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ESTIMATION OF GENETIC PARAMETERS FOR BODY MEASUREMENTS AND THEIR RELATIONSHIP WITH BODY WEIGHT IN BARKI LAMBS

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ABSTRACT

The aim of the present study was to investigate the importance of direct and maternal effects on the body measurements and live weight of Barki lambs. Data of 214 lambs progenies from 36 sires and 98 dams recorded of Barki of Sheep flock in Maryout Research Station at Desert Research Center was used to estimate the genetic parameters of body measurements and yearling live weight in Barki lambs. The used traits in present study were: body length (BL), height at withers (HW), heart girth (HG) and yearling weight (YW). The estimations were done by using DFREML software. Direct heritability by single trait analysis was estimated 0.10, for BL, 0.18, for HW, 0.10, for HG, and 0.10, for YW. The effect of permanent environmental due to dam was estimated 0.05, 0.02, 0.06 and 0.04 for BL, HW, HG and YW, respectively. Using bivariate analysis, additive genetic correlations were estimated 0.75, 0.76 and 0.93 between YW and each of BL, HW and HG, respectively. High and positive genetic and phenotypic correlations indicate that an improvement in body measurements both at the genetic and phenotypic level is expected through selection on body weight and vice versa.

keywords: Barki lambs,direct heritability, permanent environmental and genetic correlation.

INTRODUCTION

Barki sheep is one of the indigenous breeds of Egypt, known to be well adapted to the dry, harsh conditions and scarce vegetation of the north western desert. They are fat-tailed and while it is a dual-purpose sheep (meat and wool), they are mostly kept for their mutton production. For faster genetic improvement and increasing the efficiency of the prevailing production system, accurate genetic parameters for economically important traits are prerequisite in order to obtain reliable estimates to enhance the accuracy of selection for breeding animals (El-Wakil and Gad, 2014). Meat yield is a complex polygenic trait that is highly affected by non-genetic and genetic factors. Biometric characteristics or linear measurements with simple genetic controls could be used as an indirect criterion in many domestic animal species to help meat yield improvement. Body measurements beside weight measurements describe more completely an individual or population than the conventional methods of weighing and grading (Salako, 2006). Using measurement criteria, breeders can be able to identify early maturing and late maturing animals with different sizes (Brown *et al.,* 1976). In sheep breeding, it is well known that type traits have an important influence on sheep performance. Measures of size and body form are desired in many experiments with sheep, including studies of growth, inheritance and nutrition (Duguma *et al.,* 2002; Fourie *et al.,* 2002; Janssens and Vandepitte, 2004; Kunene *et al.,* 2007; Mandal *et al.,* 2008). In meat-producing species, body conformation and growth rate of animals are important selection criteria (Mandal *et al.,* 2008). These measurements, in addition to weight measurements, describe more completely an individual or population than do the conventional methods of weighing and grading (Salako, 2006a) and are of value in predicting live body weight (Mohammed and Amin, 1996) and also in judging the quantitative characteristics of meat (Bose and Basu, 1984). The genetic improvement in a trait depends upon its additive genetic variation and its genetic correlation with other traits. Currently, the generally accepted strategy is to estimate necessary (co)variance using an animal model incorporating REML procedure and use these estimates for BLUP of breeding values. For Barki sheep, the genetic information on body weight and body measurements is scarce. The aim of this study, therefore, was to estimate genetic parameters for yearling weight, body length, heart girth and height at withers, for an experimental flock of Egypt Barki sheep. The relationships between traits were also studied. It will be helpful for breeder can be used biometric linear traits as a criterion in selection program.

MATERIALS AND METHODS

Data :

Body measurements data from 214 lambs from 36 sires and 98 dams recorded during 3 years from 2008 to 2010, of Maryout Research Station, at Desert Research Center. In general, Ewes are raised in an annual breeding cycle starting in August. Young ewes are mated so as to lamb for the first time at approximately 1.5 years of age. There is one breeding season in August- October. Ewes in heat are exposed to pre-defined rams at morning. Lambing commences in mid-January and continues until April. Ewes are supplemented, depending upon the ewes' requirements, for a few days after lambing. All lambs are identified at birth and birth weights, as well as sex and pedigree information is recorded. During the suckling period, lambs are fed with their mothers' milk and also allowed dry alfalfa after 3 weeks of age. Lambs are weaned at approximately 90 days of age. Detailed feeding and flock management was described elsewhere (El-Wakil *et al.,* 2009).

Studied traits

The traits measured were yearling weight (YW) and three body dimensions measured at a year of age: body length (BL), heart girth (HG) and height at withers (HW). BL was considered as the distance between the point of the shoulder and pinbone, HG was measured behind the shoulder, HW was measured as the distance from the floor to between the shoulders. Tape measure was used to measuring BL, HW and HG.

Statistical analyses

Preliminary yearling weight and body measurements were analyzed using the GLM (Generalized Linear Models) procedure of SAS software (2004) to identify non-genetic factors to be included in the model. The fixed model for BL, HW, HG and YW included effects for year of lambing, month of lambing (January, February, March and April) and age of dam at lambing. For BL, HW, HG and YW all the factors were significant ($p<0.05$).

Consequently, they were introduced for further analysis by fitting an animal model using the MTDFREML program (Boldman *et al.,* 1995). The model included the same fixed effects mentioned earlier and considering the animal, sire and dam as random effects as follows:

$Y = Xb + Z_a a + Z_m m + Z_c c + e$, Cov (a, m) = $A\sigma_{am}$

where Y is a vector of observations on the studied trait; b, a, m, c and e are vectors of fixed effects, direct additive genetic effects, maternal additive genetic effects, maternal permanent environmental effects and the residual (direct permanent environmental) effects, respectively. X, Z_a, Z_m and Z_c are incidence matrices relating observations to the fixed effects, direct additive genetic effects, maternal additive genetic effects and maternal permanent environmental effects, respectively. It was assumed that direct additive genetic, maternal additive genetic, maternal permanent environmental and direct permanent environmental effects to be normally distributed with mean of zero and variance of $A\sigma^2_a$, $A\sigma^2_m$, $I_d\sigma^2 c$ and $I_n\sigma^2_e$, respectively; where, σ^2_a, σ^2_m, σ^2_c and σ^2_e are direct additive genetic variance, maternal additive genetic variance, maternal permanent environmental variance and the direct permanent environmental variance, respectively. "A" is the additive numerator relationship matrix, while I_d, I_l and I_n are identity matrices with dimensions equal to the number of the dams and number of records, respectively. Moreover, σ_{am} refers to the covariance between direct additive genetic and maternal additive genetic effects. Estimates of correlations between studied traits were done using a series of bivariate analyses. The appropriate covariance, phenotypic or genetic, between each pair of studied traits traits, x and y, was divided by the square root of the product of the phenotypic variance of each trait.

RESULTS AND DISCUSSION

Least squares means and standard errors of Barki lambs for BL, HW, HG and YW are presented in Table 1. The obtained results were similar to those reported for Barki sheep in the same flock (Shehata, 2013). Mandal et al, (2010) recorded mean values of 71.9, 92.6 and 73.9cm for BL, HW, HG, respectively, in Muzaffarnagari lambs in India On Makuie lambs, Jafari (2014) recorded mean values of 50.1, 63.8, 81.9 cm and 39.7 kg for BL, HW, HG and YW, respectively. Different estimates reported of average body measurements probably due to breed differences as well as the feeding and management conditions under which the flock was maintained.

Table 1. Least squares means and standard errors of body measurements and yearling weight.

Trait	Mean ±SE	C.V.(%)
Body length (BL) cm	71.6±0.5	9.6
Height at wither (HW) cm	74.9±0.4	7.9
Heart girth (HG) cm	99.6±0.5	8.2
Yearling weight (YW) kg	43.3±0.5	17.8

Apparently, these estimates in all cases are lower than our findings. This is probably caused by significant influences of husbandry system on certain body measurements. For this reason, single linear measurements are relevant for on-farm within herd use. Body weight was the most variable trait. The reason of greater CVP for YW was probably due to more variation and effect of outside environment on this trait. Similar to our findings, Fourie et al, (2002) , Janssen and Vandepitte (2004) Salako,(2006), Alfolayan et al (2006), Mandal et al (2010), Shehata, (2013) and Jafari (2014), they founds greater CVP for body weight compared to body measurements in different breeds of sheep. Larger variation within certain measurements suggests absence of selection, or the parts respond more to environment than others (Salako, 2006).

Table 2 gives the estimates of variance components and heritability for traits studied. The heritability estimates for BL, HG, HW and YW were 0.10, 0.18and 0.07 respectively. The general, scarcity of literature on the subject of estimates of heritability for body measurements for Barki sheep makes comparison difficult. In general, our results show that selecting for improved body measurements in Barki sheep would generate a relatively slow genetic progress because these traits are of relatively low heritability. Janssen and Vandepitte (2004) emphasize that the low heritability estimates imply that selection should be based on estimates breeding values obtained by best linear unbiased prediction, BLUP. In this respect, different breeds for body measurements traits reported by few researchers, Janssen and Vandepitte (2004) for three breeds of adult Belgian sheep. Their estimates of heritability for BL, HG and HW were 0.30, 0.45 and 0.43 in Blue du Main, 0.35, 0.39 and 0.57 in Suffolk, and 0.28, 0.40 and 0.40 in Texel. In Germany, Horstick (2001) who worked on adult East Friesian and Black-Brown milk-sheep, found heritability estimates of 0.72, 0.70 and 0.56 for BL, HG and HW, respectively. Mandal et al. (2008) studied body measurements at birth and weaning in Muzaffarnagari sheep and reported heritability estimates for BL, HG and HW of 0.14, 0.14 and 0.07 at birth and of 0.12, 0.16 and 0.15 at weaning, respectively. Jafari (2014) on Makuie sheep breed found heritability estimates of 0.10, 0.20 and 0.14 for the same traits at 12 months.

Table 2.Estimation of (co) variance components and genetic parameters for body measurements and yearling body weight in Barki lambs.

Trait	h^2_d	m^2	r_{am}	c^2
BL	0.10	0.01	0.00	0.05
HW	0.18	0.02	-0.32	0.02
HG	0.10	0.01	-0.10	0.06
YW	0.10	0.12	0.35	0.04

BL= Body length, HW= Height at wither, HG= Heart girth, YW= Yearling weight, h^2_d = direct heritability, m^2=maternal additive effect, r_{am} = correlation between direct and maternal additive

effect, c^2= maternal permanent environmental.

The estimated value of direct and maternal heritability (0.10 and 0.12, respectively) for YW was almost close to reported by El-Wakil and Gad (2014) with Barki sheep. Maternal additive effects were contributed 0.01% to 0.12% for body measurements and yearling weight. But, presence of maternal genetic was non- significant in affecting of total phenotypic variance for body measurements. However, our estimate is lower than those observed by Jafari (2014) on Makuie sheep breed found direct and maternal heritability was 0.07 and 0.01, , for BL, respectively, 0.20 and 0.05, , for HW, respectively, 0.10 and 0.01, for HG, respectively, and 0.20 and 0.29 for YW, respectively.

Direct and maternal genetic correlations (r_{am}) for body measurements were 0.0 to -0.32 (Table2). Recent studies have shown that the data structure plays the main role in the producing of negative correlation between direct and maternal genetic. As low progeny records per dam in data structure produce negative r_{am} Matiatis and Pollot (2003). Whereas high number of progeny records per dam produce positive r_{am}.

Permanent environmental maternal effect (c^2) explained 2% to 6% of total phenotypic variance for body measurements and yearling weight.

Correlations

Genetic correlation between traits was high and positive and ranged from 0.46 to 0.93, which indicated that traits were genetically linked Table 3. Heart girth had the highest genetic and phenotypic correlations with body weight. Salako(2006) and Abbasi and Farhad ,(2011) reported similar findings. Heart girth is a part of tissue measurements (Blackmore *et al.,* 1958), while other measurements are related to skeletal measurements. It can explain, to some extent, the higher correlation between body weight and hearth girth. However, Jafari (2014) on Makuie sheep breed reported that genetic correlation was estimated in range of 0.47 to 0.82 among body measurements.

Table 3. additive genetic (below diagonal) and phenotypic correlation (above diagonal) among body measurements and yearling weight in Barki lambs.

	BL	HW	HG	YW
BL		0.54	0.45	0.41
HW	0.81		0.43	0.56
HG	0.82	0.46		0.51
YW	0.75	0.76	0.93	

BL= Body length, HW= Height at wither, HG= Heart girth, YW= Yearling weight.

CONCLUSION

There is a substantial variability among the individuals in Barki sheep breed population. The estimated genetic parameters using animal model could be proposed to obtain accurate estimates. The high and positive genetic correlations among the body measurements indicated the importance of this effect in the similarity of traits. High correlation between body measurements and YW suggested that genetic progress in the body measurement traits and live weight traits is possible at a same time.

REFERENCES

Abbasi, M.A.and F. Ghafouri-Kesbi, 2011. Genetic (Co) variance components for body weight and body measurements in Makooei sheep. Asian-Aust.J. Anim. Sci. Vol. 24, No 6: 739-743.

Alfolayan, R. A., I.A. Adeyinka and C.A.M. Lakpini, 2006. The estimation of live weight from body measurements in Yankasa sheep. Czech J. of Anim. Sci., 51: 343-348.

Blackmore, D. W., L. D McGulliard and J. L. Lush. 1958. Genetic relationship between body measurements at three ages in Holstein. J. Dairy Sci. 41:1045-1049.

Boldman, K. G.; L. A. Kriese; L. D. Van Vleck; C. P. Van Tassell (1995). A manual for use of MTDFREML. A set of programs to obtain estimates of variances and covariances. US Department of Agriculture, Agriculture Research Service, Washington DC.

Bose, S. and S. B. Basu. 1984. Relationship between body measurements and meat production in Beetal goats. Ind. Vet. J. 61:670-673Brown et al., 1976

Brown, J.E., Brown, C.J. & Butts, W.T., 1973. Evaluating relationships among immature measures of size, shape and performance of beef bulls. J. Anim. Sci. 36, 1010-1020

Duguma, G., S. W. P. Cloete, S. J. Schoeman and G. F. Jordaan. 2002. Genetic parameters of testicular measurements in Merino rams and the influence of scrotal circumference on total flock fertility. S. Afr. J. Anim. Sci. 32:76-80.

El-Wakil, Salwa I. ; S. M. A. Gad (2014). Evaluation of direct and maternal (co) variance components and heritabilities for some body weights and growth traits in Barki sheep. Egyptian Journal of Sheep & Goat Sciences, 9 (1): 21- 30.

El-Wakil, Salwa I.; ManalElsayed; A. M. Ahmed; R. R. Sadek; A. A. Nigm. 2009. Genetic and phenotypic parameters of birth, weaning and yearling body weights of Barki sheep raised in the north western coast of Egypt.*Egyptian J. Anim. Prod., 46 (1): 43-52.*

Fourie, P. J., F. W. C. Neser, J. J. Olivier and C. V. Der Westhuizen. 2002. Relationship between production performance, visual appraisal and body measurements of young Dorper rams. S. Afr. J. Anim. Sci. 32:256-262.

Horstick, A.; Hamann, H.; Distl, O., 2001: Analysis of milk performance traits in East Friesian and Black-Brown milk sheep 2nd communication: genetic parameters of test day records. Zuchtungskunde 73(5): 343-352

Jafari S., 2014 Estimation of genetic parameters for body measurements and their association with yearling live weight in Makuie sheep breed. World App. Sci. J. 29(2):188-192.

Janssens, S. and W. Vandepitte. 2004. Genetic parameters for body measurements and linear type traits in Belgian Blue du Maine, Suffolk and Texel sheep. Small Rumin. Res. 54:13-24.

Kunene, N., E.A. Nesamvuni and A.F. Fossey, 2007. Characterization of Zulu (Nguni) sheep using linear body measurement and some environmental factors affecting these measurements. South. Afr. J. Anim Sci., 37: 11-20.

Mandal, A., G. Dass, P.K. Rout and R. Roy, 2010. Genetic parameters for direct and maternal effects on post-weaning body measurements of Muzaffarnagari sheep in India. Trop. Anim. Health Prod., 43(3): 675-683

Mandal, A., R. Roy and P. K. Rout. 2008. Direct and maternal effects for body measurements at birth and weaning in Muzaffarnagari sheep of India. Small Rumin. Res. 75:123-127.

Matiatis, N. and G.E. Pollot, 2003. The impact of data structure on genetic (co) variance components of early growth in sheep, estimated using an animal model with natural effects. J. Anim. Sci., 81: 101- 108.

Mohammed, I. D. and J. D. Amin. 1996. Estimating body weight from morphometric measurements of Sahel (Borno White) goats. Small Rumin. Res. 24:1-5.

SAS (2004). Statistical Analysis System. SAS Users Guide: Statistics. SAS Institute Inc. Editors, Cary, NC.

Salako, A.E., 2006, Application of Morphological Indices in theAssessment of Type and Function in Sheep. Int. J. Morphol, 24(1): 13-18.

Shehata M. F., 2013. Prediction of live body weight and carcass traits by some live body measurements in Barki sheep. Egy. J. of Anim. Prod. Vol. 50(2):69-75.

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تقدير المعالم الوراثية لمقاييس الجسم وعلاقتها بوزن الجسم في حملان البرقي

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الهدف من هذه الدراسة البحث عن اهمية الاثار المباشرة والامية علي صفات قياسات الجسم والوزن الحي في حملان البرقي .استخدمت في هذه الدراسة سجلات قياسات الجسم لعدد 214من الحملان ابناء لعدد 36كبش و 94نعجة في محطة بحوث مريوط التابعة لمركز بحوث الصحراء ، وذلك لتقدير المعالم الوراثية المباشرة والامية بغرض تحسين صفات قياسات الجسم في اغنام البرقي .كانت الصفات المستخدمة في هذه الدراسة قياسات الجسم وتشمل :طول الجسم – ارتفاع الجسم– محيط الصدر بالاضافة الي الوزن الحي عند عمر سنة . وقد اجري التحليل الاحصائي باستخدام برنامج نموذج الحيوان .قدر المكافئ الوراثي بمقدار 0.10لطول الجسم، 0.18للارتفاع الجسم، 0.10لمحيط الصدر 0.10 ,للوزن الحي .كانت التأثيرات البيئية الدائمة 0.05، 0.02، 0.06و 0.04لكل من طول الجسم وارتفاع الجسم ومحيط الصدر والوزن الحي علي التوالي .كانت الارتباطات الوراثية والمظهرية عالية وموجبة تشير النتائج الي توقع تحسنا في قياسات الجسم سواء علي المستوي الوراثي او المظهري من خلال الانتخاب علي وزن الجسم والعكس بالعكس .