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PRESENT STATUS AND PROSPECTS OF PERFORMANCE ASPECTS OF MURRAH BUFFALO: A REVIEW

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Review Article

ABSTRACT

The dairy industry's success in India is much dependent on buffaloes and the level of production and reproduction traits of productive animals. Murrah buffalo is the most productive buffalo breed; an attempt was made to explore this productive breed for its genetic improvements and further research. To improve productivity and obtain efficient reproduction of milch animals, it is necessary to understand the factors that affect performance traits. Those traits depend on various genetic and non-genetic factors that introduce biasness in estimating the phenotypic value of the desired performance trait. Absence of accurate phenotypic value of the traits makes it difficult to estimate the genetic parameters of the traits that determine the optimum selection criterion for the animals as planned in the improvement programme. Also, evaluating the genetic parameters and the breeding value of animals requires an assumption of adjustment of phenotypic measurements for non-genetic factors that can affect performance traits (calving period, calving season, age at calving and parity of animal). This review summarises the effects of non-genetic factors on performance traits and means or averages of various performance traits obtained by various researchers in past ten years in buffaloes. The performance traits of Murrah buffaloes studied and published in past decade i.e., 2010 to 2020 revealed variability in total lactation milk yield (1365.08 ±2.98 kg to 2229.87 ±93.70 kg), in 305 Day lactation Milk Yield (1754.79 ±28.57 kg to 2147.6 ±87.06 kg), and in Peak Yield (8.87 ±0.05 kg/day to 10.55 ±0.25 kg/day). Lactation length varies from 286.08 ±2.23 days to 344.0 ±102.0 days, service period from 146.28 ±5.58 days to 225.0 ±5.5 days and dry period from 173.34 ±5.59 days to 230.2 ±4.9 days.

Conclusion: Larger age at first calving and more extended dry period are significant problems for farmer. Temperament, along with Body conformation traits, should also be given due importance in the selection

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criterion. Genes related to increasing tolerance for drastic temperature variation in environment, parasitic load, mastitis and disease resistance should be studied for early selection.

Keywords: Murrah breed; performance traits; non-genetic factors; future aspects.

1. INTRODUCTION

India, with its 108.70 million buffalo, has the largest buffalo population globally, out of which 20% of the population comprises Murrah buffaloes (2019th livestock census) [1]. Although, the proportion of population of buffalo to cattle is nearly 1:2; besides this, buffaloes contribute around 57 per-cent (74.71 million tons) of the total milk production. Buffalo milk is valued for its quality being nearly twice as rich in fat and other milk constituents than cow milk. Thus, buffaloes are considered as the significant dairy animal and backbone of the Indian dairy industry. The country's buffalo genetic resources are represented by 13 registered breeds and graded buffalo populations adapted to different ecological niches. Murrah, with a population of 20.49 million constitutes around 65% of Indian buffaloes of well-defined breeds, is one of the superior breeds of Indian buffaloes. Buffaloes also occupy the third place as a meat-producing animal by contributing about 21.2 per-cent of total meat production. Moreover, buffalo contribute about 30 per cent of the draft power for agricultural operations and in the year 2013, India became the world's largest exporter of Carabeef (BAHS [2]). Besides this, buffaloes contribute significantly towards draft power and dung for manure. India with, 18.5% of worlds' milk production ranks first in milk production, an output of 146.3 million tons annually resulting in per capita availability of 322 g/day (NDDB [3]).

Although maximum available lactation records are widely used in assessing the genetic merit of buffaloes, the selection of dairy sires is invariably elicited from the first one or two lactation records of their progeny breeding programmes. Country's current breeding goals are primarily targeted on improving milk production and not directed towards the cost-effective dairy animals' performance. There is ample scope to improve and a vast area to work upon like a shorter productive period in terms of milk and larger unproductive life with a more extended dry period, inter calving period and large age at first calving. There are several reports of antagonistic correlation between production and reproduction traits. Therefore, an attempt must be made to merge production and reproduction traits in efficiency traits for genetic improvement programmes.

Evaluations of the genetic value of performance traits require knowledge of several genetic parameters to develop suitable breeding statergies for improvement in this species. Various non-genetic factors such as management, amount and quality of feed, calving season, calving period, parity influence performance traits. There are various non-genetic factors which introduce biasness in the estimation of the genetic value of performance traits. The situation gets more complicated when the environment becomes harsh and non-supportive for exploiting the animal fullest potential in milk production. On this ground, the present investigation was undertaken to review the effects of various non-genetic factors and genetic parameters of early performance production traits in Murrah buffaloes. This will help formulate suitable evaluation procedures in organised farms. Further, help set suitable evaluation standards and select superior animals for future generations to improve buffaloes' economic traits. The literature pertaining to the genetic and phenotypic parameters of early performance production traits and non-genetic factors affecting reviewed under:-

2. REVIEW OF LITERATURE

Data related to production traits in Murrah buffaloes obtained in research work done by various researches in past ten years (2010 to 2020) is summarised in Table 1. Important points in this Table 1 are discussed under various headings given below.

2.1 Total Lactation Milk Yield

Milk production has a significant contribution towards the income of the dairy farm. Lactation milk yield projects the real economic worth of the buffalo. Milk yield works as a central trait which leads the animal improvement programme. It is considered a significant performance trait in the selection criteria for the genetic improvement of dairy animals and given weightage accordingly. It affects almost all other traits, directly or indirectly in index selection. Milk yield depending upon the management practices and environmental condition under which animals are reared varies from place to place. The averages of first lactation milk yield (FLMY) presented in Table 1 ranged from 1365.08 ±2.98 kg [4] to 2229.87 ±93.70 kg [5] in the case of Murrah buffaloes.

2.1.1 Effect of period of calving

Significant ($P<0.05$) effect of calving period on first lactation milk yield was reported by many workers [6,7,4,8,9]. However, some workers [10,11,5] obtained a non-significant effect of period of calving on first lactation milk yield.

Table 1. Review of Literature for least-squares means, effect of non-genetic factors and heritability of various performance traits in Murrah Buffaloes

Trait	Obs	Means ± S.E	Non Genetic factors			h^2 ± S.E	References
			Per	Seas	AFC		
First lactation Milk yield	326	1937.88 ± 28.56	NS	NS	NS	0.29 ± 0.25	Chakraborty et al., [10]
	330	1942.75 ± 53.79	NS	NS	-	-	Gupta et al., [11]
	1213	1761.57 ± 506.91	-	-	-	0.28 ± 0.08	Singh and Barwal, [22]
	479	2229.87 ± 93.70	NS	S	-	-	Pawar et al. [5]
	435	-	-	-	-	0.23 ± 0.18	Pareek and Narang, [13]
	1980	1855.6 ± 16.1	S	S	-	-	Thiruvenkadan et al, [6]
	479	2086.17 ± 44.66	S	NS	NS	0.39 ± 0.14	Dev et al. [7]
	116	1365.08 ± 2.98	S	S	S	-	Pandey et al. [4]
	1637	2182.82 ± 20.19	S	NS	--	0.47 ± 0.08	Jakhar et al. [8]
	2959	-	-	-	-	0.39 ± 0.11	Jakhar et al. [8]
	536	2041.27 ± 32.78	S	NS	-	0.26 ± 0.18	Patil et al. [9]
305 day milk yield	707	1754.79 ± 28.57	-	-	-	-	Patil et al. [14]
	330	1760.69 ± 42.25	NS	NS	-	-	Gupta et al. [11]
	479	2147.6 ± 87.06	NS	S	-	-	Pawar et al. [5]
	435	-	-	-	-	0.29 ± 0.18	Pareek and Narang [13]
	961	1853.49 ± 15.88	S	S	NS	0.25 ± 0.09	Sahoo et al. [15]
	1980	1804.9 ± 14.7	S	S	-	-	Thiruvenkadan et al. [6]
	404	-	-	-	-	0.02 ± 0.01	Jamuna et al. [16]
	1637	2060.93 ± 20.22	S	NS	-	0.51 ± 0.09	Jakhar et al. [8]
	522	2078.20 ± 31.21	S	NS	-	-	Jamuna et al. [16]
	162	2065.76 ± 41.29	S	NS	-	-	Kumar et al. [17]
	2959	-	-	-	-	0.35 ± 0.12	Jakhar et al. [20]
	315	1977.9 ± 36.2	S	S	-	0.30 ± 0.18	Chitra et al. [18]
First Lactation length	330	326.13 ± 6.70	NS	NS	-	-	Gupta et al. [11]
	1213	306.76 ± 65.39	-	-	-	0.17 ± 0.08	Singh and Barwal [22]
	435	-	-	-	-	0.21 ± 0.15	Pareek and Narang [13]
	1828	297.8 ± 1.9	S	S	-	-	Thiruvenkadan et al. [6]
	116	313.16 ± 0.43	S	S	S	-	Pandey et al. [4]
	1637	311.68 ± 3.35	S	S	-	0.36 ± 0.10	Jakhar et al. [8]
	522	286.08 ± 2.23	S	NS	-	-	Jamuna et al. [16]
	2959	-	-	-	-	0.09 ± 0.08	Jakhar et al. [20]
	37	344.0 ± 102.0	-	-	-	-	Poudel et al. [19]

Trait	Obs	Means ± S.E	Non Genetic factors			h^2 ± S.E	References
			Per	Seas	AFC		
First lactation peak milk yield (kg)	326	10.16 ± 0.26	NS	NS	NS	0.19 ± 0.11	Chakraborty et al. [10]
	435	-	-	-	-	0.48 ± 0.17	Pareek and Narang [13]
	1980	8.87 ± 0.05	S	S	-	-	Thiruvenkadan et al. [6]
	479	9.96 ± 0.11	S	NS	NS	0.37 ± 0.13	Dev et al. [7]
	1637	10.08 ± 0.96	S	S	-	-	Jakhar et al. [8]
	2959	-	-	-	-	0.33 ± 0.12	Jakhar et al. [20]
	536	10.55 ± 0.25	NS	NS	-	0.24 ± 0.17	Patil et al. [9]
Service period (Days)	330	208.23 ± 9.78	NS	NS	-	-	Gupta et al. [11]
	1213	179.54 ± 125.6	-	-	-	0.17 ± 0.07	Singh and Barwal [22]
	1980	225.0 ± 5.5	S	S	-	-	Thiruvenkadan et al. [6]
	479	151.40 ± 4.86	NS	S	NS	0.32 ± 12	Dev et al. [7]
	522	146.28 ± 5.58	S	S	-	-	Jamuna et al. [16]
	1637	187.10 ± 5.91	S	S	-	0.30 ± 0.80	Jakhar et al. [8]
	2959	-	-	-	-	0.21 ± 0.00	Jakhar et al. [20]
Dry period (Days)	1213	177.08 ± 96.19	-	-	-	0.17 ± 0.08	Singh and Barwal [22]
	1980	230.2 ± 4.9	S	S	-	-	Thiruvenkadan et al. [6]
	1637	173.34 ± 5.59	NS	S	-	0.23 ± 0.08	Jakhar et al. [8]
	2959	-	-	-	-	0.22 ± 0.09	Jakhar et al. [20]

S means Significant effect at P 5% while NS means non-significant at P 5%

2.1.2 Effect of season of calving

Significant (P<0.05) effect of calving season on first lactation milk yield were obtained by Pawar et al. [5], Thiruvenkadan et al. [6], Pandey et al. [4] in Murrah buffaloes whereas, non-significant effect of season of calving on first lactation milk yield was also reported by many researchers [10,11,7, 8,9].

2.1.3 Effect of age at first calving

Significant effect (p<0.05) of age at first calving (AFC) (linear) on FLMY was reported by Pandey et al. [4]. However, non-significant effect of AFC on FLMY was reported by Chakraborty et al. [10], Dev et al. [7] and Kaur and Narang [12].

2.1.4 Heritability

Knowledge about the magnitude of heritability gives an indication about the scope for affecting genetic improvement through selection. The heritability estimates of FLMY ranged from 0.23 ±0.18 [13] to 0.47 ±0.08 [8].

2.2 Standard Milk Yield (305 Days Milk Yield)

Standard milk yield (305 days milk yield) is an important trait as it reflects total milk produced in initial 305 days of lactation, it is commonly used to measure the productivity of animal keeping concept of one calf a year in mind as an ideal. Review of literature showed that the least square means of first lactation standard milk yield (305-day milk yield) in Murrah buffaloes varies from 1754.79 ±28.57 kg [14] to 2147.60 ±87.06 [5].

2.2.1 Effect of period of calving

Highly significant (p <0.01) effect of the period of calving on 305 days milk yield in Murrah buffaloes reported by Jakhar et al. [8] while, Sahoo et al. [15], Thiruvenkadan et al. [6], Jamuna et al. [16], Kumar et al. [17] and Chitra et al. [18] reported significant (p≤0.05) effect of the period of calving on 305-day milk yield.

2.2.2 Effect of season of calving

Sahoo et al. [15], Thiruvenkadan et al. [6], Pawar et al. [5] and Chita et al. [18] obtained significant effect of season of calving on 305 days milk yield in Murrah buffaloes. Non-significant effect of season of calving on 305-DMY was reported by Gupta et al. [11], Jakhar et al. [8], Jamuna et al. [16] and Kumar et al. [17] in Murrah buffaloes.

2.2.3 Effect of age at first calving

Non-significant effect of age at first calving (AFC) (linear) on Standard milk yield was reported by Sahoo et al. [15].

2.2.4 Heritability

The heritability estimates of Standard milk yield ranged from 0.02 ±0.01 [16] to 0.51 ±0.09 [8].

2.3 Lactation Length

The period from the initiation of milk production at calving to the day when production stops, in short, the actual productive period is a lactation length. Review of lactation length indicated that the variability ranged from 286.08±2.23 kg/day [16] to 344.0 ± 102.0 [8] in Murrah buffaloes.

2.3.1 Effect of period of calving

Thiruvenkadan et al. [6], Pandey et al. [4], Jakhar et al. [8] and Jamuna et al. [16] reported significant influence of period of calving on lactation length observed corroborated with previous finding on Murrah buffalo while Gupta et al. [11] reported non-significant influence of period of calving on lactation length in Murrah buffaloes.

2.3.2 Effect of season of calving

Thiruvenkadan et al. [6], Pandey et al. [4] and Jakhar et al. [8] reported significant influence of season of calving on lactation length observed corroborated with previous finding on Murrah buffalo Gupta et al. [11] and Jamuna et al. [16] reported non-significant influence of season of calving on lactation length in Murrah buffaloes.

2.3.3 Effect of age at first calving

Pandey et al. [4], reported significant influence of Effect of age at first calving on lactation length on Murrah buffalo

2.3.4 Heritability

The heritability estimates of lactation length ranged from 0.09 ±0.08 [20] to 0.36 ±0.10 [8].

2.4 Peak Yield

Peak yield is maximum milk secreted during any single day in whole lactation. Review of first peak yield (FPY) indicated that the variability ranged from 8.87±0.05 kg/day [6] to 10.55 ± 0.25 [9] in Murrah

buffaloes. The trait shows considerable variations within breed.

2.4.1 Effect of period of calving

Thiruvenkadan et al. [6], Dev et al. [7] and Jakhar et al. [8] reported the significant ($p<0.05$) effect of the period of calving on peak yield in Murrah buffaloes; while Chakraborty et al. [10], Patil et al. [9] reported a non-significant effect of calving period on PY in Murrah buffaloes.

2.4.2 Effect of season of calving

Thiruvenkadan [14] Jakhar et al. [8] reported the significant ($p<0.05$) effect of season of calving on peak yield in Murrah buffaloes; while non-significant effect of season of calving was reported by Chakraborty et al. [10], Dev et al. [7] and Patil et al. [9].

2.4.3 Effect of age at first calving

Effect of age at first calving (quadratic & linear) reported to be non-significant by Chakraborty et al. [10] and Dev et al. [7] in Murrah buffaloes.

2.4.4 Heritability

The heritability estimates of first lactation peak milk yield ranged from 0.19±0.11 [10] to 0.48±0.17 [13].

2.5 First Service Period

It is the time period between a calving and the subsequent successful conception of the same animal. Generally, in case of buffalo an optimum period of 60 days is allowed as post-partum rest. Reports available in literature (Table-1) indicated that least-square means for first service period (FSP) in Murrah buffaloes ranged from 151.40 ±4.86 days [7] to 225.0 ±5.5 days [6]. There is a wide variability observed in the first service period in Murrah buffaloes.

2.5.1 Effect of period of calving

Thiruvenkadan et al. [6], Jamuna et al. [16], Jakhar et al. [8] observed a significant effect of the period of calving on service period in Murrah buffaloes. While, Gupta et al. [11], Dev et al. [7] reported non-significant effects of calving period on service period.

2.5.2 Effect of season of calving

A significant effect of the season of calving on service period was reported by Thiruvenkadan et al. [6], Dev et al. [7], Jamuna et al. [16] and Jakhar et al. [8].

2.5.3 Effect of age at first calving

Dev et al. [7] reported non-significant effect of AFC on service period.

2.5.4 Heritability

The heritability estimates of FSP ranged from 0.17 ± 0.07 [21,22] to 0.32±0.12 [7].

2.6 Dry Period

Dry period is the period between stoppage of milk production and next calving thus in this phase animal remains out of milk production. As, dry period being non-productive period it needs to be decreased to the minimum without interfering the production in next lactation in order to maximise the profits. Perusal of Table 1 shows that Dry period may be as long as 173.34±5.59 days [8] to as long as 230.2±4.9 days [6].

2.6.1 Effect of period of calving

Thiruvenkadan et al. [6] obtained a significant effect of period of calving on dry period in different breeds of buffaloes. However, non-significant effect was reported by Jakhar et al. [8] in Murrah buffaloes.

2.6.2 Effect of season of calving

Thiruvenkadan et al. [6] and Jakhar et al. [8] obtained a highly significant ($p<0.01$) effect of the season of calving on dry period in Murrah buffalo.

2.6.3 Heritability

The heritability estimates of Dry period ranged from 0.17 ± 0.08 [22] to 0.22±0.09 [20].

3. FUTURE PROSPECTS

To enrich the productivity of this priced buffalo breed and meet the need it is required to produce elite, proven breeding bulls, the semen of which should be available at the village level. For achieving genetic improvement in the existing Murrah buffalo population, it is necessary to focus on the following key areas:

a) Establishing a database for performance recording of Murrah buffalo; it is expected that Information Network in Animal Productivity and Health (INAPH) can become the National Database in the near future. Performance recording of a maximum number of Murrah

animals by registering in Database to identify, compare and identify genetically superior animals.

b) Establishing infrastructure like bull mother farms to produce and select genetically superior breeding bulls of Murrah breeds in the breeding tracts. Procurement of elite male calves produced by using superior semen in prize-winning Murrah buffaloes at farmer/village level.

c) Due to non-availability of superior breeding bulls at the village level, a decline in breeding value amongst the Murrah population could occur, resulting in poor performance. Strengthening the semen production facilities for the production of disease-free quality semen is the need of time. Increasing the number and percentage of animals bred through artificial insemination using semen of high genetic merit bulls of Murrah by supplying adequate numbers of semen doses of high genetic merit bulls to the village level.

d) A large amount of non-descript buffalo is present in the region, which should be upgraded with pure Murrah buffalo.

e) Involvement of rural field veterinarians in a breeding programme should be appropriately acknowledged.

f) Instead of peak milk yield, selection should incorporate test day production (production on regular intervals of lactation period).

g) Larger age at first calving and more extended dry period are significant problems for the farmer; concrete steps must be taken to work upon early sexual maturity long with the lactation length and persistency in such a way even if the animal could not conceive for few months; the milk yield should be persistent and dry period should remain constant for that lactation. Selection of bulls by incorporating the milk yield per day at the age of second calving as an essential component of the index method may help to some extent in this regard.

h) Temperament, along with Body conformation traits should be given due importance in the index as working with the animal may be eased while mastitis, lameness and post parturient disorders may be avoided to some extent.

i) Murrah buffalo is predominantly found in parts of the country showing drastic temperature variation and facing problems like parasitic load, mastitis; therefore, the genetic study on stress-related genes and disease resistance genes should be studied.

j) A separate line of heavy breeding bulls for carabeef should be developed while productive dairy lighter bulls should be used for general use.

4. CONCLUSION

Murrah has gained international recognition and is one of the seventeen documented buffalo breeds of India. Murrah buffalo's productivity has been reported to vary from territories to territories.

The animal breeder's primary focus is to increase the rate of genetic improvement through selection and improvement of several traits simultaneously. Animal Breeder prefer animals that have good production, health and reproduction.

The variations in performance traits may be more of environmental nature as opposed to genetics; a sampling of population and data edits might have widened these ranges. The low to moderate estimates of heritability for early performance traits indicated that selection based on progeny performance coupled with collateral relatives' performance would improve these traits.

Genetic improvement through selection in a breeding program relies on the precisely identifying genetically superior animals. Selection of dairy animals is generally based on the older records of their performance traits. The variations in performance traits may be even comparatively more of environmental nature as opposed to genetics and sampling of the population. As per the literature, all-vital non-genetic factors such as calving season, calving period, age at first calving, and parity of animals had a significant influence on buffaloes' performance traits. Therefore, in order to get accurate and unbiased estimates of the genetic parameter the adjustment of non-genetic factors becomes necessary.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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