Relationship between teat biometry and subclinical Mastitis in crossbred cows

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ABSTRACT

The investigation was undertaken on 110 Gir crossbred cows of different order of lactation and stage of lactation maintained at Research Cum Development Project on Cattle, MPKV, Rahuri. The overall least squares means of teat length and teat diameter were 6.88 ± 0.14 and 2.62 ± 0.06, cm respectively. The least squares analysis of variance showed significant ($p<0.01$) effect due to order of lactation on teat length and teat diameter in crossbred cows. However, stage of lactation exerted non-significant influence on all teat measurement traits. The correlation of teat length with teat diameter was positive and significant ($p<0.01$). The frequencies of cylindrical, funnel and pear shaped teats in cows were 36.36%, 39.09% and 24.55%, respectively. Among 110 cows, 48 (43.64%) were found positive for subclinical mastitis. The higher occurrence of subclinical mastitis was noticed in cows with cylindrical teats (47.5%) followed by pear (44.4%), and funnel (39.53%) shape teat. Higher incidence of subclinical mastitis was observed in cows having teat length >7 cm and teat diameter >2.5 cm. Highest occurrence (78.26%) of subclinical mastitis was found in cows of sixth and above lactation. Maximum occurrence of subclinical mastitis was noted in cows which were in late (46.15%) stage of lactation followed by early (40%) and mid (37%) stage of lactation. The incidence of subclinical mastitis was higher (51.61%) in cows who had teat end to floor distance of <42 cm, followed by cows having distance between 45-55 cm (47.27%) and distance between >55 cm (25%). It revealed that teat end to floor distance was important factor associated with occurrence of subclinical mastitis in Gir crossbred cows. The teat length had positive and significant association with incidence of subclinical mastitis in crossbred cows.

Key words: Crossbred, Mastitis, Teat, Cylindrical, Pear, Funnel

(Part of M.Sc. thesis of first author)

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Mastitis is one of the most prevailing diseases of high yielding dairy animals. Subclinical mastitis being the most common form of mastitis is 15 to 40 times more prevalent than clinical mastitis and its prevalence varied from herd to herd and place to place[3]. Clinical mastitis is problem of an individual cow that can be diagnosed easily with the presence of inflammation of udder and changes in milk. Whereas, SCM is a herd problem and difficult to detect as no gross signs of inflammation and changes in milk composition are observed. Physical characteristics of udder and teats are important traits associated with incidence of subclinical mastitis. The incidence of subclinical mastitis are higher in cows as compared to buffaloes and among cows in crossbred cows due to rapid removal of large

amount of milk which causes injury to teats and predisposing to infection[18]. Sub-clinical mastitis may cause heavy economic losses due to reduced milk production, discarded milk, early replacement of animal, reduced sale value and costly veterinary treatment. Cows with subclinical mastitis are those with no visible changes in the appearance of the milk and/or the udder, but milk production decreases by 10 to 20% with undesirable effect on its constituents and nutritional value rendering it of low quality and unfit for processing[7]. Hence the investigation was undertaken to record the teat measurements, categories various shapes of teats and estimate association of various teat traits with sub-clinical mastitis of crossbred cows.

MATERIALS AND METHODS

The observations for study were recorded from 110 Gir crossbred cows (JG, FG and FJG) maintained at Research Cum Development Project on Cattle, Mahatma Phule Krishi Vidyapeeth, Rahuri, district Ahmednagar (M.S.). The cows were fed with green fodders viz. Berseem, Lucerne, Maize, Oat, and Sorghum and dry roughages like chaffed Jowar straw. The whole milk feeding and other feeding schedule prescribed by ICAR was used for preparing feeding schedule. All the animals were confined in loose house system. Hand and Machine milking was practiced at equal interval twice-a day. All the animals were maintained under normal level of hygienic conditions with adequate health cover. Animals were vaccinated against Foot and Mouth (FMD), Hemorrhagic Septicemia (HS) and Black Quarter (BQ) diseases. The observations for the present study on teat measurement traits were recorded on the basis of order of lactation and stage of lactation of crossbred cows. The observations of crossbred cows recorded were biometry of teat, shape of teat and status of subclinical Mastitis. Teat length and diameter of teat were measured one to two hours before evening milking after securing the animals properly in a standing position on a leveled pucca floor for the accuracy. All the measurements were recorded in centimeters. Shape of teat was observed grossly and categorized in to different types viz. cylindrical, funnel and pear shaped teats as per the visual appraisal method followed

by[13]. California Mastitis Test developed by[16] was performed directly in the cowshed.

Data was analyzed by using standard procedures viz. mean, standard error, coefficient of variations, frequency distribution, analysis of variance and correlation coefficient. In order to overcome non-orthogonality of data resulting from unequal and disproportionate subclass frequencies, the least squares method as suggested by[6] was used for analysis. Duncan's multiple range test as modified by[11] was used to make pair wise comparison among the least squares means with the use of inverse elements and root mean squares for error. The correlation coefficients of various traits were computed according to the formula given by[17]. Significance of correlation was tested by correlation table of [4].

RESULTS AND DISCUSSION

Biometry of teat

The overall mean teat length in crossbred cows was 6.88 ± 0.14 cm. These results corroborated with[5] in Brown Swiss cattle at Turkey reported average teat length as 6.26 ± 0.07 cm.

Effect of order of lactation

The analysis of variance revealed that lactation order had significant ($p < 0.01$) influence on teat length and teat diameter in crossbred cows. Perusal of data showed a gradual increase in teat length as the lactation increased. Increase in teat length with the advancement of lactation may be due to the physiological development of body and udder. Further decline in teat length may be due to declined milk yield and shrinkage in udder with advancement of age.

The teat diameter in cows of 6th and above lactation was significantly higher than cows of 1st and 5th lactation which did not differed significantly from each other. Teat diameter in cows of 6th and above lactation was at par with cows in 2nd, 3rd and 4th lactations. Perusal of data showed a gradual increase in teat diameter as the lactation increased up to 3rd lactation which declined in 4th lactation and then again increased in 5th lactation onwards.

Table 1. Least squares analysis of variance indicating effect of order of lactation and stage of lactation on teat measurement traits

Traits		Teat length			Teat diameter	
Source of variation	d.f.	MSS	F	d.f.	MSS	F
OL	5	8.54	4.61**	5	1.38	3.82**
SL	2	0.23	0.12	2	0.07	0.19
Error	102	1.85		102	0.36	

** $P < 0.01$

Table 2. Teat measurements of crossbred cows in different order of lactation and stages of lactation

Traits	N	Teat length (cm)	Teat diameter (cm)
Source of variation		Mean±S.E.	Mean±S.E.
Overall means (μ)	110	6.88±0.14	2.62±0.06
Order of lactation			
OL_1	42	6.20±0.22[b]	2.37±0.08[b]
OL_2	18	7.63±0.37[a]	2.75±0.18[ab]
OL_3	15	7.83±0.27[a]	2.81±0.15[ab]
OL_4	7	6.95±0.50[ab]	2.50±0.08[ab]
OL_5	5	6.88±0.29[ab]	2.28±0.16[b]
OL_6	23	6.89±0.26[ab]	2.96±0.15[a]
Stage of lactation			
SL_1	5	6.77±0.93	2.69±0.10
SL_2	27	6.76±0.35	2.56±0.10
SL_3	78	6.93±0.15	2.63±0.08

Means under each class in the same column with different superscripts differ significantly (P<0.05) from each other

Effect of stage of lactation

The effect of stage of lactation on teat length and teat diameter in crossbred cows was non-significant. Milk yield of cow increases during early stage of lactation and reached peak at about 35-50 days and then declines gradually. With increase in milk yield the teat length also increases. Hence, teat length may be higher during early stage of lactation. The mean teat diameter in different stages of lactation ranged from 2.56 ± 0.10 to 2.69 ± 0.10 cm.

Teat diameter

The overall teat diameter in crossbred cows was 2.62± 0.06 cm. However, in Zebu cows[12] noticed lower teat diameter than present results as 2.04 ± 0.38 cm and 1.90 ± 0.40 cm for front and rear teats, respectively.

Association among teat biometry traits

The association of teat length with teat diameter (0.56) was positive and significant (p<0.01). These results indicated that teat measurement traits are highly associated with each other.

Teat morphological characteristics

A visual appraisal was made to record the shape of teats. The teat shape was grouped as cylindrical, funnel, and pear types. Perusal of the data revealed that the frequencies of cylindrical, funnel, and pear shaped teats in Gir crossbred cows were 36.36%, 39.09% and 24.55%, respectively. Thus, the funnel type teats were found maximum in cows followed by cylindrical and Pear shaped teats. In Karan Swiss cows, similar trend was observed by[9] with highest frequency of conical or funnel shaped teats (48.27%) followed by cylindrical (37.42%) and bottle (14.31%) shaped teats.

Various teat measurements in crossbred cows according to the teat shape

There was significant (p<0.01) effect of teat shape on teat length. The differences observed in mean teat length of crossbred cows due to different shape of teats were statistically significant (p<0.01). The teat length of cows having funnel (7.36±0.22 cm) and pear shaped teats (7.36±0.24 cm) was significantly higher than cows having cylindrical teats (6.03±0.19 cm). The teat measurements in crossbred cows were lowest in cylindrical shaped teats and highest in pear shaped teats. The teat shape had non-significant effect on teat diameter.

Incidence of Subclinical Mastitis in crossbred cows

For this study 110 Gir crossbred cows were screened once in month during six month period for presence of subclinical mastitis. Based on California Mastitis Test (CMT) test, 48 cows (43.64%) were found positive for sub clinical mastitis. Similar results were reported by[14&10] showed 46.80% and 34.59% crossbred cows positive for subclinical mastitis,

respectively. Variation observed in occurrence of subclinical mastitis between present study and earlier studies might be due to differences in the management practices, hygienic conditions, care of the teat injuries, prompt treatment of clinical cases, culling of carriers and adaptation of mastitis control program.

Relationship between teat morphology and incidence of Subclinical mastitis

Results showed highest occurrence of subclinical mastitis in Gir crossbred cows having cylindrical teats (47.5%) followed by pear (44.4%), and funnel (39.53%) shape teat (Table 3). The higher incidence of mastitis in cylindrical shaped teats might be due to higher incidence of teat cup crawls under machine milking. The higher risk of subclinical mastitis in cows with cylindrical teats as compared to cows with funnel shaped teats was reported by[20]. Further Hussain[8] reported 35.64% positive cases of subclinical mastitis in cylindrical teats followed by flat (35.37%), round (24.32%) and pointed (2.55%) teats.

Table 3. Incidence of subclinical mastitis in cows with different shapes of teats

Teat shape	Frequency	Incidence of SCM	Percentage
Cylindrical	40	19	47.50
Funnel	43	17	39.53
Pear	27	12	44.40
Overall	110	48	43.64

Relationship between teat biometry and incidence of Subclinical mastitis

Perusal of the data in Table 4 indicated higher incidence of subclinical mastitis in cows having longer teats (48.97%) as compared to shorter teats (39.34%). Higher incidence of subclinical mastitis in longer teats might be because of the reason that the distance between teat end and barn floor is less and such teats are more vulnerable to teat injury which might cause more number of pathogenic bacteria to thrive within the teat canal. These teats are also liable to expose themselves to external trauma more frequently than the shorter ones. Thus, selection of cows based on teat length may prove effective to control the incidence of subclinical mastitis. In

agreement with the present study[15] reported the highest correlation of subclinical mastitis in dairy cattle with average teat length of 7.5 cm. Teats with greater diameter had higher occurrence of subclinical mastitis (44.82%) as compared to teats with smaller (42.3%) diameter. The higher incidence of subclinical mastitis in quarters with greater diameter of teat might be due to larger diameter of teat canal which would allow easy passage for the microbes to the mammary tissues. The higher incidence of subclinical mastitis in the teat with larger diameter was alsoreported by[1]. The cows having lesser distance between tip of teat and barn floor were more infected with SCM. This may be due to the reason that if there is less distance of

teat tip from ground, there are more chances of contamination with microorganism. The number of cows having distance of teat end to floor as <45 cm, 45-55 cm and >55 cm were 31, 55 and 24, respectively. The incidence of subclinical mastitis was higher (51.61%) with teat end to floor distance of <45 cm, followed by distance between 45-55 cm (47.27 %) and distance between >55 cm (25%). It revealed that decreasing teat end to floor distance was important factor associated with occurrence of subclinical mastitis.

Table 4. Incidence of subclinical mastitis due to variation in teat biometry

Parameter	No. of cows	Positive for SCM	Percentage
Teat length (cm)			
<7	61	24	39.34
≥7	49	24	48.97
Teat diameter (cm)			
<2.5	52	22	42.3
≥2.5	58	26	44.82

Correlations of udder and teat measurement traits with incidence of Subclinical mastitis

The data from Table 5 showed that the correlation coefficient of udder shape (0.24) with incidence of subclinical mastitis was positive and significant (p<0.05). Similar results were reported by[2] in crossbred cows. The association of teat shape with incidence of subclinical mastitis (-0.03) was negative and non-significant. The correlation of udder length (0.19) with incidence of subclinical mastitis was positive. The udder width (0.16) and udder circumference (0.01) had positive and non-significant association with incidence of subclinical mastitis.

Table 5. Correlations of teat measurement traits with incidence of subclinicalmastitis

Traits	Incidence of subclinical mastitis
Teat shape	-0.03
Teat length	0.21**
Teat diameter	0.01
Teat tip to ground	-0.19*
Lactation order	0.37**
Stage of lactation	0.01

* P<0.05 ** P<0.01

In crossbred cows the correlation of udder depth (0.27) with incidence of subclinical mastitis was positive and significant (p<0.01). The results indicated that lesser the udder depth higher the cases of incidence of subclinical mastitis. The distance between udder floor to ground (-0.19) had negative and significant (p<0.05) correlation with incidence of subclinical mastitis. The results indicated that lesser the distance from udder floor to ground higher the cases of subclinical mastitis.

In crossbred cows the teat length (0.21) had positive and significant correlation with incidence of subclinical mastitis. These results were in line with the results of[19] observed in crossbred cows. However contradictory results were obtained by[2&15] in dairy cattle. In crossbred cows there was positive and non-significant correlation of teat diameter (0.01) with incidence of subclinical mastitis.

The teat tip to ground distance (-0.19) had negative and significant correlation with incidence of subclinical mastitis. The results indicated that lesser the teat tip to ground distance higher the cases of subclinical mastitis. Similar results were reported by[19] in crossbred cows.

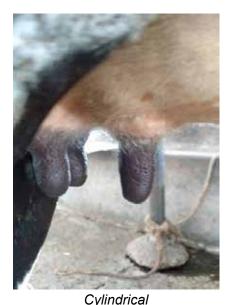*Cylindrical*   *Funnel*   *Pear*

Fig. 1. Teat shapes in crossbred cows

The association of lactation order (0.37) with incidence of subclinical mastitis was positive and significant (p<0.01). The correlation coefficient of stage of lactation (0.01) with incidence of subclinical mastitis was positive and non-significant. These results were in line with[20] reported in Holstein cows.

CONCLUSION

In Gir crossbred cows the mean teat length was 6.88 ± 0.14 and teat diameter was 2.62 ± 0.06 cm. The frequencies of cylindrical, funnel and pear shaped teats were 36.36%, 39.09% and 24.55%, respectively. Teat length had positive and significant association with incidence of subclinical mastitis in crossbred cows. Effect due to order of lactation on teat length and teat diameter in crossbred cows was significant. Stages of lactation and higher lactation order were associated with increased incidence of subclinical mastitis in crossbred cows. Therefore, due care and precautions are necessary in such cows to reduce occurrence of subclinical mastitis.

REFERENCES

1. 1.Bardakcioglu, H. E., Sekkin, S. and Oral Toplu, H. D. 2011. Relationship between some teat and body measurements of Holstein cows and subclinical mastitis and milk yield.*J. Anim. Vet. Adv.* **10**(13):1735-1737.

2. 2.Bharti, P., Bhakat, C., Pankaj, P. K., Bhat, S. A, Prakash, M. A., Thul, M. R. and Japeth, K. P. 2015. Relationship of udder and teat conformation with intra-mammary infection in crossbred cows under hot-humid climate. *Vet. World* **8**(7):93-98.

3. 3.Devi, M. and Dutta, J. B. 2018. Incidence of bovine subclinical mastitis in organized and unorganized farms based on somatic cell count. *Int. J. Chem. Stud.* **6**(4):1399-1403.

4. 4.Fisher, R. A. and Yates, F. 1986. Statistical table for biological, agricultural and medical research. Sixth End. Publishers Longman group Ltd., England. Pp.63.

5. 5.Genc, M., Coban, O., Ozenturk, U. and Etlas, O. 2018. Influence of breed and parity on teat and milking characteristics in dairy cattle. Mac. *Vet. Rev*. **41**(2): 169-176.

6. 6.Harvey, W. R. 1990. Least squares analysis of data with unequal subclass number. USDA, ARS. 144.

7. 7.Holdway, R. J. 1992. Bovine mastitis in New Zealand dairy herds. Part III. The cost of mastitis to the New Zealand dairy farmers during the 1991/1992 dairy season. Published report to the livestock improvement corporation, Hamilton.

8. 8.Hussain, R., Khan, A., Tariq J. M. and Rizvi, F. 2012. Possible factors associated with mastitis in Indigenous cattle in Punjab, Pakistan. *Pakistan Vet. J.* **32**(4):605-608.

9. 9.Kamboj, M. L., Singh, A. and Prasad, S. 2007. Effect of udder and teat shapes and their measurements on somatic cell counts in milk of Karan-Fries cows. *Indian J. Dairy Sci.* **60**(6):435-440.

10. 10.Kamboj, M. L., Singh, A. and Prasad, S. 2008. Effect of udder and teat characteristics on incidence of subclinical mastitis in crossbred cows. *Indian Vet. J.* **85**(8):846-848.

11. 11.Kramer, C. V. 1957. Extension of multiple range tests to group correlated adjusted means. *Biometrics*. **13**:13-18.

12. 12.Mingoas, K. J. P., Awah-Ndukum, J., Dakyang, H. and Zoli, P. A. 2017. Effects of body conformation and udder morphology on milk yield of zebu cows in North region of Cameroon. *Vet. World* **10**(8): 901.

13. 13.Ovesen, E. 1972. Milking ability in relation to size and shape of teats. *Anim. Prod.* **15**(3): 251-257.

14. 14.Patel, J. V., Bhingaradia, B. V., Patel, B. B., Patel, S. B., Patel, P. B. and Vahora, S. P. 2012. Study on prevalence of mastitis and antibiotic sensitivity of bacterial isolates recovered from crossbred cows of Anand District of Gujarat. *Indian J. Dairy Sci.* **65**(6):467-471.

15. 15.Pisestyani, H., Lelana A. R. P. and Septiani, Y. N. 2016. Teat length and lactation period as a predisposition factor of subclinical mastitis in dairy cattle in Bandung, Indonesia. *Int. J. Life Sci.* **10**(1):1-6.

16. 16.Pyorala, S. 2003. Indicators of inflammation in the diagnosis of mastitis. *Vet. Res.* **34**(5):565–578.

17. 17.Rao, G. N. 1985. Statistics for Agricultural Sciences Oxford and IBH Publishing Co. New Delhi. pp. 376.

18. 18.Shahid, M., Sabir, N., Ahmed, I., Khan, R. W., Irshad, M., Rizwan, M. and Ahmed, S. 2011. Diagnosis of subclinical mastitis in bovine using conventional methods and electronic detector. *ARPN J. Agriculture and Biological Science*, **6**(11):18-22.

19. 19.Sharma, T., Das, P. K., Ghosh, P. R., Banerjee, D. and Mukherjee, J. 2017. Association between udder morphology and in vitro activity of milk leukocytes in high yielding crossbred cows. *Vet. World*. **10**(3):1-6.

20. 20.Uzmay, C., Kaya, Y., Abbas, Y. and Kaya, A. 2003. Effect of udder and teat morphology, parity and lactation stage on sub-clinical mastitis on Holstein cows. *Turk. J. Vet. Anim.* Sci. **27**:695-710.