



Short Term Changes in Teats Following Machine Milking with Respect to Quarter Health Status in Cows

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ABSTRACT

The procedures and practices associated with milking are critically important and people now-a-days are switching over to machine milking to save time and money. Milking equipments if properly maintained have a positive impact on both milk production and milk quality. However, if the equipments are not used as per the recommended standard values it may have some untoward effects on udder health. In the present study the short term effect of machine milking on teats and their relationship with quarter health status was conducted on a total of 872 quarters of 218 apparently healthy lactating cows at 10 machine milked dairy farms of Punjab. The short term effects of machine milking on teats i.e., change in colour and morphology were seen in 22.9 percent (177) and 17.43 percent (152) of teats, respectively. There was no significant relationship between teat colour change and occurrence of mastitis ($\chi^2=1.13$; 01 df; $P < 0.05$). Out of the 177 quarters showing colour change 76 (42.9 percent) quarters showed morphological changes. A significant relationship was observed between change in colour and morphology of teats, immediately after milking ($\chi^2=84.95$; 01 df; $P < 0.001$).

Keywords: Teat colour, teat morphology, machine milking, quarter health

The success of the modern dairy depends on the profitable production of high quality milk. Milk quality, health and economics of a herd are significantly affected by technical operations of which milking and technology of milking are very important (Stadnik *et al.*, 2010). The largest single labour item in the care of dairy cows is that required for milking. Over 50 percent of the labour on farm is expended for milking and labour for milk harvest may account for 80 percent of annual milking costs (Bickert and Armstrong, 1975) and over 50 percent of routine operational requirements on a dairy farm (Albright, 1964). Modern dairies are searching for managerial strategies to make more efficient use of materials and labour to stay both competitive and profitable. The procedures and practices associated with milking are critically important and people now-a-days are switching over to machine milking to save time and money. Milking

machines are the most essential tools for dairy enterprise providing mechanization of milking and influencing milk productivity thereby helping to perform milking in conditions that are more hygienic. Milking equipment if properly maintained has a positive impact on both milk production and quality. However, the machine milking if not used as per the standard recommended values may have some untoward effects on udder health.

The integrity of the teat end tissue around the teat orifice is an important resistance factor to bacterial colonization of the quarter (Sandrucci *et al.*, 2014). The most frequent cause of mastitis is the infections with pathogenic bacteria entering the mammary gland via the teat canal (GVA, 2012). The worldwide trend to increase milking speed has often resulted in substantial increases in teat tissue stress and possible reduction in the efficacy of teat canal defense mechanisms (Reinemann *et al.*, 2008). The teat tissue is



constantly under the stress during the milking process due to vacuum and pulsations applied causing changes in teat tissue such as teat end congestion, changes in teat dimensions, teat colour changes, formation of callus ring on top of the teats and teat texture which are best observed within 30-60 seconds on removal of the milking cluster (Stojnovic and Alagic, 2012). Short-term changes such as teat discoloration (reddened, bluish or purple-coloured teats) and morphological changes (firmness or swelling of the teat, ringing around the upper teat barrel, wedging of the teat-end and degree of openness of the teat orifice) are generally regarded as those seen in response to faults in milking management or milking machine (Ohnstad *et al.*, 2007). These changes inhibit timely closure of the teat canal orifice after milking and increase the risk of new intramammary infections by contagious as well as environmental mastitis pathogens (Mein, 2012). So, the present work was carried out to evaluate the short term changes i.e. change in teat colour and morphology following machine milking and their relationship with quarter health status.

MATERIALS AND METHODS

The present study involved 10 machine milked dairy cow herds of Punjab, involving 218 HF × Sahiwal cross-bred dairy cows and a total of 872 quarters were analyzed. The farms were visited during the routine afternoon milking hours (between 3 pm and 5 pm). The parameters studied at the farm were arbitrary divided into four stages, viz. complete history, examination of udder and teats, evaluation of milking machine related factors and collection of milk samples. A complete history w.r.t. animals, farm management and milking machine related factors were observed and recorded. The machine related factors recorded were type of milking machine, milking frequency, routine cleaning of milking clusters, frequency of cluster change and milking machine cleaning etc. The various milking machine variables such as vacuum, pulsation ratio, number of liner slips if any, technique of cluster detachment, individual animal milking time and total milking time at the farm were observed and recorded during process of milking. Thorough examination of udder and teats for various parameters was done before milking and immediately following milking. Changes in teat colour (normal, red or blue) and morphology (swelling at the base, ringing and hardness of teat end)

were assessed visually and/or by palpation immediately after the removal of the milking unit by the same person throughout the experiment. Teat colour was not scored on teats with black skin, so teat colour and morphology was assessed in a total of 838 quarters.

The isolation and identification of microbial organisms from milk samples was done as per standard microbial procedures of National Mastitis Council (Brown *et al.*, 1969). The organisms isolated from quarter foremilk samples were tested for sensitivity to various antimicrobial agents as per method of Ward and Bates (1983). The somatic cell count was done by direct microscopic counting method described by Indian Standard Institute (1960). Results are expressed in thousand cells/ ml and in Log₁₀ SCC values. The California Mastitis Test (CMT) was conducted and interpreted as per standard method described by Pandit and Mehta (1969). The results were scored as 0, 0.5 (Trace), 1, 2 and 3 depending upon the degree of gel formation.

Defining udder health status

The quarter health status was assessed and defined on the basis of bacteriology and Somatic Cell Count estimate (CMT score) of quarter foremilk samples as described below:

Table 1.

CMT score	Microbial pathogen	
	Not detected	Detected
< 1	Healthy	Latent infection
1	Non-specific mastitis	Specific mastitis

Data Analysis

The data were analysed statistically by using Chi-square test.

RESULTS AND DISCUSSION

Change in teat colour

The change of colour in teats immediately following milking and its relation to quarter health status is presented in Table 2. The colour change in teats immediately after

machine milking was observed in 21.9 percent of the teats. The predominant colour change was redness (17.55 percent) followed by red/blue (2.98 percent) and bluish (1.38 percent). The occurrence of change in colour of teats was much less than that reported by (Hillerton, 2000). They observed that more than half of the teats after machine milking had different colour. This might be due to the differences in the cluster weight, over milking, vacuum applied during the over milking phase and the design of the liner mouthpiece. Out of the 661 quarters showing no colour change, 306 (46.29 percent) quarters had subclinical mastitis while out of 177 quarters with colour change, 74 (41.81 percent) had subclinical mastitis. Teat colour change and occurrence of mastitis did not depict any significant relationship ($\chi^2=1.13$; 01 df; $P<0.05$). The right techniques of milking and adjustment of milking equipment guarantee good health of the teat as well as the udder (Stadnik *et al.*, 2010). Teats should be as soft and supple just after milking as before milking, however machine milking induces certain changes in teats which are most noticeable the teat end. These machine milking induced alterations of teat tissue may impair local defense mechanisms and increase the risk of new intramammary infections (Zoche-Golob *et al.*, 2015). Teat discolouration immediately after cluster removal indicates impaired circulation and constriction to fluid transfer (Ohnstad, 1998). It is likely that the average level of vacuum remains higher in the over-milking period as there is no milk flow to dissipate system vacuum and thus the changes are more frequent and greater with over-milking (Hillerton *et al.*, 2001). After cluster is removed some teats may be noticeably red, either at the teat-end or over the entire teat and in extreme cases, teats become blue or already appear, indicating cyanosis (Hillerton, 2005). Reddish discolouration, indicating congestion, is exacerbated by over milking, unusually heavy cluster weight, high milking vacuum, faulty pulsation, or mismatch between the type of liner used and mean teat size within a herd. Cyanosis or oedema around the teat apex or lower barrel often indicate some type of pulsation failure such as an insufficient collapse phase of pulsation, short teatcup liners or liners with insufficient tension. Bluish discolouration, indicating cyanosis, may result from use of liners with small mouthpiece diameter relative to the internal diameter of the barrel (Mein *et al.*, 2001) or liners with hard mouthpiece lips or high mouthpiece vacuum (Hillerton *et al.*, 1998) or to over milking or prolonged

milking. When teats are congested after milking, the defense mechanism of the teat canal to resist invasion and removal of mastitis causing organisms from the canal is compromised, probably because the teat canal closes more slowly after milking when teats are congested (Gleeson *et al.*, 2004; Vinitchaikul and Suriyasathaporn, 2007; Mein and Reinemann, 2007).

Table 2. Relationship between change in teat colour immediately following machine milking and quarter health status

Change in teat colour	Quarter Health status				Total
	Healthy Quarters ¹		Mastitis Quarters ²		
	No.	Percent	No.	Percent	
No Change	355	53.71	306	46.29	661
Colour change positive	103	58.19	74	41.81	177
Total	458	54.65	380	45.35	838

¹Healthy plus Latent; ²Specific plus non-specific

Change in teat morphology

The morphological changes in teat immediately following machine milking and its relation to change in teat colour are depicted in Table 3. Change in teat morphology immediately following machine milking was observed in 17.81 percent teats with ringing as the primary change (15.92 percent) followed by hardness of teat end (1.42 percent) and ringing and hardness both (0.47 percent) teat. This is in agreement to Hillerton *et al.* (2000) who observed that greater than 10 percent of the teats had morphological changes after milking. Likewise, Boro (2002) observed ring formation of the teat orifice in 6.51 percent cases. Out of the 177 quarters showing colour change 76 (42.93 percent) quarters were also having morphological changes while out of 661 quarters having no colour only 76 (11.49 percent) showed morphological changes. A highly significant relationship occurred between the change in colour and morphology of teats immediately after milking ($\chi^2= 84.95$; 01 df; $P<0.001$). The ringing of the base of the teat is shown to be caused by a sustained vacuum in the mouthpiece chamber of the liner unrelieved during most of the milking time (Newman *et al.*, 1991). Over-milking would extend this period by a significant amount. Many teats feel soft and compliant



after milking and they contract when touched. However, some teats feel swollen or firm or, in extreme cases, hard and unresponsive to touch (Hillerton, 2005). The firmness of the teat is likely caused by an accumulation of fluids in the teat and is suggestive of impaired pulsation. Ringing at the base of the teat indicates a localized oedema which accumulates during milk extraction (Hillerton *et al.*, 2000). The exact significance of this oedema is not known although it has been suggested that if ringing develops early in milking, milk flow can be adversely affected. This may affect completeness of milking. It has been observed that cows milked with the heavier cluster usually have teats with palpable rings at the base (Hillerton *et al.*, 2000).

Table 3. Relationship between change in teat colour and morphology immediately following machine milking

Change in teat colour	Change in teat morphology (Ringing, Hardness)				Total
	Present		Not Present		
	No.	Percent	No.	Percent	
No Change	76	11.49	585	88.50	661
Colour change positive	76	42.93	101	57.06	177
Total	152	18.13	686	81.86	838

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