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Effects of Kids birth characteristics on the weight growth under pastoral husbandry

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Abstract

About 722 local kids' individual weights were carried out under pastoral conditions on range lands in arid zone. The weighing protocol was used to estimate the growth curves by kids' gender and to estimate kids' weights at some ages. Data was analyzed to establish the impacts of the kids' gender, the birth mode (litter size) and mother age upon kids' weights at ages 1, 10, 30, 60, 90, 120, 150 and 180 days. A *GLM* procedure and a means comparison test (*SNK,* α = 0.05) were applied to identify the magnitude of the statistical effects of the studied fixed factors on the kids phenotypes. The *Gompertz* model was applied on data file to assess and adjust the growth curve depending to analyzed factors. All factors seem affecting kids' growth especially at early ages, and the sex, birth mode and mother age acts only during the first 2 months age by varying significantly the kids' weights. Regarding the arid zone conditions, the kid's weight kinetic after birth seems respecting the forage scarcity and irregularities. Such growing behaviour illustrates the local population adaptation to the harsh environment by realizing the essential of growth since young age and during the favourable short period.

Key words: Kids weight, Arid environment, Gender, Kidding mode, Age of dam, Local population

Introduction

In the arid Tunisian zone, ambulant small ruminant herds regroup more than 60% of the national caprine herd estimated about 1,500,000 goats (Najari *et.al.,* 2007; DGPA, 2010). The caprine herd' main product is the meat if kids slaughtered is summer season before reaching 8 months of age (Mahjoub *et.al.,* 2005; Kaosgey *et.al.*, 2006). So, the kid's growth during this early age represents an important phenotype which affect the herd cash flow and thus, to yield the increasing income to the ambulant herds (Ouni, 2011). The caprine pastoral breeding allows, since centuries, the valorisation of the large rangelands resources of arid zone under harsh restrictive conditions (Najari, 2005; Ouni, 2011). Under pastoral harsh conditions with restricted and irregular resources, the goat productivity is mainly influenced by non-genetic factors which vary quantitatively and qualitatively the final meat production through their several direct and non direct effects upon individual performances (Najari, 2005; Mahjoub *et.al.,* 2005).

Like similar animal quantitative phenotypes, kids' weights change by all factors affecting the growth rather than the individual genetic potential differences (Walkden-Brown *et.al*., 1994; Schinckel and de Lange, 1996; Alexandre *et.al*., 1997).

The study aims to estimate the effects of the kids' gender, kidding mode and mother age on indigenous kids' weights under pastoral conditions within ambulant herds. Rather than the local population characterization, the results may improve the husbandry policy management to optimise the herd production and land conservation considering the serious desertification risks in the studied area.

Materials and Methods

Data is carried out in Arid Areas of the south-east of Tunisia submitted to an arid continental Mediterranean climate, with irregular and sporadic rains, average annual rainfall of 200mm (Ferchichi, 1996; Arbi, 2004).

The indigenous goat population constitutes an animal group adapted to the arid rangelands harsh and irregular conditions (Najari *et.al.*, 2006). The genetic adaptation criteria were acquired through a long natural and human selection process under local difficult conditions, especially climate severity and vegetation scarcity. The indigenous goat population manifests a large variability both in morphology and performances. Characteristics of the population include the ability to walk long distances, water deprivation resistance and good kidding ability. Fertility rate is about 87% and prolificacy rate varies between 110 and 130% (Najari *et.al.,* 2003). Since the fecundation period continues during summer, kidding begins in October and continues till February with a concentration in November and December when 69.2% of kids are born.

The Gompertz was applied to assess the indigenous kids' growth during the first 6 months age and to estimate individual curve parameters and kid's weights at some fixed ages (Najari, 2005).

According to Schnickel and De Lange (1196), the Gompertz function is defined by:

Kid weight (kg) =A*Exp (-Exp (-b (t-c))) (1)

t is the kid age (days); A is the curve asymptote. Parameters b and c adjust both slope and inflexion point. The first derivative, or the growth rate, is defined by:

Growth rate (g/day) =A* Exp (-Exp (b*c-b*t))*b*Exp (b*c-b*t). (2)

Having the individual growth curve parameters, we estimate for each kid, some weights at fixed ages such as 10 days, 1 month, 2 month, 3 months, 4 months, 5 months and 6 months.

Statistical analysis

The individual growth curve parameters and the estimated weights are analysed as quantitative traits. A General Linear Model (GLM) analysis was applied to decompose the total variance and to perform the F statistical significance test.

The statistical GLM model used with independent variables was as follows:

$$Y_{ijklmnop} = r_{i+} h_j + s_k + bm_l + mon_m + year_n + agem_o + interactions + e_{ijklmnop}$$

Where;

$Y_{ijklmnop}$ is the performance analyzed: the kid's weight at 10, 30, 60, 90, 120, 150 and 180 days.

S_k = the sex effect (k=1, 2; male or female) ; h_j = the herd effect (j=1,….8);

bm_l = the kidding mode (j=1,2; single or twin);

$agem_k$ = the goat mother age effect (k=1,…,8);

and $e_{ijklmnop}$= the model residual.

Except the residual error, all factors are considered as fixed. A SAS (1986) GLM procedure was used to resolve the linear equations system. The variance decomposition was followed by a Student Newman and Keuls (SNK) test, in order to compare subclasses averages of factors having a significant statistical effect ($p<0.05$ or $p<0.01$) upon the analyzed traits.

Results and Discussion

The statistical significance test for body weights at the age of 1, 30, 60, 90, 120 and 150 days according to different kids sex, birth type and the age of dam of Tunisian Local kids are presented in Table 1. The ANOVA model coefficient of determination was reduced to 0.59 for the birth weight and it remains below 0.85 for later performances. A similar coefficient of determination illustrates some variability resources that can't be considered by the model. Thus, the model seems not representing all the factors affecting really the weights phenotypes. It seems that the kids' performances depend, under arid pastoral conditions, to others factors which can't be considered as fixed. Moreover, such reduced values illustrate that the analyzed data was carried out on rangelands under difficult experimental conditions which do not allows harvesting phenotypes with the absolute accuracy.

The body weights since birth and till the age of 150 days significantly varied from the different birth type and sex. However, the age of dam has significant effect ($P<0.01$) on the body weights at the age of 60 days to 150 days. Results seem agree with those reported in the literatures (Sebhatu Gebrelul *et.al.*, 1993; Gbangboche *et.al.*, 2006). Djemali *et.al*. (1994) showed that the sex, birth type, age of dam, kidding year and ram effects are important sources of variation for growth traits from birth till 3 months of age. Gbangboche et *al.* (2006) reported, by the same, that the age of dam at first lambing was significantly ($p<0.001$) affecting kids' growth.

The average body weight at the age of 150 days is almost five times with respect the body weight at birth. According to Ouni (2011) the animals

of this breed take approximately the stature of an adult with this age. However, our findings demonstrated that only 4/5 of the adult body mass is reached at 5 months age. Morand-Fehr (1981) highlighted that birth weight of a kid primarily depends on the body conformation and size of their parents. In fact, the body weight of the dam and the birth weight of their kids have positive correlation coefficient irrespective of the litter sizes (Morand Fehr, 1981).

At the beginning of the summer, we have pointed out that the evolution of the growth is slow and the estimate of the adult body weight was 16.2 kg, which is lower than the estimate (24kg) by Najari (2005). It possibly resulted from the adaptive strategy to the different management and growth conditions (Le Gal and Planchenault, 1993).

The most important period of growth seems to be the first five month of life, when the growth rate allowed by the kids produce the main part of the adult (Najari *et.al.*, 2007; Ouni, 2011).

The kids' gender effects on growth phenotypes

The gender illustrates a significative effect upon the kids' growth. The kids' weights averages at the age of 1, 30, 60, 90, 120 and 150 days of Tunisian Local kids according to the different sexes are presented in Table 2; and the figure 1 shows the weight evolution since the birth for the kids males and females. The body weights, from birth to the age of 150 days, of male are all significantly heavier than those of the female, which is in agreement with the results reported by other literatures (Sebhatu Gebrelul *et.al*., 1993). Djemali et *al*. (1994) highlighted that the body weights at the age of 1, 30, 70 and 90 days of the male grew faster than these of the female and multiple birth lambs. However, Ndlovu *et.al*. (1996) observed that the sex of kids did not affect body weights and growth rate at the age of 90 to 180 days. Further more, the weight gap between males and females become larger with the increased age, which is consistent with Ingo Hary and Schwartz (2002). These growth advantages of male kids recorded in this study are comparable to these reported by Al-Shorepy *et.al.*, (2002). The sexual dimorphism is common in the primitive unselected breeds and animal domestic populations. This dimorphism is present along the life of the animals from the birth until the adult, when the weight is about 35 kg in the female and of approximately 55 kg in the male (Chriha *et.al*., 2001). This sexual dimorphism may be explained by the precocity of the male allowing a quick maturity and fertility since the achieving of the first year age. Indigenous goat populations and breeds seem to favours genetically the group continuity by the success of the reproductive process as a response towards harsh conditions threats. Moreover, similar sexual dimorphism is a common characteristic expressed in mammals, but in domesticated populations the level of dimorphism is closely related to the grade of selection developed on the population and its survival capacities (Najari, 2005). So the high dimorphism illustrates that the Tunisian local goat population is selected to promote the high capacity to reproduce richness in hard arid condition. As can be seen from Table 1 and 2, the local kids realized fast growth rate from birth to five months of age.

The birth type or kidding mode effect on kid's weight

The effect of birth type on the body weight of kids at different ages was significant. The means of body weights at the age of 0, 30, 60, 90, 120 and 150 days of Tunisian Local kids according to the different birth type are presented in Table 3. Figure 2 illustrates the kids' weight curve, adjusted by the Gompertz model, since the birth depending to the litter size. The kids born single are always heavier than the twins and the weight gap is higher with later ages which is in agreement with Hary and Schwartz (2002). These authors also concluded that the discrepancy in body weight of twins initially increased from 7% at birth to 22% at weaning. Portolano *et.al.* (2002) showed that the variation in birth weight was associated with type of kidding mode Alexandre *et.al*. (1997) indicated that the difference could reach up to 15% of the weight in average. Such effect can be explained by insufficient maternal production of milk to satisfy the requirements of more than one kid in the harsh irregular conditions of the arid zone. The disadvantage of the twins on the following weight growth may result from the weaker birth than the single. Birth weight of kids is regarded as one of the most important contributory factors for survival and for improving growth performance. Moreover, the growth advantage of single born at birth might results from its lower competition for nutrition.

The age of the dam effect on kids' weight

The age of dam has shown a significant effect (P<0.05) on the birth weight (table 3), Similar result have been obtained by Wenzhbong et *al.* (2005) and Djemali et *al*.(1994).

The age of dam acts primarily by the variation of dairy production according to the number of lactations (Najari, 2005). The no significance illustrated on the weights at birth and at 30 days, may illustrates that all does were able to cover the reduced needs of young kids. However, at later ages, probably the older dams shown shorter lactations which produce phenotypic differences among kids as concluded in the present study. Djemali et *al*. (1994) observed that the growth traits increased with age of dam up to 5 years, then decreased.

Under arid harsh conditions, the kids' meat production seems depending not only to the forage resources and the local population genetic capacity, but also to other factors such as the kids' sex it's birth type and the mother age. These non genetic effects varied seriously the kids' performance with respect to its age. The Tunisian goats breeds is a local genetic resource perfectly adapted to the production of goat meat in semi-arid conditions. The phenotypical variability found in this paper promises a good capacity of genetic response to selection when the breeding program could be implemented

Table (1): The GLM test of significance of the kids' sex, the birth type and the mother age on kids' body weights by age.

Effect factors	Body weights (kg)					
	1 day	30 days	60 days	90 days	120 days	150 days
Sex	**	**	*	**	**	**
Birth type	**	**	**	**	**	**
Age of dam	NS	NS	**	**	**	*
R^2	0.59	0.70	0.79	0.80	0.79	0.81

NS: P>0.05, *P<0.05, **: P<0.01, R^2: Coefficient of determination.

Table (2): The means of body weights at the age of 1, 30, 60, 90, 120 and 150 days of Tunisian local kids according to the different sex and birth type.

factors	Body weights (kg)					
	1 day	30 days	60 days	90 days	120 days	150 days
Sex						
Male	2.57[a]	4.80[a]	6.99[a]	8.90[a]	11.49[a]	13.53[a]
Female	2.29[b]	4.76[b]	6.54[b]	8.08[b]	10.24[b]	12.15[b]
Birth type						
single	2.53[a]	5.05[a]	7.38[a]	9.22[a]	11.75[a]	13.85[a]
twins	2.35[b]	4.45[b]	6.08[b]	7.70[b]	9.22[b]	11.77[b]
twins	2.35[b]	4.45[b]	6.08[b]	7.70[b]	9.22[b]	11.77[b]

[a,b]: Means with different superscripts within a column are significantly heterogeneous class according to the SNK test (P 0.05).

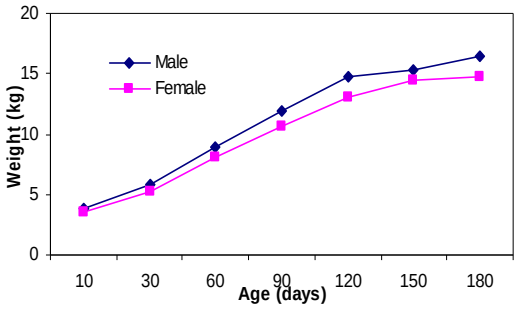

Figure 2. Kids' growth curve adjusted by Gompertz model and by kids' sex.

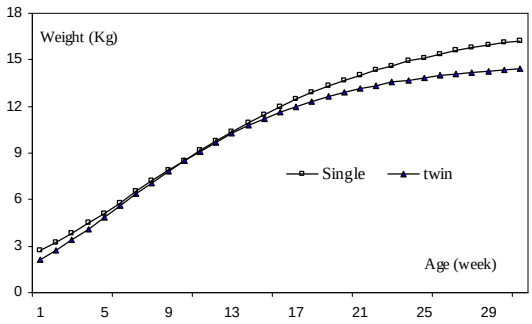

Figure 2. Kids' growth curve adjusted by Gompertz model and by kids' birth mode.

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