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Monitoring the changes in the composition of milk fat and milk solids not fat in cow milk before and after the occurrence of mastitis at different lactation stages

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Abstract
A study was conducted to determine how clinical mastitis affects the composition of major milk constituents in dairy cows before and after occurrence of mastitis at different lactation stages. The milk samples were collected local farmers from western districts of Tamil Nadu. For each dairy cow Fat percent and Solids Not Fat percent before and after mastitis at an interval of 10 days was recorded. A total of 54 mastitis affected milch cows were selected. 18 milch cows were studied in each stages during early lactation, mid lactation and late lactation. Six milch cows from each breed *viz*., Kankayam, Holstein Friesian cross breed, Jersey cross breed were selected in in each stages during early lactation, mid lactation and late lactation.

Mean of highest fat percent for Kankayam breed was recorded in late lactation period (5.56±0.06) and the lowest fat percent after 10 days of mastitis affected. Kankayam breed was recorded in early lactation period as (3.95±0.11). Mean of highest fat percent for Holstein cross breed milch cows was recorded in late lactation period (3.72±0.01) and the lowest fat per cent after 10 days of mastitis affected Holstein cross breed milch cows was recorded in early lactation period (3.01±0.02). Mean of highest fat percent for Jersey cross breed milch cow were recorded in late lactation period (3.72±0.01) and the lowest fat per cent after 10 days of mastitis affected. Jersey cross breed were recorded in early lactation period (3.01±0.02). The fat per cent of Kangayam milch cows, Holstein cross breed milch cows, Jersey cross breed milch cows in early, mid and late lactation period before mastitis and 10 days after mastitis infection differed significantly. ($p \leq 0.05$).

Mean of highest Solids Not Fat per cent for Kankayam breed was recorded in early lactation period (8.41±0.05) and the lowest Solids Not Fat per cent for Kankayam breed was recorded in late lactation period 10 days after mastitis infection as (7.98±0.13). Mean of highest Solids Not Fat per cent for Holstein cross breed milch cows was recorded in early lactation period (7.75±0.03) and the lowest Solids Not Fat per cent after 10 days of mastitis affected Holstein cross breed milch cows was recorded in early lactation period (7.01±0.1). Mean of highest Solids Not Fat per cent for Jersey cross breed milch cows were recorded in early lactation period (8.55±0.03) and the lowest Solids Not Fat per cent after 10 days of mastitis affected breed Jersey cross was recorded in late lactation period (7.99±0.11). The Solids Not Fat per cent of Kankayam breed milch cows, Holstein cross breed milch cows Jersey cross breed milch cows in early, mid and late lactation period before mastitis and 10 days after mastitis infection differed significantly. ($p \leq 0.05$).

Keywords: Milk fat, milk solids not fat, early, mid and late lactation period, clinical mastitis

Introduction
Mastitis, a prevalent disease in dairy farms exerts a profound negative influence on both the productivity of dairy cattle as well as the health of dairy cattle, leading to substantial economic losses for the farmer as well as the dairy industry. Udder infection in dairy cows has major negative effects on both yield and quality of milk.

Mastitis is one of the most persistent and widely spread disease conditions affects the total milk output and it stresses the importance to milk hygiene and quality among dairy cattle (Coulon *et al.*, 2002) [5]. Mastitis is the most challenging disease in high-producing herds, even if they follow good management practices, housing, and feeding systems. Mastitis results in a drastic decrease in production, culling of genetically superior cows, drug, veterinarian, and labor charges.

The holding of milk after treatment, which inhibits genetic improvement, also contributes to economic loss for farmers (Bastan *et al*., 2008) [1].

Thomas (2015) [13] emphasised on the study of mastitis effect on milk composition is especially needed because milk pricing system in India mostly rely on total-fat and total-solids not fat and on the lipolysis index of the delivered milk. The decrease in milk production is considered the main component of the economic losses due to different type of mastitis. Mastitis is responsible for changes in milk composition.

Due to tremendous increase in population growth, the demand for milk is increasing tremendously worldwide. However, milk production in India has been affected by mastitis. These changes result from, first, the reduction in fat, lactose and casein synthesis activity for the main components of milk and, second, the increase of presence of blood elements due to the inflammatory reaction (e.g. proteins (serum albumin and immunoglobulins, chloride, and sodium. Only changes in these parameters may thus have on-farm economic consequences**.**

The consequences of mastitis on the compositional changes of milk need to be explored. Besides, recent advances have shed light on the mechanisms involved in the udder response and subsequent milk changes in mastitis cases. This research gives an update on the impact of mastitis on milk composition and processing properties and collates recent data regarding the mechanisms involved in mastitis effects.

Mastitis has been and continues to be recognized as one of the major disease problems among dairy farmers. It is also one of the costliest diseases confronting the dairy farmer. Estimating economic losses resulting from mastitis becomes an extremely difficult ask because of the many levels of infection and other factors. It is an attempt to link field observations and experimental studies in order to better understand how mastitis affects the composition of milk. The present study is aimed at consequences of clinical mastitis on composition of major milk constituent's fat and solids not fat.

Material and Methods

The milk samples were collected local farmers from western districts of Tamil Nadu.

Experimental design

For each animal about the milk contents (Fat and SNF), milk yield before and after mastitis at an interval of 10 days. A total of 54 mastitis affected milch cows were selected. 18 milch cows were studied in each stages during early lactation, mid lactation and late lactation. Six milch cows from each breed *viz*., Kankayam, Holstein Friesian cross breed, Jersey cross breed were selected in in each stages during early lactation, mid lactation and late lactation.

Management

The animals were maintained under the prevailing conditions of the farms.

Milk Composition Analysis

The milk samples (approximately 100 ml) were collected from animals in clean and sterile plastic container before and after mastitis at an interval of 10 days.

Estimation of fat, SNF

Fat was estimated as per the procedure described in IS:SP:18 (Part XI)-1981. The Solids Not Fat content of milk was determined as per the procedure described in AOAC (1995).

Statistical Analysis

The data collected on various parameters were subjected to analysis of variance (ANOVA) procedure. The data were analysed by approved statistical methods of SPSS (Statistical Package for the Social Sciences).

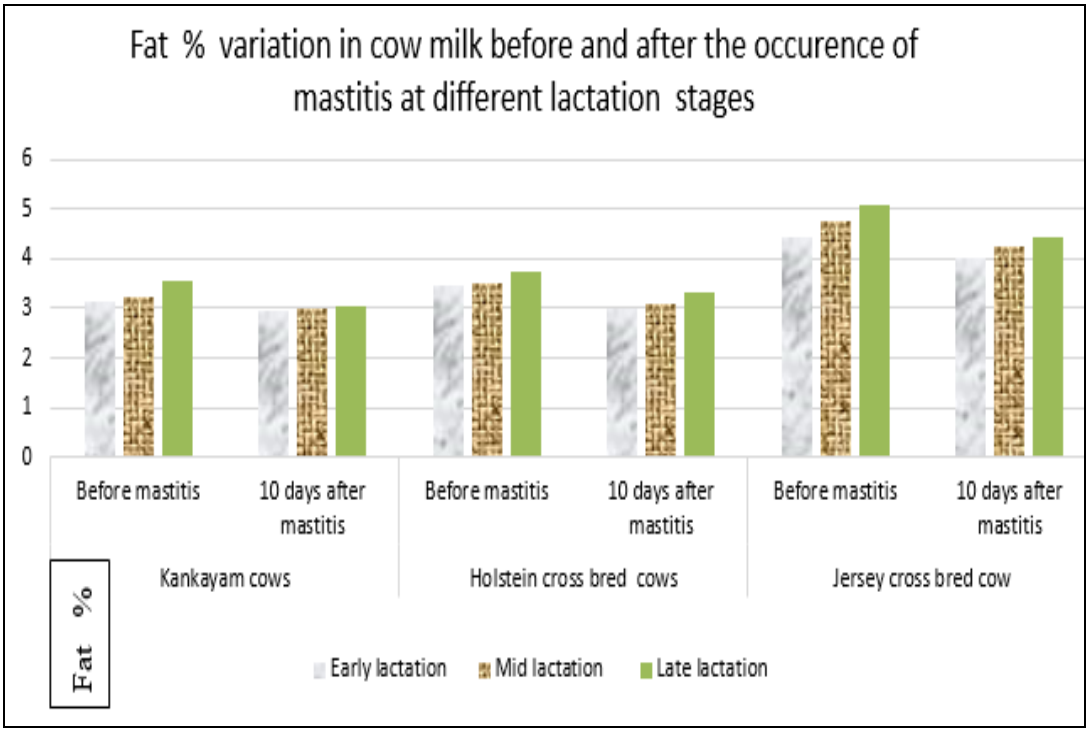

Fig 1: Fat% variation in cow milk affected with mastitis during different stages of lactation

Table 1: Milk components variation on affected animals before and after 10 days during early, mid and late lactation in Kankayam, Holstein cross breed and Jersey cross breed milch cows

Milk components	Kankayam milch cows		Holstein cross breed milch cows		Jersey cross breed milch cow	
Fat (%)	Before mastitis	10 days after mastitis	Before mastitis	10 days after mastitis	Before mastitis	10 days after mastitis
Early	3.13 ±0.13[a]	2.95±0.11[b]	3.48±0.18 [a]	3.01±0.0[ba]	4.41±0.01[a]	4.01±0.05 [b]
Mid	3.21±0.11 [a]	2.98 ±0.19[b b]	3.51±0.13 [a]	3.11±0.13[ab]	4.74±0.12[a]	4.24 ±0.01[b]
Late	3.56 ±0.06 [a]	3.04 ±0.02 [bb]	3.72 ±0.01[a]	3.33 ±0.01[a b]	5.08 ±0.11[a]	4.42±0.01b
Solids Not Fat (%)						
Early	8.41±0.05 [a]	7.98 ±0.11 [bb]	7.75±0.03 [b]	7.30±0.15[ab]	8.55±0.03[a]	8.08±0.0 [b]
Mid	8.37±0.03 [a]	8.01 ±0.05 [bb]	7.58±0.15 [b]	7.15±0.09[ab]	8.36±0.01[a]	8.02±0.01[b]
Late	8.20±0.06 [a]	7.79 ±0.13 [bb]	7.41±0.11 [b]	7.01±0.11[ab]	8.23±0.11[a]	7.99 ±0.11 [b]

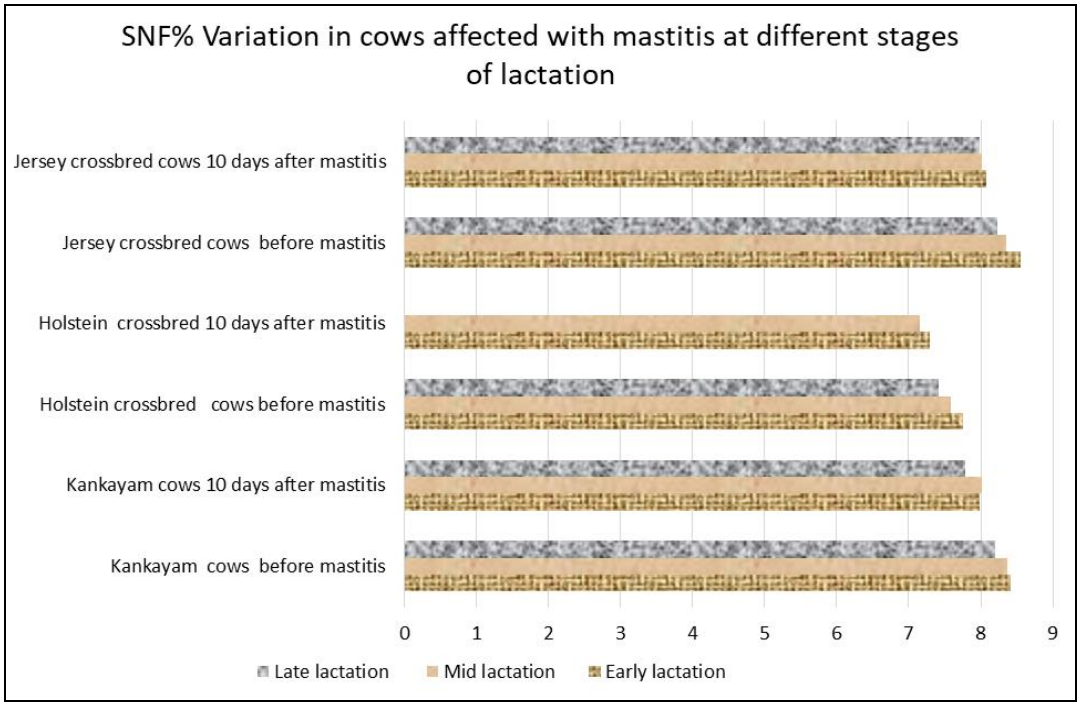

Fig 2: Solids Not Fat% variation in milch cows affected with mastitis during different stages of lactation

Results and Discussion

Fat

Mean of highest fat percent for Kankayam breed was recorded in late lactation period (3.56±0.06) and the lowest fat percent after 10 days of mastitis affected Kankayam breed was recorded in early lactation period as (2.95±0.11).

Mean of highest fat percent for Holstein cross breed milch cows was recorded in late lactation period (3.72±0.01) and the lowest fat per cent after 10 days of mastitis affected Holstein cross breed milch cows was recorded in early lactation period (3.01±0.02).

Mean of highest fat percent for Jersey cross breed milch cow were recorded in late lactation period (3.72±0.01) and the lowest fat per cent after 10 days of mastitis affected Jersey cross breed were recorded in early lactation period (3.01±0.02).

The fat per cent of Kankayam breed milch cow, Holstein cross breed milch cows, Jersey cross breed milch cow in early, mid and late lactation period before mastitis and 10 days after mastitis infection differed significantly. ($p \leq 0.05$). The fat per cent was lower in milk from cows infected with mastitis as compared to milk from uninfected cows in early, mid and late lactation period. The present finding was compared favourably with Bastan et al. (2003). From the present study of fat percentage, it was observed that the average percentage of fat significantly decreased in mastitis milk samples. This finding is in agreement with observations made by (Goncalves, 2012) who recorded lower fat content in milk from infected quarters. Mastitis is responsible for changes in milk composition and these changes results from the reduction in synthesis activity for the main components of milk (Le Maréchal, 2011) [8], (e.g. fat, lactose and casein).

Solids Not Fat

The Solids Not Fat content of Kankayam breed milch cow before mastitis and 10 days after mastitis infection in early, mid lactation period were recorded.

Mean of highest Solids Not Fat per cent for Kankayam breed was recorded in early lactation period (8.41±0.05) and the lowest Solids Not Fat per cent for Kankayam breed was recorded in late lactation period 10 days after mastitis infection as (7.98±0.13).

Mean of highest Solids Not Fat per cent for Holstein cross breed milch cows was recorded in early lactation period (7.75±0.03) and the lowest solids not fat per cent after 10 days of mastitis affected Holstein cross breed milch cows was recorded in early lactation period (7.01±0.11).

Mean of highest Solids Not Fat per cent for Jersey cross breed milch cow were recorded in early lactation period (8.55±0.03) and the lowest Solids Not Fat per cent after 10 days of mastitis affected breed Jersey cross was recorded in late lactation period (7.99±0.11).

Mean of highest yield of raw milk produced per day for Jersey cross breed milch cow was recorded in early lactation period (8.95±0.11) and the lowest yield of raw milk produced

per day after 10 days of mastitis affected Jersey cross breed was recorded in late lactation period (5.71±0.03).

From the data regarding Solids Not Fat per cent of Kankayam breed milch cow, Holstein cross breed milch cows, Jersey cross breed milch cow in early, mid and late lactation period before mastitis and 10 days after mastitis infection differed significantly. ($p \leq 0.05$). The Solids Not Fat per cent was lower in milk from cows infected with mastitis as compared to milk from uninfected cows in early, mid and late lactation period. The present finding was compared favourably with Bastan et al. (2008) [1]. From the present study of Solids Not Fat percent; it was observed that the average percentage of Solids Not Fat significantly decreased in mastitis milk samples as compared with milk from uninfected cows. Decrease in SNF in infected cow's milk depends on the destruction that occurs by invasion of pathogens to the mammary tissue causes decrease in synthetic activity of mammary gland. This finding is similar to study done by Hassan *et al*. 2009 [7].

Conclusion

Mastitis, an inflammation of the mammary gland in dairy animals, significantly impacts Tamil Nadu's dairy industry and the livelihoods of farmers due to economic losses and reduced milk production. In Tamil Nadu, the price of milk is determined by its fat and SNF. Studies reveal high incidence rates, particularly during monsoon seasons, and highlight the economic burden through treatment costs. Training programs focusing on clean milk production and mastitis management can help reduce the incidence of the disease. Implementing proper hygiene practices during milking and maintaining a clean environment for animals are crucial. Regular testing of milk samples and prompt treatment of affected animals can minimize economic losses. Providing financial assistance to farmers for treatment and implementing preventative measures can help alleviate the economic burden of farmers.

Conflict of Interest

Not available

Financial Support

Not available

Reference

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