

Prevalence of Teat End Callosity in East Azerbaijan Dairy Herds

¹S. Mosaféri, ⁴Z. Ostadi, ²A. Mohamadi, ³M. Nazeri and ¹A. Davasaztabrizi

¹Department of Clinical Science, Faculty of Veterinary Medicine,

²Department of Veterinary Medicine,

³Young Researchers Club, Tabriz Branch, Islamic Azad University, Tabriz, Iran

⁴Department of Anesthesiology, Faculty of Medicine,
Tabriz University of Medical Science, Tabriz, Iran

Abstract: Teat end callosity is a very important problem which affects cows in the farms of Iran and many other countries. This disease mainly caused by the over milking and defects in the milking machine. In this survey, we focused on the four large dairy Holstein herds consist 860 dairy cows at around of Tabriz (North-west of Iran) and we assessed the teat end callosity or hyperkeratosis and its relation with milking frequency per day. In the herds A (n = 300) and B (n = 160), cows were milked 3 times day⁻¹. In the herds C (n = 162) and D (n = 190) cows were milked 2 times day⁻¹. Prevalence of the teat end hyperkeratosis in the herds of A and B were recorded as 14.1%. In the herds of B and C this prevalence was 12.3%. Also, according to the Wilson's grading schedule the grades of 2 and 3 of hyperkeratosis more prevalent between the cows with 3 times milking day⁻¹ than cows with 2 times milking day⁻¹. Statistical analyses indicated significant differences between the herds of A, B (3 times milking day⁻¹) and herds of C, D (2 times milking day⁻¹). In conclusion, according to the results, significant relationship exists between the cow's teat end callosity and milking frequency/day.

Key words: Teat, callosity, Holstein, dairy cows, milking, Iran

INTRODUCTION

After repeated milking, changes appear in teat-end tissue, resulting in the development of a callous ring around the teat orifice. Cow factors like teat-end shape, teat position, teat length, milk production, lactation stage and parity show a relationship with callused teat-ends (Bakken, 1981; Johansson, 1957; Michel *et al.*, 1974; Neijenhuis *et al.*, 2000; Rathore, 1977; Sieber and Farnsworth, 1981). As early as 1942, eroded teat orifices were linked to machine milking (Espe and Cannon, 1942). It is clear from more recent histological studies that the observed changes result from an increase or buildup of callous tissue around the orifice rather than an erosion of teat tissue or the orifice. The changes are associated with mechanical forces exerted by vacuum and the moving liner during machine milking. The magnitude of the force depends on milking vacuum, pulsation vacuum, machine-on time, liner type and teat shape (Ebendorff and Ziesack, 1991; Hamann, 1987; Mein and Thompson, 1993; Rasmussen, 1993). The huge variation in the frequency of callosity between herds using similar milking systems suggests that a major genetic influence to susceptibility should not be overlooked (Shearn and Hillerton, 1996).

The teat canal is a primary barrier against invasion of mastitis pathogens into the udder. Maintenance of good condition of teat skin and tissues surrounding the canal is an important part of a program to obtain high quality milk. Short-term physiological effects of machine milking include teat congestion indicated by tissue swelling, hardness and color changes while hyperkeratosis is a longer-term of teat skin (Mein *et al.*, 2001).

Teat ends with rough surface is more difficult to clean during pre-milking preparation and provide a site for bacteria colonization. Neijenhuis *et al.* (2001) found a correlation between increased risk of clinical mastitis and very rough teat-ends. Hyperkeratosis (HK) of the skin surrounding the teat canal opening is a result of the stresses applied to skin when the milking liner collapses on the teat end. Liner Compression (LC) is a critical factor in reducing teat tissue congestion during milking and it can also influence peak flow rate and milking speed. At the same time, excessive Liner Compression (LC) contributes to the development of teat-end hyperkeratosis (Capuco *et al.*, 1994). Too much LC may also remove excessive amounts of keratin from the teat canal which makes teats more susceptible to infections. Hyperkeratosis is also an undesirable condition also

because it may contribute to cow discomfort during milking (Hamann, 2000). Liner Compression (LC) equal to mean arterial pressure (about 12 kPa) is thought to be sufficient to relieve congestion with additional Liner Compression (LC) providing no additional benefit for congestive relief (Mein *et al.*, 1987).

More recently, it has been speculated that the Liner Compression (LC) required to relieve congestion has also been thought to increase as the milking vacuum level increases (Mein *et al.*, 2003). The aim of this research was to assessment of teat end callosity or hyperkeratosis and its relation with milking frequency per day.

MATERIALS AND METHODS

This research was carried out on May 2007 in the four large dairy herds (A-D) of Tabriz suburb (North-West of Iran) with the Mediterranean climate and 2000 m altitude above sea level. The herds were as following: Herd A included of 300 dairy Holstein cows with mean milk production of 32 kg/day/cow and 3 times milking day⁻¹ (8 a.m. and 14, 22 p.m.) cows were breed in open shade parlor. Herd B was included of 160 dairy Holstein cows with mean milk production of 30 kg/day/cow and 3 times milking day⁻¹ (5 a.m. and 13, 21 p.m.) cows were breed in free stall parlor. Herd C was included of 180 dairy Holstein cows with mean milk production of 28 kg/day/cow and 2 times milking day⁻¹ (4 a.m. and 16 p.m.) cows were breed in open shade parlor. Herd D was included of 220 dairy Holstein cows with mean milk production of 31 kg/day/cow and 2 times milking day⁻¹ (5 a.m. and 17 p.m.) cows were breed in open shade parlor. Nutrition of herds consisted of alfa alfa and corn silage as hay compartment of diet and concentrate consist corn, oat, cottonseed meal, soybean meal, fishmeal, vitamine and mineral supplements. In all of the herds, milking procedure was performed by West Valia Company or Delaval Company and in on herd by Ravand Company (native company) milking machines. Most of these machines work for >10 years. Before milking, teats of the cows were washed and dried by special papers and then we were inspected very carefully and categorized teat end callosity according to Wilson's grading schedule. According to this schedule, grade 1 is the normal teat end and grade 4 is the teat end with maximum hyperkeratosis. After milking post milking teat dipping were performed by iodine solutions. In this study, researchers used Cluster Random Method for sampling. Finally, collected data were analyzed by software of SPSS Version 13 and statistical method of Chi-square and Mann-Whitney tests.

RESULTS AND DISCUSSION

Overall rate of teat end hyperkeratosis in the four groups (a total number of 860 cows) was 26.4% (Fig. 1). But in detail, the rate of teat end hyperkeratosis in the groups of 2 times milking/day/cows was 12.3% and in the groups of 3 times milking/day/cows was 14.1% (Fig. 2 and 3).

The rates of teat end hyperkeratosis in the two groups analyzed by Crosstab and Chi-square tests. The difference between two groups of cows (3 vs. 2 times milking day⁻¹) was highly significant (p<0.01) (Table 1 and 2). On the other hand, according to the Wilson's grading schedule, the rates of grade 2 teat end hyperkeratosis were more prevalent than of grades 3 and 4 in the herds (Fig. 4).

By using the Mann-Whitney U test for all of the quarters, it was revealed that the intensity of teat end hyperkeratosis in the 3 times milking day⁻¹ cows is >2 times milking day⁻¹ cows (p<0.01) (Table 3). Teat end callosity is a very important complication in the dairy herds of Iran and many other countries. A study categorized the forms of teat end hyperkeratosis into four

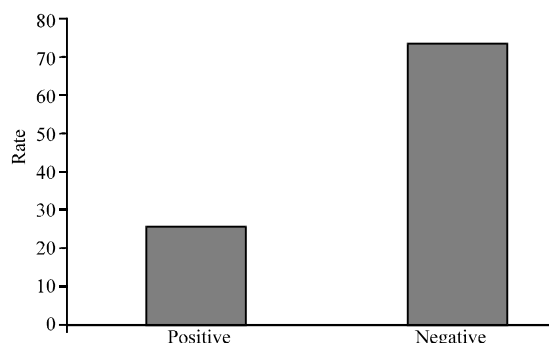


Fig. 1: Overall rate of teat end hyperkeratosis prevalence in the herds (A-D)

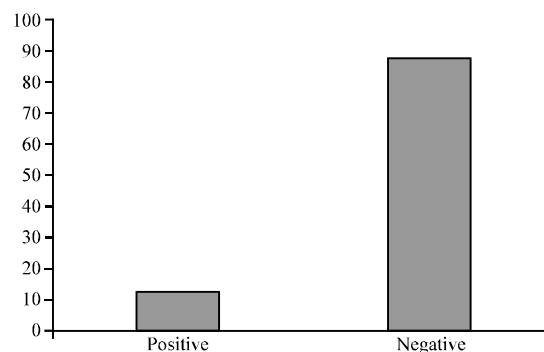


Fig. 2: Prevalence of teat end hyperkeratosis in the herds with 2 times milking day⁻¹ (C and D)

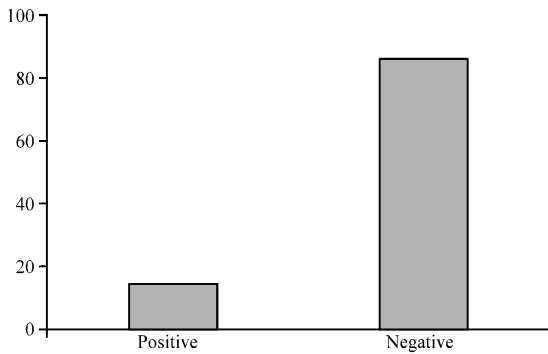


Fig. 3: Prevalence of teat end hyperkeratosis in the herds with 3 times milking day⁻¹ (A and B)

Table 1: Comparing the rates of teat end callosity between the herds with 2 and 3 times milking day⁻¹ by Crosstab test

Measuring rates	Crosstab milking		Total
	3	2	
Disease			
Negative count	284.0	181.0	429.0
Expected count	296.1	132.9	429.0
Percent within disease	57.8	42.2	100.0
Percent within milking	44.5	72.4	53.2
Percent of total	30.7	22.4	53.2
Positive count	309.0	690.0	378.0
Expected count	260.9	117.1	378.0
Percent within disease	81.7	18.3	100.0
Percent within milking	55.5	27.6	46.8
Percent of total	38.3	50.6	46.8
Total count	557.0	250.0	807.0
Expected count	557.0	250.0	807.0
Percent within disease	69.0	31.0	100.0
Percent within milking	100.0	100.0	100.0
Percent of total	69.0	31.0	100.0

Table 2: Comparing the rates of teat end callosity between the herds with 2 and 3 times milking day⁻¹ by Chi-square test

Statistical tests	Chi-square tests			
	Values	df	Asymp. sig. (2-sided)	Exact sig. (1-sided)
Pearson Chi-square	53.848 ^b	1	0.000	-
Continuity correction ^a	52.735	1	0.000	-
Likelihood ratio	55.474	1	0.000	-
Fisher's exact test	53.782	1	0.000	0.000
linear-by-linear association				
No. of valid cases	807	1	0.000	-

^aComputed only for a 2x2 table; ^bCells have expected count <5. The minimum expected count is 117.10

grades which grade 1 was the normal teat end and grade 4 was the teat end with the maximum hyperkeratosis. The results of the study show that prevalence of teat end callosity in 3 times milking/day/cows was significantly higher (14.1) than the groups of 2 times milking/day/cows was (12.3%). Although, overall rate of teat end hyperkeratosis in this study was 26.4% that higher than world mean reported for this injury (15%).

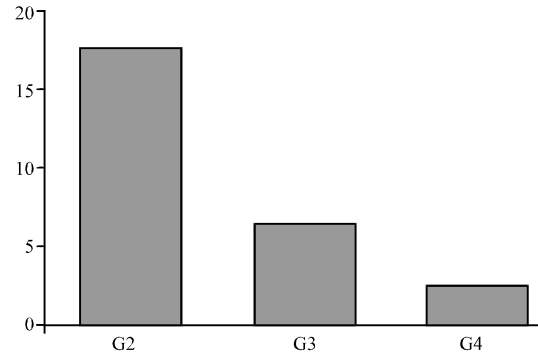


Fig. 4: Prevalence of grades 2-4 in the herds (A-D)

Table 3: Comparing intensity of teat end callosity between the herds with 2 and 3 times milking day⁻¹ by Mann-whitney U test

Milking	Ranks			
	N	Mean rank	Sum of ranks	
Rcr 3	456	444.02	202471.50	
2	350	350.71	122749.50	
Total	506			
Rca 3	457	454.99	207930.50	
2	349	336.08	117290.50	
Total	806			
Lcr 3	456	444.13	202525.00	
2	349	349.26	121890.00	
Total	805			
Lca 3	456	440.46	200852.00	
2	350	355.34	124369.00	
total	806			
Test statistics ^a	Rcr ¹	Rca ²	Lcr ³	Lca ⁴
Mann-whitney U	61324.500	56215.500	60815.000	62944.000
Wilcoxon W	122749.500	117290.500	121890.000	124369.000
Z	-7.533	-9.233	-7.763	-6.975
Asymp.	0.000	0.000	0.000	0.000
Sig. (2-tailed)				

^aGrouping variable: Milking; ¹Right cranial quarter; ²Right caudal quarter; ³Left cranial quarter; ⁴Left caudal quarter

On the other hand according to the Wilson's grading schedule, the prevalence of grade 2, 3 and 4 teat end hyperkeratosis in the study were 17.5, 6.4 and 2.5%, respectively. This show that the prevalent of grades 2 and 3 teat end callosity is significantly higher than grade 4 in Azerbaijan dairy herds. Gleeson *et al.* (2004) in a study reported that the rate of teat end hyperkeratosis in the Irish Holstein dairy herds is 31.4% and the rates of grades 2-4 hyperkeratosis are 20, 5.5 and 0.5%, respectively. Kirk reported that the rate of teat end hyperkeratosis in the dairy farms of California is 23.8% and the rates of grades 2-4 are 24, 4.4 and 0.25%, respectively. In contrast with the above mentioned data, the results showed high rate teat end hyperkeratosis prevalence in the Tabriz dairy herds, especially in the herds with 3 times milking day⁻¹. Also, the rates of grades 2-4 teats end hyperkeratosis more prevalent than of other countries (Mein *et al.*, 2001). Shearn and Hillerton (1996) in UK studied deferent injures of teat end causes by milking machine and milking parlor

staffs. In this study, teats end hyperkeratosis have the highest prevalence (12.3%). These differences partly are related to the utilization of non-standard milking machines and non-standard teat dippers. But the most important factor in this case is the milking frequency/day. The following factors could be affecting the rate of teat end hyperkeratosis in a herd:

- Teat shape: convex teat ends are more susceptible to the hyperkeratosis than flat teat ends
- Incidence of teat end hyperkeratosis is more prevalent in the cold seasons (Winter and Spring) than warm seasons
- Defect in the milking machine function, directly lead to hyperkeratosis
- Hyper sensitivity to the teat dippers could be cause hyperkeratosis
- Increases in the cow age
- High milk production (Andrews *et al.*, 1992)

CONCLUSION

According to the results, milking frequency/day has a direct effect on the rate of teat end hyperkeratosis in the herds. In other word, increase in the milking frequency/day lead to increase in the teat end hyperkeratosis and consequent diseases such as black spot and mastitis in the herd.

REFERENCES

Andrews, F.M., A. Abbey and L.J. Halman, 1992. Is fertility-problem stress different? The dynamics of stress in fertile and infertile couples. *Fertil. Steril.*, 57: 1247-1253.

Bakken, G., 1981. Relationships between udder and teat morphology, mastitis and milk production in norwegian red cattle. *Acta. Agric. Scand.*, 31: 438-444.

Capuco, A.V., G.A. Mein, S.C. Nickerson, L.J. Jack and D.L. Wood *et al.*, 1994. Influence of pulsationless milking on teat canal keratin and mastitis. *J. Dairy Sci.*, 77: 64-74.

Ebendorff, W. and J. Ziesack, 1991. Studies into reduction of milking vacuum (45 kPa) and its impact on teat stress, udder health as well as on parameters of milk yield and milking. *Mh. Vet. Med.*, 46: 827-831.

Espe, D. and C.Y. Cannon, 1942. The anatomy and physiology of the teat sphincter. *J. Dairy Sci.*, 25: 155-160.

Gleeson, D.E., E.J. O'Callaghan and M.V. Rath, 2004. Effect of liner design, pulsator setting, and vacuum level on bovine teat tissue changes and milking characteristics as measured by ultrasonography. *Irish Vet. J.*, 57: 289-296.

Hamann, J., 1987. Machine milking and mastitis section 3: Effect of machine milking on teat end condition: A literature review. *Bull. IDF.*, 215: 33-53.

Hamann, J., 2000. Teat tissue resistance mechanisms with special regard to machine milking. Proceedings of the International Dairy Federation International Symposium on Immunology of Ruminant Mammary Gland, June 13-14, 2000, Stresa, Italy -

Johansson, J., 1957. Investigation on variation in udder and teat shape of cows. *Z. Tierz. Zuchtungsbiol.*, 70: 233-233.

Mein, G.A. and P.D. Thompson, 1993. Milking the 30,000-pound herd. *J. Dairy Sci.*, 76: 3294-3300.

Mein, G.A., D.M. Williams and C.C. Thiel, 1987. Compressive load applied by the teatcup liner to the bovine teat. *J. Dairy Res.*, 54: 327-337.

Mein, G.A., D.M.D. Williams and D.J. Reinemann, 2003. Effects of milking on teat-end hyperkeratosis: 1. Mechanical forces applied by the teatcup liner and responses of the teat. Proceedings of the 42nd Annual Meeting of the National Mastitis Council, January 26-29, 2003, Fort Worth Texas, USA.

Mein, G.A., F. Neijenhuis, W.F. Morgan, D.J. Reinemann and J.E. Hillerton *et al.*, 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/AABP, Vancouver, (MMQ'01), National Mastitis Council Inc., Madison, WI., pp: 347-351.

Michel, G., W. Seffner and J. Schulz, 1974. Hyperkeratosis of teat duct epithelium in cattle. *Mh. Vet. Med.*, 29: 570-574.

Neijenhuis, F., H.W. Barkema, H. Hogeveen and J.P.T.M. Noordhuizen, 2000. Classification and longitudinal examination of callused teat ends in dairy cows. *J. Dairy Sci.*, 83: 2795-2804.

Neijenhuis, F., H.W. Barkema, H. Hogeveen and J.P.T.M. Noordhuizen, 2001. Relationship between teat-end callosity and occurrence of clinical mastitis. *J. Dairy Sci.*, 84: 2664-2672.

Rasmussen, M.D., 1993. Influence of switch level of automatic cluster removers on milking performance and udder health. *J. Dairy Res.*, 60: 287-297.

Rathore, A.K., 1977. Teat shape and production associated with opening and prolapse of the teat orifice in Friesian cows. *Br. Vet. J.*, 133: 258-262.

Shearn, M.F. and J.E. Hillerton, 1996. Hyperkeratosis of the teat duct orifice in the dairy cow. *J. Dairy Res.*, 63: 525-532.

Sieber, R.L. and R.J. Farnsworth, 1981. Prevalence of chronic teat-end lesions and their relationship to intramammary infection in 22 herds of dairy cattle. *J. Am. Vet. Med. Assoc.*, 178: 1263-1267.