Journal of Animal and Veterinary Advances 10 (21): 2824-2830, 2011
ISSN: 1680-5593
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Genetic and Non-Genetic Effects on Body Weight of West African Dwarf Sheep

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Abstract: The purpose of this study was to evaluate the genetic parameters of monthly weights from birth to 180 days and of preweaning daily gain (0-90 days) and post weaning (90-180 days) of West African Dwarf sheep from the Betecoucou breeding farm of Benin Republic. The variance and covariance component for growth traits were estimated using Multiple Trait Animal model and Sire model. The average Weights at Birth (BW), 30 days Weight (W1), 60 days weight (W2), 90 days (W3), 120 days (W4), 150 days (W5) and 180 days weight (W6) were 1.93±0.02, 4.25±0.06, 7.60±0.12, 10.97±0.12, 13.58±0.15, 14.85±0.20 and 17.30±0.21 kg, respectively. The pre and post weaning Average Daily Gains were 100.41±1.30 g day^{-1} (ADG1) and 71.08±1.70 g day^{-1} (ADG2), respectively. The sex of lamb, birth type, parity of ewe, season and year of birth, revealed significant effects on all weights and daily gains using the General Linear Model procedure (proc GLM) of SAS®. Estimates of heritability from animal model and sire model were 0.43 and 0.44 (BW), 0.10 and 0.07 (W3), 0.13 and 0.09 (W6), 0.05 and 0.05 (ADG1), 0.10 and 0.05 (ADG2), respectively. From sire model, heritability estimates were 0.20 (W1), 0.25 (W2), 0.08 (W4) and 0.10 (W5). Genetic and phenotypic correlations ranged from -0.02 to 0.87 and -0.16 to 0.95 in the animal model and from -0.21 to 0.99 and -0.20 to 0.99 in the sire model. Selection for body weight would not affect other weight but could increase probably the frequency of dystocia and to avoid this situation, selection of heavier W1 could be used.

Key words: Growth trait, djallonke, genetic trend, weight gain, probably, Sire model

INTRODUCTION

Small ruminants have, for a long time, not been considered in livestock development program in sub-Saharan Africa as well as in Benin Republic where they play a crucial role in sustaining agricultural production, providing flexible financial reserves, important social, religious and cultural roles (Glimp and Wiegand, 1991). According to Lebbie and Ramsay (1999), account for 62% of the total number of domesticated ruminant livestock in sub-Saharan Africa regions with 28% for sheep. In Benin, the most predominant sheep breeds widely distributed throughout the savannah and humid zones (Epstein, 1971) of West and Central Africa are commonly named West African Dwarf sheep or Djallonke sheep. They remain productive in tsetse infested areas where other breeds cannot survive without treatment (Osaer *et al*., 1994; Backer, 1995; Goossens *et al*., 1999) and mostly raised for meat. Due to its adaptation to local conditions, the challenge to meet meat demands and alleviate poverty in rural areas should lead to the growth traits genetic improvement of the West African Dwarf (WAD) sheep because body weight and rate of gain are the most economically important and easily measured traits (Snowder and Van Vleck, 2003). However, most of studies have shown the effect of various factors such as the year and season of birth, type of birth, sex and parity of ewe, on the growth of WAD lambs (Armbruster *et al*., 1991; London and Weniger, 1995; Yapi-Gnaore *et al*., 1997) while little information is available on the results of genetic parameters utilizing indigenous WAD sheep breeds (Bosso *et al*., 2007).

The purpose of this study was to assess the non genetic factor influencing growth traits and to estimate genetic parameters of growth traits from birth to 180 days of age.

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MATERIALS AND METHODS

The data used in this study consisted of growth records of West African Dwarf (WAD) sheep kept on the Betecoucou breeding farm of the Ministry of Agriculture, Livestock and Fisheries in Republic of Benin with the objective to promote good management practices and to provide elite animals to sheep farmers. This farm is situated in Central region of Benin (West Africa) where rainy season extends from March to October and dry season from November to February. About 1000 heads of purebred WAD sheeps are raised in semi extensive condition. They graze for 7 h a day (9.00-13.00 and 14.30-17.30 h) on cultivated and natural pastures containing leguminous (*Pterocarpus erinaceu*, *Tephrosia pedicellata*, *Alysicarpus ovalifolius*, *Tephrosia bracteolate*, *Cajanus cajan*) and grass (*Panicum maximium* C1, *Setaria barbata*, *Brachiaria falcifera*, *Pennicetum* sp., *Andropogon tectorium*, *Hyparrhenia subplumosa*). Quantity and quality of forage available for grazing vary according to the season and the distribution of rainfall: During the dry season the grass is reduced to standing straw with poor nutritive value or burned by bush fires. Supplemental feeding (Mineral, cottoncakes, wheat bran, rice and maize straw and vitamins) is usually provided. Health management involved routine dipping against external parasites, deworming and vaccination for the control of ruminant's rinderpest. The annual brucellosis analyses are done by the national veterinary laboratory, any positive animals are culled. Sexually mature ewes were exposed to rams for the first time at 12-18 months of age and lamb in 8 months breeding cycles. Sires were randomly mated naturally to about 25-30 breeding ewes based on strategy that aims to minimize mating of relative (son-dam, daughter-sire and full sib mating are avoided). The peak of lambing occurred in rainy season. Ewes with newborn lambs were housed during the 1st 7 days in individual box to ensure that lambs received adequate colostrums before being moved to larger outside pens with other ewes and their lambs. Lambs were nursed by their dams up to weaning at 90 days of age. The average litter size was between 1.2 and 1.4. Triplets were rarely observed. The average mortality rate in the pre-weaning stage never exceeds 7-10% nor differs between single and multiple lambs. Weaned male and female lambs grazed separately under similar conditions. The founding dam where bought (randomly) from village flocks across the country, based on their conformation and physical examination of their reproductive system (for abdominal conditions). Sires were brought from Kolokope (Togo) where they have been selected for general health (trypanosomonis resistant), body weight, vigor, body conformation, lack of observable defects (small testes, hocked joint, over and under shot jaw) and in this study have been used for 4 reproductive year (at 2 years of age).

Data were collected on 469 males and 422 female lambs, born and reared as twins (330) and single (561). These 891 lambs were progeny of 726 lambing and 9 rams. Performance recording of progeny (Table 1) included identification number, date of birth, sire, sex, type of birth and parity of ewes. Birth Weight (BW), 30 days weight (W1) and 60 days weight (W2) were recorded using a platform-type dial balance (10 kg of capacity, accuracy of 0.05 kg). The 90 days weight or weaning weight (W3), 120 days weight (W4), 150 days weight (W5) and 180 days weight (W6) were taken using a suspended spring balancer (25 kg of capacity, 0.1 kg of accuracy).

To attain a more reliable estimate of empty live body weight, animals were deprived of feed and water overnight, prior to each weighing. Besides those weights, pre weaning Average Daily Gain (ADG1) and post weaning Average Daily Gain (ADG2) were computed. The sires have been only recorded for BW, W3, W6, ADG1 and ADG2.

Data were first analysed using Proc GLM of SAS (1989). All interactions among fixed effects were found to be non-significant and were ignored in the final model which was:

$$Y_{ijklmno} = \mu+S_i+A_j+B_k+C_l+D_m+F_n+e_{ijklmno}$$

Where:

$Y_{ijklmno}$	=	The record on the oth animal
μ	=	The population mean
S_i	=	The effect of the ith sire (i = 1, ..., 9)
A_j	=	The jth year of birth (j = 1, 2, 3 and 4 for 2005, 2006, 2007 and 2008)
B_k	=	The effect of kth season of birth (k = 1 for rainy season, k = 2 for dry season)
C_l	=	The effect of lth sex of lambs (l = 1 for male, l = 2 for female)
D_m	=	The effect of mth type of birth (m = 1 for single, m = 2 for twins)
F_n	=	The effect of nth parity of ewe (n = 1, 2 and 3)
$e_{ijklmno}$	=	The residual error

The comparison of the means was made by the student's t-test. Significance level was chosen at 5%. The variance and covariance components for growth traits were estimated from multiple trait animal model and multiple trait sire model using REML Procedure form VCE program. The multiple trait animal model provide an even

Table 1: The number of records, means and standard deviations for birth weight, pre and post weaning weights and pre and post weaning average daily gain in West African Dwarf (WAD) sheep

	Monthly weights (kg) from birth to 180 days of age							Average daily gain (g day^{-1})	
Progeny performances	BW	W1	W2	W3	W4	W5	W6	ADG1	ADG2
No. of records	891.00	864.00	831.00	778.00	728.00	594.00	590.00	778.00	590.00
Mean	1.98	4.29	7.62	11.02	13.69	14.94	17.29	100.30	71.23
Standard deviation	0.60	1.55	2.41	2.03	2.52	2.65	2.93	20.61	23.41
Minimum	0.30	0.70	3.00	4.60	6.60	8.00	10.80	33.33	11.11
Maximum	4.70	10.20	16.30	18.00	23.30	25.00	30.00	172.22	154.44
Sire performances									
No. of records	9.00	-	-	9.00	-	-	9.00	9.00	9.00
Mean	2.42	-	-	13.51	-	-	20.41	123.26	76.90
Standard deviation	0.44	-	-	1.40	-	-	1.40	16.90	1.06
Minimum	2.10	-	-	11.20	-	-	18.10	97.70	75.50
Maximum	3.12	-	-	15.20	-	-	22.10	151.00	79.50
No. of dams (without records)	726.00	699.00	677.00	634.00	599.00	484.00	482.00	634.00	482.00

Birth Weight (BW), 30 days weight (W1), 60 days weight (W2), 90 days weight (W3), 120 days weight (W4), 150 days weight (W5) and 180 days weight (W6), ADG1: Average Daily Gain from birh to 3 months (weaning), ADG2: Average Daily Gain from weaning to 6 months

greater accuracy by using the genetic relationships and in the case additional information for W1, W3, W6, ADG1 and ADG2 from sires records. However, multiple trait sire model was implemented because it allowed estimating genetic parameter for W2, W4 and W5 which were not available in sires. Sire model was fitted to records on 891 lambs born from 9 sires. Animal model was fitted to records on 891 born lambs and to records on 9 sires. The pedigree file included 891 offspring and 9 sires. Ancestor information was not available for sires. Furthermore, some non genetic factors were unknown for sires so animal model included year and sex as fixed effect when sire model Included year x Season of birth, parity of ewe, birth type and sex of lambs. Phenotypic correlations (r_p) were calculated from heritability (h^2) and from environment (r_e) and genetic (r_g) correlations.

RESULTS AND DISCUSSION

Number of records in the final data set and the descriptive statistics are shown in Table 1. From birth to 180 days of age, the number of records decreased due to the lack of weighing and mortality. The overall mean of the weights in this study is within the range reported for WAD sheep for BW of 1.50 and 2.2 kg (Armbruster *et al.*, 1991; London and Weniger, 1995; Yapi-Gnaore *et al.*, 1997; Bosso *et al.*, 2007) and for W3 of 7.0 and 12.7 kg (Armbruster *et al.*, 1991; London and Weniger, 1995). On the other hand, the value in WAD sheep of 6.02 kg for W2 (London and Weniger, 1995), 5.75-9.1 kg for W4 (Yapi-Gnaore *et al.*, 1997; Bosso *et al.*, 2007) and 15.1 kg for W6 were lower than those of this study. The Averages Daily Gain of 100.41 g (ADG1) and 71.1 g (ADG2) found in this study were higher than 69.6 g for ADG from 0-80 days (Yapi-Gnaore *et al.*, 1997). The differences between the growths of WAD lambs observed in the literature could be attributed to the management, the level of genetic make up, the nutritional factors, the incidence of diseases, the herdsman skills and other factors. The least squares means (±standard errors) and test of significance (F) are shown in Table 2 with the significant effects of all fixed factors, except birth type for ADG1 and ADG2, sex of lambs and ewe parity for ADG2 and season of birth for ADG1, W5 and W6. The effect of sex agrees with those reported previously in WAD and in West African Long legged sheep (Adeleye and Oguntola, 1975; Armbruster *et al.*, 1991; London and Weniger, 1995; Ebangi *et al.*, 1996; Yapi-Gnaore *et al.*, 1997). The sex effect might be attributed to physiological difference mainly of hormonal mediation that tends to become more pronounced as animal approach sexual maturity (Ebangi *et al.*, 1996). However, the sex effect tended to disappear, from birth to 30 days and to 120 days of age (Tuah and Baah, 1985). The superiority of male over female lambs in this study was +0.04 kg for BW and +1.04 kg for W6. The advantages of single lambs over twins have been observed in West African Dwarf and other tropical sheep breed (Armbruster *et al.*, 1991; Rajab *et al.*, 1992; Bonfoh *et al.*, 1996; Ebangi *et al.*, 1996; Yapi-Gnaore *et al.*, 1997). This could result from the limited capacity of ewes to provide enough nourishment for the development of multiple foetuses and more milk for lambs as reported by Rajab *et al.* (1992). In this study, increasing multiple births may be an efficient method to increase meat production in adequate nutritional conditions. In this study single lambs produced 2.2 and 17.9 kg and twins 3.2 and 33.4 kg ewe^{-1} at birth and at 180 days of age, respectively. All growth traits increased with advanced ewe parity. The effect of ewe parity found in this study have been early reported (Filius *et al.*, 1986; Balogun *et al.*, 1993; London and Weniger, 1995; Ebangi *et al.*, 1996; Yapi-Gnaore *et al.*, 1997). Young ewe continued to grow and would

Table 2: The Least-Squares Means±Standard Errors (LSM±SE), number of observations and significance level for birth weight, pre and post weaning weights (kg) and pre and post weaning average daily gain (g) in WAD sheep

	BW		W1		W2		W3	
Fixed effects	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N
Overall	1.93±0.02	891	4.25±0.06	864	7.60±0.12	831	10.97±0.12	778
Season	**		**		*		**	
DS	1.71±0.01	391	3.83±0.05	380	7.45±0.10	372	10.68±0.10	352
RS	2.14±0.01	500	4.68±0.05	484	7.76±0.09	459	11.26±0.10	426
Year	**		**		**		**	
2005	1.99±0.02^{a}	177	4.62±0.08^{a}	176	7.72±0.16^{a}	166	11.30±0.16^{a}	162
2006	1.79±0.02^{b}	221	3.37±0.06^{b}	221	5.74±0.12^{b}	221	10.56±0.12^{b}	
2007	1.94±0.02^{c}	249	4.36±0.06^{c}	229	7.84±0.12^{c}	229	11.05±0.13^{c}	192
2008	1.99±0.02^{a}	244	4.67±0.08^{a}	238	9.11±0.14^{d}	215	10.96±0.15^{c}	203
Birth type	**		**		**		**	
Single	2.22±0.01	561	4.60±0.04	552	7.85±0.08	527	11.33±0.08	500
Twins	1.63±0.01	330	3.90±0.06	312	7.36±0.10	304	10.61±0.11	278
Sex	**		*		**		**	
Male	1.95±0.01	469	4.33±0.05	456	8.18±0.09	441	11.42±0.09	406
Female	1.91±0.01	422	4.18±0.05	408	7.03±0.09	390	10.52±0.10	372
Parity	**		**		**		**	
1	1.56±0.01^{a}	341	3.25±0.06^{a}	326	7.07±0.11^{a}	316	10.19±0.12^{a}	289
2	1.91±0.01^{b}	321	4.37±0.06^{b}	314	7.41±0.11^{b}	296	11.02±0.11^{b}	277
3	2.31±0.02^{c}	229	5.14±0.07^{c}	224	8.34±0.13^{c}	219	11.69±0.14^{c}	212

	ADG1	W4		W5		W6		ADG2
Fixed effects	LSM±SE	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
Overall	100.41±1.29	13.58±0.15	728	14.85±0.18	594	17.30±0.21	590	71.08±1.67
Season	NS	**		NS		NS		**
DS	99.61±1.15	12.99±0.13	339	14.65±0.15	295	17.27±0.18	292	73.62±1.48
RS	101.20±1.06	14.16±0.12	389	15.04±0.14	299	17.34±0.17	298	68.54±1.35
Year	*	**		**		**		**
2005	103.46±1.80^{a}	13.62±0.20^{a}	151	15.07±0.24^{a}	108	17.77±0.28^{a}	107	71.79±2.30^{a}
2006	97.38±1.37^{b}	14.19±0.15^{b}	221	14.64±0.16^{b}	221	17.54±0.19^{b}	221	77.84±1.54^{b}
2007	101.18±1.43^{c}	14.22±0.16^{b}	185	15.68±0.17^{c}	185	16.44±0.20^{c}	182	59.29±1.65^{c}
2008	99.61±1.68^{c}	12.28±0.19^{c}	171	14.00±0.28^{d}	80	17.46±0.33^{d}	80	75.41±2.70^{d}
Birth type	NS	**		**		**		NS
Single	101.22±0.90	14.00±0.10	470	15.43±0.13	374	17.89±0.15	373	72.75±1.22
Twins	99.59±1.22	13.16±0.14	258	14.26±0.16	220	16.72±0.20	217	69.41±1.59
Sex	**	**		**		**		NS
Male	105.19±1.0	14.01±0.11	368	15.33±0.14	288	17.83±0.17	287	71.03±1.37
Female	95.62±1.0	13.14±0.12	360	14.36±0.14	306	16.78±0.17	303	71.13±1.40
Parity	**	**		**		**		NS
1	95.87±1.29^{a}	12.29±0.14^{a}	274	13.54±0.17^{a}	230	16.56±0.20^{a}	230	71.78±1.63^{a}
2	101.18±1.2^{b}	13.88±0.14^{b}	257	15.00±0.16^{b}	209	17.40±0.19^{b}	207	71.78±1.63^{a}
3	104.17±1.5^{c}	14.56±0.17^{c}	197	16.00±0.20^{c}	155	17.96±0.24^{c}	153	70.00±1.94^{a}

Birth Weight (BW), 30 days weight (W1), 60 days weight (W2), 90 days weight (W3), 120 days weight (W4), 150 days weight (W5) and 180 days weight (W6); ADG1, Average Daily Gain from birh to 3 months (weaning); ADG2, Average Daily Gain from weaning to 6 months; DS, Dry Season, Rs, Rainy season means with same superscripts do not differ significantly (p>0.05) from each other. **(p<0.01), *(p<0.05), NS (Not differ Significantly)

compete with foetus for available nutrients (London and Weniger, 1995). Cloete *et al.* (2003) in Merino sheep, reported that lamb weaning weight increased curvi-linearly with dam age, reaching a maximum in 3-5 years old dams. The seasonal influences on lamb growth have also been reported (London and Weniger, 1995; Ebangi *et al.*, 1996). Season represents not only changes of the physical and nutritional environment of the lambs but also of the pregnant ewe which could affect indirectly the birth weight (Yapi-Gnaore *et al.*, 1997). In this study, lambs born in the rainy season were heavier than those born in the dry season +0.43, +0.58 and +1.12 kg for BW, W3 and W4, respectively. For W5 and W6, the difference was slight. Consequently, mating at the end of dry season (February) and at the beginning of rainy season (March, April and May) would increase the growth performance of the flock. Also, the effect of year is in agreement with the literature (Rajab *et al.*, 1992; Ebangui *et al.*, 2001) and could be explained by the variations in management, health, feeding and climatic conditions and herdsman skills. Wilson (1987) reported a non-significant effect of year on birth weight and pre-weaning weight.

The heritability, genetic and phenotypic correlations estimates from animal model and sire model are shown in Table 3. The heritability estimates for body weight, tended to decrease with age, ranging from 0.05-0.44. The decrease in heritability with age is probably explained by the fact that animals at later ages not received maternal effect may

Table 3: The estimates (±SD) of genetic parameters from multiple traits analysis using animal model and sire model on growth traits of WAD sheep

Traits	BW	W1	W2	W3	W4	W5	W6	ADG1	ADG2
BW	0.43±0.06*	-	-	0.17±0.04*	-	-	0.10±0.05*	0.81±0.27*	0.04±0.07*
	0.44±0.15**	0.16±0.30**	-0.21±0.44**	0.82±0.19**	0.99±0.14**	0.63±0.22**	0.53±0.25**	0.62±0.35**	0.12±0.32**
W1	-	-	-	-	-	-	-	-	-
	0.14±0.2**	0.20±0.05**	0.38±0.07**	0.68±0.21**	0.44±0.27**	0.97±0.05**	0.81±0.12**	0.76±0.19**	0.03±0.05**
W2	-	-	-	-	-	-	-	-	-
	0.21±0.43**	0.20±0.3**	0.25±0.02**	-0.14±0.52**	-0.11±0.48**	0.94±0.06**	0.78±0.12**	-0.12±0.58**	-0.13±0.53**
W3	0.95±0.07*	-		0.10±0.03*	-	-	0.68±0.02*	0.96±0.00*	0.03±0.29*
	0.80±0.14**	0.45±0.03**	0.74±0.03**	0.07±0.04**	0.54±0.25**	0.65±0.20**	0.70±0.17**	0.97±0.03**	0.81±0.38**
W4	-	-	-	-	-	-	-	-	-
	0.99±0.13**	0.40±0.05**	0.59±0.04**	0.44±0.22**	0.08±0.04**	0.91±0.10**	0.22±0.43**	0.32±0.36**	0.83±0.20**
W5	-	-	-	-	-	-	-	-	-
	0.63±0.22**	0.73±0.02**	0.74±0.02**	0.68±0.18**	0.70±0.18**	0.10±0.05**	0.71±0.17**	0.62±0.23**	0.33±0.35**
W6	0.59±0.16*	-	-	0.79±0.13*		-	0.13±0.06*	0.97±0.05*	0.97±0.05*
	0.62±0.20**	0.82±0.02**	0.83±0.02**	0.65±0.21**	0.91±0.10**	0.75±0.13**	0.09±0.04**	0.79±0.21**	0.81±0.15**
ADG1	-0.03±0.04*	-	-	0.97±0.00*	-	-	0.83±0.11*	0.05±0.03*	-0.02±0.04*
	-0.20±0.08**	0.40±0.03**	0.70±0.02**	0.99±0.01**	0.87±0.02**	0.80±0.02**	0.66±0.02**	0.05±0.03**	0.00±0.04**
ADG2	-0.03±0.05*	-	-	-0.02±0.04*	-	-	-0.16±0.31*	0.45±0.38*	0.10±0.06*
	0.80±0.07**	0.08±0.05**	0.10±0.04**	0.00±0.04**	0.20±0.04**	0.40±0.04**	0.74±0.02**	0.23±0.44**	0.05±0.04**

*Animal model; **Sire model. Heritability (diagonal), genetic correlations (above diagonal), phenotypic correlations (below diagonal). Birth Weight (BW), 30 days weight (W1), 60 days weight (W2), 90 days weight (W3), 120 days weight (W4), 150 days weight (W5) and 180 days weight (W6); ADG1, Average Daily Gain from birth to 3 months (weaning); ADG2, Average Daily Gain from weaning to 6 months

cause differences in both genetic and environmental variances (Bosso *et al*., 2007). The BW heritability in animal model (0.43) and sire model (0.44) was in agreement with 0.48 found in Bakhtiari sheep (Edriss *et al*., 2002). Various heritability estimates for BW were found in the literature for tropical sheep breeds: 0.60 in Fulbe sheep (Ebangui *et al*., 2001); 0.39 (Bosso *et al*., 2007) and 0.33 in WAD sheep; 0.07 in Muzaffarnagari sheep (Mandal *et al*., 2003) and 0.05 in Yankassa sheep (Osinowo *et al*., 1993). The higher heritability estimates for BW could be lead to the maternal effects before weaning (Snyman *et al*., 1995; Lewis and Beatson, 1999) as also found by Abegaz *et al*. (2002) who compared different models with and without genetic maternal effects. The heritability estimates of 0.20 (W1), 0.25 (W2), 0.10 and 0.07 (W3), 0.08 (W4), 0.10 (W5), 0.13 and 0.09 (W6) from both models in this study (Table 3) were lower than the estimates of 0.30 (W1), 0.34 (W2), 0.46 (W3), 0.32 (W4) reported by Poivey and of 0.54 (W4) by Bosso *et al*. (2007) in WAD sheep. Similar heritability estimates for W3 within the range from 0.07 to 0.16 were reported by Notter (1998) for Polypay sheep (0.07), Marria *et al*. (1993) for Romanov sheep (0.09) and El Fadili *et al*. (2000) for D'man x Timahdite sheep (0.16).

The low heritability for ADG1 (0.05 for both models) and ADG2 (0.05 for sire model and 0.10 for animal model) in this study, contrast with the estimates from 0.18-0.56 (Mavrogenis *et al*., 1980; Shrestha *et al*., 1985; El Fadili *et al*., 2000; Mandal *et al*., 2003). In this study, post natal weights and ADGs, generally had lower heritability and largely contradict the results of Bosso *et al*. (2007). This contradiction would be due to environmental factors that have more influence on the growth trait, providing lower weight gains in this study. Das *et al*. (1996) reported that the post-weaning phase of growth in sheep is a critical stage because this is the stage when there is little or no maternal protection and the kid is more exposed to environmental stress which limits the rate of growth. When model choice in the objective, animal model seems the most appropriate to estimate heritability for body weights on account of the slightly higher values and of the lower standard error for BW. The BW was positively genetically correlated with most of the post natal weights. Genetic correlations among other weights were in general moderate to high, in agreement with those reported in others studies, ranging from 0.88-1.00 for the genetic correlations between BW and W1, W2, W3 and W4 (El Fadili *et al*., 2000; Mandal *et al*., 2003). The positive and high genetic correlations between BW and other weights traits indicated that selection for BW would not affect adversely the other weights.

However, increase in BW through direct or indirect selection is expected to lead to an undesired increase the frequency of dystocia. The W1 show moderate to high genetic correlate with other weight, implying that they are genetically similar traits and that selection for heavier W1 could consequently be applied, in order to avoid dystocia. The phenotypic correlations between BW and other body weights (Table 3) showed a tendency to increase with increasing age, contrasting with the report of Bosso *et al*. (2007). This could be partly attributed to environmental influences and partly to genetic factors. The values of the phenotypic correlations between adjacent weights of this study were within the ranges from -0.07 to 0.98 found in other studies (Yazdi *et al*., 1997; El-Fadili *et al*., 2000; Abegaz *et al*., 2002; Mandal *et al*., 2003; Bosso *et al*., 2007).

Although, in general, genetic and phenotypic correlations among monthly body weights and ADG, obtained from animal model and sire model in this study were all comparable.

CONCLUSION

The result of this study can be used to improve the selection strategy. Some environmental factors as sex of lamb, parity of ewe, year and season of birth and litter type, showed significant effects on growth traits of the WAD sheep and should therefore be taken into account. BW was the more heritable trait and was genetically correlated with most post natal weights. Therefore, post-natal weights could be indirectly improved by selection on BW but care must be taken to avoid possible problems related to dystocia. However, as W1 is moderate to high genetically correlate with other weights, selection for heavier W1 could consequently be applied, to avoid dystocia. However, the data produced by the breeding farm need to be improve, in order to strengthen further genetic parameters estimation. The process of genetic improvement should also include other traits such as mothering ability, milk production, litter size or survival rate in the breeding objective to meets the needs of the local farmers.

ACKNOWLEDGEMENTS

This study was made possible through support provided by the Directorate General for International Cooperation (DGIC) of Belgium and the Belgian Technical Cooperation (BTC). Special thanks to the staff of national livestock office and of the breeding farm of Betecoucou in Benin.

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