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ESTIMATES OF DIRECT AND MATERNAL GENETIC EFFECTS ON BIRTH AND WEANING WEIGHTS IN EGYPTIAN BUFFALO CALVES

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ABSTRACT

A total of 1173 first calves of Egyptian buffalo kept at Mehalet Mousa Farm, belonging to Animal Production Research, Ministry of Agriculture, Dokki, Cairo, Egypt during the period from 2000 to 2015 were used to estimate variances of direct and maternal genetic effects for birth weight (BW) and weaning weight (WW). Two animal models are used. Model 1 (full model) includes month and year of birth and sex as fixed effects and direct genetic, maternal genetic, covariance between direct and maternal genetic and residual as random effects. Model 2 is similar to model 1 while additive maternal genetic and covariance between direct and maternal effects were omitted from the analysis. Year of birth and sex had highly significant effects on BW and WW, while month of birth had no significant effects on both traits studied. Bulls of the buffalo had highly significant effects on BW and WW. Direct heritability estimates for BW are 0.30 and 0.33, for Model 1 and Model 2, respectively. Direct heritability estimates for WW are 0.34 and 0.39 for Model 1 and Model 2, respectively. Maternal heritability estimates are 0.10 and 0.03 for BW and WW, respectively. Phenotypic and genetic correlations among BW and WW are positive and highly significant. These results indicate the important of maternal genetic effect on birth weight.

Keywords: *Bubalus bubalis*, buffaloes, direct, maternal, birth, weaning, Egyptian buffaloes

INTRODUCTION

Growth traits such as birth weight and weaning weight in farm animals are influenced by non genetic factors (i.e., sex, year and month of birth) and genetic parameters such as direct heritability, maternal heritability, phenotypic and genetic correlations). The primary goal of animal breeders is to maximize the rate of genetic improvement.The main objectives of this study are to (1) estimate non genetic factors affecting birth weight and weaning weight, (2) estimates genetic parameters associated with direct and maternal genetic effects on birth and weaning weights for Egyptian buffalo calves.

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MATERIALS AND METHODS

A total of 1173 first calves of Egyptian buffaloes sired by 99 bulls were used in the present study. Data were collected from the history sheets of the herd kept at Mahalla Mousa Farm, kaferelsheikh, government, belonging to Animal Production Research Institute, Ministry of Agriculture, Dokki, Cairo, Egypt.

Calves were suckled colostrum from their dams for the first three days after calving, after that they were given natural milk by bucked and free fodder calf starter till the end of weaning period at fifteen weeks of age. Beside milk, green fodders were given to the calves ad lib., according to the schedule applied under the feeding and management system of Animal Production Research Institute (APRI), Egypt. Calves were fed on *(Trifolium alexandrinum*) during winter seasons, while for summer seasons calves were fed on concentrate ration and rice straw. The concentrates (calf meal) were offered to calve from the beginning of the third or fourth week of age according to their age and consisted of 48% yellow maize, 17% cotton seed cake, 10% wheat bran, 10 rice starch residue, 10% linseed meal, 2% molasses, 1% limestone, 1% bone meal and 1% salt. Calves were weighted for the first time within 24 h from birth and also at weaning at the age of 15 weeks. Weight was recorded before eating or drinking. Weights of calves were recorded for the nearest 2 kg. Traits studied are birth weight (BW) and weaning weight (WW).

Preliminarily analysis of data was made by Statistical Analysis System (SAS) version 8.2. The linear mixed model includes, the fixed of month and year of birth and sex and random effects of sire of calve and error. Heritability, genetic and phenotypic correlation are estimated by using multi trait animal model (Boldman *et al*., 1995). Two animal models were used. Model 1 (full model) includes the fixed effects of month and year of birth and sex and direct genetic, maternal genetic, covariance between direct and maternal genetic and residual as random effects. Model 2 is similar to Model 1, while excluding additive maternal and covariance between additive direct and maternal genetic effects.

RESULTS AND DISCUSSIONS

Unadjusted means, standard deviation (SD) and coefficient of variability (CV%) for birth weight (BW) and weaning weight (WW) are presented in Table 1. Means of BW and WW are 36.05 and 112.04 kg, respectively (Table 1). The present mean of BW was higher that those reported by El- Shaife (1994) (27.34 kg) and Karima Shahin *et al*. (2010) (33.50 kg) working on other sets of Egyptian buffalo calves. Also, Van Sanh (2007) with swamp buffaloes, found that the average birth weight for four groups, ranged from 20.30 to 24.20 kg. Naderi and Maded (2016) with Iranian buffaloes found that the average BW was 32.27 kg. Overall mean of WW was 112.04 kg (Table 1). The average WW was higher than those reported by Karima Shahin *et al.* (2010) (77.28 kg) and Ashmawy and Manal El-Bramony (2017) (84.0 kg) working on Egyptian buffaloes, while the present mean of WW was lower than that reported by Filho *et al*. (2007) working on buffaloes in Brazil, found that the average BW and WW are 37.60 and 192.7 kg, respectively.

The small CV % values for BW and WW (16.70 and 5.43%, respectively Table 1), reflect a small variation between calves in birth and weaning weight. Our estimates are higher than those recorded by Karima Shahin *et al*. (2010), 4.43 and 3.75%, respectively. The different between the present results and other investigators may be attributed to different climatic and managerial conditions, feeding system, genetic differences among herds, different methods, and programs of analysis.

Least squares analysis of variance (Table 2) show that sire of the calf had a significant effect on BW and WW (P<0.01). Our results indicate the possibility of genetic improvement in body weight at weaning through selection. Similar results are reported by El-Shafie (1994); Mahdy *et al*. (1999); Ashmawy and Manal El- Bramony (2017) working other sets of Egyptian buffaloes.

Table 2 show significant effect of year of birth and sex on BW and WW (<P<0.01). The differences in BW and WW among different year of birth can be due to differences in management and agro climatic conditions. And the effect of sex on BW and WW can be assigned to the differences in endocrine system of female and males. El Shafie (1994); Malhado *et al*. (2007) working on Egyptian buffaloes and Murrah buffaloes, respectively. While, month of birth had no significant effect on BW and WW (Table 2).

Estimates of variance components, heritability, phenotypic and genetic correlations among BW and WW as estimated from Model 1 (full model) and Model 2 are presented in Table 3. Estimates of direct heritability for BW are 0.30 and 0.33 and for WW are 0.34 and 0.39, estimated from Model 1 (full model) and Model 2, respectively. Our estimate for BW was higher than those reported by many authors working on different breeds of buffaloes. In this respect, El- Shafie (1994) (0.203), Mahdy *et al*. (1999) (0.14), Malhado *et al*. (2007) (0.09) and Naderi and Maded (2016) (0.13). Also, our estimates of WW are higher than those found by Karima Shahin *et al*. (2010) (0.10) and Ashmawy and Manal El -Bramony (2017) (0.189). The moderate direct h^2 estimates for BW and WW indicated that the genetic improvement of birth and weaning weight can be achieved through selection breeding programs as well as better managerial practices. Malhado *et al*. (2007) in a study based on 6,992 buffaloes, using multi trait animal model found that direct heritability for BW and WW are 0.09 and 0.45. The high heritability estimates for WW, show potential for genetic gain and indicate selection should be used for improvement of buffaloes. Ashmawy and Manal El- Barmony (2017) with another set of Egyptian buffaloes concluded that selection to improve weight at weaning is expected to have a positive response in age at calving.

Estimates of maternal heritability for BW and WW are 0.10 and 0.03, respectively (Table

Table 1. Means, Standard deviation (SD) and coefficients of variability (CV%) for birth weight (BW) and weaning weight (WW) in Egyptian buffaloes calves.

Traits	N	Mean, kg	SD, kg	CV%
BW, kg	1173	36.05	6.02	16.70
WW, kg	1173	112.04	6.08	5.43

Table 2. Least squares analysis of variance for factors affecting birth weight (BW) and weaning weight (WW) on Egyptian buffaloes calves.

S.O.V.	df	F-values	
		BW	WW
Between Sires	98	3.82**	3.84**
Between month of birth	11	0.96ns	0.98ns
Between year of birth	12	22.86**	22.69**
Between sex	1	15.79**	15.02**
Residual, M.S.	1050	26.34	26.87

Table 3. Variance components and heritability estimates for birth weight (BW) and weaning weight (WW) for Egyptian buffaloes claves as estimated from Model 1 and Model 2.

Variance components and heritability	o^{2}a	o^{2}m	oam	o^{2}e	o^{2}p	h^{2}d	h^{2}m
Model 1							
BW	8.31	2.665	1.12	19.64	27.61	0.30+0.01	0.10+0.001
WW	10.22	0.807	0.34	19.86	30.08	0.34+0.02	0.03+0.001
rp_{12}	0.94						
rg_{12}	0.97±0.14						
ram11	-0.44±0.14						
ram 22	-0.09±0.15						
-2 log L	6282.98						
Model 2							
BW	9.97			20.12	30.08	0.33+0.08	
WW	13.22			20.59	33.81	0.39+0.08	
rp_{12}	0.44						
rg_{12}	0.53±0.10						
-2 log L	6282.98						

Where σ^2a = additive direct genetic effect; σ^2m = additive maternal genetic effect;
σam = covariance between direct and maternal genetic effect;
σ^2e = residual error; σ^2p = phenotypic variance; h^2d = direct heritability; h^2m = maternal heritability;
r_p = phe1notypic correlation; r_a = genetic correlation; r_{am} = genetic correlation between direct and maternal effects.

3). The present results indicate the important of maternal genetic effect on birth weight, while small amount of additive maternal genetic effects for weaning weight, it may be concluded that the additive maternal genetic effects and covariance between additive maternal and direct genetic effects do not seem to make important contribution to the phenotypic variance of weaning weight, probably because the important environmental influence of the dams on their calves is from conception to birth. Similar results are obtained by Malhado *et al*. (2007); Ashmawy and Manal El-Barmony (2017) and ranged from 0.07 to 0.09. The removal of additive genetic maternal effects and covariances between direct and maternal effects from the model (Model 2) increased estimates of heritability of direct genetic effects by 0.01 and 0.05 for BW and WW, respectively.

Estimates of phenotypic correlations, genetic correlations and genetic correlations between direct and maternal effects are presented in Table 3. Estimates of phenotypic correlation between BW and WW are 0.94 and 0.44 as estimated from Model 1 and Model 2, respectively. Genetic correlation between BW and WW are 0.97 and 0.53 as estimated from Model 1 and Model 2, respectively. Positive and highly significant phenotypic and genetic correlation among BW and WW suggested that selection for higher birth weight would cause a correlated increase in weaning weight. Similar results are reported by Karima *et al*. (2010) with another set of Egyptian buffalo calves reported that the genetic and phenotypic correlation among BW and WW 0.97 and 0.35, respectively.

Genetic correlations between direct and maternal genetic effects are negative and are -0.44 and -0.09 (Table 3). Negative genetic correlation between direct and maternal genetic effects for BW and WW suggest that many of genes which favor the milking and mothering ability of a cow are partly detrimental for growth of the young calf (Mohuiddin, 1993).

CONCLUSION

It is concluded that year of birth, sex and bull were important factors affecting BW and WW, while season of birth was not important factors affecting growth traits.

Moderate heritability estimates BW and WW indicate the possibility of genetic improvement for BW and WW through sire selection. Positive genetic correlation between BW and WW suggests that selection for higher weaning weight has caused an increase in birth weight and is a good insurance policy. Direct and maternal genetic effects and their covariance were previously established as important for birth weight and little effect on weaning weight.

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