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Shashikant
M.V.Sc Scholar, Department of Animal Genetics and Breeding, CVAS Navania, Vallabhnagar, Udaipur, Rajasthan, India

RK Nagda
Professor & Head, Department of Animal Genetics and Breeding, CVAS Navania, Vallabhnagar, Udaipur, Rajasthan, India

Vishnu Kumar
Assistant Professor, Department of Animal Genetics and Breeding, CVAS Navania, Vallabhnagar, Udaipur, Rajasthan, India

VK Meena
Ph.D. Scholar, Department of Veterinary Medicine, CVAS Navania, Vallabhnagar, Udaipur, Rajasthan, India

Corresponding Author
Shashikant
M.V.Sc Scholar, Department of Animal Genetics and Breeding, CVAS Navania, Vallabhnagar, Udaipur, Rajasthan, India

Effect of non-genetic factors on calving interval in Surti buffaloes

Shashikant, RK Nagda, Vishnu Kumar and VK Meena

Abstract
The records of 123 Surti buffaloes with 240 lactations sired by 44 sires maintained at Livestock Research Station, Navania, Vallabhnagar (Udaipur) born from 2006 to 2020 were collected to estimate the effect of non-genetic factors *viz.,* period, season and parity on calving interval. The average calving interval in Surti buffaloes was found to be 501.06±10.90 days. The analysis of variance revealed the highly significant effect of period and season of calving but a non-significant effect of parity on calving interval. Calving interval showed declined trend from 2006-2010 (Period 1st) to 2016-2020 (Period 3rd) indicates improvement of breeding and management practices over the period in the farm.

Keywords: calving interval, period, season, parity, non-genetic factor

Introduction
India is an agricultural country and 60-70 per cent population belongs to the agricultural and livestock sector. The livestock sector plays an important role in the Indian economy in terms of income, employment and foreign exchange and also provides a regular supply of food and draft power. India possesses about 303.34 million bovines (192.49 million cattle and 109.85 million buffaloes) which contribute about 27.2% and 53% of the world population, respectively. India is the largest milk producer in the world with the increased production of 55.6 million tonnes (1991-92) to 198.4 million tonnes (2019-20) (NDDB, 2020) [13]. The per capita availability of milk in India was 394 grams/day in 2019. The total milk production of buffaloes was 91.82 million tonnes, which was 49 per cent of total milk production of India (DAHD, 2020) [2].

Buffalo is a triple purpose animal, being suitable for milk, meat and draught. Surti buffalo is a reputed breed of buffalo with its origin in Charotar region of Gujrat. Surti is a medium-sized buffalo and well adapted to its native breeding tract. Calving interval is one of the important traits in dairy industry. Many factors such as feed and fodder availability and managemental conditions along with seasonal variation affect it. Thus, segregation of factors like season of calving, period of calving and parity and their effect on trait like calving interval will enable the breeder in assessing the effectiveness of selection program and managemental conditions over time. This will help in designing more appropriate breeding strategies to maximize genetic gain and also suggest amendments in managemental standards if desired. Therefore, the present investigation was planned with a view to study the non-genetic factors affecting calving interval in Surti buffaloes.

Materials and Methods
In order to achieve the objective, the present data were collected from history cum pedigree sheets maintained at Livestock Research Station, Navania, Vallabhnagar (Udaipur) over a period of 15 years from 2006 to 2020. The records with abortion, stillbirth or any other pathological causes affecting production and reproduction traits of the animals considered as abnormalities were not be included in this proposed study. The duration of 2006 to 2020 was divided into 3 periods: Period 1st (2006-2010), Period 2nd (2011-2015) and Period 3rd (2016-2020). The three seasons were delineated as rainy (July to October), winter (November to February) and summer (March to June) on the basis of geo-climatic conditions prevailing in the region.

Statistical methods
For analysis Harvey (1990) [4] software was used following LSMLMW mix model:

$$Y_{ijkl} = \mu + A_i + B_j + C_k + e_{ijkl}$$

Where,
Y_{ijkl}= is the l[th] observation pertaining to the trait under focus in i[th] season, j[th] period and k[th] parity.
μ= population mean
A_i= fixed effect of i[th] season of calving where i= 1, 2 and 3
B_j= fixed effect of j[th] period of calving where j= 1, 2 and 3
C_k= fixed effect of k[th] parity where k= 1, 2, 3, 4, 5 and above
e_{ijkl}= random errors which is assumed to be normally independently distributed with zero mean and constant variance (NID 0, σ^2).
Duncan's Multiple Range Test (DMRT) as modified by Kramer (1956) [8] were used for testing differences among least-squares means

$$R_p = r_{\alpha\rho\gamma}\sqrt{\frac{MSE}{n}}$$

Where,
R_p = Least significant range for subsets of p sample mean.
$r_{\alpha\rho\gamma}$ = Duncan's Significant Range Value with parameter p (range-value), γ (MSE degree of freedom) and α (Significance level).
n = Sample size for each treatment.

Results and Discussions

The overall least-square mean for calving interval was found to be 501.06±10.90 days as presented in Table 1. The estimated calving interval of the present study was similar with the results obtained by Nagda (2005) [12], Jatolia (2008) [6] and Kumar (2018) [9] in Surti buffaloes. Whereas, the average estimate of calving interval was higher than those reported by Mehta (1990) [11], Tailor (1995) [20], Charlini and Sinniah (2015) [1], Rathod *et al.* (2018) [19] and Dangar *et al.* (2019) [3] in Surti buffaloes. However, the average estimate of calving interval was lower than those reported by Mathur and Nagpal (1992) [10] in Surti buffaloes. The differences in calving interval due to parity were found to be statically non-significant in present study (Table 2). Similar finding was reported by Jain and Tailor (1994) [5], Patel and Tripathi (1998) [15] and Vyas *et al.* (2021) [21] in Surti buffaloes.

Effect of Season of Calving

Season of calving had a significant (P≤0.01) effect on calving interval. The rainy and winter season calved animals have longer calving intervals as compare to summer calved animals (Table 1). Similar results were reported by Paliwal (1994) [14], Patel (1994) [16], Tailor (1995) [20], Pathodiya (1997) [18], Pathodiya *et al.* (1998) [17], Kothari (2004) [7], Nagda (2005) [12] and Vyas *et al.* (2021) [21] in Surti buffaloes.

Effect of Period of calving

Period of calving had a significant (P≤0.01) effect on calving interval. Period 3rd had shortest calving interval as compare to 1st and 2nd period. Similar results were reported by Patel (1994) [16], Tailor (1995) [20], Pathodiya (1997) [18], Pathodiya *et al.* (1998) [17], Kothari (2004) [7], Nagda (2005) [12] and Vyas *et al.* (2021) [21] in Surti buffaloes.

Effect of Parity

Parity had non-significant effect on calving interval. Similar results were reported by Jain and Tailor (1994) [5], Patel and Tripathi (1998) [15] and Vyas *et al.* (2021) [21] in Surti buffaloes.

Conclusion

Significant decline in calving interval during period 1st and 2nd (2006-2015) and the review better managemental farm practices followed during these periods might have resulted lowest calving interval during period 3rd (2016-2020).

Table 1: Period, Season and Parity wise least-squares mean and standard error for calving interval in Surti buffaloes.

Factors	N	Mean±SE (in days)
Overall	240	501.06±10.90
Period of calving		
j_1 (2006-2010)	52	574.41±22.42[c]
j_2 (2011-2015)	106	483.27±13.57[b]
j_3 (2016-2020)	82	445.50±18.18[a]
Season of calving		
k_1 (July to Oct.)	83	522.55±14.40[b]
k_2 (Nov. to Feb.)	41	542.74±18.98[b]
k_3 (March to June)	116	437.89±12.79[a]
Parity		
l_1 (First)	77	505.19±15.98
l_2 (Second)	60	496.75±15.45
l_3 (Third)	45	510.10±17.21
l_4 (Four)	26	494.34±23.23
l_5 (Fifth and above)	32	498.92±22.20

Table 2: Analysis of variance (ANOVA) for various factors affecting calving interval in Surti buffaloes

Calving interval in days		
Source	**DF**	**MS**
Period of calving	2	85092.06**
Season of calving	2	206888.12**
Parity of animal	4	1642.73
Error	231	10247.81

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