}/\text{cm}^3$  and  $1.029 \pm 0.000 \text{ g}/\text{cm}^3$ ), than in hand milking ( $T_2$ ) in the morning session. Similar results were obtained in evening session also. With hand milking ( $T_2$ ), the mean SG of milk was found to be slightly less with  $1.028 \pm 0.000 \text{ g}/\text{cm}^3$  and  $1.027 \pm 0.000 \text{ g}/\text{cm}^3$ , for morning and evening sessions, respectively [8]. and [6] reported that the increased permeability of blood vessels during infections may result in seepage of blood components into the alveoli of the udder and ultimately change the physical quality of milk. Thus, the changes in the milk specific gravity may be associated to the slight degree of slight degree of inflammatory changes occurring due to the positive pressure exerted while squeezing each teat during hand milking which was absent in the other two milking systems, where negative pressure was exerted to draw the milk.

The milk protein in the morning session was observed as  $3.33 \pm 0.04$ ,  $3.21 \pm 0.05$  and  $3.31 \pm 0.03$ , per cent for  $T_1$ ,  $T_2$  and  $T_3$  respectively. The difference was statistically significant ( $P < 0.01$ ). Similarly, in the evening session, the protein per cent of the milk was  $3.36 \pm 0.05$ ,  $3.23 \pm 0.03$  and  $3.36 \pm 0.03$  per cent, in  $T_1$ ,  $T_2$  and  $T_3$  respectively [3]. and [2] stated that, the capability to synthesise protein by the cells involved in protein biosynthesis gets impeded due to inflammatory changes occurring in mammary tissues as a consequence of harsh handling of teat tissue. The decrease in protein per cent in the milk obtained by hand milking might be due to this reason.

**Table 1:** The constituents of milk under different milking methods during morning milking

Parameters	$T_1$	$T_2$	$T_3$	P-value
Fat (%)	$3.59 \pm 0.16$	$3.42 \pm 0.17$	$3.66 \pm 0.19$	0.273 <sup>ns</sup>
SNF (%)	$8.47 \pm 0.11$	$8.16 \pm 0.11$	$8.41 \pm 0.07$	<0.001**
SG ( $\text{g}/\text{cm}^3$ )	$1.029 \pm 0.000$	$1.028 \pm 0.000$	$1.029 \pm 0.000$	<0.001**
Protein (%)	$3.33 \pm 0.04$	$3.21 \pm 0.05$	$3.31 \pm 0.03$	<0.001**

Means with ns have no-significant difference. Means with \*\* differ significantly at 1% level.

**Table 2:** The constituents of milk under different milking systems during evening milking

Parameters	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	P-value
Fat (%)	4.96 ± 0.08	5.09 ± 0.12	4.89 ± 0.15	0.23 <sup>ns</sup>
SNF (%)	8.44 ± 0.10	8.17 ± 0.09	8.52 ± 0.08	<0.001**
SG (g/cm <sup>3</sup> )	1.028 ± 0.00	1.027 ± 0.00	1.029 ± 0.00	<0.001**
Protein (%)	3.36 ± 0.05	3.23 ± 0.03	3.36 ± 0.03	<0.001**

Means with ns have no-significant difference. Means with \*\* differ significantly at 1% level.

The results of Somatic Cell Count (SCC) and Total Viable Count (TVC) are presented in Table. 3. The average SCC was found to be higher in T<sub>2</sub> (817.60 ± 151 x 10<sup>3</sup> somatic cells/ml) compared to T<sub>1</sub> (179.933 ± 384 x 10<sup>3</sup> somatic cells/ml) and T<sub>3</sub> (193.333 ± 418 x 10<sup>3</sup> somatic cells/ml). [9] Reported an increase in SCC of the milk obtained by hand milking compared to that of machine milking in buffaloes. The increase in SCC under hand milking might be due to the mild inflammatory changes occurring in the teat due to constant squeezing and unhygienic practices associated with the hand

milking. The TVC of T<sub>1</sub> was 280.70 ± 30.428 cfu/ml and T<sub>3</sub> was 312.93 ± 29.705 x 10<sup>3</sup> cfu/ml while the TVC of T<sub>2</sub> was 456.867 ± 37.838 x 10<sup>3</sup> cfu/ml. This value reveals that the microbiological quality of milk was poor in hand milking and better in electrical and manual milking machines [4]. had stated that the inefficient disinfection of hands, teats and udder prior to milking, type of milking methods and hygiene of water used play a major role in the microbial activity of raw milk.

**Table 3:** Average Somatic Cell Count (SCC) and Total Viable Count (TVC) of milk under different milking methods

Parameters	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	P-value
SCC (x 10 <sup>3</sup> cells/ml)	179.933 ± 384	817.60 ± 151	193.333 ± 418	<0.001**
TVC (x 10 <sup>3</sup> cfu/ml)	280.70 ± 30.428	456.867 ± 37.838	312.93 ± 29.705	<0.001**

Means with \*\* differ significantly at 1% level.

## Conclusion

Based on the results obtained from the present study and the discussion on the same, it was concluded that hand milking yields comparatively less hygienic milk, reduces SNF, protein and subsequently the price of the milk. It also induces teat injury causing inflammatory changes in teat tissues. Electrical milking machine produces superior quality milk with less microbial load. Manual milking machine produces clean and hygienic milk than hand milking. Based on the quality of milk produced, manual milking machine can be recommended to small holder milk producers which can improve the milk quality at the milk collection centres.

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