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Effect of non-genetic factors on lifetime performance attributes of Murrah buffaloes

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Abstract
The success of a dairy industry in India is much dependent on buffaloes and the level of lifetime performance traits. These performance traits depend on several genetic and non-genetic factors which introduce biasness in the estimation of genetic value of performance traits. In the absence of accurate phenotypic value of milk production traits, it becomes difficult to estimate genetic parameters of the traits which determine the optimum selection criterion for planned improvement programme of the animals. Also, genetic evaluation of animals requires the assumption that phenotypic measurements are adjusted for non-genetic factors that can affect production efficiency and reproduction traits (ex. Year/period of calving, season of calving, calving order, age at calving, length of lactation) to obtain accurate estimates of the genetic parameters and the breeding value of animals. This research paper aimed to analyse the effect of various non genetic factors on Longeiveity (LV), Milk yield per day of productive life(MY/PL) and Milk yield per day of longeveity (MY/LV). The data on performance records of 2959 Murrah buffaloes, progeny of 220 sires were collected from the pedigree, breeding and performance records from 1992-2015 maintained at Buffalo Research Center (BRC), LUVAS, Hisar and Central Institute for Research on Buffaloes, Hisar. The overall least-squares means for LV, MY/PL and MY/LV were 2738.80±32.07, 4.38±0.08 and 2.03±0.04, respectively. The period of calving had highly significant effect on LV and MY/PL. The LV showed an decreasing trend across the periods. Effect of season of calving was non-significant on all the longevity traits. Regression of age at first calving (linear) had significant effect on LV and MY/LV only. Effect of various non genetic factors help us to provide a deep role of management strategies in improvement of lifetime performance traits in dairy animals and it may also lead to a better progressive strategy for increasing most probable producing ability also of the Murrah buffaloes.

Keywords: Longeiveity, milk yield per day of productive life, milk yield per day of longeveity, Murrah

Introduction
The dairy industry in India is heavily reliant on buffaloes, particularly the Murrah breed, due to their significant contribution to milk production. Murrah breed of buffalo is considered to be the best milk-cum-meat breed. The home tract of breed is around the Southern part of Haryana comprising the districts of Rohtak, Jind, Hisar, Gurgaon and Delhi. Home tract has relatively hot and dry climate. In any breeding programme it is important to bring about the improvement in production performance traits so as to select the best performing individuals. These production performance traits were influenced by several non-genetic factors like parity, period of calving, season of calving which have significant effect on full expression of these production traits. Difference in season weather summer or winter, availability of fodder in different climatic areas and also different managemental activities of farm manager largely affect the production traits. Therefore, the present investigation was conducted to study the effect various non genetic factors on production performance traits in Murrah buffaloes. The success of this industry is largely determined by the lifetime performance traits of these animals. Accurate phenotypic values of milk production traits are essential for estimating genetic parameters, which are crucial for developing optimal selection criteria in planned improvement programs. Additionally, the genetic evaluation of animals necessitates adjusting phenotypic measurements for non-genetic factors to ensure precise estimates of genetic parameters and breeding values.

This study aims to analyze the effect of various non-genetic factors Longeiveity(LV), Milk yield per day of productive life(MY/PL) and Milk yield per day of longeveity(MY/LV) in Murrah buffaloes.

Materials and Methods

Classification of data: The data on longevity traits was classified according to parity, period of calving and season of calving.

Period of calving: Due to the changes in feeding and management practices over the particular time interval, there might be variation in the expression of different traits of animals in different periods of calving in the farm(s). Assuming that there is not much variation in adjacent years, entire period of twenty-four years will be divided into 6 periods, each consisting of 4 consecutive years:

Period	Duration (year)
Period (P_1)	1992-95
Period (P_2)	1996-99
Period (P_3)	2000-03
Period (P_4)	2004-07
Period (P_5)	2008-11
Period (P_6)	2012-15

Season of calving: Season is an environmental factor that may influence the expression of performance traits in buffaloes because of wide variation of climatic condition throughout the year. Each year will be divided into four seasons according to the ambient temperature and relative humidity:

Seasons	Months
Summer	S_1 (April to June)
Rainy	S_2 (July to September)
Autumn	S_3 (October to November)
Winter	S_4 (December to March)

Statistical analysis

In order to overcome non-orthogonality of the data due to unequal subclass frequencies, least squares and maximum likelihood computer program of Harvey (1990) using Henderson method 111 (Handerson, 1973) will be utilized to estimate the effect of various tangible factors on various traits under study. The following mathematical model will be used to explain the underlying biology of the traits included in the study.

$$Y_{ijklmn} = \mu + s_i + h_j + c_k + rl + b_l (X_{ijklmn} - \bar{X}) + b_2 (X_{ijklmn} - \bar{X})^2 + e_{ijklmn}$$

Where

Y_{ijklmn}	=	is the n^{th} record of individual of the i^{th} sire calved at j^{th} farm, k^{th} period, l^{th} season and m^{th} parity
μ	=	is the overall population mean
s_i	=	is the random effect of i^{th} sire
h_j	=	is the fixed effect of j^{th} farm
p_k c_l r_m	=	is the fixed effect of k^{th} period of calving is the fixed effect of l^{th} season of calving is fixed effect of m^{th} parity
b_1 and b_2	=	are linear and quadratic partial regression coefficients of age at first calving on the traits, respectively.
X_{ijklmn}	=	is the age at first calving.
$\bar{X}$	=	is the mean of age at first calving.
e_{ijklmn}	=	is the random error associated with each observation and assumed to be normally and independently distributed with mean zero and variance σ^2_e.

Results and Discussion

Least squares means and factors affecting different longevity traits

The analysis of variance and least-squares means for longevity traits are presented in the Tables 1 and 2, respectively

Longevity (LV)

Longevity is one among the lifetime production traits and higher longevity is one of the indications of fit and healthy herd. A longer mean longevity increases profitability, because it decreases replacement costs and increases the proportion of the most productive mature age groups in the herd. The average longevity (2738.80± 32.07 days) observed in Murrah buffaloes in the current study was comparable to the values reported earlier for Murrah buffaloes. However, higher values for LV were reported by Dev (2015) [3] and Thiruvenkadan *et al.* (2015) [12] in Murrah buffaloes

(a) Farm: The analysis of variance revealed non-significant effect of farm on LV. The longevity was highest on farm 1 (2755.16±49.19 days) as compared to farm 2 (2722.45±44.04 days). The longevity was highest on farm 1 as compared to farm 2. Whereas, Bashir, *et al.* (2007) [1] reported significant effect of farm on LV.

(b) Effect of period of calving: The analysis of variance revealed highly significant ($p<0.01$) effect of period of calving on LV. The longevity was highest (3134.64±167.28 days) in period 1992-95 and lowest (2307.25±119.66 days) in period 2012-15. The longevity showed a decreasing trend across the periods. The longevity showed a decreasing trend across the periods. Dutt and Taneja (1994) [5] reported significant effect of period of calving on LV. However, Dev *et al.* (2016) [4] reported that effect of period of calving was statistically non-significant on LV.

(c) Effect of season of calving: The effect of season of calving on LV was non-significant. The longevity was highest (2761.69±59.65 days) in summer calvers and lowest (2712.47±47.48 days) in rainy calvers. The longevity was highest in summer calvers and lowest in rainy calvers. Similar results were reported by Dutt *et al.* (2001) [6] and Dev *et al.* (2016) [4] in Murrah buffaloes.

(d) Regression effect of age at first calving: Effect of age at first calving (linear as well as quadratic) was found to be non-significant on LV. The significant influence of age at first calving on the variation of longevity was reported by Thiruvenkandan *et al.* (2015) in Murrah buffaloes. However, Gowane and Tomar (2007) [7] reported non-significant effect of age at first calving on this trait.

2. Milk yield per day of productive life (MY/PL)

The overall least-squares mean for MY/PL was estimated as 4.38±0.08 kg/days. The results were comparable with the findings of Rao and Rao, 1996 [10]; Kumar *et al.*, 2006 [8]. However, Chander (2002) [2] and Dev *et al.* (2016) [4] reported higher values for MY/PL in Murrah buffaloes. Results reported by Thiruvenkadan *et al.* (2015) [12] was on lower side of the present findings.

(a) Farm: The analysis of variance revealed non-significant effect of farm on MY/PL. The milk yield per day of productive life was highest on farm 1 (4.73±0.12 kg/days) as compared to farm 2 (4.02±0.11 kg/days).

(b) Effect of period of calving: The analysis of variance revealed highly significant (p<0.01) effect of period of calving on MY/PL. The MY/PL was highest (4.86±0.19 kg/days) in period 2004-07 and lowest (4.01±0.19 kg/days) in period 2000-03. similar results were reported by Dev *et al.* (2016) [4] in Murrah buffaloes.

(c) Effect of season of calving: The effect of season of calving on MY/PL was non-significant. The MY/PL was highest (4.50±0.14 kg/days) in winter calvers and lowest (4.20±0.15 kg/days) in summer calvers. The MY/PL was highest in winter calvers and lowest in summer calvers. The results reported by Dutt *et al.* (2001) [6] and Dev *et al.* (2016) [4] in Murrah buffaloes were in accordance with the present findings.

(d) Regression effect of age at first calving: Effect of age at first calving was found to be non-significant on MY/PL. Thiruvenkadan *et al*. (2015) [12] reported non-significant effect of AFC on MY/PL. The regression coefficient (0.0003±0.0003) of AFC on MY/PL indicated that with one day increase in AFC, there will be corresponding increase in 0.00001kg/day in MY/PL.

3. Milk yield per day of Longevity (MY/LV)

The overall least-squares mean for MY/LV was estimated as 2.03±0.04 kg/days. Kuralkar and Raheja (1997) [9] and Dutt *et al.* (2001) [6] reported values comparable with the present findings. However, Thiruvenkadan *et al.* (2015) [12] reported lower value for MY/LV in Murrah buffaloes

(a) Farm: The analysis of variance revealed significant (<0.05) effect of farm on MY/LV. The milk yield per day of longevity was highest on farm 1 (2.21±0.07 kg/days) as compared to farm 2 (1.86±0.06 kg/days).

(b) Effect of period of calving: The analysis of variance revealed non-significant effect of period of calving on MY/LV. The MY/LV was highest (2.26±0.22 kg/days) in period 19920-95 and lowest (1.68±0.16 kg/days) in period 2012-15. The MY/LV showed a decreasing trend across the periods. Dutt *et al.* (2001) [6] and Dev *et al.* (2016) [4] findings were in consonance with the present findings.

(c) Effect of season of calving: The effect of season of calving on MY/LV was non-significant. The MY/LV was highest (2.06±0.07 kg/days) in autumn calvers and lowest (1.98±0.07 kg/days) in winter calvers. Non-significant effect of season of calving on MY/LV reported under the present study is in congruence with the findings of Dutt *et al.* (2001) [6] and Dev *et al.* (2016) [4] in Murrah buffaloes.

(d) Regression effect of age at first calving: Effect of age at first calving (linear) was found to be highly significant (<0.01) on MY/LV. Whereas, effect of age at first calving (quadratic) was non-significant**.** Thiruvenkadan *et al.* (2015) [12] reported highly significant (p<0.01) effect on milk yield per day of longevity. The regression coefficient (-0.0006±0.00) of AFC on MY/LV indicated that with one day increase in AFC there would be corresponding decrease in MY/LV by 0.0003 kg/day.

Table 1: Least squares analysis of variance for different Longevity traits

Source of variation	d.f.	Mean squares		
		LV	MY/PL	MY/LV
Sire	149	515250.26	3.64	1.14
Farm	1	109692.02	6.79	5.35 *
Period	5	2952569.21**	10.43**	0.80
Season	3	85590.12	3.40	0.27
Regression linear	1	25159223.41**	2.90	11.03**
Regression quadratic	1	156595.13	6.29	0.79
Remainder	807	472163.32	2.81	0.87

* p<0.05 and ** p<0.01

Table 2: Least- squares means and their standard errors for different Longevity traits

Source of variation	Obs.	LV (Days)	MY/PL (Kg/ Days)	MY/LV (Kg/ Days)
Overall mean	968	2738.80 ±32.07	4.38± 0.08	2.03± 0.04
Farm F1	400	2755.16^{b}±49.19	4.73^{a}±0.12	2.21^{a}±0.07
F2	568	2722.45^{a}±44.04	4.02^{b}±0.11	1.86^{b}±0.06
Periods: P_1(1992-95)	67	3134.64^{a}±16.28	4.20^{d}±0.41	2.26^{b}±0.22
P_2(1996-99)	176	3032.53^{b}±95.56	4.37^{c}±0.23	2.21^{a}±0.13
P_3(2000-03)	229	2919.01^{b}±77.83	4.01^{c}±0.19	2.02^{ab}±0.10
P_4(2004-07)	222	2538.71^{c}±79.46	4.86^{b}±0.19	2.10^{ab}±0.11
P_5(2008-11)	202	2500.68^{c}±85.52	4.50^{b}±0.21	1.81^{ab}±0.11
P_6(2012-15)	72	2307.25^{d}±11.66	4.60^{a}±0.29	1.68^{ab}±0.16
Seasons: Summer	193	2761.69^{b}±59.65	4.20^{a}±0.15	2.05^{a}±0.08
Rainy	350	2712.47^{ab}±47.48	4.37^{ab}±0.12	2.05^{b}±0.06
Autumn	209	2743.60^{a}±56.37	4.43^{bc}±0.14	2.06^{ab}±0.07
Winter	216	2737.45^{ab}±55.68	4.50^{c}±0.14	1.98^{b}±0.07
Regressions AFC(Lin)		0.93±0.12	0.0003±0.0003	-0.0006±0.00
AFC (Quad.)		-0.0001±0.003	00	00

Means superscripted by different letters differ significantly among themselves

Conclusion

This research demonstrates that non-genetic factors, especially the farm and period of calving, significantly influence the lifetime performance traits of Murrah buffaloes. Understanding these effects can help in devising better management strategies to improve the productivity and longevity of dairy animals. Future research should focus on integrating genetic and non-genetic factors to develop comprehensive breeding programs that enhance the overall performance of Murrah buffaloes in the dairy industry.

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