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Chi square analysis of parity, period of calving, season of calving and lactation yield influencing mastitis incidence in *Bubalus bubalis*

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Abstract
The present study was conducted using 406 records for investigation of effect of parity, period of calving, season of calving and milk yield on incidence of mastitis in Murrah buffaloes raised at Livestock Research Center, National Dairy Research Institute, Karnal utilizing chi-square analysis in SPSS version 23. The parity and period of calving were found to have highly significant effect (p<0.01) on mastitis incidence while season of calving and level of lactation yield did not show significant effect in our study. Studying these factors as predisposing factors for mastitis occurrence in dairy animals is crucial for effectively managing dairy farms at farmers' as well as organized herds level.

Keywords: Parity, season, mastitis, chi square, murrah, calving

Introduction
Mastitis is regarded as the most common and serious disease affecting dairy livestock because it causes such substantial economic losses and has an immense impact on the global dairy sector by lowering milk output. Massive antibiotic use, poor milk quality that renders it unfit for human consumption, and a high culling rate are the end outcomes (Halasa *et al.,* 2007) [3]. Depending on the degree, type, duration, and underlying cause of the condition, mastitis can manifest in either clinical or subclinical forms. Clinical mastitis is the symptomatic form and is characterised by pathological changes that are visible in the glandular tissue of the udder as well as physical, chemical, and bacterial alterations in the milk, such as the presence of blood, water, flakes, and pus with clots. Somatic cell count rises with normal udder and milk appearance during subclinical mastitis. As a result, screening procedures like the California Mastitis Test, the detection of bacterial agents, and electrical conductivity can all be used to find it. According to Fagiolo and Lai (2007) [7], management practises, interactions between different microbial diseases, and host reactions in the udder all play a significant role in determining the occurrence of mastitis. According to Ndahetuye *et al.* (2019) [6], increasing parity and age both raised the incidence of subclinical mastitis. They linked it to the numerous times multiparous cows were exposed to mastitis pathogens while milking in an unhygienic environment, as well as to the ease with which the mammary gland may be infected due to ageing and deteriorating teat canal integrity. Although buffaloes have thicker streak canal epithelium than cattle, which makes them less susceptible to mastitis (Uppal *et al.,* 1994) [4], maternal mastitis causes a high mortality rate in the first three months of life in the calves, which further reduces buffalo productivity (Akhtar and Ali, 1994) [5]. The prevalence of clinical mastitis varies depending on the animal's physiological condition and, more importantly, the environment. The present study aimed to find effect of various non-genetic factors on clinical mastitis incidence using chi square analysis.

Materials and Methods
Murrah buffaloes (n=96) maintained during the 19 years period (2000–2018) in Livestock Research Centre of NDRI (National Dairy Research Institute) were investigated for clinical mastitis incidence. All the buffaloes were reared under loose housing (brick paved) having proper drainage system with an adequate slope. Each individual's mastitis incidence was recorded as one, and the recurrence of mastitis in same buffalo even during same lactation was counted as a fresh incidence. A total of 406 records were investigated to know effect of non-genetic factors on mastitis incidence in adult Murrah buffaloes using chi square analysis in

SPSS Statistics version 23.0. The parameters recorded include parity, period of calving, season of calving and lactation yield which were collected from health register and history sheets. The data classification for different non-genetic factors was done before going for analysis. The season of calving was divided into four classes *viz*. December–March (Winter), April–June (Summer), July–August (Rainy), September–November (Autumn); period of calving into five groups *viz*. 2000-2003, 2004-2007, 2008-2011, 2012-2015 and 2016-2020, parity was classified into six classes (1st, 2nd, 3rd, 4th, 5th and >5), 3 classes of first lactation yield (kg) to classify them as low, medium and high producers *viz*. low (<1500 kg), medium (1500-2500 kg) and high (>2500 kg). To assess the effect of these non-genetic parameters on mastitis incidence, Chi-square (χ^2) test of independence of attributes (Snedecor and Cochran, 1994) [11] was utilized.

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where O_i = observed value and E_i = expected value.

Results and Discussion

Chi square analysis revealed highly significant effect (p<0.01) of parity and period of calving on incidence of mastitis while season of calving and level of lactation yield did not show significant effect in our study. Similar results were obtained by Manoj *et al.* (2015) [2], Sharma *et al.* (2016) [9] who found similar results as parity to be highly significant (p<0.01) on somatic cell count indicative of subclinical mastitis. Table 1 shows that the incidence was maximum during second parity (7.7%) followed by third parity (5.7%), first parity (4.4%), fifth parity (4.0%) and minimum during sixth and above (3.5%). This was in agreement with the results obtained by Singh *et al.* (2021) [8] where they reported highest prevalence of mastitis in 2nd parity and lowest in 7th and above parity. The higher incidence during higher parity number must be due to widening of teat canal with advancement of age along with increasing parity which makes the lactating buffaloes more prone to mastitis. Several workers reported different pattern of high incidence during different parities *viz*. Sinha *et al.* (2023) [10] found highest mastitis incidence during third parity whereas Mourya *et al.* (2020) [13] and Sinha *et al.* (2019) [12] reported highest prevalence of subclinical mastitis in fourth parity. In contrast to the present study, Abo-Gamil *et al.* (2021) [15] did not found significant effect of parity on incidence of mastitis.

The period of calving (2004-2007) *viz*. 14.7% showed maximum mastitis incidence followed by (2016-2020 *viz*. 5.4%), (2012-2015 *viz*. 3.8%), (2008-2011 *viz*. 2.1%) and minimum during (2000-2003 *viz*. 1.6%). The evidence of highest incidence of mastitis during (2004-2007) period of calving might be reflecting imbalance in managemental conditions affecting hygiene and germ-free environment around these animals posing greater threat to them for mastitis incidence. Manoj *et al.* (2015) [2], Chand *et al.* (1995) [18] also found significant effect of period of calving on mastitis incidence. In contrast, Taraphder *et al.* (2006) [17] did not found significant effect of period of calving on mastitis incidence.

Rashid *et al.* (2017) [1] and Chand *et al.* (1995) [18] did not found significant effect of season calving on mastitis incidence which is in agreement with the results obtained in our study. Our results indicated that autumn season had maximum mastitis incidence (10.5%) followed by winter (8.6%), summer (4.6%) and rainy (4.0%). In contrast, many studies like Elghafghuf *et al.* (2014) [16], Abo-Gamil *et al.* (2021) [15], Taraphder *et al.* (2006) [17] found season of calving significantly affecting mastitis incidence but they reported non-significant effect of 305 days milk yield on mastitis incidence which is in agreement with the results obtained in our study. In the present study, the medium level milk producer buffaloes had maximum mastitis incidence *viz*. 18.7% followed by low producers (6.4%) and high producers *viz*. 3.3%. Such contrasting results might be due to lesser number of animals in three levels of milk production which might have led to difficulty in attaining the significance threshold during chi square analysis. In contrast to our study, several studies have reported significant effect of milk yield on mastitis incidence including Sinha *et al.* (2019) [12], Jingar *et al.* (2014) [14], Manoj *et al.* (2015) [2] who have found significant effect of level of milk production on the incidence of clinical mastitis in cattle. The high yielders were found to be affected most as compared to low and medium milk producers.

Table 1: Impact of non-genetic parameters on mastitis incidence using chi square analysis

Non-genetic factors	Classification	Df	Calculated chi square (χ^2)	P value at calculated χ^2	Healthy (Control)	Mastitis affected (Case)	% mastitis incidence of total
Parity	1st	5	14.919	0.010*	78	18	4.4
	2nd				70	31	7.7
	3rd				67	23	5.7
	4th				38	15	3.7
	5th				18	16	4.0
	>6th				17	14	3.5
Season of calving	Dec to Mar	3	2.273	0.522NS	69	32	8.6
	Apr to Jun				50	17	4.6
	Jul to Aug				54	15	4.0
	Sept to Nov				97	39	10.5
Period of calving	2000-2003	4	15.217	0.004*	57	6	1.6
	2004-2007				102	55	14.7
	2008-2011				27	8	2.1
	2012-2015				32	14	3.8
	2016-2020				52	20	5.4
Milk production	<1500 Kg	2	0.709	0.714NS	65	25	6.4
	1500-2500 Kg				173	73	18.7
	>2500 Kg				41	13	3.3

*significant at 1% level (p<0.01); NS non-significant

Conclusion

Mastitis being a multi-factorial disease of dairy animals, still studying impact of various environmental factors paves a way to better execute the management and maintenance of hygienic conditions at dairy farms and framers' place as well. Parity and period of calving were found to be affecting occurrence of mastitis in the present study highly significantly which indicated that as parity as well as age advances, the lactating animals become more prone to such incidences owing to greater widened teat canals providing easy access to bacteria causing mastitis into the streak canal and thus into the udder. Therefore, effective management during later parities is much needed to prevent incidence of mastitis in dairy farms and cleanliness should be taken care of such as properly cleaning udder before and after milking with Potassium Permanganate water to control mastitis occurrence.

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