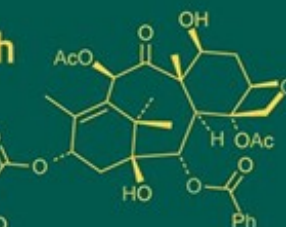


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Comparative evaluation of California Mastitis Test, electrical conductivity and somatic cell count for detection of mastitis in Holstein Friesian crossbred and Deoni cows

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ABSTRACT

Mastitis is one of the most important diseases affecting dairy cattle and is a major cause of reduced milk production and deterioration of milk quality. Early detection, particularly of subclinical mastitis, is therefore essential for effective udder-health management. The present study was undertaken to compare three commonly used mastitis screening methods, namely California Mastitis Test (CMT), electrical conductivity (EC) and somatic cell count (SCC), in Holstein Friesian (HF) crossbred and Deoni cows. A total of 244 lactating cows comprising 152 HF crossbred and 92 Deoni cows maintained at organized farms and adjoining villages of *Karnataka* were screened. Milk samples were examined by CMT, EC and microscopic SCC. Based on CMT, 128 (52.5%) samples were classified as mastitis positive, including 109 HF crossbred and 19 Deoni cows. Electrical conductivity identified 148 (60.7%) samples as positive, comprising 126 HF crossbred and 22 Deoni cows. Based on the conventional threshold of > 5,00,000 cells/ml, SCC identified 119 (48.8%) samples as mastitis affected, including 100 HF crossbred and 19 Deoni cows. Considering the greater diagnostic reliability of SCC compared with CMT and EC, animals were finally classified according to SCC results. Thus, 100 of 152 HF crossbred cows (65.8%) and 19 of 92 Deoni cows (20.7%) were classified as mastitis affected. The findings demonstrate considerable variation among screening methods and emphasize the importance of SCC as a reliable indicator of subclinical mastitis. CMT remains useful as a rapid cow-side screening test, whereas EC can provide useful information on udder health but should not be used as a sole diagnostic criterion.

Keywords: Mastitis, Dairy cattle, California Mastitis Test, Electrical conductivity, Somatic cell count, HF crossbred, Deoni, Subclinical mastitis

Introduction

Mastitis is an inflammatory disease of the mammary gland and a major cause of reduced milk yield, poor milk quality, increased treatment costs and economic losses in dairy cattle. Early detection is essential, particularly for subclinical mastitis, which may occur without visible changes in the udder or milk.

Mastitis can be diagnosed using direct methods, such as bacteriological culture, and indirect methods, including California Mastitis Test (CMT), electrical conductivity (EC) and somatic cell count (SCC). Although bacterial culture is useful for identifying causative pathogens, its routine application is limited by cost, time and laboratory requirements (Ruegg *et al.*, 2002) [1]. CMT is a simple and rapid cow-side test that indirectly reflects SCC, whereas EC detects changes in milk electrolyte concentrations associated with mammary inflammation. However, EC may be influenced by physiological and non-mastitis-related factors. SCC is a widely used indicator of udder health and subclinical mastitis, although it can also vary with age, parity and stage of lactation.

The present study was undertaken to compare CMT, EC and SCC for mastitis screening and to assess the prevalence of mastitis in Holstein Friesian (HF) crossbred and Deoni cows.

Materials and methods

The study was conducted on 244 cows comprising 152 Holstein Friesian (HF) crossbred and 92 Deoni cows. HF crossbred cows were maintained at the Department of Instructional Livestock Farm Complex, Veterinary College, Bengaluru, and adjoining villages, while Deoni cows were maintained at the Livestock Research and Information Center, Hallikhet (B), Bidar, and adjoining villages of Bhalki taluk, *Karnataka*.

Individual milk samples were screened for mastitis using California Mastitis Test (CMT), electrical conductivity (EC) and somatic cell count (SCC). For CMT, milk from individual quarters was collected in a four-

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cup paddle, mixed with an equal volume of reagent and immediately scored as negative, trace, 1, 2 or 3 based on thickening and gel formation. Milk EC was measured using a Milk Checker (Oriental Instruments Ltd., Tokyo, Japan) after calibration with 0.1 M KCl. The sensor was rinsed with distilled water between samples, and an EC value of ≥ 6.5 mS/cm was considered positive.

SCC was estimated by the microscopic method of Prescott and Breed as described by Schalm *et al.* Milk samples were thoroughly mixed, and 10 μ l was spread over a 1 cm² area on a glass slide, air-dried and stained with Newman Modified stain. The stained smears were examined under oil immersion and cells were counted in 20 microscopic fields. With a microscopic field diameter of 0.20 mm, the microscopic factor was approximately 3,184 and was rounded to 3,000. Cell concentration was calculated as: **Cells/ml = average cells per field $\times$ microscopic factor $\times$ 100**. Samples with SCC $> 5,00,000$ cells/ml were classified as mastitis affected, and SCC was used as the principal criterion for final classification.

Results

A total of 244 milk samples from 152 HF crossbred and 92 Deoni cows were screened using CMT, EC and SCC. CMT identified 128 (52.5%) samples as positive, including 109 HF crossbred and 19 Deoni cows. The remaining 116 samples were negative. The proportion of CMT-positive animals was higher in HF crossbred (71.7%) than in Deoni cows (20.7%).

Electrical conductivity classified 148 (60.7%) samples as positive, comprising 126 HF crossbred and 22 Deoni cows, while 96 (39.3%) were negative. The proportion of EC-positive animals was 82.9% in HF crossbred and 23.9% in Deoni cows. Thus, EC recorded the highest proportion of positive animals among the three tests.

Based on the SCC threshold of $> 5,00,000$ cells/ml, 119 (48.8%) samples were classified as mastitis affected and 125 (51.2%) as mastitis free. Among HF crossbred cows, 100 (65.8%) were positive, while 52 (34.2%) were negative. Among Deoni cows, 19 (20.7%) were positive and 73 (79.3%) were negative. In HF crossbred cows, 24, 13 and 15 animals had SCC values of 0–1, 1–2 and 2–5 lakh cells/ml, respectively, whereas 67 Deoni cows had counts of 0–1 lakh and six had 1–2 lakh cells/ml.

Overall, the three tests showed differences in mastitis classification, with EC identifying the highest number of positive animals (60.7%), followed by CMT (52.5%) and SCC (48.8%). Based on SCC, which was used as the principal criterion for final classification, mastitis prevalence was substantially higher in HF crossbred cows (65.8%) than in Deoni cows (20.7%).

Discussion

Accurate detection of subclinical mastitis is essential for effective dairy herd health management. The suitability of a diagnostic test depends on its accuracy, cost, speed and ease of application. In the present study, CMT, EC and SCC showed differences in the proportion of animals classified as mastitis positive.

CMT identified 128 (52.5%) animals as positive, including 109 HF crossbred and 19 Deoni cows. The higher positivity in HF crossbred cows indicates a greater mastitis burden in this group. CMT is a simple, rapid and inexpensive cow-side test for detecting increased somatic cell concentration and is therefore useful under field conditions (Schalm *et al.*, 1957) [2]. However, its interpretation may be influenced by physiological factors.

EC test offers the advantage that it can be used 'on-site', non-mastitis-related variations in EC can present problems in diagnosis (Viguiet *et al.*, 2009) [3]. EC measurements in milk from healthy cows generally ranged from 5.5 to 6.5 mS/cm (Norberg *et al.*, 2004) [4]. In the current study, EC categorized the samples into two broad groups *i.e.*, samples with EC < 6.5 mS/cm and > 6.5 mS/cm which were considered as mastitis free and mastitis affected, respectively. Out of 244 samples screened 148 with EC ≥ 6.5 mS were considered as mastitis affected. Among 148 samples, 126 and 22 were from HF crossbred

and Deoni cows, respectively. EC recorded the highest positivity (148; 60.7%). Therefore, EC is more appropriately considered a supportive indicator of udder health rather than a stand-alone diagnostic test.

There is high genetic correlation (0.6 - 0.8) between somatic cell count and clinical mastitis (Shook *et al.*, 1994) [5] which indicates that progress can be made in the reduction of mastitis by selecting animals for decreased somatic cell count. Somatic cell count has been included as a component of the definition of mastitis, and the original limit for SCC of a healthy quarter is 500 000 cells/ml (Anon., 1971) [6].

In the present study, the SCC value of $> 5,00,000$ cells/ml of milk was taken as criteria to declare the milk/animal as mastitis affected which is in accordance with the reports of Hegde *et al.* (2012) [7] and Sripad *et al.* (2013) [8]. Out of 244 milk samples screened, 119 were considered as mastitis affected, which included 100 HF (65.8%) crossbred and 19 (20.7%) Deoni cows.

The prevalence based on SCC was substantially higher in HF crossbred cows (65.8%) than in Deoni cows (20.7%). This difference may be associated with breed, milk production level, management practices or environmental exposure. Nevertheless, factors such as parity, stage of lactation and age may also influence SCC and should be considered when interpreting breed-related differences (Dohoo *et al.*, 1982) [9].

Overall, EC identified the highest proportion of positive animals, followed by CMT and SCC. The variation among tests indicates that their results are not directly interchangeable. CMT is advantageous for rapid field screening, EC provides supplementary information on udder health, and SCC offers a more objective measure of milk cellularity. Accordingly, SCC was used as the principal criterion for final classification in the present study.

Conclusion

The study showed higher mastitis prevalence in HF crossbred cows than Deoni cows, with variation among diagnostic methods. CMT, EC and SCC detected 52.5%, 60.7% and 48.8% positive animals, respectively. Based on SCC, mastitis prevalence was 65.8% in HF crossbred and 20.7% in Deoni cows.

SCC was more reliable for final diagnosis, while CMT was a simple, rapid and cost-effective field screening test. EC provided supportive information but was less specific. Combining these methods can improve early detection and management of subclinical mastitis.

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