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GENETIC AND NON GENETIC FACTORS AFFECTING BODY CONDITION SCORE IN NILI RAVI BUFFALOES AND ITS CORRELATION WITH MILK YIELD

R. H. Mirza, K. Javed, M. Abdullah and T. N. Pasha*

Department of Livestock Production, *Department of Animal Nutrition, University of Veterinary and Animal Science Lahore, Pakistan
Corresponding author:riazmirza71@yahoo.com

ABSTRACT

Pakistan supports approximately 33.7 million buffaloes and Nili Ravi buffalo is the main dairy animal. Among physical characteristics, Body Condition Score (BCS) is very important and various reports indicate that it is under the genetic control to varying levels in different breeds. The present study was planned to score buffaloes on the basis of body condition and to estimate some genetic and non genetic factors affecting this trait and its genetic and phenotypic correlations with milk yield in Nili Ravi buffaloes. Nili Ravi buffaloes maintained at 5 institutional herds and some private farms in Punjab were utilized in this study. A total of 437 milking buffaloes with 1180 records using a linear scale of 1-9 for BCS scoring of buffaloes following ICAR guidelines. Each animal was scored thrice in lactation with an interval of about 90 days. Least squares mean for BCS was found as 4.92±1.08 with a coefficient of variation 22.04 %. A highly significant effect of herd, stage of lactation and parity was observed on BCS. Significant linear and quadratic effect of age was seen on body condition score. Genetic parameters were estimated fitting Animal Model using ASREML program. A fairly moderate estimate of heritability (0.14±0.091) for BCS was observed in the present study. A negative phenotypic correlation of -0.156±0.35 with 305 days milk yield and -0.216±0.03 with score day milk yield was observed. Low genetic correlations (0.051±0.0001 and 0.117±0.017) of BCS with 305 days milk yield and score day milk yield were estimated. It is the first study and more investigations are needed before using BCS as selection criterion for milk yield in Nili Ravi buffaloes.

Key words: Nili Ravi, Buffalo, BCS, Heritability, Correlation, linear scale, milk yield

INTRODUCTION

Pakistan supports approximately 33.7 million buffaloes and are the main dairy animals (Anonymous, 2013). Nili Ravi buffalo is considered one of the best dairy breed in the world. It has great potential for high milk yield but its true potential has not yet been exploited. Efforts for its improvement through selection have been started at institutional as well as at field level. At field level, animals are raised on traditional husbandry practices with no system of record keeping. The physical appearance of the animal is considered more important than any other quality including milk yield at farmer's level. Physical appearance of most of cattle breeds has been studied extensively especially in developed countries but only few references are available regarding some body measurements in buffalo breeds. Among physical characteristics, Body Condition Score (BCS) is very important and various reports indicate that BCS is under the genetic control to varying levels in different dairy cattle breeds and is affected by various non genetic factors including herd, stage of lactation, parity and age of the cow at classification. This trait has been reported to be negatively correlated with milk yield by many workers (Pryce *et al.* 2001, Muller *et al.* 2006, Dal Zotto, 2007, Mushtaq *et al.* 2012). The present study was planned to score buffaloes on the basis of body condition and to estimate the effect of some genetic and non genetic factors affecting this trait along with estimation of genetic and phenotypic correlations with milk yield in Nili Ravi buffaloes.

MATERIALS AND METHODS

Nili Ravi buffalo herds maintained at 5 Institutional herds in Punjab and some private farms were utilized in the present study. General management and feeding practices at these stations were almost similar. Adult animals were being maintained in open enclosures with sufficient covered area for extreme weather conditions. Animals were allowed to graze on available fodders for 4-6 hours daily and lactating buffaloes were fed concentrate at the rate of 1 kg for every 3 kg of milk produced. Buffaloes were milked twice daily with an interval of approximately 12 hours at all the farms. Calves were not weaned for the purpose of proper milk let down and were allowed to suckle their milk allowance directly from their dams at all the farms.

Data collection: Data recording was started during July, 2010 and continued till June 2012. Body condition scoring of buffaloes was carried out on a linear scale of 1-9. The International Committee for Animal Recording

(ICAR, 2010) guidelines for conformational recording of dairy cattle were followed in this study. A total of 437 milking buffaloes were scored as follows:

1. First scoring	15 to 90 days of calving
2. Second scoring	90 to 180 days of calving
3. Third scoring	180 to 270 days of calving

Milk yield was recorded in kilograms using weighing scale. Body Condition Scoring was done visually by accessing the covering of fat over the tail head, rump, sacral bone and loin and withers area. A linear scale 1-9 was used for BC Scoring and was categorized as 1-3 for thin, 4-6 for average and 7-9 for fat buffaloes. Productive performance traits including score day milk yield and 305 days milk yield were recorded.

Evaluation Model: Genetic parameters including heritability, phenotypic and genetic correlations were estimated using BLUP (Best Linear Unbiased Prediction) evaluation techniques. Influencing factors such as age of the buffalo at scoring, stage of lactation, parity and herd were included in the model. Individual Animal Model was fitted under Restricted Maximum Likelihood (REML) Procedure outlined by Patterson and Thompson (1971). Season of scoring was defined as Hot humid (July to September), Autumn (October and November), Winter (December to January), Spring (February to April) and Hot dry (May and June).

The following general mathematical model was used to estimate the fixed effects

$Y_{ijklm} = \mu + S_i + H_j + P_k + T_l + b_1 (a_{ijklm}) + b_2 (a_{ijklm})^2 + e_{ijklm}$ (**Model 1**)

Where:

Y_{ijklm} is the record of m^{th} buffalo at l^{th} stage of lactation during k^{th} parity of j^{th} herd in i^{th} season

μ is the overall population mean

S_i is the effect due to i^{th} season (i=1-5)

H_j is the effect due to j^{th} herd (j=1-6)

P_k is the effect due to k^{th} parity (k = 1-4)

T_l is the effect due to l^{th} stage of lactation (l = 1-4, early, mid, late and dry)

a_{ijklm} is the age of buffalo at classification

b_1 and b_2 are the linear and quadratic regression coefficient of age at classification

e_{ijklm} is the random error associated with the observation on m^{th} buffalo at l^{th} stage of lactation during k^{th} parity of j^{th} herd in i^{th} season

Data were analysed using the mixed model procedure of the Statistical Analysis Systems (SAS, 2011). Fixed effects observed to be significant in the initial analysis were included in the model for estimation of genetic parameters.

Estimation of Genetic Parameters: Genetic parameters were estimated fitting an Individual Animal Model. The ASREML (Gilmour *et al.* 2009) set of computer programs was used to estimate genetic parameters. Heritability estimates for BCS was computed using a statistical model as follows:

$Y_{ijk} = \mu + F_i + A_j + Pe + e_{ijk}$ (Model 2)

Where,

Y_{ijk} = measurement of a particular trait:

μ = population mean;

F_i = fixed effects observed to be significant from the initial analyses Model 1

A_j = random additive genetic effect of j^{th} animal with mean zero and variance σ^2_A

$_{Pe}$ = random permanent effect of j^{th} animal with mean zero and variance σ^2_A

e_{ijk} = random error with mean zero and variance σ^2_A

The heritability was calculated by the following formula:

Heritability (h^2) = σ^2_A / σ^2_P

Genetic and phenotypic correlations: Genetic and phenotypic correlations of BCS with milk yield were estimated using bivariate analysis fitting individual animal model in ASREML computer program. The fixed effects for BCS in this analysis were same as considered above.

RESULTS AND DISCUSSION

A total of 1180 records on BCS were generated over a scoring period of 2 years. Sources of variation due to environmental factors (herd, stage of lactation, parity, season of scoring and age of the buffalo at classification) were included in the model along with genetic and residual effects on BCS. Effect of herd, parity, stage of lactation and age of the buffalo at scoring on BCS were evaluated and genetic parameters like heritability of BCS and its phenotypic and genetic correlations with milk yield were estimated.

Description of BCS: Least squares mean for body condition score (on 1-9 scale) in Nili Ravi buffaloes has been found as 4.92±1.08 with a coefficient of variation of 22.04 %. Various workers scored BCS on a linear scale of 1-5 in different buffalo breeds (Lubis and Fletcher, 1985 in Swamp buffaloes as 2.9, Qureshi *et al.,* 2010 and Tariq *et al.*, 2012 in Nili Ravi buffaloes as 3.20±0.58 and 3.8±0.77, respectively and Alapati *et al.*, 2010 in Murrah buffaloes as 3.29). No report of scoring this trait on a scale of 1-9 in buffaloes is available. The trait has been scored on a linear scale of 1-9 in many of the cattle breeds. Koenen *et al.* (2001) documented an average score of 4.94±1.51 in Holstein breed and Zavadilova *et al.* (2011) a score of 4.90±1.26 in Czech Holstein breed. These findings are closer to the findings of current study. However, slightly lower score of 3.80±0.61 in Holstein Friesian and Jersey breeds and 3.90±1.3 in Holstein Friesian cows has been reported by Roche *et al.* (2007) and Royal *et al.* (2002), respectively. Due to negative genetic correlation of body condition score with milk yield, an optimal score of below average ranging from 4 to 5 is generally recommended.

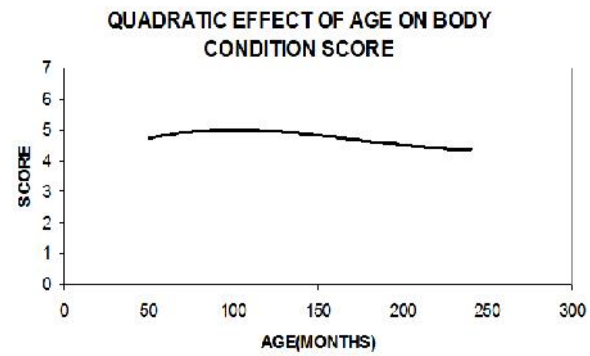
Environmental factors affecting BCS: Level of significance and F values for environmental factors affecting body condition score are presented in Table 1. A highly significant effect of herd, stage of lactation and parity was observed on body condition score in the current study. Significant linear and quadratic effect of age of the buffalo at scoring was seen on body condition score. Most of the reports (Moro Mendez *et al.*, 2008; Heins *et al.*, 2008; Khan, 2009) have indicated significant differences due to herds in Ayrshire and Holstein, Holstein and its crosses with Jersey and in Sahiwal breed, respectively. However, Khan (2009) has reported non significant effect of parity and age on BCS in Sahiwal cows. The reason may be due to species, morphological, environmental and management differences in different agro ecological zones.

Table 1. Significance level and F values for body condition score in Nili Ravi buffaloes

Effect	DF	F value	Pr > F
Herd	5	18.69	<.0001
Stage of lactation	3	12.47	<.0001
Parity	3	10.22	<.0001
Season of scoring	4	2.21	0.0666
Linear effect of age (b1)	1	14.59	0.0010
Quadratic effect of age (b2)	1	18.01	<.0001

Heritability estimates of BCS: Pedigree records of buffaloes were traced back up to five available generations and these buffaloes were the progeny of 88 sires and 303 dams. Number of base animals were 119 with no pedigree records. Heritability estimate of BCS in Nili Ravi buffaloes was estimated as 0.14±0.091. Almost similar (0.16 and 0.15,) had been reported in literature (Norman, 1988; Wiggans *et al.*, 2006 and Dal Zotto *et al.*, 2007) in Brown Swiss cows. However, Veerkamp *et al.* (2001), Piotr *et al.* (2005), Gredler *et al.* (2006), Haas *et al.* (2007), and Zavadilova and Stipkova (2012) have reported higher heritability estimate of BCS in different dairy cattle breeds as 0.38±0.02, 0.37, 0.44±0.05, 0.35±0.02, and 0.30, respectively. Khan (2009) has reported a further high value as 0.62±0.03 in Sahiwal cows. It is an established fact that the genetic parameters may vary due to species, breed, herd/location, year, age, method of estimation and other management differences (Javed *et al.*, 2003).

Genetic and phenotypic correlations of BCS with milk yield: Genetic and phenotypic correlations of BCS with score day milk yield and 305 days milk yield were estimated using a bivariate analysis fitting an individual animal model in ASREML program (Gilmour *et al.* 2009). A negative phenotypic correlation of -0.156 ± 0.35 with 305 days milk yield and -0.216±0.03 with score day milk yield has been observed. Similar findings have been reported regarding negative phenotypic correlation of BCS with milk yield (-0.17±0.04 and -0.15±0.01) by Muller *et al.* (2006) and Kadarmideen (2005) in Holstein cattle. However, Khan (2009) has reported a very weak phenotypic correlation of BCS with 305 days milk yield as 0.00±0.06 and with score day milk yield as 0.04±0.06 in Sahiwal cows.



Genetic correlation of BCS with 305 days milk yield was observed as 0.051±0.0001 and with score day milk yield as 0.117±0.017. A positive genetic correlation of 0.19 was reported by Piotr *et al.* (2005) in Black and White cattle whereas Kkan (2009) as 0.13±0.00 with 305 days milk yield and 0.20±0.00 with score day milk yield in Sahiwal cows. These findings are in agreement with the findings of current study. In contrast to these findings, many workers have reported negative genetic correlation of BCS with milk yield (Pryce *et al.*, 2001 in Holstein cows as -0.63±0.10, Veerkamp *et al.*, 2001 in Black and White cows as -0.30, Muller *et al.*,2006 in Holstein cows as -0.42±0.15 and Haas *et al.*, 2007 in Holstein cows as -0.46). The possible reason of differences among reports may be due to species, breed, herd, year, age and other environmental differences.

Conclusions: A medium estimate of heritability of BCS in the current study suggest that it is under the genetic control and improvement in this trait is possible to some extent through selection. Further studies are needed before using BCS as selection criterion for milk yield in Nili Ravi buffaloes. Due to negative phenotypic correlation of body condition score with milk yield, an optimal score of below average ranging from 4 to 5 may be recommended.

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