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Genetic Analysis of Pre-Weaning Growth Traits of Anglo-Nubian and Baladi Kids

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ABSTRACT

Data representing 592 Anglo-Nubian and 347 Baladi kids born at Alexandria University Experimental Station, between 1997and 2014 were utilized in this investigation to estimate genetic parameters, breeding values and genetic trends of birth weight (BW), weaning weight (WW) and average daily gain (ADG) from birth to weaning. The analysis of variance indicated that the overall means of BW, WW and ADG of Anglo-Nubian kids were 2.54 kg, 13.12 kg and 86.8 g, while the corresponding values for Baladi kids were 2.27 kg, 10.21 kg and 64.9 g, respectively. The effect of season and year of birth, sex of kid, type of birth and parity on all traits were significant ($P<0.01$or $P<0.05$) except for the effect of parity on WW and ADG of Baladi kids which were not significant. Genetic parameters and breeding values for the studied traits were estimated for each breed separately using Wombat program, fitting multivariate animal models. Estimates of the direct heritability (h^2_a) were 0.097, 0.109 and 0.095 for BW, WW and ADG of Anglo-Nubian kids, respectively. The corresponding values for Baladi Kids were 0.060, 0.280 and 0.292for the respective traits. Estimates of the maternal heritability (h^2_m) were 0.238, 0.106 and 0.097 for BW, WW and ADG of Anglo-Nubian kids, respectively. The corresponding values for Baladi Kids were 0.045, 0.178 and 0.162 for the respective traits. Estimates of the fraction of variance due to maternal permanent environmental effects (c^2) were 0.488, 0.057 and 0.066 for BW, WW and ADG of Anglo-Nubian kids, respectively. The corresponding values for Baladi kids were 0.295, 0.038 and 0.021 for the respective traits. These results indicate that maternal effect is an important source of variation for pre-weaning growth traits of kids of both breeds. The genetic correlations (r_g) among growth traits of both breeds were significant ($P<0.01$), ranging from 0.677 to 0.999. These high and positive correlations indicate that selection for any of growth traits can lead to positive genetic progress in the others. The maternal genetic correlations (r_m) were low to high, being 0.329, 0.061 and 0.962 between BW and WW, between BW and ADG and between WW and ADG of Anglo-Nubian kids, respectively. The corresponding values for Baladi kids were 0.347, -0.027 and 0.919. The maternal permanent environmental correlations (r_c) among growth traits of Anglo-Nubian kids were considerably high and ranged from 0.925 to 0.999, the respective values for Baladi kids were close to unity. The phenotypic correlations (r_p) were 0.393 and 0.240 between BW and each of WW and ADG of Anglo-Nubian kids, while the value between WW and ADG was greatly higher being 0.962. The corresponding values in the case of Baladi kids were close to unity. The breeding values for BW, WW and ADG of Anglo-Nubian bucks varied between -0.131 and 0.324 kg, between -0.591 and 1.818 kg and between -4.64 and 12.27 g, respectively, the corresponding values for Baladi bucks were between -0.144 and 0.112 kg, between -2.277 and 1.205 kg and between -18.08 and 9.28 g for the respective traits. The genetic trends estimated by the regression of bucks breeding values on time were positive but non-significant for all studied traits of both breeds. The results in general indicate the need for designing an effective selection program to improve growth traits of kids in both breeds.

Keywords: *Variance components, heritability, maternal effects, pre-weaning growth, Anglo-Nubian, Baladi, kids*

INTRODUCTION

The pre-weaning growth traits are important in any goat's enterprise. Birth and weaning weights of kids are related to survival and postnatal development. Rapid pre-weaning growth of kids can reduce the rearing costs, resulting in more profit to goat producers (Roy *et al* 2008, Hermiz *et al*. 2009, Zhang *et al*. 2009, Bazzi and Ghazaghi 2011, Kuthu *et al*. 2013, Belay and Mengistie 2013, Hasan *et al*. 2014 and Bolacali *et al*. 2017).

Numerous investigators worked on various goat breeds worldwide indicated that maternal effects are important source of variation in pre-weaning growth traits of kids (Boujenane and El Hazzab 2008, Roy *et al*. 2008, Supakorn and Pralomkarn 2009, Zhang *et al*. 2009, Gholizadeh *et al*. 2010, Gowane *et al.* 2011, Mohammadi *et al*. 2012, Bedhane *et al*. 2013, Sadegh *et al*. 2013, Gupta *et al.* 2016 and El-Awady *et al*. 2019). Therefore, the maternal effects should be taken into consideration when carrying out genetic evaluations of pre-weaning growth traits of kids in order to achieve an accurate assessment genetic merits (Boujenane and El Hazzab 2008, Roy *et al.* 2008, Gholizadeh *et al*. 2010, Gowane *et al.* 2011, Osman 2013, Sadegh *et al*. 2013, Rout *et al*. 2018 and El-Awady *et al*. 2019).

The estimates of genetic and phenotypic parameters are essential for formulating efficient breeding programs and selection strategies for the genetic improvement of kids' growth traits (Boujenane and El Hazzab, 2008, Kantanamalakul *et al*. 2008, Otuma and Osakwe 2008, Supakorn and Pralomkarn 2009, Alade *et al*. 2010, Gholizadeh *et al*. 2010, Supakorn *et al*. 2011, Mohammadi *et al*. 2012, Bedhane *et al*. 2013, Bhattarai *et al*. 2017 and Kuthu *et al*. 2017). Accurate estimate of breeding values of pre-weaning growth traits of kids are important to achieve genetic evaluations that are necessary to select parents of the next generation (Supakorn and Pralomkarn 2009 and Kuthu *et al*. 2017). Genetic trends for early growth traits of kids of different goat's breeds have been reported by several researchers (Snyman 2012, Hasan *et al*. 2014, Kuthu *et al*. 2017, Rout *et al*. 2018 and El-Awady *et al*. 2019).

The objective of this investigation was to estimate genetic parameters, breeding values and genetic trends of birth and weaning weights and average daily gain from birth to weaning of Anglo-Nubian and Baladi kids in Egypt.

MATERIALS AND METHODS

Source of data:

Data used for this investigation were collected from the records of the goat herd of the Experiment Station, Faculty of Agriculture, Alexandria University. The data covered the period from 1997 to 2014 and were collected from the records of 592 and 347 Anglo-Nubian and Baladi kids' offspring of 21 and 18 bucks and 132 and 89 does, respectively. Descriptive statistics and distribution of the data are presented in Table 1.

Table 1. Descriptive statistics and distribution of the data for studied traits of Anglo- Nubian and Baladi kids.

Items	Anglo-Nubian			Baladi		
	BW	WW	ADG	BW	WW	ADG
Mean, (kg or g)	2.54	13.12	86.8	2.27	10.21	64.9
SD	0.54	3.45	27.66	0.43	2.58	19.79
C.V (%)	21.13	26.33	31.87	19.05	25.23	30.50
No. of records	592	459	459	347	291	291
No. of bucks	21	19	19	18	17	17
No. of does	132	95	95	89	83	83
No. of buck kids	291	224	224	174	139	139
No. of doe kids	301	235	235	173	152	152
No. of single kids	132	103	103	110	92	92
No. of twin kids	389	300	300	219	184	184
No. of triplet kids	71	56	56	18	15	15

BW: birth weight, WW: weaning weight, ADG: average daily gain

Herd management:

Animals were housed in semi closed pens, fed on berseem (*Trifolium alexandrinum*) during winter and spring and on stubble and berseem hay and/ or fodder sorghum (*Sorghum bicolor)* during summer and autumn. Supplementary concentrate ration of about 0.25 kg / head were offered daily along the year.

The herd was managed for all year round kidding. Females were first mated at about 18 months of age. Bucks and does were selected as yearlings on the basis of visual appraisal for type and size rather than on a pre-set intensive selection programme. Once the doe entered the breeding herd, there is no chance for culling until the end of its productive life. Kids were weighed 12-24 hours after birth to the nearest 0.01 kg. They were weaned at about 4 months of age.

Statistical analysis:

Least squares analysis of variance were utilized to test the significance of the fixed effects of season of birth (4 seasons), year of birth (6 periods), sex of kid (male and female), type of birth (single, twin and triplet) and parity (6 parities) on birth weight (BW), weaning weight (WW) and average daily gain (ADG) from birth to weaning. Months of birth were classified by season into autumn (September, October and November), winter (December, January and February), spring (March, April and May) and summer (June, July and August). Years of birth were classified to six periods (1= 1997-1999, 2= 2000 - 2002, 3=2003 - 2005, 4= 2006 – 2008, 5= 2009-2011 and 6= 2012-2014). Parity was between 1 and 6 or over. Data were analyzed for each breed separately using GLM procedure (SAS 2008). The statistical model fitted was:

$$Y_{ijklmn} = u + A_i + B_j + C_k + D_l + P_m + e_{ijklmn}$$

where,

Y_{ijklmn}: either BW, WW or ADG; µ: an underlying constant specific to each trait; A_i: the fixed effect of i^{th} season of birth (i=1,2,3 and 4); B_j: the fixed effect of j^{th} year of birth (j=1,2,3……6); C_k: the fixed effect of k^{th} sex of kid (k=1 and 2); D_l: the fixed effect of l^{th} type of birth (l=1,2 and 2); P_m: the fixed effect of m^{th} parity (m=1,2,3…..6) and e_{ijklmn}: random residual assumed to be independently and normally distributed with mean zero and variance σ_e^2.

(Co) variance components, genetic parameters and breeding values were estimated using the Wombat program (Meyer 2006) fitting a multivariate animal model. The assumed model was:

$$y = Xb + Z_a a + Z_m m + Z_c c + e$$

where

y is a n × 1 vector of observations for each trait; b, a, m, c and e are vectors of fixed effects (season of birth, year of birth, sex of kid and type of birth and parity), direct additive genetic, maternal additive genetic, maternal permanent environmental and the residual effects, respectively; X, Za, Zm, Zc are the incidence matrices of fixed effects, direct additive genetic, maternal additive genetic and maternal permanent environmental effects;

A is the numerator relationship matrix between animals; and σ_{am} is the covariance between additive direct and maternal genetic effects. The (co)variance structure for the model was:

$$V(a) = A\sigma^2_a, V(m) = A\,\sigma^2_m, V(c) = I_P\,\sigma^2_c, V(e) = I_R\,\sigma^2_e \text{ and } Cov(a, m) = 0$$

where

I_P and I_R are identity matrices with orders equal to the number of dams and the number of kids, respectively and 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 residual variance, respectively. Estimates of heritability (h^2_a), maternal heritability (h^2_m) and permanent maternal environmental effect (c^2) were calculated as ratios of estimates of σ^2_a, σ^2_m, and σ^2_c, respectively, to the phenotypic variance (σ^2_p).

The genetic trends for the studied traits were computed as the regression coefficients of bucks breeding values on their year of birth.

RESULTS AND DISCUSSION

Descriptive statistics and distribution of the data for studied growth traits of Anglo-Nubian and Baladi kids are shown in Table 1. The overall means of BW, WW and ADG of Anglo-Nubian kids were 2.55 kg, 13.18 kg and 87.17 g, respectively, the corresponding values for Baladi kids were 2.25 kg, 10.19 kg and 64.74 g for the respective traits (Table 1).

I- Fixed effects:

The results of analysis of variance in Table (2) show that fixed effects on the studied traits were generally significant (P<0.01or P<0.05), except for the effect of parity on WW and ADG of Baladi kids which were not significant. The results found in this study are in agreement with those reported by Alade *et al.* 2008, Boujenane and El Hazzab 2008, Otuma and Osakwe 2008, Rashidi *et al.* 2008, Hermiz *et al*. 2009, Zhang *et al*. 2009, Thiruvenkadan *et al*. 2009, Sodiq *et al*. 2010, Supakorn *et al*. 2011, Mohammadi *et al.* 2012, Andries 2013, Bedhane *et al.* 2013, Deribe and Taye 2013, Kuthu *et al.* 2013, Osman 2013, Bingol *et al*. 2014, Ray *et al*. 2015, Gupta *et al*. 2016, Syahirah *et al*. 2016, Bolacali *et al*. 2017, Msalya *et al*. 2017, and Rout *et al.* 2018.

II- Genetic and phenotypic parameters:

A- Variance components and heritabilities:

Estimates of variance components (σ^2_a, σ^2_m, σ^2_c, σ^2_e and σ^2_p), heritabilities (h^2_a and h^2_m) and fraction of variance due to maternal permanent environmental effects (c^2) for BW, WW and ADG of Anglo-Nubian and Baladi kids are shown in Table (3). The estimates of variance components for BW, WW and ADG of Anglo-Nubian kids were higher than those of Baladi, except the estimates of σ^2_a for WW and ADG.

Table 2. Mean squares (MS) and level of significance (P<) of factors affecting studied traits of Anglo- Nubian and Baladi kids.

Source of variation	Anglo-Nubian					Baladi				
	df*	MS (P<)	BW	WW	ADG	df*	MS (P<)	BW	WW	ADG
Season of birth	3	MS	4.54	58.21	4142.0	3	MS	0.51	27.72	1734.7
		(P<)	0.0001	0.0080	0.0047		(P<)	0.0428	0.0064	0.0046
Year of birth	5	MS	1.30	32.46	1959.2	5	MS	0.83	38.24	2430.8
		(P<)	0.0005	0.0196	0.0267		(P<)	0.0006	0.0001	0.0001
Sex of kid	1	MS	6.82	141.890.00	7496.8	1	MS	4.54	196.36	9779.4
		(P<)	0.0001	06	0.0019		(P<)	0.0001	0.0001	0.0001
Type of birth	2	MS	14.84	137.160.00	6459.2	2	MS	5.39	92.52	4426.1
		(P<)	0.0001	01	0.0003		(P<)	0.0001	0.0001	0.0001
Parity	5	MS	3.82	52.03	2168.7	5	MS	1.16	6.56	236.7
		(P<)	0.0001	0.0007	0.0156		(P<)	0.0001	0.4244	0.6961
Error		MS	0.29 (575)	11.93 (442)	764.7 (442)		MS	0.19 (330)	6.62 (290)	391.2 (290)

BW: birth weight, WW: weaning weight, ADG: average daily gain
Not significant (P>0.05); Significant (P< 0.05); highly significant (P< 0.01)
Values between parentheses are the degrees of freedom (df) of the error term. Degrees of freedom of BW of both Anglo-Nubian and Baladi breeds were the same for WW and ADG except for error.

Table 3.Variance components, and heritabilities for studied traits of Anglo-Nubian and Baladi kids.

Item	Anglo-Nubian			Baladi		
	BW	WW	ADG	BW	WW	ADG
σ^2_a	0.039	1.43	78.36	0.012	2.00	120.40
σ^2_m	0.096	1.39	79.88	0.009	1.27	66.94
σ^2_c	0.072	0.755	54.09	0.059	0.27	8.54
σ^2_e	0.197	9.56	610.74	0.120	3.60	216.23
σ^2_p	0.404	13.14	823.07	0.200	7.14	412.11
h^2_a± S.E	0.097(0.112)	0.109(0.096)	0.095(0.099)	0.060(0.057)	0.280(0.067)	0.292(0.027)
h^2_m± S.E	0.238(0.135)	0.106(0.091)	0.097(0.092)	0.045(0.499)	0.178(0.448)	0.162(0.468)
c^2± S.E	0.488(0.093)	0.057(0.074)	0.066(0.092)	0.295(0.484)	0.038(0.432)	0.021(0.453)

BW: birth weight, WW: weaning weight, ADG: average daily gain
σ^2_c: maternal permanent environmental variance
c^2: fraction of phenotypic variance due to maternal permanent environmental effects.

The estimates of h^2_a were 0.097, 0.109 and 0.095 for BW, WW and ADG of Anglo-Nubiankids, while those of Baladi kids were 0.060, 0.280 and 0.292, respectively. The low h^2_a estimates obtained in this study for BW, WW and ADG of Anglo-Nubian kids indicate that direct genetic effects constitute a small portion of the phenotypic variances for these traits. Hence, low genetic response through direct selection for these traits in Anglo-Nubian kids would be expected. The h^2_a estimate obtained in this study for BW of Baladi kids was low, while those of WW and ADG of Baladi kids were moderate. Thus, improving these traits by selection would be possible. Low to high h^2_a estimates varying from 0.04 to 0.50, from 0.02 to 0.52 and from 0.04 to 0.43 for BW, WW and ADG of kids of various goats breeds were reported in the literature (Shaat *et al.* 2007, Boujenane and El Hazzab2008, Kantanamalakul *et al.* 2008, McManus *et al.* 2008, Rashidi *et al.* 2008, Roy *et al.* 2008, Thiruvenkadan *et al.* 2009, Zhang *et al.* 2009, Gholizadeh *et al.* 2010, Gowane *et al.* 2011, Supakorn *et al.* 2011, Mohammadi *et al.* 2012, Osman 2013, Sadegh *et al.* 2013, Bedhane *et al.* 2013, Hasan *et al.* 2014,Gupta *et al.* 2016, Kuthu *et al.* 2017, Rout *et al.* 2018 and El-Awady *et al.* 2019). The present estimates of h^2_a for all studied traits are generally in agreement with those found in the literature on several breeds of goats.

The current estimates of h^2_m were 0.238, 0.106 and 0.097 for BW, WW and ADG of Anglo-Nubian kids, and the corresponding values for Baladi kids were 0.045, 0.178 and 0.162, respectively. The estimates of h^2_m for body weights of Anglo-Nubian kids showed a tendency to decrease from birth to weaning. This tendency has also been documented in several studies on goats (Roy *et al.* 2008, Rashidi *et al.* 2008, Zhang *et al.* 2009, Gholizadeh *et al.* 2010, Sadegh *et al.* 2013, Osman 2013, and Gupta *et al.* 2016). An opposite trend was observed for BW and WW in Baladi kids, where the estimate of h^2_m for BW was higher than that of WW. Hence, maternal additive effects constitute an important part of variation for BW of Anglo-Nubian kids. An adverse trend was observed for Baladi kids. Hence, the maternal genetic effect was determined to be less important for BW of Baladi kids. The low h^2_m estimates for WW and ADG of Anglo-Nubian and Baladi kids indicate that maternal genetic effects constitute a little portion of the phenotypic variances for these traits in both breeds. Low to high h^2_m estimates ranged from 0.04 to 0.43, from 0 to 0.30 and from 0.01 to 0.30 for BW, WW and ADG of kids of various goats breeds in different countries have been well documented in the literature (Boujenane and El Hazzab 2008, Kantanamalakul *et al.* 2008, McManus *et al.* 2008, Rashidi *et al.* 2008, Roy *et al.* 2008, Zhang *et al.* 2009, Gholizadeh *et al.* 2010, Gowane *et al.* 2011, Supakorn *et al.* 2011, Mohammadi *et al.* 2012, Snyman 2012, Bedhane *et al.* 2013, Osman 2013, Sadegh *et al.* 2013 and El-Awady *et al.* 2019). Hence, the current estimates of h^2_m for all studied traits are generally in accordance with those reported in the literature on several breeds of goats.

The present estimates of the fraction of variance due to maternal permanent environmental effects (c^2) were 0.488, 0.057 and 0.066 for BW, WW and ADG of Anglo-Nubian kids, and the corresponding values for Baladi kids were 0.295, 0.037 and 0.021, respectively. The c^2 estimate for BW of Anglo-Nubian kids was high, but for Baladi kids was moderate. Whereas, the c^2 estimates for WW and ADG of both breeds were low. Estimates of c^2 for WW and ADG of Anglo-Nubian were relatively higher than those for Baladi kids. Maternal permanent environmental effect probably reflects the differences in the uterine capacity of the does for growth of the fetus and the effect of multiple births. Low to moderate c^2 estimates varying from 0 to 0.35, from 0 to 0.24 and from 0.05 to 0.07 for BW, WW and ADG of kids of various goats breeds in different countries have been reported in the literature (Boujenane and El Hazzab 2008, Kantanamalakul *et al*. 2008, McManus *et al*. 2008, Rashidi *et al*. 2008, Gholizadeh *et al*. 2010, Gowane *et al*. 2011, Snyman 2012, Bedhane *et al*. 2013, Osman 2013, Sadegh *et al*. 2013, Rout *et al*. 2018 and El-Awady *et al*. 2019). In view of the current c^2 values, maternal permanent environmental effect is a crucial portion of variation for BW of both breeds especially for Anglo-Nubian.

The present h^2_m and c^2 estimates indicate that maternal effects are an important source of variation for pre-weaning growth traits of Anglo-Nubian and Baladi kids. Similarly, several studies on goats showed that maternal effects are important source of phenotypic variation for early growth traits of kids (Roy *et al*. 2008, Rashidi *et al*. 2008, Zhang *et al*. 2009, Gholizadeh *et al*. 2010, Gowane *et al*. 2011and Osman 2013, Sadegh *et al*. 2013, Gupta *et al*. 2016 and Rout *et al*. 2018). Therefore, the maternal effects should be taken into consideration when carrying out genetic evaluations of pre-weaning growth traits of kids of both breeds in order to achieve accurate assessment genetic merits.

B- Genetic and phenotypic correlations:

All correlations (r_g, r_m, r_c and r_p) among all studied traits of both breeds are shown in Table 4. The r_g, r_c and r_p values were positive and significant (P<0.01). The r_m values between BW and WW and between WW and ADG of kids of both breeds were positive and significant (P<0.01). The r_m value between BW and ADG of Anglo-Nubian was positive and non-significant but that of Baladi kids was negative and non-significant.

The genetic correlations (r_g) between BW and each of WW and ADG were high for Anglo-Nubian and Baladi kids. The correlations between WW and ADG of both breeds were extremely high close to unity. Hence, selection for any of growth traits could result in positive genetic response in the others. In view of the current r_g values, there are high genetic correlations among the growth traits of the two breeds. Low to high r_g values ranging from 0.23 to 0.71, from 0.18 to 0.92 and from 0.47 to 0.93 between BW and WW, between BW and ADG and between WW and ADG of kids of various goats breeds have been reported in the literature (Shaat *et al*. 2007, Boujenane and El Hazzab 2008, McManus *et al*. 2008, Rashidi *et al*. 2008, Supakorn and Pralomkarn 2009, Thiruvenkadan *et al*. 2009, Gowane *et al.* 2011, Supakorn *et al*. 2011, Snyman 2012, Bedhane *et al*. 2013, Sadegh *et al*. 2013, Hasan *et al.* 2014, Bhattarai *et al*. 2017, Kuthu *et al*. 2017 and El-Awady *et al*. 2019). The direct genetic correlation measures the relationship between the breeding values of two traits. Therefore, this correlation is important for any breeding strategy based on selection of one trait which will result in positive change in the second trait.

Table 4. Correlation coefficients among studied growth traits of Anglo-Nubian and Baladi kids.

Item	Anglo-Nubian			Baladi		
	BW& WW	**BW& ADG**	**WW& ADG**	**BW& WW**	**BW& ADG**	**WW& ADG**
r_g±	0.847**	0.677**	0.962**	0.820**	0.793**	0.999**
S.E	(0.441)	(0.626)	(0.054)	(0.355)	(0.429)	(0.140)
r_m±	0.329**	0.061 ^{NS}	0.962**	0.347**	0.027 ^{NS}-	0.919**
S.E	(0.430)	(0.519)	(0.044)	(0.361)	(0.533)	(0.302)
r_c±	0.925**	0.926**	0.999**	0.992**	0.981**	0.997**
S.E	(0.327)	(0.362)	(0.036)	(0.484)	(0.578)	(0.010)
r_p±	0.393**	0.240**	0.962**	0.986**	0.982**	0.998**
S.E	(0.053)	(0.059)	(0.004)	(0.140)	(0.150)	(0.089)

BW: birth weight, WW: weaning weight, ADG: average daily gain
r_c: maternal permanent environmental correlation
NS: Not significant (P>0.05); *: Significant (P< 0.05); **: Highly significant (P< 0.01)

Maternal genetic correlations (r_m) between BW and WW of Anglo-Nubian and Baladi kids were moderate (0.329 and 0.347, respectively), but the correlations between BW and ADG were close to zero (Table 4). However, the r_m values between WW and ADG of the two breeds were extremely high. Rashidi *et al*. (2008) reported moderate r_m value of 0.43 between BW and WW of Markhoz kids in Iran. Supakorn and Pralomkarn (2009) obtained moderate r_m estimate of 0.70 between BW and WW of goats in Thailnd. Later, Supakorn *et al*. (2011) reported moderate to high r_m estimates of 0.66, 0.52 and 0.74 between BW and WW, between BW and ADG and between WW and ADG of meat goats, respectively. Snyman (2012) found moderate r_m value of 0.44 between BW and WW of goats in South Africa. El-Awady *et al.* (2019 obtained moderate r_m estimate of 0.60 between BW and WW of Zaraibi kids. In view of the current r_m values, there is a high maternal genetic correlation between WW and ADG of kids in the two breeds.

All maternal permanent environmental correlations (r_c) among growth traits of both breeds were extremely high, ranging from 0.925 to 0.999. In Iran, Rashidi *et al.* (2008) reported moderate r_c value of 0.58 between BW and WW of Markhoz kids. The maternal permanent environmental correlation measures the degree to which two traits respond to the same maternal permanent environmental variation. In view of the current r_c estimates, there is high degree of resemblance among the growth trait of both Anglo-Nubian and Baladi kids in their response to the same maternal permanent environmental variation.

The phenotypic correlations (r_p) were moderate (0.393) and low (0.240) between BW and WW and between BW and ADG of Anglo-Nubian, but were extremely high close to unity for Baladi kids. The correlations between WW and ADG of both breeds were extremely high close to unity. Similarly, low to high r_p values ranging from 0.13 to 0.67, from 0.11 to 0.98 and from 0.13 to 0.80 between BW and WW, between BW and ADG and between WW and ADG of kids of various goats breeds in different countries have been intensively documented in the literature (Shaat *et al*. 2007, Boujenane and El Hazzab 2008, McManus *et al*. 2008, Rashidi *et al*. 2008, Supakorn and Pralomkarn 2009, Thiruvenkadan *et al*. 2009, Gowane *et al*. 2011, Supakorn *et al*. 2011, Snyman 2012, Bedhane *et al*. 2013, Sadegh *et al*. 2013, Hasan *et al*. 2014,Gupta *et al*. 2016, Bhattarai *et al*. 2017, Kuthu *et al*. 2017 and El-Awady *et al*. 2019). Hence, the current estimates of r_p for all studied traits are generally in accordance with those reported in the literature on several breeds of goats.

C- Breeding values (BV):

The estimated breeding value (EBV) is an estimate of the genetic potential of the animal expressed relative to the population average. The EBV for BW, WW and ADG of bucks of both breeds are presented in Table 5. The ranges of EBV for WW and ADG were higher for Anglo-Nubian bucks than Baladi. In view of the obtained EBV, there is good evidence that bucks of both breeds had never been neither evaluated nor selected. Consequently, a considerable rate of genetic improvement in early growth traits of kids could be achieved through selection of bucks. In Pakistan, Kuthu *et al*. (2017) indicated that the EBV for BW, WW and ADG of teddy bucks varied from -0.16 to 0.08 kg, from -0.61 to 0.40 kg and from -0.21 to 1.20 g, respectively. The estimated breeding values of pre-weaning growth traits of kids are important for evaluating bucks for genetic merits.

Table 5. Estimated breeding values (EBV) for studied t raits of Anglo-Nubian and Baladi bucks.

Trait	Anglo-Nubian EBV			Baladi EBV		
	Min.	Max.	Range	Min.	Max.	Range
BW(kg)	-0.131	0.324	0.455	-0.144	0.112	0.256
WW (kg)	-0.591	1.818	2.409	-2.277	1.205	3.482
ADG (g)	-4.64	12.27	16.91	-18.08	9.28	27.36

BW: birth weight, WW: weaning weight, ADG: average daily gain

D- Genetic trends:

Table (6) shows that regression coefficients (b) of estimated breeding values of bucks on time were positive but insignificant for all traits of both breeds. This might be attributed to lack of or ineffective selection of bucks and to the changes occurred in the feeding regimes and management practices across the years. Snyman (2012) obtained positive genetic trends of 0.04 and 0.57 kg for BW and WW of goats. Hasan *et al*. (2014) reported negative genetic trends of -0.019 and -0.020 kg for BW and WW of Ettawa goats. Kuthu *et al*. (2017) showed positive genetic trends for BW and WW, but negligible negative trend close to zero for ADG of Teddy goats. Rout *et al*. (2018) showed positive genetic trends for BW and WW of Jamunapari kids. El-Awady *et al*. (2019) found positive genetic trends of 6.22 for BW and 33.50 for WW of Zaraibi kids.

Table 6. Regression coefficients (b± SE) of estimated breeding values of bucks on studied traits of Anglo-Nubian and Baladi breeds.

Trait	Anglo-Nubian b ± SE	Baladi b ± SE
Birth weight (kg)	0.004^{NS} ±0.004	0.001^{NS}± 0.004
Weaning weight (kg)	0.028^{NS} ±0.023	0.010^{NS} ± 0.044
Average daily gain (g)	0.204^{NS} ±0.159	0.073^{NS} ± 0.340

NS: Not significant (P>0.05)

CONCLUSION

The low direct additive genetic variations in WW and ADG of Anglo-Nubian kids confirmed that low genetic response by direct selection for these traits would be expected, but moderate direct additive genetic variations in WW and ADG of Baladi confirmed that considerable genetic response by direct selection for these traits would be expected. The results indicated that maternal effects are considerable source of variation in pre-weaning growth traits of kids of both breeds. The high and positive genetic correlations among kids' growth traits indicated that improvement of any trait by selection would result in positive changes in the others. The low positive and insignificant genetic trends for BW, WW and ADG of both breeds were probably due to the absence of selection or planned matings since the bucks had never been neither evaluated nor selected. Consequently, a considerable rate of genetic progress in kids' growth traits could be achieved through selection of bucks based on their breeding values. In general, the results showed the need for designing an effective selection program to improve growth traits of kids of both breeds in this herd.

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REFERENCES

Alade, N.K., S.T. Mbap and J. Aliyu, 2008. Genetic and environmental factors affecting growth traits of goats in semi arid area of Nigeria. Global J. Agr. Sci., 7: 85-91.

Alade, N.K., M.A. Dilala and A.O. Abdulyekeen, 2010. Phenotypic and genetic parameter estimates of litter size and body weights in goats. Int. J. Sci. Nat., 1: 262–266.

Andries, K. M., 2013. Growth and performance of meat goat kids from two seasons of birth in Kentucky. Sheep and Goats Res. J., 28: 16-20.

Bazzi, H. and M. Ghazaghi, 2011. Effects of environmental factors on body weight of goats at different ages. J. Anim. and Vet. Advances, 10: 2819-2823.

Bedhane, M., A. Haile, H. Dadi and T. Alemu, 2013. Estimates of genetic and phenotypic parameters for growth traits in Arsi-Bale goat in Ethiopia. J. Anim. Sci. Adv., 3: 439-448.

Belay, D. and T. Mengistie, 2013. Evaluation of growth performance of Abergelle goats under traditional management systems in Sekota District, Ethiopia. Pak. J. Biolog. Sci., 16: 692-696.

Bhattarai, N., M.R. Kolachhapati, N.R. Devkota, U.C. Thakur and S.P. Neopane, 2017. Estimation of genetic parameters of growth traits of *Khari* goat kids (*Capra hircus*L.) in Nawalparasi, Nepal. Int. J. Lives. Res., 7: 80–89.

Bingol, M., I. Daskiran and A. Yilmaz, 2014. A description of growth performances of Norduz kids and milk yield of Norduz goat. Bulgarian J. Agri. Sci., 20: 690-698.

Bolacali, M., Y. Öztürk, O. Yilmaz, M. Küçük and M. A. Karsli, 2017. Effect of genotype and non-genetic factors on growth traits and survival rates in Turkish indigenous Hair goats and their first cross with Boer bucks. Indian J. Anim. Res., 51: 975-981.

Boujenane, I. and A. El Hazzab, 2008. Genetic parameters for direct and maternal effects on body weights of Draa goats. Small Rumin. Res., 80: 16-21.

Deribe, B. and M. Taye, 2013. Growth performance and carcass characteristics of central highland goats in Sekota District, Ethiopia. Sci. J. Agri. Adv., 2: 250-258.

El-Awady, H.G., M.M. El-Moghazy, I.A.M. Abu El-Naser, and A.A. El-Raghi, 2019. Direct and maternal genetic trend estimates for growth traits of Zaraibi goats in Egypt using multivariate animal Models. Int. J. Modern Biol. Med., 10: 1-19.

Gholizadeh, M., G. Rahimi Mianji, M. Hashemi and H. Hafezian, 2010. Genetic parameter estimates for birth and weaning weights in Raeini goats. Czech J. Anim. Sci., 55: 30-36.

Gowane, G.R., A. Chopra and V. Prakash, 2011. Estimates of (co)variance components and genetic parameters for growth traits in Sirohi goat. Trop. Anim. Health Prod., 43: 189-198.

Gupta, J. P., D.P. Pandey and R.R. Shah, 2016. Genetic studies on growth traits of Mehsana goat of Gujarat, India. Indian J. Anim. Res., 50: 164-167.

Hasan, F., b. Jakaria, and A. Gunawan 2014. Genetic and phenotypic parameters of body weight in Ettawa Grade goats. Media Peternakan, 37: 8-16.

Hermiz, H.N., J.E. Alkass, A.A. Hobi, and M.K. Asofi, 2009. Genetic and phenotypic parameter estimates of body weights in Iraqi local goat and their crosses with Damascus. The 2nd Kurdistan Conference on Biological Sciences. J. Duhok Univ. Vol. 12, No. 1 (Special Issue), Pp 189-194, 2009. Univ. Duhok 6-8 may, 2008.

Kantanamalakul, C., P. Sopannarath, M. Duangjinda, S. Anothaisinthawee and S. Tumwasorn, 2008. Genetic parameters for birth weight and weaning weight in Anglo-Nubian, Saanen, Thai Native and crossbred goats. Kasetsan J. (Nat. Sci.), 42: 640-680.

Kuthu, Z.H., K. Javed. M.E. Babar, Abdul Sattar and M. Abdullah, 2013. Environmental effects on growth traits of Teddy goats. J. Anim. Plant Sci., 23: 692-698.

Kuthu, Z.H., K. Javed, M.E. Babar, A. Sattar and M. Abdullah. 2017. Estimation of genetic parameters for pre-weaning growth traits in Teddy goats. J. Anim. Plant Sci., 27: 1408-1414.

Msalya, G., V.S. Sonola, P. Ngoda, G.C. Kifaro and L.O. Eik, 2017. Evaluation of growth, milk and manure production in Norwegian dairy goats in one highland of Tanzania 30 years after introduction. S. Afr. J. Anim. Sci., 47: 202-212.

McManus, C., G.S. Filho, H. Louvandini, L. T. Dias, R.D.A. Teixeira and E.L.S. Murata, 2008. Growth of Saanen, Alpine and Toggenburg goats in the Federal District, Brazil: Genetic and environmental factors. Ciencia Anim. Bras., 9: 68-75.

Meyer, K., 2006. WOMBAT–Digging deep for quantitative genetic analyses by restricted maximum likelihood. Proc. 8th World Congress of Genetics Applied for Livestock Production, Communication No. 27-14.17.

Mohammadi, H., M.M. Shahrebabak and H.M. Shahrebabak, 2012. Genetic parameter estimates for growth traits and prolificacy in Raeini Cashmere goats. Trop. Anim. Health Prod., 44: 1213-1220.

Osman, M. A. 2013. Estimates of direct and maternal effects for early growth traits of Zaraibi goats.Egypt. J. Sheep and Goat Sci., 8: 7-14. (4th Intern.Scientific Conference on Small Rumn.Dev., 3-7 Sept., 2012, Sharm El Shiekh, Egypt).

Otuma, M.O. and I.I. Osakwe, 2008. Estimation of genetic parameters of growth traits in Nigeria Sahelian goats. Res. J. Anim. Sci., 2: 83-86.

Rashidi, A., M. Sheikhahmadi, J. Rostamzadeh and J.N.B. Shrestha, 2008. Genetic and phenotypic parameter estimates of body weight at different ages and yearling fleece weight in Markhoz goats. Asian-Aus. J. Anim. Sci., 21: 1395-1403.

Ray, S., G.D. Nayak, S.K. Dhal, S.K. Mishra, G. Sahoo, S. Mishra, S.K. Dash, 2015. Non-genetic effect on body weight and body measurements of Indigenous goats at different stages of growth in north central plateau climatic zone of Odisha, India. Explor. Anim. Med. Res., 5: 196-201.

Rout, P.K, O. Matika, R. Kaushik, G. Dass, M.K. Singh, M.D. Dige and S. Bhusan, 2018. Genetic analysis of growth parameters and survival potential of Jamunapari goats in semiarid tropics'. Small Rumn. Res., 165: 124-130.

Roy, R., A. Mandal and D.R. Notter 2008. Estimates of (co)variance components due to direct and maternal effects for body weights in Jamunapari goats. Animal, 2: 354-359.

Sadegh, Y.M., V.T. Rasoul, E.J.K. Naser and A. Mehdi 2013. Estimation of genetic parameters for direct and maternal effects of growth traits in Iranian goats. Annals Biolog. Res., 4: 20-26.

SAS, 2008. Statistical Analysis System User's Guide, (Release 9.2). SAS Institute Inc., Cary, North Carolina, USA.

Shaat, I., M. Mabrouk, A. Abdel-Raheem and A. Hamed, 2007. Estimates of heritability and correlations for milk and growth traits in Zaraibi goat. Egyptian J. Anim. Prod., 44: 161-171.

Snyman, M.A., 2012. Genetic analysis of body weight in South African Angora kids and young goats. S. Afr. J. Anim. Sci., 42: 146-155.

Sodiq, A., A. Priyono and E.S. Tawfik, 2010. Assessment of the kid production traits of Kacang goat under smallholders production System. J. Anim. Prod., 12:111-117.

Supakorn, C. and W. Pralomkarn, 2009. Estimation of genetic and phenotypic parameters on pre-weaning growth traits in goats for meat raised at a commercial farm in southern Thailand. Thai. J. Agri. Sci., 42: 21-25.

Supakorn, C. and W. Pralomkarn and S. Tumwasorn, 2011. Estimation of additive, non additive gene effects and genetic parameters on pre weaning growth traits in meat goats in Southern Thailand.Walailak J. Sci. and Tech., 8: 41-50.

Syahirah, M.Y., K.B. Mat, N.D. Rusli and C.H. Hasnita, 2016. Preliminary Study on Birth Weight and Pre-weaning Growth Pattern in Crossed Boer Kids. J. Trop. Resour. Sustain. Sci., 4: 6-9.

Thiruvenkadan, A.K., M. Murugan, K. Karunanithi, J. Muralidharan and K. Chinnamani, 2009. Genetic and non-genetic factors affecting body weight in Tellicherry goats. S. Afr. J. Anim. Sci., 39: 107-111.

Zhang, C.Y., Y. Zhang, D.Q. Xu, X. Li, J. Su and L.G. Yang, 2009. Genetic and phenotypic parameter estimates for growth traits in Boer goat. Livest. Sci., 124: 66-71.

التحليل الوراثي لصفات النمو قبل الفطام للجديان الأنجلونوبيان والبلدي

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اجرى هذا البحث على بيانات سجلات لجديان عددها 592 أنجلونوبيان و347 بلدي مولوده في محطة بحوث كلية الزراعة جامعة الإسكندرية خلال الفترة من 1997-2014م. وذلك لتقدير المعايير الوراثية، القيم التربوية والاتجاهات الوراثية لصفات وزن الميلاد، وزن الفطام ومعدل النمو اليومي من الميلاد حتي الفطام للجديان. تم تحليل البيانات إحصائياً بطريقة الحد الأدنى للمربعات باستخدام برنامج الـ SAS. أظهرت النتائج أن المتوسط العام كان 2.54 كجم لوزن الميلاد, 13.12 كجم لوزن الفطام و86.8 جم لمعدل النمو اليومي للجديان الأنجلونوبيان وكان 2.27 كجم, 10.21 كجم و64.9 جم لنفس الصفات علي الترتيب للجديان البلدي. وأظهرت النتائج أن تأثيرات موسم الميلاد، سنة الميلاد، جنس الجدي، نوع الميلاد وترتيب موسم الميلاد كانت معنوية (P< 0.05 أو P<0.01) علي الصفات موضع البحث فيما عدا أن ترتيب موسم الميلاد ليس له تأثيراً معنوياً على وزن الفطام ومعدل النمو اليومي في سلالة البلدي. أيضاَ تم تحليل البيانات بواسطة نموذج الحيوان Multivariate Animal Model بإستخدام برنامج Wombat وذلك بتطبيق نموذج تضمن التأثير الوراثي للحيوان، التأثير الوراثي الأمي، التاثير الأمي البيئي المستديم والتأثير المتبقي كتأثيرات عشوائية كما تضمن تأثيرات العوامل الثابتة موضع البحث. كانت تقديرات المكافيء الوراثي االمباشر0.097، 0.109 و0.095 لوزن الميلاد, وزن الفطام ومعدل النمو اليومي علي الترتيب للجديان الأنجلونوبيان وكانت 0.060، 0.280 و0.292 لنفس الصفات علي الترتيب للجديان البلدي. كانت تقديرات المكافيء الوراثي الأمي 0.238، 0.106 و0.097 لوزن الميلاد, وزن الفطام ومعدل النمو اليومي علي الترتيب للجديان الأنجلونوبيان وكانت 0.045، 0.178 و 0.162 لنفس الصفات علي الترتيب للجديان البلدي. ويلاحظ أن تقديرات كل من المكافيء الوراثي المباشر والأمي لصفة وزن الميلاد أعلي في الأنجلونوبيان عنها في البلدي والعكس بالنسبة لصفتي وزن الميلاد ومعدل النمو اليومي حيث كانت أعلى في البلدي عنها في الأنجلونوبيان. كانت تقديرات نسبة التباين نتيجة للتأثير الأمي البيئي المستديم 0.488، 0.057 و0.066 لوزن الميلاد, وزن الفطام ومعدل النمو اليومي علي الترتيب للجديان الأنجلونوبيان وكانت 0.295، 0.038 و0.021 بالنسبة للصفات السابقة علي الترتيب للجديان البلدي. تعتبر التأثيرات الأمية من مصادر التباين الهامة بالنسبة لصفات النمو قبل الفطام في السلالاتين. كانت تقديرات التلازم الوراثي المباشر فيما بين صفات النمو في السلالتين معنوية (P<0.01) وتراوحت بين 0.677 و 0.999 توضح هذه القيم العالية والموجبة للتلازم الوراثي أن الانتخاب لأي صفة سوف يؤدي إلي تحسين باقي الصفات. كانت تقديرات التلازم الوراثي الأمي في سلالة الأنجلونوبيان 0.329، 0.061، 0.962 بين وزن الميلاد وكلاً من وزن الفطام ومعدل النمو اليومي وبين وزن الفطام ومعدل النمو اليومي على التوالي، بينما كانت هذه القيم في سلالة البلدي 0.347، -0.027 ، 0.919 لنفس الصفات. كانت تقديرات التلازم الأمي البيئي المستديم في سلالة الأنجلونوبيان 0.925، 0.926 و 0.999 بين وزن الميلاد وكلاً من وزن الفطام ومعدل النمو اليومي وبين وزن الفطام ومعدل النمو اليومي على التوالي، بينما كانت هذه القيم في سلالة البلدي 0.992، 0.981 ، 0.997 لنفس الصفات. وكانت تقديرات التلازم المظهري في سلالة الأنجلونوبيان 0.393، 0.240 و 0.962 بين وزن الميلاد وكلاً من وزن الفطام ومعدل النمو اليومي وبين وزن الفطام ومعدل النمو اليومي على التوالي، بينما كانت هذه القيم في سلالة البلدي 0.986، 0.982 ، 0.998 لنفس الصفات. تراوحت تقديرات القيم التربوية للتيوس الأنجلونوبيان بين -0.131-0.324 كجم، -0.591- 1.818 كجم وبين -4.64-12.27 جم لوزن الميلاد, وزن الفطام ومعدل النمو اليومي علي الترتيب وتراوحت بين -0.144-0.112 كجم، -2.277-1.205 كجم وبين -18.08-9.28 جم بالنسبة للصفات السابقة علي الترتيب للتيوس البلدي. ويلاحظ أنه يوجد مدي واسع نسبياَ للقيم التربوية للتيوس البلدي بالنسبة لصفتي وزن الفطام ومعدل النمو اليومي مقارنة بالأنجلونوبيان. تم تقدير قيم الاتجاة الوراثي عن طريق حساب معاملات اعتماد القيم التربوية للتيوس علي السنوات وكانت موجبة غير معنوية لكل الصفات في السلالاتين. وبالتالي لم يوجد تحسين وراثي ملحوظ بالنسبة لكل الصفات وذلك لغياب الانتخاب الفعال للأباء. توضح نتائج هذا البحث بصفة عامة أن هناك ضرورة حتمية لتصميم برنامج انتخاب فعال لتحسين صفات النمو للجديان في كل من السلالاتين في هذا القطيع موضع البحث.