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Effect of Non-genetic Factors on Test Day Milk Yield and First Lactation 305 Day Milk Yield in Jaffarabadi Buffaloes

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ABSTRACT

The study was conducted on data of first lactation traits of 213 Jaffarabadi buffaloes spread over a period of 24 years (1991-2014) collected from the history -cum-pedigree registers maintained at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh. Least squares maximum likelihood program was used to estimate non-genetic parameters affecting monthly test day yields and First lactation 305 day milk yield. The overall least squares mean for First lactation 305 day milk yield was 1477.33 ± 64.91 litre and was not found to be influenced by season of calving, period of calving and age at first calving. The overall least squares means for all 11 individual monthly test day yields varied from 2.76 ± 0.21 litre (1st test day) to 5.98 ± 0.29 litre (5th test day). The season of calving had significant effect ($p<0.05$) on milk yield on 3rd and 9th test day. Effect of period of calving was highly significant ($p<0.01$) on 2nd test day and significant ($p<0.05$) on 3rd test day. It was revealed that 8th & 9th test day showed highly significant ($p<0.01$) and significant ($p<0.05$) difference in test day milk yield due to age at first calving, respectively. All these non-genetic factors markedly affected the rising phase and declining phase of the first lactation over a period of time in the population due to change in climatic conditions and population structure. Hence, non-genetic factors were important to adjust some of the test day yields.

Keywords: First lactation 305 day milk yield, Jaffarabadi buffalo, non-genetic factors, test day milk yield

India is the treasure house of world's best buffalo germplasm with the population of about 108.7 million in 2012, which was about 57.3 percent of total buffalo population of the world (19th Livestock census, 2012). India has continued to be the largest milk producing country in 2014-15 with an anticipated milk production of 146.3 million tonnes. The country's share in world milk production stands at 18.5 percent and buffaloes contribute 51 percent of total milk yield of the country, even though they are less in number than cattle (DAHDF, 2016). About 63 % of the world's buffalo milk and 95% of buffalo milk in Asia is contributed by Indian buffaloes (FAO, 2012). Gujarat owns 10.38 million buffaloes, which contribute around 9.55 percent of total buffalo population of the country. Gujarat has 1.47 million buffaloes which are classified as Jaffarabadi breed, against (1.80 million) total population of Jaffarabadi buffaloes in the country (DAHDF, 2013).

Jaffarabadi is considered to be one of the best dairy buffalo breed in India. The native breeding tract of Jaffarabadi buffalo is Saurashtra region of Gujarat *viz.* Junagadh, Bhavanagar, Jamnagar, Amreli, Gir Somnath, Rajkot and Morbi districts as well as some part of Surendranagar district. They are massive and the heaviest riverine buffalo. They are good milker and thrive well on natural grazing due to their greater feed conversion efficiency.

Milk Yield is the most important economic trait determining economic returns to the dairy farmers and is influenced by several factors. When the genetic component of variance is low for a trait, it shows low heritability and the environment has the greatest influence on that trait. Non-genetic factors tend to suppress or inhibit the expressivity of the true genetic ability of the animals in various ratios according to climatic conditions. Hence, to find out the true genetic ability of the animals it is essential to estimate the contribution of environmental factors in milk production in the model.

The productivity of the buffaloes could be enhanced through various genetic, management and nutritional interventions. Knowledge of the various climatic factors affecting the production performance of these animals shall go a long way in improving the overall productivity of the animals and shall result in better genetic gain. Hence, the present investigation was carried out to know the effect of various Non-genetic factors on Monthly Test Day Milk Yield (MTDMY) and first lactation 305 day milk yields Milk Yield (FL305DMY) in Jaffarabadi buffaloes.

MATERIALS AND METHODS

Source of data

The data on first lactation traits of 213 Jaffarabadi buffaloes spread over a period of 24 years (1991-2014) were collected from the history-cum-pedigree registers of Jaffarabadi buffaloes maintained at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh.

General Management

The animals were fed good quality chaffed green fodder, hay and dry fodder *ad lib*. The animals were supplemented with mineral mixture to meet the dietary requirements. Concentrate were provided to buffaloes as per their milk production. The animals were stall-fed. Loose housing system had been followed to maintain the buffaloes in the herd. In order to ensure good health of the animals, all types of veterinary aids, prophylactic and sanitary measures were taken care of for all buffaloes throughout the year. All the females were bred using Artificial insemination.

Data collection and standardization

A total of 11 individual monthly milk yield records with an interval of 30 days (i.e. 4th day, 34th day, 64th day, 94th day, 124th day, 154th day, 184th day, 204th day, 244th day, 274th day and 304th day of lactation) for each animal were collected from daily milk yield register of Jaffarabadi buffaloes. The traits considered were MTDMY and FL305DMY. Jaffarabadi buffaloes were milked twice a day and daily milk yield was calculated by adding the milk yield obtained in a particular day. Standard lactation milk yield was calculated by adding daily milk yield till 305th days of lactation. Colostrum yield for the first three days after calving was not added. The records of the animals with only known pedigree and normal lactation were considered for this study. Culling in the middle of lactation, abortion, still-birth or any other pathological causes affecting the lactation yield were considered as abnormalities and thus, such records were not taken for the study. The records of animals with lactation length lesser than 120 days were not considered for study. To ensure the normal distribution, the outliers were removed and data within the range of Mean ± 2SD were only considered for the present study.

Classification of data

The data were classified according to the season of calving, period of calving and age at first calving. The years were classified into 5 periods of 5 consecutive year duration except the last period which was of 4 years (1991 – 1995, 1996 – 2000, 2001 – 2005, 2006 – 2010 and 2011 – 2014). Each year was divided into five seasons viz. summer (April - June), rainy (July - September), autumn (October - November), winter (December - January) and spring (February - March). The age at first calving was proposed to be classified into 7 age groups as less than 1300 days, 1301 – 1500, 1501 – 1700, 1701 – 1900, 1901 – 2100, 2101 – 2300 and more than 2300 days.

Statistical analysis

The data were analysed to study the effect of non-genetic factors (season, period and age at first calving) on all 11 MTDMY records and FL305DMY. Statistical analysis was carried out using least squares and maximum likelihood analysis method for non-orthogonal data as described by Harvey (Harvey, 1987) using following model.

$$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl}$$

Where,

Y_{ijkl} = Observation on the l^{th} individual in i^{th} season, j^{th} period and k^{th} age group

μ = Overall population mean

a_i = Effect of i^{th} season of calving

b_j = Effect of j^{th} period of calving

c_k = Effect of k^{th} age group of first calving

e_{ijkl} = Random error, NID (0)

Duncan's multiple range test as modified by Kramer (1957) was used for testing significant differences among least squares means.

RESULTS AND DISCUSSION

The overall least squares mean for all 11 monthly test day milk yields (MTDMY) and first lactation 305 day or less milk yield (FL305DMY) in Jaffarabadi buffaloes are presented in Table 2.

First lactation 305 day or less milk Yield

The least squares mean of FL305DMY was estimated as 1477.33 ± 64.91 litre in the present study, which were in consonance with those reported by Jain and Taneja (1982) and Suresh *et al.* (2004) in Murrah buffalo. However, it was found lower than those reported by Shukla and Gajbhiye (1986), Dutta and Tajne (1998), Dutta *et al.* (2011) in Jaffarabadi buffalo, Jamuna *et al.* (2015a) and Kumar *et al.* (2015) in Murrah buffalo and Khan *et al.* (2012) in Nili-Ravi buffalo. While present finding were higher than that reported by Gajbhiye *et al.* (2007) in Jaffarabadi buffalo; Ahmad *et al.* (2013) in Nili-Ravi buffalo and Tailor and Singh (2014) in Surti buffalo.

The least squares mean estimated in present study showed that performance of FL305DMY in Jaffarabadi buffalo was in the range of other dairy buffalo breeds such as Murrah, Nili-Ravi, and Mehsana. However, Jaffarabadi buffalo was found producing higher milk yield in first lactation than Surti breed of buffalo. The differences in FL305DMY obtained by different workers might be due to differences in breeds, herds, management practices, location, number of observations, level of productivity and even the periods of time for this particular trait.

Table 1: Least squares analysis of variance (mean squares only) for individual monthly test day milk yields (litre) in Jaffarabadi buffalo

Effects	Season	Period	AFC	Error
d. f.	4	4	6	
MTDMY1	0.21	2.272	0.745	2.155
MTDMY2	5.219	19.624**	4.571	4.223
MTDMY3	11.822*	12.049*	2.901	4.051
MTDMY4	1.522	7.553	2.537	4.759
MTDMY5	1.609	3.125	0.947	4.958
MTDMY6	0.175	6.714	6.366	4.293
MTDMY7	0.867	2.964	6.276	4.267
MTDMY8	1.341	4.061	7.861*	3.349
MTDMY9	7.684*	3.027	9.224**	2.748
MTDMY10	6.595	1.837	0.737	3.071
MTDMY11	2.906	1.285	4.206	2.893
FL305DMY	166891	318811	347606	252794.601

* significant at 5% level ($P<0.05$)

** significant at 1% level ($P<0.01$)

Effect of Season of Calving

The effect of season of calving was not found to be significant on the first lactation 305 day or less milk yield in Jaffarabadi buffalo in present study (Table 1). Similar non-significant effect of season of calving on FL305DMY was reported by Sahoo *et al.* (2014), Jamuna *et al.* (2015a) and Jamuna *et al.* (2015b) in Murrah buffalo; Singh *et al.* (2011) in Nili-Ravi buffalo and Tailor and Singh (2014) in Surti buffalo. Contrary to this, significant effect of season of calving was reported by Kumar *et al.* (2014a), Kumar *et al.* (2014b), Sahoo *et al.* (2014), Sahoo and Singh (2015) and Singh *et al.* (2016) in Murrah buffalo. Similarly, Kushwaha *et al.* (2013) also reported significant variation in FL305DMY due to season of calving in Bhadawari buffalo.

Non-significant Seasonal differences revealed that most of the buffaloes calved during rainy and autumn season and acquired a better management for the favourable climatic conditions and abundant availability of green fodder during these seasons.

Effect of Period of Calving

Period of calving was not found to influence the

Table 2: Least squares means for individual TDMY and FL305DMY (litre) in Jaffarabadi buffalo

Effect	TDMY 1	TDMY 2	TDMY 3	TDMY 4	TDMY 5	TDMY 6	TDMY 7	TDMY 8	TDMY 9	TDMY 10	TDMY 11	FL305DMY
Overall	2.76 ± 0.21	4.83 ± 0.27	5.25 ± 0.26	5.80 ± 0.28	5.98 ± 0.29	5.51 ± 0.27	5.39 ± 0.27	5.16 ± 0.24	4.72 ± 0.23	4.45 ± 0.26	4.35 ± 0.26	1477.33 ± 64.91
Season of calving												
Summer	3.05 ± 0.69	5.90 ± 0.86	6.36 ± 0.84^{d}	6.36 ± 0.92	6.50 ± 0.63	5.48 ± 0.87	5.11 ± 0.87	5.78 ± 0.77	5.83 ± 0.70^{d}	5.15 ± 0.92	5.27 ± 0.79	1759.53 ± 210.99
Rainy	2.78 ± 0.20	5.10 ± 0.26	5.87 ± 0.26^{c}	5.84 ± 0.28	5.77 ± 0.28	5.58 ± 0.27	5.53 ± 0.27	4.98 ± 0.24	4.27 ± 0.24^{b}	4.65 ± 0.27	4.38 ± 0.28	1442.34 ± 63.29
Autumn	2.70 ± 0.28	4.79 ± 0.35	5.47 ± 0.34^{c}	5.59 ± 0.37	5.88 ± 0.38	5.57 ± 0.36	5.37 ± 0.38	5.28 ± 0.35	5.35 ± 0.34^{c}	5.08 ± 0.36	4.63 ± 0.35	1422.62 ± 86.05
Winter	2.71 ± 0.34	4.38 ± 0.47	4.73 ± 0.46^{b}	5.94 ± 0.50	5.49 ± 0.51	5.37 ± 0.47	5.16 ± 0.47	5.06 ± 0.43	4.51 ± 0.41^{b}	3.59 ± 0.44	3.75 ± 0.49	1422.16 ± 114.09
Spring	2.57 ± 0.58	3.98 ± 0.76	3.85 ± 0.74^{a}	5.28 ± 0.81	6.26 ± 0.82	5.54 ± 0.77	5.76 ± 0.76	4.69 ± 0.68	3.67 ± 0.67^{a}	3.77 ± 0.66	3.71 ± 0.76	1339.98 ± 185.57
Period of calving												
1991-1995	2.52 ± 0.34	4.01 ± 0.45^{a}	4.66 ± 0.44^{a}	5.19 ± 0.48	5.51 ± 0.49	4.70 ± 0.46	4.85 ± 0.46	4.50 ± 0.40	4.17 ± 0.38	4.46 ± 0.42	4.42 ± 0.43	1347.38 ± 109.49
1996-2000	3.32 ± 0.42	5.76 ± 0.52^{c}	5.89 ± 0.51^{b}	6.27 ± 0.56	6.36 ± 0.57	6.01 ± 0.53	5.86 ± 0.53	5.59 ± 0.48	5.04 ± 0.45	4.81 ± 0.51	4.43 ± 0.50	1654.66 ± 128.15
2001-2005	2.62 ± 0.32	4.77 ± 0.43^{b}	5.63 ± 0.42^{b}	5.97 ± 0.46	5.96 ± 0.47	5.56 ± 0.44	5.46 ± 0.44	5.28 ± 0.40	4.88 ± 0.37	4.06 ± 0.43	3.93 ± 0.48	1422.12 ± 104.12
2006-2010	2.89 ± 0.29	5.55 ± 0.38^{c}	5.69 ± 0.37^{b}	6.22 ± 0.40	6.26 ± 0.41	5.82 ± 0.38	5.46 ± 0.39	5.31 ± 0.35	4.93 ± 0.33	4.65 ± 0.37	4.63 ± 0.37	1540.76 ± 92.80
2011-2014	2.46 ± 0.30	4.07 ± 0.39^{a}	4.51 ± 0.38^{a}	5.37 ± 0.41	5.86 ± 0.42	5.44 ± 0.39	5.28 ± 0.40	5.11 ± 0.36	4.60 ± 0.34	4.26 ± 0.38	4.33 ± 0.39	1421.72 ± 94.85
Age at First Calving												
≤1300	3.08 ± 0.48	5.41 ± 0.64	5.04 ± 0.63	5.48 ± 0.68	5.77 ± 0.69	5.35 ± 0.64	5.01 ± 0.67	5.34 ± 0.60^{bc}	4.85 ± 0.54^{b}	3.90 ± 0.59	4.04 ± 0.65	1464.37 ± 156.10
1301-1500	2.77 ± 0.30	5.44 ± 0.40	5.22 ± 0.40	5.97 ± 0.43	6.17 ± 0.44	5.92 ± 0.41	5.68 ± 0.41	5.45 ± 0.37^{bc}	5.35 ± 0.35^{c}	4.54 ± 0.40	4.63 ± 0.39	1605.88 ± 99.03
1501-1700	2.99 ± 0.30	4.98 ± 0.41	5.59 ± 0.40	5.68 ± 0.43	6.30 ± 0.44	6.09 ± 0.42	5.99 ± 0.42	6.09 ± 0.04^{d}	5.70 ± 0.38^{c}	4.44 ± 0.42	5.15 ± 0.44	1505.80 ± 98.93
1701-1900	2.63 ± 0.26	5.19 ± 0.36	5.59 ± 0.35	6.18 ± 0.38	6.03 ± 0.39	6.20 ± 0.36	5.78 ± 0.36	5.60 ± 0.32^{c}	5.44 ± 0.30^{c}	4.61 ± 0.35	4.59 ± 0.35	1624.92 ± 86.92
1901-2100	2.72 ± 0.39	4.15 ± 0.53	4.75 ± 0.53	5.81 ± 0.58	5.83 ± 0.60	4.92 ± 0.56	5.32 ± 0.55	5.05 ± 0.50^{b}	4.74 ± 0.47^{b}	4.59 ± 0.49	4.19 ± 0.50	1398.47 ± 130.15
2101-2300	2.54 ± 0.56	4.57 ± 0.63	5.78 ± 0.62	6.34 ± 0.67	6.15 ± 0.68	5.70 ± 0.64	6.05 ± 0.66	5.38 ± 0.59^{bc}	4.72 ± 0.56^{b}	4.50 ± 0.49	5.00 ± 0.61	1590.27 ± 154.48
>2300	2.69 ± 0.56	4.08 ± 0.73	4.81 ± 0.71	5.14 ± 0.77	5.63 ± 0.79	4.37 ± 0.73	3.88 ± 0.73	3.25 ± 0.67^{a}	2.28 ± 0.72^{a}	4.55 ± 0.82	2.84 ± 0.80	1151.59 ± 177.28

Means with same superscript did not differ significantly

FL305DMY in Jaffarabadi buffalo in present study (Table 1). Similar findings were also reported by Kumar *et al.* (2014a), Kumar *et al.* (2014b), Sahoo and Singh (2015) and Singh *et al.* (2016) in Murrah buffalo; Sing *et al.* (2011) in Nili-Ravi and Tailor and Singh (2014) in Surti buffalo. Contrary to this, significant influence of period of calving was observed by Sahoo *et al.* (2014), Jamuna *et al.* (2015a,b) in Murrah buffalo. Similarly, Ahmad *et al.* (2013) reported significant influence of period of calving in Nili-Ravi buffalo.

Non-significant periodical differences in FL305DMY indicated uniform feeding and management practices followed in the farm throughout year during these periods.

Effect of Age at Calving

Age at first calving (AFC) did not have any significant effect on FL305DMY in Jaffarabadi buffalo (Table 1). Similarly, Non-significant effects were reported by Chakraborty *et al.* (2010), Sahoo *et al.* (2014) and Sahoo and Singh (2015) in Murrah buffalo. Likewise, Singh *et al.* (2011) also reported non-significant influence of AFC in Surti. These results were in agreement with the results of present study. However, contrary results were reported by Gupta *et al.* (2012), Jamuna *et al.* (2015a,b), and Singh *et al.* (2016) in Murrah buffalo.

Monthly Test Day Milk Yields

The overall least squares means for 11 individual MTDMYs varied from 2.76 ± 0.21 litre (MTDMY1) to 5.98 ± 0.29 litre (MTDMY5). The least squares of individual MTDMYs obtained in the present study were more or less neighbouring with those reported by Galsar (2015) and Penchev *et al.* (2011) in Murrah buffaloes, but the estimates of present findings were slightly lower. Contrary to present findings, Tailor and Singh (2011) reported the late decline in milk yield after MTDMY6 with lower estimates for monthly test day milk yields in Surti buffalo.

Effect of Season of Calving

The season of calving had significant effect ($p<0.05$) on milk yield on MTDMY3 and MTDMY9, whereas season of calving did not exert significant effect on rest of the test day yields (Table 1). The findings of Galsar (2015) and Kumar *et al.* (2015) were in partial agreement with the present result, whereas Penchev *et al.* (2011) and Gupta *et al.* (2013) reported non-significant effect of season of calving on all test day yields, which are contrary to results of present study.

Effect of Period of Calving

In present study, effect of period of calving was highly significant ($p<0.01$) on MTDMY2, significant ($p<0.05$) on MTDMY3 and non-significant on rest of the monthly test day yields in Jaffarabadi buffalo (Table 1). Similarly, Geetha (2005) also reported significant variation in MTDYMY2, but non-significant variations in MTDMY3 due to period of calving, However, Chakraborty *et al.* (2010) and Tailor and Singh (2011) reported contrary results to the present study in Murrah and Surti buffalo, respectively.

Effect of Age at First Calving

The results of present study revealed highly significant ($p<0.01$) and significant ($p<0.05$) differences in test day milk yields due to Age at first calving in MTDMY8 and MTDMY9, respectively in Jaffarabadi buffalo (Table 1). The findings of present investigation were in partial agreement with Kumar *et al.* (2015) and Singh *et al.* (2016). However, Gupta *et al.* (2013) reported non-significant effect on all the monthly test day yields.

CONCLUSION

The present investigation indicated that season of calving, period of calving and age at first calving had no significant effect on standard lactation milk yield. However, monthly test day milk yields were significantly affected by season of calving, period of calving and age at first calving indicated that non-genetic factors markedly affected the rising phase and declining phase of the first lactation by over a period of time in the population due to change in climatic conditions and population structure. Hence, these non-genetic factors were important to adjust some of the test day yields.

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