Estimates of Phenotypic and Genetic Parameters of weight productivity traits of Tunisian D'man ewes

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Abstract: The aims of the study were to investigate the fixed effects which are considered to influence ewe productivity and to estimate the genetic parameters for ewe productivity traits of Tunisian D'man sheep. Data on weight productivity of 1023 ewes of the D'man breed calculated using an original file on growth performances of 2026 lambs born and raised in the north of Tunisia (Mateur, Kef) and in the south under an oasian environment (Gabes) between 1994 and 1999, were used in this study. The studied variables were litter weights of lambs at 10, 30, 70 and 90 days of age and respectively designated LW_{10}, LW_{30}, LW_{70} and LW_{90}. The results showed that average LW_{10}, LW_{30}, LW_{70} and LW_{90} were 8.22, 13.72, 24.51 and 29.46 kg, respectively. The factors parity within station, age of the dam, and type of lambing-rearing were the highly significant ($P<0.001$) sources of variation on the average litter weights. Heritability coefficients were 0.17, 0.23, 0.08 and 0.08 for LW_{10}, LW_{30}, LW_{70} and LW_{90}, respectively. Genetic and Phenotypic correlations were high and positive respectively varying between 0.81 and 0.94 and between 0.82 and 0.96.
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1.Introduction

Sheep husbandry in Tunisia has been a historically important component of rural development and still fulfils a sustainable role in the livelihood of farmers. The country has a tradition in the consumption of sheep products, especially lamb and mutton. D'man is an important sheep breed of Tunisia. It acquires its importance from its exceptional reproductive performances and its high adaptation to the oasian environment. In Tunisia, the Moroccan D'man breed is selected because of its adaptation to local climatic conditions. Following its introduction into Tunisia in 1994, the breed population has increased from 100 to approximately 6000 breeding ewes in 2001 (Ministry of Agriculture, 2002). It is known as one of the most prolific sheep breeds in the world having a litter size of 2.2 and one that does not exhibit seasonal anoestrus. It is a small sheep with a fine bone structure and a narrow head. Females are characterised by a slightly curved profile. Rams present a convex profile and sometimes a skin fold on the forehead. Presence of horns is an undesirable trait in this breed. The legs of D'man breed are slender and often defective because the animals are raised in confinement, which makes them unsuitable for extensive management on rangeland. The fleece is coarse in texture and of various combinations of one, two or three colours: black, brown or white. Mature ewes and rams are 30-45 kg and 50-70 kg, respectively (Boujnane, 1996). The first D'man breeding program was initiated by INRA in the early 1970s (Bouix and Kadiri, 1975). The three herds composed of animals purchased from the region and gathered in three research stations. The real growth and development of lambs in the period after birth is a prerequisite for satisfactory efficiency in further phases of rearing and breeding (Momani et al., 1995; Said et al., 2000). Several traits have been used as indicators of ewe productivity. Litter weights are one of these traits.

The main aim of this study were to estimate phenotypic and genetic parameters of weight productivity traits of Tunisian D'man breed in order to investigate the importance of possible contributing non-genetic sources of variation on the ewe productivity.

2.Material and Methods

Database description: The data used in this study were obtained from three flocks in Tunisia. An initial database of 2026 D'man lambs of 1023 ewes growth records , collected during six years (from 1994 to

1999), were used. The farms are situated in the north (Kef and Mateur) with an average annual rain fall of 350 and 550 mm, respectively and in the south (Gabes) under an oasis environment with an average annual rain fall < 150 mm (table 1).

Table 1. Data used in the study

		N (ewes)
Flock (station)	Mateur	344
	Kef	102
	Gabes	577
Lambing type	simple	199
	twice	474
	triple	350
Year of lambing	1994	30
	1995	196
	1996	138
	1997	313
	1998	135
	1999	181
Total of ewes		1023
Total of lambs		2026

In the three stations, ewes were kept permanently in door. After being bred for the first time at approximately 8 to 10 months of age, the females were managed in an accelerated lambing rhythm of three lambing every two years. Ewes were managed to lamb in spring (March and April, 43%), summer (July and August, 29.2%) and autumn (October, November and December, 27.8%). The studied variables were litter weight at 10, 30, 70 and 90 days of age (LW_{10}, LW_{30}, LW_{70} and LW_{90}).

Statistical analysis: Recorded data were statistically analyzed using the least-squares method with the procedure GLM for General Linear Model with SAS software (SAS Institute, 2000). The systematic effects were parity within station, age of the ewe and type of lambing-rearing.

The following fixed model equation was used for statistical calculations:

$Y_{ijk} = \mu + P*S_i + AE_j + TLR_k + e_{ijk}$; Where: Y_{ijk} is the measured trait, μ is the overall mean, $P*S_i$ is the fixed effects of parity within station (7 levels within 3 stations), AE_j, is the the effect of age of the ewe (five levels: 16 months, 17 to 31 months, 32 to 46 months,47 to 61 and older than 62 months), TLR_k, is the effect of type of lambing-rearing (7 levels: single; twin or greater raised as single; twin; triplet or greater raised as twin; triplet; and quadruplet or greater raised as triplet) and e_{ijk} is the residual error.

Genetic parameters (heritability, genetic and phenotypic correlations) were estimated using the sire models of Harvey (1990). The model for the estimation is: $Yijk = \mu + Si + Dj + F_k + eijk$; where: Y_{ijkl}= measurement of a particular trait; μ = population mean; Si= random effect of i th sire with a mean of zero and constant variance σ_s^2; D_j= random effect of jth dam with a mean of zero and constant variance σ_d^2; F_k= fixed effects observed to be significant; e_{ijk}= random error with a mean of zero and constant variance σ_e^2.

3.Results and Discussion

Average weight productivity performances: Means and standard errors of litter weights (LW) at age of 10, 30 70 and 90 days are 8.22 ±2.91, 13.72±4.64, 24.51±8.79 and 29.46 ±11.11 kg, respectively (table 2).

Table 2. Average weights of the litter (kg) at 10, 30, 70 and 90 days of age of the litter

Traits	N	Mean	SE
LW_{10}	1023	8.22	2.91
LW_{30}	1022	13.72	4.64
LW_{70}	973	24.51	8.79
LW_{90}	877	29.46	11.11

At the age of 70 days, our results are higher than those Boujnane and Kansari (2002) who reported a litter weight of 23.4 kg. According to Bedhiaf et al. (2002), this difference is mainly due to the large size of the litter. However, LW at 30 days obtained in the current study was smaller than those reported by Boujnane and Kansari (2002) for the D'man in Morroco. It is also worth mentioning that the 29.46 kg achieved by the litter at 90 days of age corresponds to a production cycle of 8 months. On an annual base, a D'man ewe would produce approximately 45 kg, which would represent more than twice the litter weight of the Barbarine at 90 days of age (Jmal, 1995).

Factors influencing weight productivity traits: The obtained results of litter weights variation analysis are shown in table 3. All effects retained in the model significantly (P<0.001) affected weight productivity traits and the models determination coefficients (R^2) varied from 68 to 73% indicating as well is the model.

Table 3. Analysis of variance for weight productivity traits

SV	df	LW_{10}	LW_{30}	LW_{70}	LW_{90}
P*S	18	***	***	***	***
AE	4	***	***	***	***
TLR	6	***	***	***	***
R^2 (%)		70	68	71	73

P*S = Parity within station; AE= Age of the ewe; TLR = Type of lambing-rearing; *** P<0,001

The parity within station is somewhat similar to the more conventional year-season of lambing effect reported by most authors (Jmal, 1995; Ben Gara, 2000) to considerably influence growth of the lambs and productivity of the ewes particularly under the prevalent highly variable arid and semi-arid conditions. Moreover, significances of parity for LW were similar to the results obtained by Akkahart and Sukwong (2009) and Wiriyasombat et al. (2003) who studied factors affected body weight and body measurement in Thai sheep population. However, Oke and Ogbonnaya (2011) and Savar-Sofla et al. (2011) reported that location of raising and lambing year significantly influenced on body weight. In the studies of More O'Ferrall (1975) and Boujenane and Kansari (2002), effects of age of ewe on litter weight at birth and at weaning were reported to be significant. Several authors also reported similar pattern of change in ewe productivity traits (Boujenane et al., 1991; More O' Ferrall, 1976). The effects of age of ewe and type of lambing–rearing, through the quantity of milk available (Berny, 1979), are an important determinant of the individual lamb growth hence of the ewe weight productivity.

Genetic parameters: A summary of estimates of the genetic parameters is reported in table 4. Estimated heritabilities were 0.17, 0.23, 0.08 and 0.08 for LW_{10}, LW_{30}, LW_{70} and LW_{90}, respectively. Heritability estimates obtained in the current study were in close agreement with those reported by Ben Gara (2000), but were higher than those reported by Bonaïti et al. (1976) and Snyman et al. (1997). The obtained heritability values are higher (LW10 and LW30) and very similar (in the case of LW_{70}) in comparison to those reported for the Barbarine breed (Jmal, 1995; Ben Gara, 2000). This trend in the variation of heritability is inversed in the case of the individual lamb growth performances with higher heritability estimates at older ages (Snyman et al., 1997; Ben Hamouda, 1985). Phenotypic and genetic correlations amongst all traits of weight productivity are positive and very high (Table 4).

Table 4. Estimates of heritabilities (h^2), genetic and phenotypic correlations for weight productivity traits of ewes

Traits	LW_{10}	LW_{30}	LW_{70}	LW_{90}
LW_{10}	0.17	0.94	0.87	0.81
LW_{30}	0.94	0.23	0.91	0.84
LW_{70}	0.85	0.93	0.08	0.94
LW_{90}	0.82	0.89	0.96	0.08

Diagonal: heritability coefficients, above diagonal: genetic correlations, below diagonal: phenotypic correlations.

These correlations varied between 0.81 and 0.94 and between 0.82 and 0.86 respectively for the genetic and the phenotypic correlations. The genetic correlation was in accordance with that reported for the Barbarine breeds reported by Jmal (1995) and Ben Gara (2000). Therefore selection of D'man ewes on LW_{30} would probably improve litter weight at others ages.

In coclusion, the results of this study indicated that several non-genetic fixed factors have a significant influence on Litter weights. Litter weights of D'man ewes raised in Tunisia are not very different from the performances of the breed in its native country Morocco indicating a good adaptation of the breed to its new environment (Boujenane et al., 1991). These performances are higher than those recorded for the autochthonous meat producing breeds as a result of the exceptional reproductive characteristics of the D'man mainly its high litter size and its accelerated lambing rhythm. Estimated phenotypic and genetic parameters showed that heritabilities were low. All phenotypic correlations between litter weights were positive and high.

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