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Milking machine induced teat reactions in crossbred cows milked in automated herringbone milking parlour*

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On most dairy farms including small family farms, machine milking of cows have replaced hand milking to save time, money and labour. The dairy industry promoted the intensive development of accurately working and highly efficient milking systems that could improve the performance of both animals as well as milker (Fahim *et al.* 2017). The milking machines are designed to milk the cows by the rhythmic movement of liner between open and closed position on application of vacuum and pulsation creating a pressure difference across the teat canal opening at the end of the teat) (Basier *et al.* 2016). The stress exerted on teat tissues during milking causes teat reactions which may be visible either as short term or medium to long term effects in some or many animals of a herd. The short term effects that are visible immediately after the cluster removal in response to single milking include congestion in teat, colour change and drying of teat etc (Stojnovic and Alagic 2012). The long term effects are prominent only after few days of continuous and faulty milking operation such as swelling in udders, cracking and chapping of teats, callosities at teat ends etc. (Ohnstad *et al.* 2007, Sandrucci *et al.* 2014). To study the ill-effects associated with machine milking and to judge the appropriateness and functioning of milking equipment under existing farm management conditions, the present study was carried out to evaluate the machine induced changes in teats occurring in crossbred cows following machine milking and its effect on milk yield and quality in automated herringbone milking parlour.

The study was conducted on 62 crossbred cows maintained at the Livestock Research Centre of the institute, over a period of 3 months. The animals were kept in loose housing system and monitored through automatic animal identification system consisting of neck transponder, portal identification antenna, system controller and software based herd management programme on personal computer (PC). The animals were taken to milking parlour situated close to their shed for milking thrice a day. Milking was carried out in low–line automated herringbone milking parlour with provision of cluster removal at the end of milking. The milking machine was operated at the recommended setting for milking of cows keeping a vacuum of 42 kPa, pulsation ratio of 65:35 and ACR of 0.2 kg/min. The teats were visually observed in each animal just after the milking when the clusters were automatically removed on fortnightly basis for any changes in teat as well as the teat ends. Teat reactions associated with milking are described in Table 1. The teat ends were scored on the basis of teat end hyperkeratosis and scoring method developed by Neijenhuis *et al*. (2000). Milk yield, somatic cell count and electrical conductivity were determined in morning session of milking on test day.

The machine induced changes observed on teat surface immediately after cluster removal were ring formation on teat base, dry teats, swelling in teats and redness on teats. Similarly, there was swelling in udder and changes associated with teat end callosities noted in subsequent fortnights (Figs 2–8). The overall percentage of teat reactions in automated herringbone parlour operated at manufacturers' settings for machine milking ranged from 6.45 to 28.81% during the study period (χ^2 = 18.69, 01 df, P<0.001). The changes on the teat surface were ring formation, dry teat skin, redness on teat, swelling in teat and swelling in udder (Table 2). There were no incidences for chaps and scratches on teats during this period. The percentage ring formation at the teat base ranged from 3.23 to 6.78. Such visible line or mark caused by contact with the liner mouthpiece lip have been reported due to several reasons which include over-milking, especially with wide-bore liners or tapered liners with wide upper barrels (Hillerton *et al.* 1999); teat-cup crawling; or liner mouthpiece lips that are unusually stiff or narrow in relation

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Table 1. Milking related teat reactions

Trait	Description
Ring formation	A clear, well pronounced ring around the base of teat where the cluster opening touches the teat, no other exception noted
Dry teat skin (D)	The teat skin is dry which is felt rough with an apparent drag on the finger, but without skin flakes from the surface
Redness (Rd)	A well-defined (sometimes even slightly raised) redness on the teat skin
Swelling in teat (SwT)	When examined after milking, edematous swelling along the entire length of teat, or near the teat base which may persist or disappear
Swelling in udder (SwU)	Consistent swelling in the udders which does not disappear
Chaps (C)	Straight chap in the teat skin, either longitudinal or horizontal in direction
Scratches (S)	Very superficial wound on the teat skin in any direction

Table 2. Occurrence of teat reactions in cows milked in automated herringbone parlour at fortnightly intervals (N=62)

Teat reactions (%)	Fortnights					
	1	2	3	4	5	6
Ring formation	3.23	4.84	4.84	3.33	5.00	6.78
Dry teat skin	1.61	4.84	3.23	5.00	5.00	3.39
Redness	1.61	4.84	3.23	3.33	6.67	5.08
Swelling in teat	0.00	0.00	3.23	6.67	8.33	6.78
Swelling in udder	0.00	0.00	0.00	3.33	3.33	6.78
Overall	6.45	14.52	14.52	21.67	28.33	28.81

to teat size (Mein *et al.* 2001). Similarly, there were animals which showed dryness of teat skin immediately when the clusters were removed. The incidence of dry teats ranged from 1.61 to 5%. The results were similar to those reported by Berglund *et al*. (2002) who compared 2 × 8 herringbone parlour (milking at udder level) and AMS parlour (milking at quarter level) for various teat reactions and found that there was significant difference in per cent dry teat (3.6±1.7 vs. 26.3±1.7). This was attributed is to use of water and air in connection to frequency of milking. This effect could probably be eliminated if special teat dip for extra teat care is used. The occurrence of redness in teat ranged from 1.61 to 6.67%. Reddish discolouration of teats in some animal may due to congestion caused by unequal weight of clusters on teat, fluctuating milking vacuum; faulty pulsation; or mismatch between liner used and mean teat size within a herd (Ohnstad *et al*. 2007). Berglund *et al.* (2002) also reported that 6.6% cows milked in 2 × 8 herringbone parlour showed redness which was due to impact of milking machine in udder based milking compared to quarter milking.

Further, it was observed that the symmetry of udder had significant effect on the occurrence of teat reactions in crossbred cows (χ^2 = 8.94, 01 df, P<0.001). The animals having unsymmetrical udder structure showed a sharp decline in percentage of normal teats compared to symmetrical and balanced udder over the different fortnights (Fig. 1). It may therefore be suggested that machine milking is more suitable for animals having apparently normal udder with normal symmetry. The animals having unsymmetrical udder shape should be either hand milked or if machine milked may need special attention for any adverse reactions taking place. Mein *et al.* (2001) also reported that the primary cause of short-term changes in colour, firmness, thickness or swelling of teats, or degree of "openness" of the teat orifice may be faults in milking machines or milking management. Improved management practices include selecting and allowing only those animals in machine milking that really perform better under such practices.

The teat end callosity improved from very rough and rough teat ends to smooth ring and no ring condition over subsequent intervals in cows milked in automated herringbone parlour provided with automatic cluster removal programming. The rough and very rough condition of teat ends improved significantly over different fortnights (χ^2 = 9.98, 01 df, P<0.001). The teat end callosity in cows having rough teat ends gradually improved indicating the appropriateness of machine setting and automatic cluster removal at flow rate of 0.2 kg/min (Table 3). Mein *et al.* (2001) reported that the degree of teat-end hyperkeratosis (roughness, cornification or callosity) is a dynamic

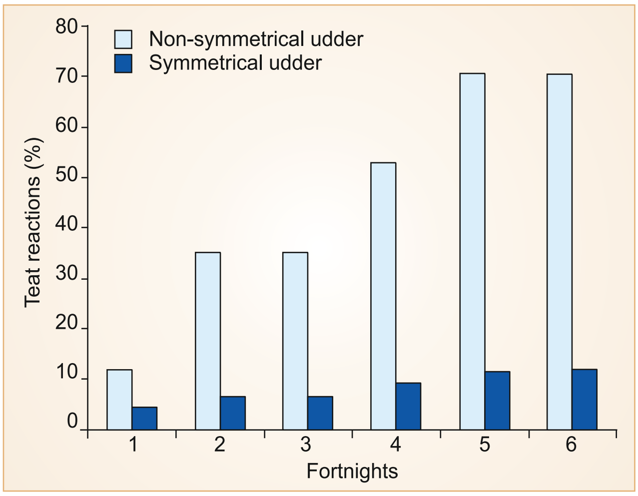

Fig. 1. Changes on teat surface (teat reactions) after milking of non-symmetrical and symmetrical udder.

Table 3. Changes in teat ends of cows milked in automated herringbone parlour at different fortnights (N=62)

Teat end callosity (%)	Fortnights					
	1	2	3	4	5	6
No ring	53.2	56.5	58.1	61.7	61.7	64.4
Smooth ring	24.2	24.2	27.4	26.7	28.3	28.8
Rough ring	12.9	16.1	12.9	10.0	10.0	8.5
Very rough ring	9.7	3.2	1.6	1.7	0.0	0.0







Figs 2–6. Visible teat changes observed in cows milked in automated herringbone parlour. **2.** Ring formation (teat base), **3**. Dry teat, **4**. Redness in teat, **5**. Swelling in udder, **6**. Swelling in teat. Figs 7–8. Teat end callosity. **7**. Rough teat ends, **8**. Very rough teat ends.

Table 4. Changes in milk yield and quality on the occurrence of teat reactions in cows milked in automated herringbone parlour at different fortnights (Mean±SE)

Parameter	Teat reaction	N	Fortnights						Overall
			1	2	3	4	5	6	
Milk yield (kg)	Present	14	15.00±0.95	14.11±1.10	14.57±1.10	15.76±1.17	14.04±0.99	13.97±1.06	14.58±0.42
	Absent	23	13.36±0.74	13.39±0.78	13.84±0.86	13.90±0.91	13.07±0.77	13.00±0.82	13.44±0.33
			(0.182)	(0.626)	(0.600)	(0.218)	(0.445)	(0.452)	(0.034)
SCC ($\times 10^5$ counts)	Present	14	1.64±0.15	1.54±0.15	1.37±0.14	1.32±0.14	1.29±0.14	1.28±0.14	1.41±0.06
	Absent	23	1.43±0.12	1.38±0.12	1.30±0.10	1.31±0.11	1.28±0.11	1.26±0.11	1.33±0.05
			(0.281)	(0.387)	(0.674)	(0.929)	(0.936)	(0.886)	(0.254)
Electrical conductivity (ms/cm)	Present	14	6.47±0.15	6.34±0.16	6.34±0.15	6.25±0.17	6.11±0.15	6.01±0.15	6.25±0.06
	Absent	23	6.15±0.12	6.06±0.12	6.06±0.12	6.01±0.13	5.88±0.12	5.80±0.11	6.00±0.05
			(0.099)	(0.156)	(0.169)	(0.266)	(0.219)	(0.271)	(0.001)
Peak conductivity (ms/cm)	Present	14	6.86±0.17	6.74±0.16	6.73±0.13	6.77±0.13	6.66±0.12	6.61±0.14	6.73±0.06
	Absent	23	6.75±0.13	6.64±0.10	6.62±0.10	6.50±0.10	6.44±0.10	6.25±0.11	6.53±0.05
			(0.592)	(0.607)	(0.517)	(0.108)	(0.185)	(0.043)	(0.009)

Figure in parentheses indicate P value.

condition. Status of teat-ends for an individual cow or herd can change within days due to several reasons including machine factors (especially slow milking and over-milking). They reported that of the milking management or machine factors, the total time/day when milk flow rate is less than about 1 kg/min appears to have a major effect on teat-end condition.

The overall mean daily milk yield differed significantly

(P<0.05) in animals with and without teat reactions (Table 4). There was significant (P<0.01) effect of teat reactions on the conductivity values both in terms of average as well as peak conductivity in crossbred cows. However, the overall SCC values were similar irrespective of the presence or absence of teat reaction is present or absent. The fortnightly change in the daily milk yield showed non-significant effect of teat reactions on the yield of crossbred cows. The animals with and without teat reactions had no adverse effect on somatic cell count and electrical conductivity values. The automatic cluster removal at flow rate less than 0.2 kg/min improved the quality of production over the fortnights. This improvement in quality may be due to prevention of over-milking with the installation of ACR setting in the milking system (Jago *et al.* 2010). Besier *et al.* (2016) reported that decreased machine on-time and increased average milk flow rate can improve the teat condition as well as teat-end thickness during milking in dairy herds. They reported no adverse effects due to early cluster detachment on milk yield or milk composition and no effect on the incidence or prevalence of subclinical mastitis. Similar results were reported by Mir *et al*. (2015) in their study on machine milked dairy crossbred cow herd in Punjab.

SUMMARY

The study conducted to investigate the changes in teats following machine milking in crossbred cows in automated parlour showed formation of ring on teat base, dry teats, swelling in teats and redness on teats soon after cluster removal. There were medium to long term changes in udder and teats including swelling in udder, swelling in teats and appearance of teat end callosities. It was observed that the udder symmetry had significant effect on the occurrence of teat reactions in crossbred cows. The animals with unsymmetrical udder showed an increase in teat reactions compared to symmetrical and balanced udder. The automatic removal of cluster markedly improved the occurrence of teat ends callosities in the automated parlours. The overall mean daily milk yield was significantly affected by the teat reactions, as well as, there was significant effect on the conductivity values and peak conductivity. However, overall SCC values were similar irrespective of the presence or absence of teat reaction. The study revealed that there may be machine induced short and long term changes in teats in certain cows which is likely dependent on the symmetry of udder. The milking machine having ACR settings for cluster removal could improve the roughness of the teat ends and enhance the quality of production.

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REFERENCES

Berglund I, Pettersson G and Svennersten-Sjaunja K. 2002. Automatic milking: Effects on somatic cell count and teat-end quality. *Livestock Production Science* **78**: 115–24.

Besier J, Lind O and Bruckmaier R M. 2016. Dynamics of teat-end vacuum during machine milking: types, causes and impacts on teat condition and udder health – a literature review. *Journal of Applied Animal Research* **44**(1): 263–72.

Fahim A, Kamboj M L, Prasad S, Sirohi A S, Bhakat M, Mohanty T K and Malhotra R. 2017. Effect of parity, stage of lactation and udder type on milkability of crossbred dairy cows milked in automated Herringbone milking parlour. *Indian Journal of Animal Sciences* **87**(6): 761–67.

Hillerton J E, Pankey J W and Pankey P. 1999. Effects of machine milking on teat condition. *Proceedings of 38th Annual Meeting of National Mastitis Council*. pp. 202–03. 14–17 February. Arlington, VA, USA.

Jago J G, Burke J L and Williamson J H. 2010. Effect of automatic cluster removal settings on production, udder health, and milking duration. *Journal of Dairy Science* **93**(6): 2541–49.

Mein G A, Neijenhuis F and Morgan W F. 2001. Evaluation of bovine teat condition in commercial dairy herds: 1. Non-infectious factors. *Proceedings of the 2nd International Symposium on Mastitis and Milk Quality.* NMC. pp. 347–51. 13–15 September. Vancouver, British Coloumbia, Canada.

Mir A Q, Bansal B K and Gupta D K. 2015. Short term changes in teats following machine milking with respect to quarter health status in cows. *Journal of Animal Research* **5**(3): 467–71.

Neijenhuis F, Barkema H W, Hogeveen H and Noordhuizen J P T M. 2000. Classification and longitudinal examination of callused teat ends in dairy cows. *Journal of Dairy Science* **83**: 2795–04.

Ohnstad I, Mein G A, Baines J R, Rasmussen M D, Farnsworth R, Pocknee B R, Hemling T C and Hillerton J E. 2007. Addressing teat condition problems. *Proceeding of 46th Annual Meeting of the National Mastitis Council.* pp. 188–99. 21–24 January. San Antonio, Texas, USA.

Sandrucci A, Bava L, Zucali M and Tamburini A. 2014. Management factors and cow traits influencing milk somatic cell counts and teat hyperkeratosis during different seasons. *Revista Brasileira de Zootecnia* **43**(9): 505–11.

Stojnovic M and Alagic D. 2012. Animal Science Days. *Proceedings of 20th International Symposium*. pp. 19–21. Kranjskagora, Slovenia.