BF-1658
[1-3]

RESEARCH ARTICLE

Indian Journal of Animal Research

Estimation of Genetic Parameters for Weights at Different Ages in Anatolian Buffalo Calves

Yusuf Kaplan[1], M. İhsan Soysal[2], Mustafa Tekerli[3]

10.18805/IJAR.BF-1658

ABSTRACT

Background: The determination of the breeding potential and direction of the population in terms of traits of interest depends on the genetic variation. Therefore, it is essential to know the genetic parameters of economic traits to improve yields in animal breeding. The objective of this study was to investigate the heritability, genetic and phenotypic correlations among growth traits in Anatolian buffaloes of İstanbul province.

Methods: A total records of 7649 birth weights, 4623 sixth-month weights and 3133 yearling weights belonging to buffalo calves born between 2012 and 2021 were used. Genetic and phenotypic parameters were estimated from univariate and bivariate animal model using restricted maximum likelihood (REML) procedure in Wombat software. Village, year, season, sex and age of dam were considered as fixed effects and animal additive genetic effect was taken as random effect.

Result: The heritability estimates for birth, sixth-month and yearling weights were 0.14±0.03; 0.22±0.05; 0.39±0.07 respectively. Genetic and phenotypic correlations among growth traits were generally significant and positive and ranged from 0.28±0.02 to 0.97±0.02. As a consequence, the moderate to high estimates of heritability, genetic and phenotypic correlations on growth traits showed that there were some opportunities for genetic improvement in buffaloes of İstanbul. These genetic parameters should be considered in selection programs.

Key words: Anatolian buffalo, Animal model, Genetic parameters, REML.

INTRODUCTION

Estimating the genetic parameters of traits in livestock populations is a key requirement for genetic improvement programmes. These parameters include the heritabilities of all traits of interest as well as the genetic and phenotypic correlations among them. The genetic parameters such as heritability should be estimated with reliability to determine the accurate breeding values of buffaloes for different growth yields. The heritability is estimated from recorded livestock performance data and the pedigree relationships in the population. Genetic parameters are estimated by classic methods like paternal half-sib correlation. But modern methods such as REML procedure is accepted more confident in last decades. Due to using animal models which take advantage of all relationships between an animal and the other recorded individuals in the population. This method provides an unbiased estimation of genetic parameters in the selection (Thevamanoharan *et al*., 2001). Using this type of methods would accelerate the speed of contemporary breeding programs. Community based Anatolian Buffalo Breeding Project is one of the genetic improvement purpose programs in the world. It is conducted with approximately 28809 buffalo cows maintained at 2767 farms in 18 provinces throughout Turkey. The pure breeding and selection method was preferred in this national project started in 2011 by the Turkish Ministry of Agriculture and Forestry (MAF) for 5 year of periods continued until now (Kaplan *et al*., 2019). This study was planned to estimate the heritabilities, genetic and phenotypic correlations of body weights in Anatolian Buffaloes occupied a significant place in terms of animal genetic resources in Turkey (Kaplan *et al*., 2015).

[1]General Directorate of Agricultural Research and Policies, Ankara, Türkiye.
[2]Department of Animal Science, Faculty of Agriculture, Tekirdağ, Türkiye.
[3]Department of Animal Science, Faculty of Veterinary Medicine, Afyonkarahisar, Türkiye.

Corresponding Author: Yusuf Kaplan, General Directorate of Agricultural Research and Policies, Ankara, Türkiye.
Email: yusufkaplan66@gmail.com

How to cite this article: Kaplan, Y., Soysal, M.İ. and Tekerli, M. (2023). Estimation of Genetic Parameters for Weights at Different Ages in Anatolian Buffalo Calves. Indian Journal of Animal Research. doi:10.18805/IJAR.BF-1658.

Submitted: 17-04-2023 **Accepted:** 23-06-2023 **Online:** 05-07-2023

MATERIALS AND METHODS

The study was carried out in the community-based Anatolian Buffalo Breeding Project of İstanbul between the years 2012-2021. The project is governed by the General Directorate of Agricultural Research and Policies centered in Ankara. Buffaloes were maintained at 80 different farms under extensive conditions. A total of 7649 birth weight (BW), 4623 sixth-month weight (SMW) and 3133 yearling weight (YW) records were obtained from the software named "manda

Table 1: Variance analysis results of BW, SMW and YW body weights.

	BW		SMW		YW	
Variance sources	DF	MS	DF	MS	DF	MS
Village	21	242.18***	21	3905.90***	21	16135***
Birth year	9	25.39	9	932.40	9	1574
Birth season	3	320.59 ***	3	12045.8***	3	34668***
Sex	1	261.18***	1	2212.80*	1	14285*
Age of dam	5	1208.17***	5	2840.60***	5	3999
Error	7609	35.03	4583	661.70	3093	2209

BV: Birth weights, SMW: Sixth month weight, YW: Yearling weights, DF: Degree of freedom, MS: Mean square.*: P<0.05; **: P<0.01; ***: P<0.001.

Table 2: Heritability of body weights.

Traits	n	h^2±SE
Birth weight	7649	0.14±0.03
Sixth month weight	4623	0.22±0.05
Yearling weight	3133	0.39±0.07

Table 3: Genetic and phenotypic correlation coefficients between body weights.

Body weights	BW	SMW	YW
BW	1	0.48±0.17	0.42±0.21
SMW	0.29±0.01	1	0.97±0.02
YW	0.28±0.02	0.88±0.01	1

BV: Birth weights, SMW: Sixth month weight, YW: Yearling weights.*: Above diagonal genetic correlations, below diagonal phenotypic correlations.

yıldızı" (Tekerli, 2015-2019). Firstly, least squares analysis was performed to calculate fixed effects on traits under investigation by using Minitab general linear options (Minitab, 2017). Environmental factors observed to be significant sources of variation for body weights were fitted as fixed effects in the subsequent analysis. Genetic parameters were estimated with animal models by using the REML procedure of Wombat software (Meyer, 2006).

The statistical mixed model is as follows:

$$Y = Xb + Zu + e$$

Where:

Y = Vector of observations for each trait.

b = Vector for the fixed effects.

u = Vector of the effects for individual animals.

e = Vector of residuals.

X and Z = Incidence matrices for b and u.

RESULTS AND DISCUSSION

The result of analysis of variance and heritabilities for various body weights obtained from the animal model analysis have been presented in Table 1 and 2. The estimate of heritability for birth weight (0.14±0.03) was in agreement with the findings of some researchers (Malhado *et al*., 2007; Thiruvenkadan *et al*., 2009; and Pandya *et al*., 2015; Joshi *et al*., 2022) who reported the heritability estimates ranging from 0.09 to 0.19 in different breeds of buffaloes. However, several other researchers (Thevamanoharan *et al*., 2001; 2006; Shahin *et al*., 2010; Akhtar *et al*., 2012; Falleiro *et al*., 2013; Gupta *et al*., 2015; El-Naser, 2019; Kaplan, 2021; Medrado *et al*., 2021) have reported higher estimates (0.23-0.66) of heritability for this trait. A wide variation of heritability for a trait may be due to some factors like breed, herd, growing side and even periods of time. A low heritability estimate for birth weight in this population indicated that larger proportion of the phenotypic variation was due to the environmental effects and a smaller fraction was due to effects of the genes.

The heritability estimate for sixth-month weight of the buffaloes was 0.22±0.05. A few moderate estimates of heritability for the trait have also been reported by several researchers (Thiruvenkadan *et al*., 2009; Pandya *et al*., 2015) in Murrah and Surti buffaloes. In a study conducted by Shahin *et al.* (2010) heritability estimates for sixth-month weight were reported to be high as compared with the present study, but Gupta *et al.* (2015) and Joshi *et al.* (2022) reported lower heritabilities. The results of the present study suggested that sixth-month weight of the buffaloes was moderately heritable and could be used in selection.

The heritability estimate for yearling weight was 0.39±0.07 in this study. This is in agreement with the findings of Malhado *et al.* (2007) and Medrado *et al.* (2021) in different buffalo breeds. The estimate of heritability for yearling weights obtained in the present study was higher than the values (0.10-0.20) reported by some researchers (Thiruvenkadan *et al*., 2009; Akhtar *et al*., 2012; Falleiro *et al*., 2013; Pandya *et al*., 2015; Joshi *et al*., 2022). But different studies (Shahin *et al*., 2010; Falleiro *et al*., 2013; Gupta *et al*., 2015; Kaplan, 2021) reported higher estimates of heritability for certain buffalo breeds. Nearly high and greater than twice the standard error estimate of heritability for body weight at one year of age suggested that most of the observed variation in this trait may be due to the additive effects of the genes.

The result of genetic and phenotypic correlation coefficients among body weights at different ages have been presented in Table 3. The estimates of genetic correlation between birth weight and weight at different ages were medium to high and positive and it is higher than the previous reports (Gupta *et al*., 2015; Kaplan, 2021; Medrado *et al*., 2021; Joshi *et al*., 2022) on buffaloes. This situation may be due to the structure of the data and using a different method.

Genetic correlations were generally positive and higher while phenotypic correlations were relatively lower. The higher genetic correlations between sixth-month and yearling weights in this study indicate that selection to one of them would also result in rapid development in growth traits in subsequent generations.

CONCLUSION

Genetic variations in growth traits of Anatolian buffalo calves were found to be promising for improvement. The present study reveals that the yearling weight can be used as a selection tool for genetic improvement of growth traits considering its high heritability and positive genetic correlations at different ages.

ACKNOWLEDGEMENT

We would like to thank the Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies, Türkiye, for allowing access to these invaluable data.

Conflict of interest: None.

REFERENCES

Akhtar, P., Kalsoom, U., Ali, S., Yaqoob, M., Javed, K., Babar, M.E., Mustafa, M.I., Sultan, J.I. (2012). Genetic and phenotypic parameters for growth traits of Nili-Ravi buffalo heifers in Pakistan. The Journal of Animal and Plant Sciences. 3: 347-352.

El-Naser, İ.A. (2019). Assessment of genetic relationships between growth traits and milk yield in Egyptian buffaloes. Jurnal Ilmu Ternak dan Veteriner. 4: 143-150. DOI:10.14334/jitv.v24i4.2034.

Falleiro, V., Silveira, E.S., Ramos, A.A., Carneiro, P.L.S., Carrillo, J.A. Malhado, C.H.M. (2013). Genetic parameters for growth traits of mediterranean buffaloes from Brazil, estimated by bayesian inference. Buffalo Bulletin. 2: 627-631.

Gupta, P.G., Sachdeva G.K, Gandhi, R.S., Chakaravarty A.K. (2015). Developing multiple-trait prediction models using growth and production traits in murrah buffalo. Buffalo Bulletin. 3: 347-355.

Joshi, P., Gowane, G.R., Alex, R., Gupta, I.D., Worku, D., George, L., Yanjan, A., Verma, A. (2022). Estimation of genetic parameters of growth traits for direct and maternal effects in Murrah buffalo. Tropical Animal Health and Production. 54: 352. DOI: 10.1007/s11250-022-03343-z.

Kaplan, Y. (2021). Estimation of Genetic and Non-Genetic Factors Effecting Some Growth, Reproduction and Production Traits of Anatolian Buffaloes of Yozgat Province in Turkey. PhD, Afyon Kocatepe University, Afyonkarahisar, Türkiye.

Kaplan, Y., Alkoyak, K., Öz, S., Daşkıran, İ., Sözen, Ö. (2015). Türkiye manda yetiþtiriciliğine genel bir bakış ve Gıda Tarım ve Hayvancılık Bakanlığı (GTHB) çalışmaları. 9. Ulusal Zootekni Bilim Kongresi. 378s., Konya. Türkiye.

Kaplan, Y., Ayar, A., Alkoyak, K., Sarıkaya, Ö. (2019). National Project About Anatolian Buffalo Breeding in Turkey (2019) 12. World Buffalo Congress Efficient Production for the World.

Malhado, M., Ramos, A., Carneiro, S., De Souza, J.C., Lamberson, W.R. (2007). Genetic and phenotypic trends for growth traits of buffaloes in Brazil. Italian Journal of Animal Science. 2: 325-327. DOI: 10.4081/ijas.2007.s2.325.

Medrado, B.D., Pedrosa, V.B., Pinto, L.F.B. (2021). Meta-analysis of genetic parameters for economic traits in buffaloes. Livestock Science. 251: 104614. DOI: 10.1016/j.livsci.2021.104614.

Meyer, K. (2006). WOMBAT-A tool for mixed model analyses in quantitative genetics by restricted maximum likelihood (REML). Journal of Zhejiang University-Science B. 8: 815-821.

Minitab. (2017). Minitab Statistical Software Version 18.1 Minitab Inc, State College, PA, USA.

Pandya, G.M., Joshi, C.G., Rank, D.N., Kharadi, V.B., Bramkshtri, B.P., Vataliya, P.H., Desai, P.M., Solanki, J.V. (2015). Genetic analysis of body weight traits of Surti Buffalo. Buffalo Bulletin. 2: 189-195.

Shahin, K.A., Abdallah, O.Y., Fooda, T.A., Mourad, K.A. (2010). Selection indexes for genetic improvement of yearling weight in Egyptian buffaloes. Archiv Tierzucht. 4: 436-446.

Tekerli, M. (2015-2019). Manda Yıldızı Veri Kayıt, Hesap ve Proje Takip Programı. Version 5.00 Akademik. Afyon Kocatepe Üniversitesi. Afyonkarahisar. http://88.249.41.173:83/iletisim.aspx erişim tarihi 05.07.2020.

Thevamanoharan, K., Vandepitte, W., Mohiuddin, G., Chantalakhana, C. (2001). Restricted maximum likelihood animal model estimates of heritability for various growth traits and body measurements of swamp buffaloes. Pakistan Journal of Agricultural Sciences. 2: 19-23.

Thiruvenkadan, A.K., Panneerselwam, S., Rajendran, R. (2009). Non-genetic and genetic factors influencing growth performance in Murrah buffalos. South African Journal of Animal Science. 5: 102-106.