GENETIC PARAMETERS OF LITTER TRAITS IN A LOCAL BALADI BLACK RABBIT IN EGYPT

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ABSTRACT

Some genetic parameters on Baladi Black (BB) litter trait rabbits were evaluated through two years, using Multi-Trait Derivative-Free Restricted Maximum Likelihood (MTDFREML). A total of 111 litters from 49 does, 12 dams and 7 sires were raised to measure some litter traits (litter sizes and weights at birth, 21 days and at weaning). The animal model analysis included parity and month of birth as fixed effects as well as animal and permanent environmental effect as random effects. Heritability's of considered traits were somewhat low being 0.03, 0.01, 0.01 and 0.01, 0.08 and 0.09 for litter sizes and weights at the three ages studied respectively. Also, permanent environmental effects were low for both litter sizes and weights at the three ages studied (0.00002, 0.02 and 0.000045 and 0.00042, 0.0086 and 0.0006).

Key words: Litter traits, heritability, correlation.

INTRODUCTION

The Egyptian breeds of animals, specially rabbit breeds in this respect are considered the Egyptian genetic resources, that must have researched and improvement, thus we try to make an evaluation for Baladi Black (BB) rabbit breed which was derived from native breed and an exotic one (Giant Flander breed) since 1950. BB breed still has a huge variability in its gene bank, and may receive a selected program. Animal model Method is increasingly becoming one of the preferred methods of estimation that accounts for selection and downward bias in the data (Searle, 1989). The accuracy of estimates of variance components is dependent on the choice of data, methods and models of analysis Misztal (1990). Moreover, estimates of heritability and repeatability for litter traits have a broad range among reports, as reviewed by Iraqi and youssef (2006).

The aim of this work was to evaluate one of our local rabbit breed (BB) by: (1) estimate the effect of non-genetic factors (parity and moth) on litter sizes and weights traits, (2) evaluate the genetic parameters (e.g. variance components, heritability) for BB rabbits using multi trait animal model of covariance analysis.

MATERIALS AND METHODS

Animals and experimental design

Data of the present study consisted of rabbit records collected through two consecutive years (2008–2009) on litter size and weight traits in Baladi Black (BB) rabbits raised at the Experimental Rabbitry, Animal Production Research Institute, Sakha, Kafr El-Sheikh Governorate, Egypt. Does were housed in individual cages provided with nest boxes, feeders and automatic drinkers. They were fed a commercial pelleted diet containing approximately 16% protein, 2.39% crude fat and 12.8% crude fiber. Feed and water were provided ad libitum all time. Breeding does and bucks were lodged separately in individual universal galvanized wire cages arranged back to back in single-tier batteries. Mating started in October -2008 and terminated at the end of spring-2009. Doe litter sizes at birth (LSB), at 21 days (LS21) and at weaning at 4 weeks of age (LSW) and litter weights at birth (LWB), at 21 days (LW21) and weaning (LWW) traits were recorded. Each doe was transferred to the cage of its assigned buck to be mated, and palpated 10 days past mating. Does that failed to conceive were returned to the same assigned buck to be rebred. Nest boxes were supplied with sawdust in the 25th day of the pregnancy. Data were analyzed using Derivative Free Restricted Maximum Likelihood Animal Model. The model adopted for analyzing the data comprised the effect of month (7 months) and parity (4 parities) as fixed effects in addition to direct additive and permanent environmental effects. Numbers of does and dams along with number of litters are listed in table1 below:

Table 1: Structure of the data analyzed for Baladi Black (BB) rabbits

Litters	Does	Dams	Sires	Bunnies	
				Born	Weaned
111	49	12	7	642	322

Statistical analysis

Litter size and litter weight traits at birth, 21 days and at weaning for 111 litters of BB rabbits were recorded. Starting variance and covariance values were obtained by REML method of VARCOMP procedure (SAS, 1996) to be used for the estimation of the more precise and reliable estimates of multi-trait animal model variance and covariance components. The following animal model was used: $y = Xb + Z_a u_a + Z_c u_c + e$
where y= vector of observations on animal; b= vector of fixed effect (month and parity); u_a= vector of random direct additive genetic effect of the animal for the ith trait; u_c= vector of random permanent dam environmental effect; e= vector of random error; X, Z_a and Z_c are incidence matrices relating records of ith trait to the fixed, random animal and random permanent environmenta effects, respectively. Records of some of months were not included in the statistical analysis because of their unavailability because of the effect of the hemorrhagic viral disease and low number of its records. The relationship coefficient matrix (A^{-1}) among animals was considered in such single-trait animal model (Korhonen 1996). MTDFREML program of Boldman et al (1995) was adapted to use the sparse matrix package, SPARSPAK (George and Ng 1984). Convergence was assumed when the variance of the log-likelihood values in the simplex reached <10-12. Occurrence of local maxima was checked by repeatedly restarting the analyses until the log-likelihood did not change beyond the first decimal. The Multi Traits Animal Model (MTAM) was used to estimate direct additive genetic effects (σ^2_a), direct heritability (h^2a), permanent environmental effects (P^2), and error (e^2). Direct heritabilities (h^2_a) were computed as: $h^2_a = \sigma^2_a / (\sigma^2_a + \sigma^2_p + \sigma^2_e)$
Where: σ^2_a = direct additive genetic variance, σ^2_p = permanent environmental effects variance, and σ^2_e = error variance.

RESULTS AND DISCUSSION

Means and coefficients of variation of uncorrected records:

Means of litter size (LS) traits in this study were within the ranges reviewed in most of the Egyptian studies (Azoz and el Kholy 2006 on Bauscat rabbits, Kishk *et. al.*, 2006, Iraqi and Youssef 2006) while, it was less than Gadalla 2006 in LWW trait (2782.6 g.) and Hussien et.al. 1999. Coefficient of variation (CV %) for most traits were moderate and ranging from 36 to 41%, for litter size traits and from 29-34 % for litter weight traits, (Table 2) that there was a higher variation due to LS traits that the genetic improvement can be achieved. These estimates were within reviewed estimates of CV% of Iraqi 2008 (ranging from 12.4 to 59.8%). He stated that these traits in rabbits were subjected to many effects such as genetic make up of the does, non-genetic effects (year-season, parity and management of the herd). Also, these percentages in the present study were larger than that of Gharib *et.al.* 2008.
The coefficient of variation for litter sizes and litter weights increased with advancement of age (Table 2). Similar results were reported by Afifi *et al.*, (1992). This is attributed to differences in litter losses during the suckling period and to differences in post natal growth of the litter up to weaning caused by differences in their genotypes and in milk production of their dams during the sulking period (Afifi *et al.*, 1992). Thus, BB rabbits may be still having a huge variability in its gene bank to receive genetic improvement, especially in latter ages.

Table 2: Overall actual Means, standard deviations (SD) and coefficients of variability (CV %) on litter sizes and litter weight (Kg.) traits in Baladi Black (BB) rabbits.

Traits	Mean	SD	CV (%)
Litter size at birth	5.78	2.11	36.52
Litter size at 21 days	4.52	1.82	40.23
L[tter size at weaning	4.29	1.77	41.2
Litter weight at birth	0.276	0.092	33.3
Litter weight at 21 days	1.238	0.364	29.4
Litter weight at weaning	1.673	0.572	34.19

Month and Parity effect:

Parity and month of kindling (Table 3) had no effect on all litter sizes and weight traits. El Meghawry, 1997 showed a significant effect of parity on LSW. Also, He found the same effect of month of kindling on litter sizes in most ages studied. Parity effects in our study showed inconsistent and no significant source of variation in all litter traits. This may be due to the changes in physiological efficiency of the doe with advance of age. These agreed with results of El-Raffa *et. al.* 1997 and Afifi and Khalil 1990 who reported that litter size decrease insignificantly with advance of parity.

Table 3: Least squares means of parity and month for litter sizes and weights for Baladi Black (BB) rabbits.

Independent Variabl	N°.	LSB Mean±SE.	LS21 Mean±SE	LSW Mean±SE	LWB Mean±SE	LW21 Mean±SE	LWW Mean±SE
MU	111	5.69±0.37	3.47±0.26	2.85±0.26	0.276±17.69	0.959±64.25	1.142±95.28
				Parity^{ns}			
1$^{ST.}$	35	5.67±0.56	3.12±0.57	2.51±0.56	0.270±25.11	0.877.±138.72	0.976±205.70
2ND.	32	5.97±0.57	4.17±0.58	3.53±0.57	0.278.±25.34	1.096±140.72	1.257±208.68
3RD.	18	5.14±0.69	3.61±0.74	3.02±0.73	0.270±30.15	1.094±180.29	1.335±267.36
4$^{TH.}$	26	5.98±0.59	2.97±0.61	2.32±0.60	0.287±26.27	0. 769±148.66	0.998±220.44
				Month^{ns}			
FEB.	18	6.06±0.65	3.96±0.69	3.35±0.68	0.291±28.64	1.026±168.17	1.200±249.37
APRIL	17	6.33±0.65	3.97±0.69	3.20±0.68	0.300±28.62	0.956±168.06	1.042±249.21
MAY	15	5.22±0.71	4.06±0.77	3.83±0.75	0.247±30.92	1.160±186.47	1.419±276.52
JUNE	17	5.57±0.69	2.60±0.74	2.10±0.73	0.240±30.16	0.832±180.37	0.906±267.48
SEPT.	13	5.35±0.84	3.91±0.94	2.88±0.92	0.317±36.45	0.996±229.18	1.199±339.84
NOVE.	12	5.38±0.76	2.22±0.84	1.43±0.83	0.270±33.29	0.695±204.97	0.867±303.95
DECE	19	5.91±0.65	3.56±0.70	3.14±0.68	0.269±28.70	1.049±168.68	1.360±250.14

ns=non significant; LSB, LS21, LSW=Litter size at birth, 21 days, at weaning; LWB, LW21, LWW= Litterweight at birth, at21 days, at weaning

Variance Component (σ^2):

Inconsistent trend was observed in the additive variance (σ^2_A) in the animal model analysis of litter sizes data. The σ^2_A (diagonal elements) in BB rabbits were decreased as increase the age of does (Table 4). While in litter weights were on the contrary of these findings. A high additive σ^2a in litter weights highlight that selection criteria on LWW can take place. The additive variance attributable to the animal model for litter sizes were in less than the additive of litter weights. This may be due to that BB rabbits had a short term of selection belonging to litter weight than litter size traits. El-Raffa et.al. 1997 reported the same percentages on sire variance components for litter sizes of line N rabbits. These results give implication that BB rabbits in the flock under consideration were expected to respond better to direct selection at both early ages regarding to litter sizes, and at later ages regarding to litter weights. These results came to the logical finding of error term, that the error percentages of litter size traits except at LSB were of larger than litter weight traits. In this respect, the phenotypic variance (diagonal elements) of litter sizes were decreased as age advanced, while it shows inconsistent trend belonging to litter weight traits which observed a larger estimates (Table 4).These low figures of additive variance components were highlighted the importance and the strong magnitude of the environmental component of variance linked with the genetic differences connected with LS and LW traits, and also highlighted to the rich gene bank of BB rabbits to be accepting any improvement. As an estimator of such an environmental variance (permanent environment) was evaluated as percentage that it was relatively larger at LS21 (0.02 %) and decrease thereafter in LS traits. This may be due to the litter had somewhat large effects from their dams after some birth (the early ages) and decrease thereafter, that the animal began to express his own gene expression. The same trend was observed in the case of LW.

Table 4: Additive genetic and phenotypic variance co-variance, permanent environment and the error (as proportion of the phenotypic variance of litter sizes and litter weight traits in Baladi Black (BB).

GENETIC VARIANCE CO- VAR.							
	LSB	LS21	LSW		LWB	LW21	LWW
LSB	0.147			LWB	0.068		
LS21	-0.040	0.013		LW21	-0.071	0.875	
LSW	-0.005	0.007	0.019	LWW	-0.151	-0.492	0.856
PHENOTYPIC VARIANCE CO- VAR.							
	LSB	LS21	LSW		LWB	LW21	LWW
LSB	4.415			LWB	9.221		
LS21	1.590	2.437		LW21	-6.277	11.561	
LSW	0.766	1.729	2.028	LWW	-4.360	5.222	9.427
Environmental variance and co-var.							
	LSB	LS21	LSW		LWB	LW21	LWW
LSB	0.97			LWB	0.99		
LS21	0.51	0.97		LW21	-0.63	0.92	
LSW	0.26	0.79	0.99	LWW	-0.48	0.6	0.91
Permanent variance and co-var.							
	LSB	LS21	LSW		LWB	LW21	LWW
LSB	0.00002			LWB	0.00042		
LS21	0.17	0.02		LW21	-0.015	0.0086	
LSW	1	0.16	0.000045	LWW	-0.092	-0.92	0.0006
Heritabilities and genetic corr.							
	LSB	LS21	LSW		LWB	LW21	LWW
LSB	0.03			LWB	0.01		
LS21	-0.92	0.01		LW21	-0.29	0.08	
LSW	-0.1	0.47	0.01	LWW	-0.62	-0.57	0.09

Khalil *et al*., (1987) reported that the low percentages of sire variance component reflect the large environmental component of variance associated with the doe during kindling and raising its litters to weaning. Also, they added that since milk production and subsequently litter gain are of the fitness traits and were influenced by litter size. This is supposed that the additive variance has been diminished through long term natural selection.

Heritability estimates:

Heritability estimated for litter sizes and weights traits (Table 4) were relatively low in both of LS and LW traits. These ranges were within the ranges of El-Reffa *et.al.* 1997 and Baselga *et.al.* 1992. This may be attributed to the effects of non-genetic factors which were not taken in our account and constitute the major source of variation for those traits.

Genetic correlation

Some estimates of genetic correlations among litter sizes and weights (Table 4) were negative correlation, except the estimate between LSW and LS21 traits. Thus we may build the strategy on selection criteria on these traits.

CONCLUSIONS

BB rabbits is still have a short term of selection belonging to litter weight than litter size traits. BB rabbits in the flock under consideration were expected to respond better to direct selection at both early ages regarding to litter sizes, and at later ages regarding to litter weights. The low figures of additive variance components highlighted the importance and the strong magnitude of the environmental component of variance linked with the genetic differences connected with LS and LW traits and also highlighted to the rich gene bank of BB rabbits to be accepting any improvement. We can built our strategy on selection criteria on these traits LSW and LS21 traits that followed by improving the other composed traits.

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