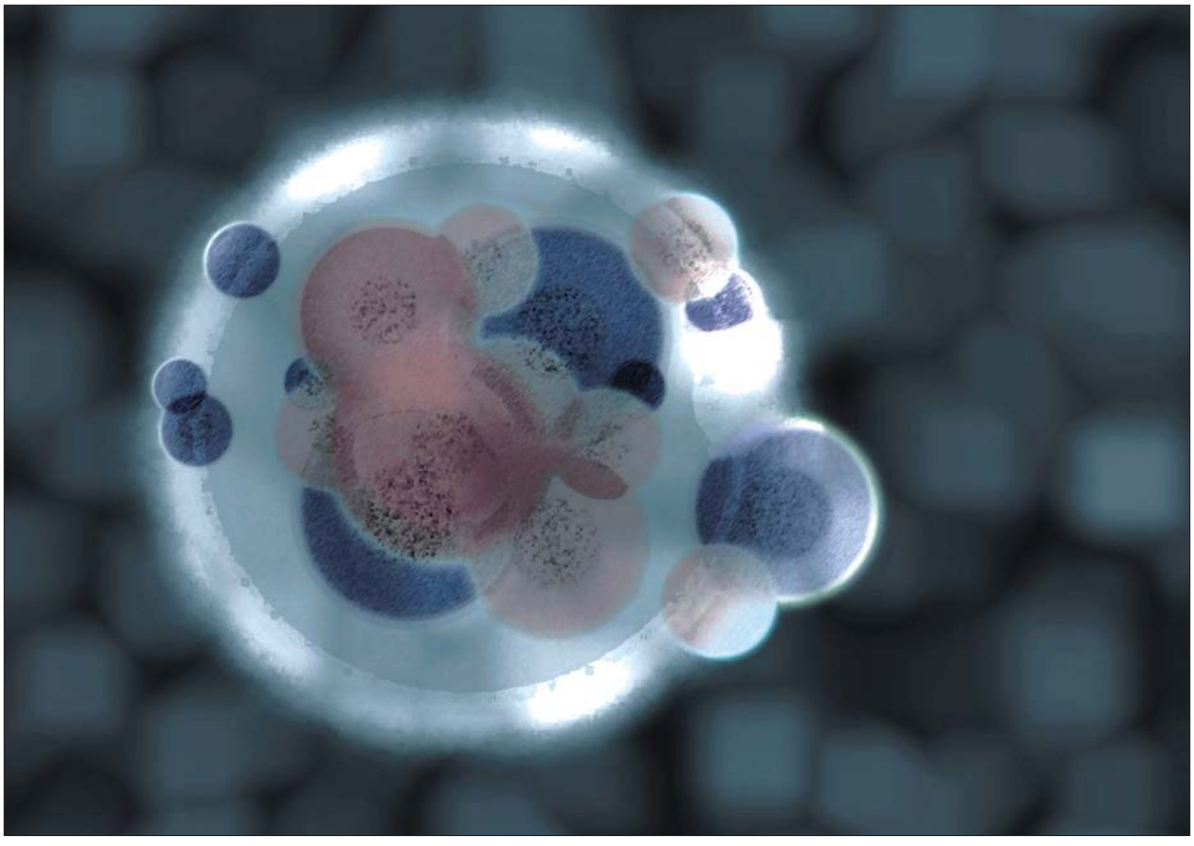


Journal of Biological Sciences

ISSN 1727-3048

science alert

ANSInet
an open access publisher
http://ansinet.com

Journal of Biological Sciences 7 (7): 1194-1200, 2007
ISSN 1727-3048

Early Growth of Morphometric Traits of Local Goat Population in Tunisian Arid Zone

[1]Ouni Mabrouk, [1]Najari Sghaier, [1]Gaddour Amor and [2]Andrea Criscione
[1]Laboratoire d'Elevage et de la Faune Sauvage des Régions Arides et Désertiques,
Institut des Régions Arides, Médenine, Tunisie
[2]DISTAFA, Facoltà di Agraria, Università degli studi Mediterranea,
Polo Universitario di Feodivito, Reggio Calabria, Italy

Abstract: Data collected during four years periodic control on 276 indigenous kids was used to study morphometric linear growth of 17 body parts under arid zone pastoral conditions. The aim is to establish the kinetic of the kid's stature growing, from birth till five months age and the impact of some non genetic factors as a step of the local goat population characterization. The individual data was used to estimate, by intra or extrapolation, kids' measurements at standard ages: birth, 1, 2, 3, 4 and 5 months of age. These kid's individual performances were statistically analyzed by GLM procedure as quantitative traits. A means comparison test (SNK α = 5%), was applied to identify homogenous group for each environmental factor, such as year and kidding month. Results show that local goat population is characterized by a small size since the birth. Indeed, the height with-at-withers do not exceed 30 cm at birth and 51 cm at the 5 months age. Besides, an average 83% of kid is reached during the 5 first month of life. Since early summer, the kids' growth stagnates in relation to the environmental condition effects. GLM analysis showed that the kid's body parts vary enormously according to environmental factors acting on the range lands resources availability. The factors years and months of birth illustrate signifying impacts ($p<0.01$) on all kids' morphometric traits. Indeed, the remarkable inter and intra annual irregularity of the arid climatic conditions largely influences the rangelands resources affecting, thus, kids and goat mother's performances. The expression of kids' genome during the growth period seems to be dependent on resources and kids requirements. The performances variability becomes considerable only after 2 month age. Such aspects supplement the characterization of the population and help to the establishment of practical selection criteria for mobile goat herds.

Key words: Local goat population, body parts, weight, non genetic factors, Tunisia arid zone

INTRODUCTION

Since centuries, local goat population was raised in an extensive pastoral mode and mobile herds valorize scarce resources of the Tunisian arid region under a harsh climate (Najari *et al*., 2007a). The lactated kid's meat is the main product for this breeding system and contributes with about 75% of the local meat consumption (Gaddour *et al*., 2007a; Ouni *et al*., 2006a, b). Under arid conditions, the natural selection oriented the goat genome to acquire adaptative characters towards harsh natural conditions (Najari *et al*., 2006; Bouche and Hugot, 2002).

After a marginalisation period, the caprine husbandry interest is nowadays increasing and goats constitute, actually, a major component of the extensive production system (Morand Fehr and Doreau, 2001; Mohammad *et al*., 2006).

For manmalian animals, the essential body evolution occurred before the maturity stage and growth follow a general pattern till maturity stage (De Lange *et al*., 1998; Schinckel and Graig, 2001). Moreover, the meat production can be apprehended by analyzing the weight or other correlated traits such as morphometric characters. Indeed, morphological characters provide useful information to detect genetic structure and individual of breed's potentiality due to the intrinsic relation between all biological characters (Ismail *et al*., 2005).

As well as for all animal quantitative traits, kids' body parts' evolution was affected by the genome and the effects of the environmental factors. The kid's genome, acquired at the fertilization, defines the target mature size and the growing potential (Najari *et al*., 2007a); whereas environmental factors affect the genotype expression and modify the resulting phenotype.

The present study aims at characterizing the stature kinetic of indigenous kids raised under arid rangeland conditions of southern Tunisia as well as to establish some non genetic factors effects upon kid's measurements at standard age. In fact, the arid zone scarce resources and irregular climate affect often animal

Corresponding Author: Ouni Mabrouk, Laboratoire d'Elevage et de la Faune Sauvage des Régions Arides et Désertiques, Institut des Régions Arides, Médenine, Tunisie Tel: +216 75 63 30 05 Fax: +216 75 63 30 06

survival and production. Among all factors affecting kid's growth, a particular importance was currently assigned to climatic factors represented by the year and the season of birth due to the large variability of the arid natural conditions (Le Gal Planchenault, 1993; Guney *et al*., 2006). The specific aim is to identify how the year and the month of birth, affect the kids' body part with respect to the age. This work may lead to optimise herd's management, to apprehend genetic improvement and therefore, to prevent excessive land degradation.

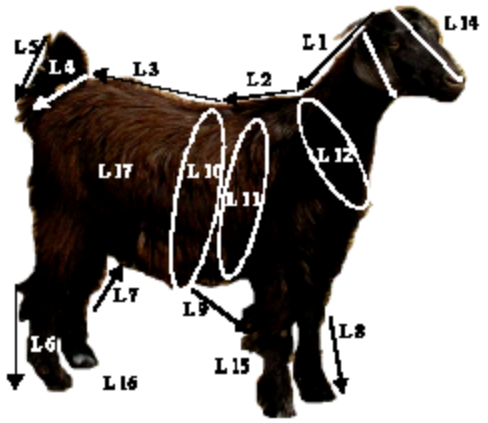
MATERIALS AND METHODS

Study area: The study was carried out in the experimental station of the Institute of Arid Regions, located at 22 km of Médenine, in the south-east of Tunisia (33° 30'N and 10° 40'E). The Tunisian arid zone was ecologically defined in the arid Mediterranean zone (Floret and Pontanier, 1982). The climate is very hard and precarious (Ouled Belgacem, 2006) with a mean annual precipitation of 140 mm. January is the coldest month of the year, with a mean temperature of 10, 7°C, whereas August is the hottest month with a mean of about 27.3°C (Ferchichi, 1996). The arid zone colonizes actually the most important rangelands of the country and is mainly used for extensive camel and small ruminants grazing (Ouled Belgacem, 2006; Nasr *et al*., 2000).

Animal material: Local population goats vary in colour, body weight, size, morphostructural characteristics, shape of horns and presence or absence of horns and wattles. Also, differences can be observed among goats of different geographical parts of the country.

The indigenous goats population shows a large variability both in morphology and performances (Najari *et al*., 2007a) This population is characterised by its small size with a mean average height of 76 cm for the male and 60 cm for the female (Ouni *et al*., 2007; Najari *et al*., 2007b). It is distinguished by the its walking ability for a long distance, water shortage resistance and good kidding ability. The native goat is hairy and basically black coats collared with spots on the head horned and has bread and dewlap on the neck. Fertility rate is about 87% and prolificacy rate varies from 110 to 130% (Najari *et al*., 2006). Kidding season begins in October and continues till February with a concentration in November and December When 69.2% of kid's is born (Greyling, 2000).

Kids data collection: The kid's body parts control program begins starts, yearly since December with the kidding period starting and continues until August when kids are, usually, weaned. Figure 1 illustrates the linear



L1 Length of the neck
L2 Length of the chine
L3 Length of loin
L4 Length of rump
L5 Length of tail
L6 Length hocks to hoof
L7 Length flank to hocks
L8 Length knee to hoof
L9 Length elbow to knee
L10 Perimeter of barrel
L11 Heart girth
L12 Turn of the neck
L13 Length of the ears
L14 Length forehead-muzzle
L15 Heigth at withers
L 16 Heigth at hip bone
L 17 Body length

Fig. 1: Indigenous kids studied body parts

measurement periodically registered at every control day. Data file regroups for each kid: kid number, mother and buck numbers, date of birth, sex, kidding mode, mother age, morphological type, weight and body measurements at birth and at every control day.

Checked data was used to estimate the body parts length at some standard ages (Birth, 1 month, 2 months, 3 months, 4 months, 5 months). This standardization was done either by extrapolation or intrapolation method (Ouni, 2006; Gaddour *et al*., 2007b).

Statistic analysis: The studied parameters were subjected to a statistical analysis by using a software SAS. Kids measurements were analyzed by quantitative traits. The model used for the GLM analysis was The following:

$$Y_{ijk} = Mo_i + Ye_j + e_{ijk}$$

Where:

Y_{ijk} : Performance to analyse: weight and L1 to L17 at 1, 30, 60, 90, 120 and 150 days;
Mo_i : Factor month at birth;
Ye_j : Factor years;
e_{ijk} : The model residual error.

Note that only year and month effects, when performances can vary under the effect of other non heritable factors, were included in the model. This is

explained by the fact that under arid conditions, animal performances were mainly affected by climatic factors. Several studies concluded that including all factors in the same model can omit the effects of sex, birth mode and mother age (Najari *et al*., 2007a; Gaddour *et al*., 2007a).

After the analyses of variance (ANOVA) a mean comparison test (SNK, α = 0.05) was applied to distinguish homogeneous class from each non genetic factor. For each body part these statistical analysis were done at all studied age.

RESULTS AND DISCUSSION

Kid's stature at birth and at five month age: Kids' body parts parameters at the standard ages were presented in Table 1. At birth, kids have, in average 30 cm ± 3 of height-at-withers and increased to 51 cm ± 7 at 150 days, in addition body length is in average 25.11 cm at birth and increased till 45 cm.

Results of descriptive statistics showed that kids had small stature; also, the quantitative evolution is not similar for all body parts. For example (Table 1), the mean weight average increased five times compared to the value registered at birth day. Results confirm that the local goat is of small size. Chriha and Ghadri (2001) indicate that the height with the height-at-withers east does not exceed 60 cm for the female and 73 cm for the male. The small size of the goat is observed for the majority of goats populations in all the hot zones of the world (Oltenacu, 1999; Najari, 2005). The small size is considered as a genetic adaptation criteria towards the difficult conditions (Le Gal and Planchenault, 1993). A small animal body corresponds to low survival requirements which were correlated to the metabolic weight for several bovidae species (Najari, 2005). Small animal is moreover able for long walks necessary for survival and production on sparse rangelands. Rather, the typical local breeds small body supports an early maturity for starting reproductive live since the first year age (Chemineau *et al*., 1996).

The year of birth effects upon the kids body measurements: This non genetic factor presents a highly significant effect ($p<0.01$) especially after 30 days and until 5 months (Table 2). As for the morphometric parameters, the factor year presented a highly significant effect ($p<0.01$) on the kids' weights at standard ages. However at birth, the year does not act significantly on L3 L7 L15 and L16. Similar results were observed for L6 and L7 at 30 days age.

The mean comparison SNK test (α = 5%) results were presented in Table 3 and 4. For L1 and L17 traits, the evolution after birth during four studied years was illustrated by Table 5 and 6.

Table 1: Weight (kg) and body parts length (cm) at birth and at five month age determined on 276 indigenous kids

Parameters	Birth	Five month age	*Ratio: 5 months/1 days
Weight	2.45±051	12.90±3.71	5.26
L1	12.84±1.56	22.48±3.16	1.75
L2	11.85±1.59	20.35±2.69	1.71
L3	7.82±1.34	15.19±2.21	1.94
L4	6.75±1.36	11.98±2.74	1.77
L5	6.63±1.37	9.47±1.80	1.42
L6	15.17±4.19	21.71±2.63	1.43
L7	14.84±1.45	22.83±2.81	1.53
L8	12.23±1.62	20.61±3.22	1.68
L9	13.13±1.59	21.50±2.98	1.63
L10	31.25±3.18	60.42±7.41	1.93
L11	29.97±3.27	54.00±6.21	1.80
L12	18.56±2.89	28.96±5.33	1.56
L13	10.07±1.11	14.36±1.98	1.42
L14	12.66±1.36	19.53±2.75	1.54
L15	30.39±3.13	50.16±6.81	1.65
L16	31.31±3.00	51.07±6.75	1.63
L17	25.11±3.33	44.76±6.61	1.78

* The ratio: Performance at 5 month/performance at birth

Table 2: Results of the variance analysis by GLM procedure of the year effect upon the kid's morphometric traits at standard ages

Parameters	Birth	30	60	90	120	150
weight	*	**	**	**	**	**
L1	**	**	**	**	**	**
L2	**	**	**	**	**	**
L3	NS	**	**	**	**	*
L4	**	**	**	**	**	*
L5	**	**	**	**	**	**
L6	**	NS	**	NS	**	**
L7	NS	NS	**	**	**	**
L8	**	**	**	**	**	**
L9	**	**	**	**	**	**
L10	**	**	**	**	**	**
L11	**	**	**	**	**	**
L12	**	**	**	**	**	**
L13	**	*	**	**	**	**
L14	**	**	**	**	**	**
L15	NS	**	**	**	**	**
L16	NS	**	**	**	**	**
L17	**	**	**	**	**	**

NS: Non Significant; *: Significant ($p<0.05$); **: Highly significant ($p<0.01$)

Table 3: SNK means comparison of kids' body parts at birth by year of birth

Parameters	2002	2003	2004	2005
Weight	2.57a*	2.34b	2.46ab	2.41ab
L1	12.62b	13.42a	12.51b	12.84b
L2	11.89b	12.44a	11.43b	11.59b
L3	8.07a	7.95a	7.39b	7.87a
L4	6.62b	7.60a	6.20b	6.58b
L5	6.39b	7.33a	6.43b	6.30b
L6	14.40b	18.51a	13.59b	14.07b
L7	14.89ba	15.32a	14.54b	14.57b
L8	11.16b	12.92a	12.48a	12.47a
L9	11.92b	13.81a	13.43a	11.92b
L10	31.98a	32.70b	30.30b	29.64b
L11	30.48b	31.98a	28.98c	28.01d
L12	18.93a	19.48a	17.99b	17.64b
L13	18.93a	19.48a	17.99b	17.64b
L14	13.26a	13.07a	11.96b	12.26b
L15	30.55a	31.14a	29.91a	29.85a
L16	31.24ba	32.15a	30.91b	30.86b
L17	31.24ba	32.15a	30.91b	30.86b

*: The same letter(s) corresponds to homogenous class (SNK α = 5%)

Table 4: SNK means comparison of kids' body parts at 5 months age by year of birth

Parameters	2002	2003	2004	2005
Weight	12.17c*	13.68b	15.01a	9.96d
L1	21.95b	23.44a	23.15a	21.04b
L2	20.41a	20.80a	20.70a	19.17b
L3	15.09b	15.06b	16.05a	14.31b
L4	11.31b	12.54a	12.25ba	12.09ba
L5	9.83 a	9.83a	10.07a	8.17b
L6	20.90c	22.23b	23.48a	19.71d
L7	22.00b	23.75a	24.34a	20.69c
L8	19.02c	21.10b	23.08a	18.79c
L9	20.16c	21.84b	23.82a	19.72c
L10	58.39c	61.55b	64.57a	56.06d
L11	54.55a	51.51a	47.13a	54.39a
L12	29.35ba	30.82a	28.51b	26.60c
L13	29.35ba	30.82a	28.51b	26.60c
L14	19.05c	20.63a	19.85b	18.30d
L15	50.48a	51.38a	51.84a	45.78b
L16	50.70b	52.02ba	53.66a	46.75c
L17	50.70b	52.02ba	53.66a	46.75c

*: The same letter corresponds to homogenous class (SNK $\alpha = 5\%$)

Table 5: The evolution of the indigenous kid weight after birth by year

Days	2002	2003	2004	2005
1	2.57	2.34	2.46	2.41
30	4.83	5.32	4.90	3.86
60	6.58	7.34	7.33	5.60
90	8.03	9.14	9.98	6.39
120	9.55	11.47	13.08	9.10
150	12.17	13.68	15.01	9.96

Table 6: The evolution of the indigenous kid body length (L17) cm after birth by year

Days	2002	2003	2004	2005
1	25.40	27.16	24.08	23.42
30	32.21	32.70	30.91	29.66
60	35.88	36.27	36.85	31.76
90	38.86	40.63	42.27	35.07
120	41.39	43.32	46.33	38.89
150	43.52	45.87	47.94	40.62

Until one month age, results showed a similar growth during the four years of study for all kids. It seems that until this age, the kids reducing requirements could be recovered whatever the year; a weak production of the mother is enough to express the kids growth potentialities at less than 30 days age (Najari *et al*., 2002; Ouni, 2006).

The year effect appears remarkable upon the development of the morphometric characters and it increases with the age and the kids requirements (Table 5 and 6). Indeed, the variation related to the year of birth becomes more felt especially after 2-3 months age, when the kid's nutrition depends much more on the pastoral resources than the on mother dairy production. During the dry years, such as 2001/2002; kids start their growths with a weak weight and a small size which evolves in a linear mode. However during favourable years, the kids' morphometric characters evolution seems to be relatively more important (year 2003-2004). Consequently, it is mainly the growth rate which seems to be the most affected by the year conditions.

In arid zone, the large irregularity precipitation, the heats picks and the climatic stresses remain the first natural factors conditioning animal performances (Novikoff and Skouri, 1981; Floret and Pontannier, 1982). This natural variability affects the dairy production of the goat's mothers and consequently the kids growth. Hence, the effect of year factor has to be highly significant for all the variables ($p<1\%$) achieved under pastoral conditions. Generally, the effect of the year factor is translated through the forage availability which is dependent on annual rainfall. The year effect is expected in such husbandry mode and the importance of the year effect on the kid's performances under the harsh conditions was reported by several authors (Najari *et al*., 2002; Alexandre *et al*., 1997).

Nevertheless, the year conditions acts by the bias of the annual precipitations and resources availability. In fact, even trough in oasis of the arid zone where the breeding mode is intensified. The year factor influences significantly kids' weight (Jalouali, 2000; Gaddour *et al*., 2007a). This aspect contributes to the comprehension of environment action on the variability of the productive aptitudes under the difficult conditions and illustrates a specificity of the adaptive goats towards harsh environment.

As presented on Table 3 and 4 relative to the SNK test, the best kids' performances at birth were registered during the year 2003. At 150 days age, the year 2004 performances seem to be high and comparable to those realized during 2003 (Table 4). The performances ranking per year vary with the considered character. For L17, the year 2005 seems to be the most difficult; which is not verified for L1 when the kids' performances were statistically comparable during 2005 and 2002 (Table 5 and 6).

The effect of the month of birth upon kids body parts growth: The results of variance analysis by GLM procedure, relative to the effect of the kidding month on kid's weight and body measurements at the standard ages, was presented in Table 7.

Concerning the kid's weights, results showed that the month of birth does not have a significant impact ($p<0.05$) at one month age; this factor acts upon kid's weight till 150 days age (Table 7). Upon kid's body parts, the impact of the month varied with the age and the trait (Table 5). In fact, at birth kids' morphometric characters: L1, L4, L5, L10, L11, L13, L14 and L17 were not affected by this non genetic factor; so the kid's stature seams to be independent to the kidding month at birth. However, this effect proves to be highly significant at the age of 3, 4 and 5 months upon some body parts. The influence of the

Table 7: Variance analysis relative to the effect of the month upon the kids' weight and body parts at standard ages

Characters	Birth	30	60	90	120	150
Weight (kg)	**	NS	*	**	**	**
L1	NS	**	**	**	NS	NS
L2	**	**	**	**	**	**
L3	**	NS	*	**	NS	**
L4	NS	NS	NS	**	*	*
L5	NS	NS	**	**	**	*
L6	**	**	**	NS	*	NS
L7	**	**	**	**	**	NS
L8	**	**	**	**	**	*
L9	*	**	**	NS	**	NS
L10	NS	NS	*	**	**	*
L11	NS	NS	*	**	**	**
L12	**	**	**	**	**	**
L13	NS	NS	**	**	**	NS
L14	NS	**	**	**	**	**
L15	*	*	**	**	NS	NS
L16	**	**	**	**	*	NS
L17	NS	**	**	*	**	NS

NS: Non Significant; *: Significant ($p<0.01$) **: Highly significant ($p<0.01$)

month appears high significant ($p<0.01$) on all the kid's characters at the age of 2, 3 and in 4 months, except for L4 at 2 months, L6 and L9 at 3 months and for L1 L3 L15 at 4 months. At 5 months age L1, L6, L7, L9, L13, L15, L16 and L17 were independent of the factor month.

The best kids' performances were occurred for January and February births for the most morphometric characters, especially before 30 days age, for March births. The lowest performances are registered (Table 8-10). The growth rate of the morphometric characters appears very important in particular during the one month age in the same (Table 8-10). At this last age and regarding the birth date, this period corresponds to the spring season. As mentioned by several ecologists (Floret and Pontanier, 1982; Ouled Belgacem, 2006), the almost favorable season in arid region is the spring. The growth rate of body parts seems decreasing after the 2 months age with the summer beginning, as concluded by Najari *et al.* (2007a). The growth speed under pastoral conditions stagnates since the aestival season beginning. The aestival period acts on the growth speed attenuation of morphometric characters for all the kids and for all birth months (Table 8-10). Thus, it seems that indigenous kids grew till the end of spring and the growth rate decreases seriously at summer even if the kid ages are reduced.

Similar impacts of the birth season, on the kid body traits during early age, were reported by several authors (Nadarajah *et al.*, 1995; Abebe, 1996). Such effect is so important for performances modelling when animals were raised under harsh irregular conditions. As when justifying the year effect, the variability of the climate of the arid areas generates different food conditions per season (Floret and Pontanier, 1982; Ferchichi, 1996). The intra annual irregularity is one of the most important

Table 8: Effect of the birth month on L11 at the standard ages

Days	2002	2003	2004	2005
1	30.48	31.98	28.98	28.01
30	38.34	38.24	36.02	33.26
60	42.41	44.66	42.35	38.56
90	45.96	49.59	48.51	41.40
120	48.94	53.51	53.50	46.20
150	52.09	58.77	55.25	48.70

Table 9: Effect of the birth month on L15 at the standard ages

Days	January	February	Mars	December
1	31.44	30.48	28.67	30.18
30	36.43	36.07	33.02	37.26
60	41.52	41.10	37.57	40.70
90	45.77	43.96	41.86	44.24
120	47.81	48.84	46.14	47.26
150	51.24	51.72	50.43	49.70

Table 10: Effect of the birth month on L17 at the standard ages

Days	January	February	Mars	December
1	24.97	27.00	22.10	25.13
30	31.95	32.47	27.80	31.38
60	36.48	37.14	36.74	34.94
90	40.74	39.24	38.89	39.27
120	43.78	40.60	41.03	42.84
150	45.87	43.53	47.00	44.54

ecological characteristics of arid climate. Indeed, about 50% of annual rainfall can precipitate during one day and any season; so, range land resources vary largely for season to another (Ferchichi, 1996), affecting directly the morphometry and the growth of the kids and indirectly by acting upon the dairy production of the goat mother (Sajlu, 1999).

CONCLUSIONS

The results offer precious information about local goat production and kid's meat production. This allows filling the actual knowledge missing relative to this animal group and its specific environment factors. The study of indigenous kids' body parts contributes to the local goat characterisation by assessing the animal size during young age, when the essential of the meat production was realized. Results confirm that the local goat have a small size since the birth. The small body can be considered as a genetic adaptation criteria usually, observed for almost caprine breeds and goat's populations raised in hot areas. Indeed, a small size contributes in the control of the thermal stress and corresponds to reduced animal requirements. Also, the small breed body animal presents generally an early maturation for starting the reproductive life. These criteria, acquired through natural selection, support goat survival under difficult and restrictive conditions.

The kid's stature evolution seems to be not similar for all body parts and kid's performances vary dependently to environmental factors. Indeed, the year

and the month of birth affect kids' stature growth by acting on the inter and intra annual climatic irregularity in arid zone. The rangeland resources vary largely with years and seasons conditioning animal performances especially after 1 month age when individual requirements become important to ward forage availability.

In conclusion, kid's body stature kinetic deserves to be focused as way to improve meat production and to manage herd production with respect to arid environment factors. It remains necessary to study the relation between body character and weight through barometry approach. In fact, the sleds to elaborate selection criteria for the local goat population raised under pastoral mode and in mobile herds in the Tunisian arid zone.

ACKNOWLEDGMENTS

Dr. M. Mnifi (Jaoued) and Rejili Mokhtar are acknowledged for help.

REFERENCES

Abebe, G., 1996. Studies on performance potential of Somali goats and their crosses with Anglo-Nubian: A contribution to breed documentation and evaluation. Dissertation. Humboldt Universität Berlin. Institut für Nutztierwissen schaften. Verlag Dr. Köster, ISBN 3-89574-204-X, pp: 258.

Alexandre, G., G. Aumont, P. Despois, J.C. Mainaud, O. Coppry and A. Xandé, 1997. Productive performances of guadeloupean Creole goats during the suckling period. Small Rumin. Res., 34: 157-162.

Bouche, R. and S. Hugot, 2002. The Island of the shepherds: Paradox of an evolution solidified between reproducibility and progress. The Island of laboratory (Editions Alain Piazzola < http://www.eurisles.com/Textes/Labo/Default.htm >). pp: 10. www.eurisles.com/Textes/Labo/txt12.htm.

Chriha, A. and G. Ghadri, 2001. Caprine in the Arab world 2nd version Department of Livestock production. Fateh university; Libby Conservation of Biodiversity and Environments in the Arab Countries, pp: 478.

Chemineau, P., M. Mahieu, H. Varo, E. Shitalou, Y. Jego, A. Grude and J. Thimonier, 1996. Reproduction of caprine and the Creole sheep of Guadeloupe and Martinique. Rev. Elev. Méd. Vét. Special, pp: 45-50.

De Lange, C.F.M., B. Szkotnicki, J. Morphy and C. Dewey, 1998. Establishing Feed Intake and Growth Curves for Individual Growing-Finishing Pig Units. Community Center Proceedings of 17th Anuual Centralia Swine research update, Kirkton-Woodham, pp: 341.

Ferchichi, A., 1996. Proposal for a new index of climatic subdivision of the stages Mediterranean arid and Saharan. In: International seminar scientific and perspective Assets for a durable development of the arid regions. Review of the Arid Areas. Special No. pp: 13-25.

Floret, C. and R. Pontanier, 1982. Aridity in Tunisia présaharienne: Climate-ground-vegetation and installation. Wk. and Doc. ORSTOM. No. 150. Paris, pp: 544.

Gaddour, A., S. Najari and M. Ouni, 2007a. Dairy performances of the goat genetic groups in the southern Tunisian. Agric. J., 2: 248-253.

Gaddour, A., S. Najari and M. Ouni, 2007b. Kid's growth and dairy performances of pure breeds and crossed caprine genotypes in the coastal oases of southern Tunisia. Pak. J. Biol. Sci., (In Press).

Greyling, J. and P.C., 2000. Reproduction traits in the Boer goat doe. Small Runin. Res., 96: 171-178.

Guney, O., O. Torun, O. Ozuyanik and N. Darcan, 2006. Milk production, reproductive and growth performances of Damascus goats under northern Cyprus Conditions Small Rumin. Res., 65: 176-179.

Ismail, S., Z. Mohammad, J. Tabbaaa and S. Bdourb, 2005. Differentiation of native goat breeds of Jordan on the basis of morphostructural characteristics. Small Rumin Res., 56: 173-182.

Jalouali, S., 2000. Profitability of the crossing of absorption of the local goat in the oases of the Tunisian south. Memory of end of higher education, School Superior of Mograne, Tunisia, pp: 134.

Le Gal Planchenault, 1993. Use of the Caprine Races in the hot zones. Constraints and interest. UCARDEC CTA. Editions CIRAD., pp: 260.

Muhammad, F., H. Pervez. M. Zubair and G. Nawas, 2006. Relationship of Body weight with linear body Measurements in Goats. J. Anim. Vet. Adv., 5: 452-455.

Morand-Fehr, P. and M. Doreau, 2001. Ingestion and digestion in the ruminants subjected to a stress of heat. Livestock Productions (INRA). Prod. Anim., 14: 15-27.

Nadarajah, K., E.B. Burnside and D. Kennedy, 1995. Estimation of Phenotypic and Genetic

Najari, S., 2005. Zootechnical and genetic characterization of a caprine population. Case of the local caprine population of the Tunisian arid areas, Ph.D Thesis, State, pp: 214.

Najari, S., M. Ben Hamouda and G. Khaldi, 2002. Expression of the Kid's Genotypes in Arid Regions Conditions. In: Elsen, J.M. and V. Ducroq (Eds.), 7th Word Congress on Genetics Applied to livestock Production, 2002, Montpellier, France, 33: 401-404.

Najari, S., A. Gaddour, M. Abdennebi, M. Ben, G. Hamouda and G. Khaldi, 2006. Morphological characterization of the local caprine population of the Tunisian arid areas, Review of the Arid Areas, 17: 23-41.

Najari, S., A. Gaddour, M. Ben Hamouda, M. Djemali and G. Khaldi, 2007a. Growth model adjustment of local goat population under pastoral conditions in tunisian arid zone. J. Agron., 6: 61-67.

Najari, S., A. Gaddour, M. Ouni, M. Abdennebi and M. Ben Hamouda, 2007b. Indigenous kids weight variation with respect to non genetic factors under pastoral mode in Tunisian Arid Region. J. Anim. Vet. Adv., 6: 441-450.

Novikoff, G. and M. Skouri, 1981. Balancing Development and Conservation in Pre-Saharan Tunisia. Ambio (Journal of hulan environment). Ambio. Vol. X Number 2-3 (Special Issue), pp: 135-141.

Nasr, N., M. Ben Salem, Y. Lalaoui Rachidi, J. Benisad and Y. Medouni, 2000. Change of the systems of breeding and management of the collective courses in arid regions. El-Ouara of Tataouine (Tunisia). Science and changes planetaires/Secheress, 11: 93-100.

Ouled Belgacem, A., 2006. Ecological statute, biological performance and aptitude of the reinstalment of stipa lagascae R and SCH in the degraded ecosystems of the Tunisian arid mediums. Ph.D Thesis, Faculty of Science of Sfax, pp: 147.

Oltenacu, E.A.B., 1999. Using math to see ho welle your goat is growing. New York state 4H Meat goat project fact sheet 16. Cornell University, Ithaca, NY.

Ouni, M., 2006. Morphometric Charactérization of the goat genetic resources in the Tunisian arid zones, M.Sc. in Genetics and Bioressources, pp: 78.

Ouni, M.A., S. Gaddour, M. Najari, M. Abdennabi, Ben Hammouda and T. Khorchani, 2006a. Morphometric Characterization of the Genetic Resources of the Small Ruminants (Caprine) of the Tunisian Arid Areas. Will, G. (Ed.), Procceding of the Seminar. September 18-21, 2006.

Ouni, M.A., S. Gaddour, M. Najari and Abdennabi, 2006b. Factors influencing the characters morphometric with the age-types of the local caprine population of the Tunisian arid areas Meeting internatinal Stock management biotechnologiques and application in aridocultures and cultures oasiennes: Perspectives for the valorization of the potentialities of the Sahara (25-28 December 2006).

Ouni, M.A. Gaddour, S. Najari, M. Abdennabi and T. Khorchani, 2007. Influences of the nongenetic factors on the Ponderal growth of the kids of the local caprine population in the Tunisian arid areas 18èmes Biological Days. 2nd Day of Biotechnology Tunisian Association of Biological Sciences Association Maghrébine de Biotechnologie, (25-28 March 2007).

Parameters for Growth of Goats Enroled in the Ontario Goat Herd Improvement Program (GHIP). Centre for Genetic Improvement of Livestock, 1995. Annual Report.

Sajlu, T., S.P. Hart and A.L. Goetsch, 1999. Effects of level of feed intake on body weight, body components and mohair growth in Angora goats during realimentation. Small Rumi. Res., 33: 251-259.

Schinckel, A.P. and Graig, 2001. Purdue swine Research Reports, pp: 20-25.