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Effect of Non-Genetic Factors on Somatic Cell Count in Tharparkar Cows under Hot Arid Region of Thar Desert Area

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ABSTRACT

The study was conducted to determine the effect of non genetic factors on Sub Clinical Mastitis (SCM) and to investigate the relationships between these factors with Somatic cell count (SCC) in Tharparkar Cattle raised at Livestock Research Center, Chandan, Jaisalmer in Thar desert of Rajasthan, India. Quarter wise milk samples were collected and examined by somatic cell count to check the status of subclinical mastitis. Data were collected from the record register maintained at farm and data evaluated by Parity, Stage of Lactation and Season of calving by the SPSS packet program. On analysis of variance result revealed that the parity had highly significantly ($P<0.01$) effect on SCC. Higher incidence of SCM was in later parities in comparison to primiparous animals. No statistical difference was found between different stages of lactation. Season of calving had significant ($P<0.05$) effect on SCC. Lower incidence of SCM and SCC were revealed in summer and winter season of calving as compared to the autumn and rainy season of calving groups. So it can be concluded from the present study that the non genetic factors like parity, stage of lactation and season of calving have a significant effect on Milk SCC. Thus, dairy farmers are advised to spend more time on their herds and given extra care to their animals in later parity stage, early stage of lactation and in the autumn or rainy season of calving to prevent the infection of sub clinical mastitis.

Keywords: Somatic cell count, Subclinical mastitis, Parity, Stage of lactation, Season of calving

Subclinical mastitis is economically one of the most costly and menacing disease of dairy industry worldwide and stands as the major obstacle towards healthy milk production (Bharti *et al.*, 2015). Among the several barriers in achieving the milk production targets, subclinical mastitis (SCM) continues to remain as a most challenging impediment, as the infected udder quarters show 4-18 per cent less production (Neilson *et al.*, 2009).

Somatic Cell Count is a helpful predictor of intra mammary infection (IMI), and therefore, an important component of milk in assessment of aspects of quality, hygiene and mastitis control. Somatic cells are mainly milk-secreting epithelial cells that have been shed from the lining of the gland and white blood cells that have entered the mammary gland in response to injury or infection (Dairyman's digest, 2009).

Somatic cell count is influenced by several factors, including host and environmental factors. Housing and managemental practice are the major environmental factors while age, stage of lactation, parity and season of calving is the major host related factors. The most risk factors associated with management and the environment are addressed by introducing extra management during highest susceptibility, hygiene measures and selecting dairy cows, which are less susceptible to mastitis is also a control measure worthy of consideration. A number of studies have been done to investigate the relation of these non-genetic factors i.e. parity, stage of lactation, season, calving season etc. with occurrence of intra-mammary infection in exotic and cross bred cattle under different climatic conditions but information regarding Indigenous cattle breeds are scanty. So the present study

was conducted to determine the effect of parity, stage of lactation and season of calving on milk Somatic Cell Count in Tharparkar cattle.

MATERIALS AND METHODS

Location

The study was conducted at the Livestock Research Station, Chandan (RAJUVAS), cattle yard located in Jaisalmer city of Rajasthan, India. The altitude of Jaisalmer city is 238.21 meters above mean sea level, latitude and longitude position being 26° 54' 57N and 70° 54' 51E, respectively.

Animal

Out of total number of animals in milk total, 105 healthy lactating Tharparkar cows with no evidence of clinical mastitis were selected and the evaluation of udder and teat traits and the collection and analysis of milk samples were performed on the same day.

Collection of samples and diagnosis of Intra-mammary Infection

Representative milk samples were collected from all the four quarters of lactating cows. For this purpose, quarters were designated as Left Fore (LF), Left Hind (LH), Right Fore (RF) and Right Hind (RH). About 30 ml of milk was collected aseptically in the clean sampling bottles after discarding the first 2-3 streaks of fore milk. The collected samples were brought to the laboratory immediately for further analysis. Within 6 h of collection, the milk samples were spread on 2 microscope slide areas, which were 10X10 mm^2 in size subsequently. The slides were fixed with pouring of ethyl alcohol for 2 minutes and the prepared smears were stained with the modified Newman's Lampert stain, by keeping the prepared slide in the staining solution for 1 to 2 minutes. The smears were gently washed in tap water and dried. The dried stained smears were examined under the oil immersion lens of the microscope. Thirty different fields per smear were observed, and the average number of somatic cells per field was calculated. The average number of cells per field was then multiplied by the microscopic factor of the microscope, i.e. 393174 to obtain the number of somatic cells per ml of the milk. Due to SCC not displaying a normal distribution, data of SCC were log transformed to base 10.

Data Collection

Data were collected from the record register maintained at farm and data of SCC from all animals were classified according to parity, stage of lactation and season of calving. All these parameters were taken into consideration as for the factors influencing the occurrence of SCM and SCC.

Parity: All animals were classified under the different parities (viz., 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, 5^{th} and above) according to their lactation number.

Stage of lactation: The whole lactation was partitioned early stage of lactation (up to 90 days), mid stage of lactation (91 to 180 days) and late stage of lactation (181 days & above).

Season of calving: All the animals were classified in to four calving seasons on the basis of their date of calving. Cattle which calved during december to february fall under winter, march to may under summer season, june to august under rainy season and cows which calved during september to november month fall under autumn season of calving categories.

Statistical analysis

Obtained SCC values were transformed to $\log_{10}$SCC for normality and homogeneity of variance. In the study, parity, stage of lactation and season of calving were evaluated as independent variables. The data were examined by Analysis of Variance (ANOVA) and means were compared by Duncan's multiple range test. The model was as follows:

$$y_{ijklm} = \mu + a_i + b_j + c_k + d_{ijklm}$$

Where,

y_{ijklm} = Observation value for SCC
μ = Population mean
a_i = Effect of Parity (I = 1,2,3,4, 5 and above)
b_j = Effect of Stage of lactation (j =1,2,3)
c_k = Effect of Season of calving (k = Summer, Rainy, Winter and Autumn)
d_{ijklm} = The Random residual effect

All statistical analysis was performed using SPSS software statistical package (16.0).

RESULTS AND DISCUSSION

Results of SCC in milk samples of healthy cows are presented in Table 1. The overall animal wise and quarter wise prevalence on the basis of SCC was 52.38 (55/105) and 40.80% (162/397), respectively. The arithmetic mean ± SE of SCC (absolute and logarithmic) of animal wise milk samples were 220472 ± 37189.50 cells/ml of milk and 5.343 ± 0.037 respectively. Range of SCC varied from 39,370 cells/ml of milk in healthy quarter to 1916007 cells/ml of milk in severely infected quarters.

Table 1: Incidence, Mean ± SE values & range of somatic cell counts

Number of observations	Per cent Incidence of SCM	Mean ± SE (cells/ ml)	Mean ± SE (Log_{10}SCC)	Range (cells/ ml)
105	52.38	220472 ± 37189.50	5.343 ± 0.037	39370 - 1916007

SE=Standard error, SCC=Somatic cell count

Effect of Parity on SCC

After statical analysis results of the present study revealed that incidence of SCM increased with number of parity. The lowest incidence was observed in 1st parity (19.54 per cent), gradually increased and highest in >5th parity (70.00 per cent) in Tharparkar cows. Several workers reported similar findings that are enhancing milk production level and a rise in SCC with Increasing parity in cows and buffaloes (Sharma, 2007; Sharma and Prasad, 2002; Kavitha *et al.*, 2009; Saravanan *et al., 2015*).

The analysis of variance showed that the effect of parity on Log_{10}SCC was highly significant (P<0.01). Mean Log_{10}SCC of Individual parity was compared by Duncan's Multiple Range Test. The results of post hoc test revealed that the mean Log_{10}SCC of 1st, 2nd and 5th parity differed significantly (P<0.05) from each other. The difference between the means Log_{10}SCC of 3rd parity was non-significantly differ from 1st and 2nd parity group, whereas the means Log_{10}SCC of 4th parity was non-significantly differ from 2nd and 5th parity of animals.

Similar significant association of parity with log_{10}SCC were reported by Erden *et al.* (2010), Yu *et al.* (2011), Houda *et al.* (2012) and Saravanan *et al.* (2015) whereas Singh and Ludri, (2001), Ahn *et al.* (2006) and De *et al.* (2011) reported non-significant effect of parity on SCC.

The higher incidence of SCM and high SCC in later parity in comparison to primiparous animals may be due to the fact that constant exposure of animals to the pathogens and loosening of sphincters, help the easy entry of organism through streak canal which is responsible for higher rates of infection in multiparous animals in comparison to their younger counterparts. Further, animal's resistance to mastitis might also be lowered with the advancement of parity or age. Yu *et al.* (2011) reported that with the increase of parity, the ratio of macrophages (MAC) and polymorphonuclears (PMN) tended to be increased and suggested that progressive increase of SCC when parity increased. Heuven *et al.* (1988) claimed the increase of SCC over parities shows that older cows were more likely to suffer prolonged elevation of SCC or even prolonged udder damage.

Table 2: Mean ± SE of Log_{10}SCC in different non genetic factors in Tharparkar cows

Traits	Number of observations	Mean ± SE of Log_{10}SCC
Parity	**397**	**5.384±0.021**
1	87	$5.191±0.037^{a}$
2	152	$5.366±0.033^{b}$
3	87	$5.377±0.043^{ab}$
4	21	$5.570±0.080^{bc}$
5 and Above	50	$5.704±0.065^{c}$
Stage of Lactation	**397**	**5.384± 0.021**
Early stage	113	5.371±0.030
Mid stage	165	5.361±0.032
Late stage	119	5.428±0.036
Season of calving	**397**	**5.384±0.021**
Summer season	228	$5.342± 0.032^{a}$
Rainy season	49	$5.476±0.045^{ab}$
Autumn season	23	$5.597±0.053^{c}$
Winter season	97	$5.386±0.030^{b}$

Mean showing different superscripts in lower case letters in respective categories in a column differ significantly (p<0.05), SE=Standard error, SCC=Somatic cell count

Streak canal of the teats consists keratinized layer and accumulated cellular debris, which is wax like and having sebum like nature, consisting of long chain fatty acids, which provides bacteriostatic effects (Mostert *et al.*, 2001). The breakdown of such streak canal barrier with advancing lactation leads to increased frequency of infection with successive increase in parity. The incidence of SCM and SCC increased as the lactation progressed and it attained the highest proportion during the 5th and above lactation.

Table 3: Analysis of variance showing the effect of non genetic factors on SCC in Tharparkar cows

Source of variance	Degree of freedom	Sum Square	Mean Sum square	F – value
Parity	4	9.137	2.284	14.099**
Error (Parity)	392	63.515	0.162	
Stage of Lactation	2	.334	0.167	0.910
Error (Stage of Lactation)	394	72.319	0.184	
Season of Calving	3	1.870	0.623	3.461*
Error (Season of calving)	393	70.782	0.180	

SCC=Somatic cell count, ** Highly Significant (p<0.01), *Significant (p<0.05)

Effect of Stage of lactation on SCC

The prevalence of SCM in Tharparkar cows were 38.93, 38.78 and 45.38 per cent and mean ± SE values of Log_{10}SCC has been 5.371±0.030, 5.361±0.032 and 5.428±0.036 in early, mid and late stages of lactation, respectively. Results reported higher incidence of SCM and high SCC in early stage followed by slightly decrease in mid lactation stage and highest in late stage of lactation.

The analysis of variance revealed that the stage of lactation had a non significant effect on the Log_{10}SCC (Table 3). The Duncan multiple range test revealed that the difference between the mean Log_{10}SCC of early, mid and late stage of lactation were not differ significantly from each other.

Ceron- Munoz (2002), Ghosh *et al.* (2004), Ahn *et al.* (2006) and Sharma *et al.* (2007), found higher incidence of SCM and high SCC in early and late stage of lactation. Ceron-Munoz *et al.* (2002) reported that SCC in uninfected cows is high at freshening, lowest from peak to mid-lactation, and highest at drying off. Harmon (1994) suggested that a modest rise in the SCC of uninfected quarters at the end of lactation is in fact a dilution effect. Dahoo and Meek (1982) reported that the SCC increases with progressing lactation (late lactation) regardless of whether the cow is infected or not. Saravanan *et al.* (2015), Houda *et al.* (2012), De *et al.* (2011) and Wicks and leaver (2006) reported non-significant changes in SCC during different stages of lactation which support the results of the present study.

Effect of Season of calving on milk SCC

The per cent quarter-wise incidence of SCM was 37.72, 46.97, 69.57 and 38.15 per cent in summer, rainy, autumn and winter season of calving respectively. The mean (±SE) Log_{10}SCC in case of summer, rainy, autumn and winter season of calving was 5.342 ± 0.032, 5.476 ± 0.045, 5.597 ± 0.053 and 5.386 ± 0.030 respectively. The analysis of variance revealed that the season of calving has significant (P<0.05) effect on Log_{10}SCC. The mean Log_{10}SCC of winter, summer and autumn calving cows were significantly differ from each other, whereas mean Log_{10}SCC of rainy season calving was non-significantly differ from summer and winter calving cows but significantly differ from autumn season calving cows. Baul *et al.* (2011) and Wicks and Leaver (2006) supported the present findings and reported that the season of calving had a significant effect (P<0.01) on changes in the somatic cell count.

Lower incidence of SCM and SCC in summer and winter season of calving as compared to the autumn and rainy season of calving can be better explained by the adaptability of animals to the environment (Reis *et al.*, 2013). Tharparkar cows are native breed of Thar region which are more adoptable in hot and arid region. Environmental conditions of hot arid region are humid during the rainy and autumn season, which favor the growth of microorganism. Animals calved during autumn and rainy season are more susceptible to infection, having a greater number of somatic cells count in raw milk.

It can be concluded from the present study that the non-genetic factors, i.e. parity, season of calving and Stage of lactation have some degree of association with prevalence of subclinical mastitis. Thus, dairy farmers are advised

to spend more time on their herds and given extra care to their animals in later parity, first stage of lactation and in autumn or rainy season of calving which may help to reduce the incidence of mastitis in indigenous cattle.

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