# Effects of feed resources in arid lands on growth performance of local goat kids in southern Tunisia

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# Effects of feed resources in arid lands on growth performance of local goat kids in southern Tunisia

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**Abstract.** In southern Tunisia, breeders have developed several strategies to ensure the nutritional requirements of their herds. They profit of the favourable season to establish reserves by harvesting and drying range species and weeds as natural hay called "*khortane*". Other dried resources are commonly used such as *Stipa tenacissima* (*gueddim*) and olive leaves. The objective of this study was to evaluate the effects of local feed resources on intake and growth performances in goat kids. Twenty seven goat kids of local breed (average body weight and age: 15.85 kg and 4.5 months, respectively) were equitably divided in three homogenous groups and used for 90 days. Groups received respectively oat hay (Diet 1), dried olive leaves+ dried *gueddim* (D2) and *khortane* (D3). There were supplemented with 350 g of concentrate and received water twice a day. During the experimental period, animals were weighed every week until slaughter day. Live body weight (LBW) was higher ($p<0.001$) in D 2 (17.65 ± 1.61) compared to D1 and D3 (16.69 ±1.67 and 17.1 ± 1.56 kg respectively). The average dry matter intake was 488.82 ± 21.92; 619.23 ± 16.70 and 591.51 ± 23.08 respectively for D1, D2 and D3. Daily body gain (DBG) in D2 and D3 groups was comparable (35.2 and 34.4 g, respectively), but lower ($P<0.0001$) in D1 group (24.8 g). In conclusion, *khortane*, *gueddim* and dried olive leaves could efficiently substitute oat hay during fattening period of local goat kids.

**Keywords.** Arid land – Local feed resources – Goats – Growth performance.

***Effet des ressources fourragères locales dans les zones arides sur la croissance des chevreaux de la population locale du sud tunisien***

***Résumé.*** *Dans les régions arides tunisiennes, pour gérer les sécheresses saisonnières et prolongées, les éleveurs du sud tunisien ont recours à diverses stratégies d'adaptation pour assurer les besoins alimentaires de leurs troupeaux. Ils profitent des saisons favorables pour produire des réserves alimentaires notamment par la fauche et le séchage d'espèces végétales pastorales comme le type de foin naturel connu sous l'appellation populaire « khortane ». D'autres ressources sont également utilisées comme le gueddim (*Stipa tenacissima*) sec et les feuilles d'olivier séchées. L'objectif de ce travail est d'évaluer l'effet de ces ressources fourragères locales sur les performances de croissance des chevreaux de la population caprine locale. Trois groupes homogènes de 9 chevreaux chacun (poids et âge moyen : 15,85 Kg ;et 4,5 mois, respectivement) ont été utilisés durant l'expérience (90 j). Les 3 groupes ont reçu respectivement 400 g de foin d'avoine, 250 g de feuilles d'olivier séchées +200 g de gueddim et 500 g de khortane. Dans tous les groupes, les chevreaux ont été complémentés par 350 g de concentré et ont reçu l'eau deux fois par jour. Au cours de la période expérimentale, les animaux ont été pesés chaque semaine. Les résultats ont montré que le poids vif moyen a été supérieur chez le groupe 2 (*17,65 ±1,61*) comparativement aux groupes 1 et 3 (*16,69 ±1,67 kg et 17,1 ±1,56 kg respectivement). *L'ingestion moyenne de la matière sèche a été de l'ordre de* 488,82 ±21,92; 619,23 ±16,70 *et* 591,51 ±23,08 *respectivement pour le foin d'avoine, le gueddim + feuilles d'olivier séchées et le khortane. Le gain moyen quotidien (GMQ) dans les groupes 2 et 3 était comparable (35,2 et 34,4 g, respectivement) alors qu'il était plus faible ($p<0,0001$) dans le groupe 1 (24,8 g). En conclusion : nos résultats indiquent que l'utilisation traditionnelle du khortane, du gueddim et des feuilles d'olivier séchées a montré son efficacité pour substituer les fourrages commercialisés durant la période d'engraissement des chevreaux de la race locale.*

***Mots-clés.*** *Régions arides – Ressources fourragères locales – Chevreaux de la population locale – Performances de croissance.*

# I – Introduction

In Tunisian arid lands, small ruminant feeding is based on natural resources, range land and crop residues. The availability of such resources is uncertain (Elloumi *et al.,* 2001). In addition, the arid regions aremarked by a long dry season (6-9 months) and grazing is available only during a short period of about 3 to 4 months, mainly in the spring (Le Houérou, 1962). During favourable years, the pastoral species may provide excellent food for animals from autumn to spring. These ressources are used, either green by direct grazing during the growth of grass or collected to be preserved as natural forage (range species and weeds hay, called *khortane*, and *Stipa tenacissima*, called *gueddim*) and used during dry periods (Ayeb *et al.*, 2010; Genin, 2005; Visser *et al.*, 2002). The use of natural resources is a standard practice in southern Tunisia, therefore it's useful to study their impact on animal performances, particularly for goats, which are considered as an important source of meat by a large class of local population.

# II – Materials and methods

## 1. Animals and diets

Twenty seven local goats kids ((body weight and age averaged: 15.85 kg and 4.5 months respectively) belonging to the experimental heard of Laboratory of Livestock and Wildlife in Arid Land Institute (Medenine, Tunisia), were used in this study. Animals were treated against internal and external parasites. Kids were housed in individual boxes (1.5×1 m) in a stable covered with metal roof. Kids were divided in 3 groups of 9 animals each and used during 90 days (from 10 july to 10 october 2011, mean temperature ranged from 20.97 to 34.00 and 0.6 mm of precipitation). Groups received: 400 g oat hay (Diet 1, which was the control group), 250 g dried olive leaves+ 200 g dried *gueddim* (D2) and 500 g *khortane* (D3). All animals were supplemented by 350 g of concentrate (which included barley; wheat and corn bran; calcium carbonate and vitamin mineral supplement) and received water twice a day.

*Stipa tenacissima* L and *khortane* were harvested during the spring and placed in open air to be dried during 20 and 12 days respectively for *gueddim* and *khortane*. *S. tenacissima* was gathered in the forms of small balls from 3 to 4 kg but *khortane* collected was placed in a pile. *Khortane* used in this study was mainly composed of 90% of *Lolium multiflorum* and *Launea residifolia*. Floristic composition of *khortane* is presented in Table 1.

Forage samples were dried at 65℃ for 48 hours to determine the chemical composition. The feed samples were dried at 105ºC to determine dry matter (DM); ash was determined by incinerating samples in a furnace at 600℃ for 6 h and crude protein (CP) was determined by Kjeldahl method (AOAC, 19…). Analysis of neutral and acid detergent fiber (NDF, ADF) was done according to the method described by Van Soest *et al.,* (1991). Experimental feeds characteristics are reported in Table 2.

## 2. Measurements during the experimental period

After three weeks of adaptation period, feeding began at 09.00 a.m. daily, and collection of feed refusals was done 24 h later. Feed offered and refusals from each group were weighed individually. Intake was calculated as the difference between feed offered and refused corrected for dry matter content. Each kid's was weighed at the beginning of the experiment and weekly thereafter. Average daily gains (g/d) were calculated as differences between final and initial body weights divided by number of days of feeding experiment.

## 3. Statistical analysis

Data were analysed statistically by ANOVA (SPSS (11.5)) to determine the effects of feeds on growth performance. Means and standard deviations (s.d.) were calculated. Significance of

difference ($p<0.05$) between means was determined by Duncan test. Chemical composition was analysed by Kruskal-Wallis.

**Table1. Floristic composition of the *Khortane* used in the experiment**

| N. | Identification | BT | SC (%) | IP |
|---|---|---|---|---|
| 1 | *Anacyclis cyrtoploïdes* | a | 4.12 | 2 |
| 2 | *Argyrolobium uniflorum* | p | 0.00 | 5 |
| 3 | *Avena sterelis* | a | 0.00 | 4 |
| 4 | *Brassica tourneforti* | a | 1.37 | 3 |
| 5 | *Chenopodium murale* | a | 0.00 | 0 |
| 6 | *Chrysanthemum coronarium* | a | 6.60 | 1 |
| 7 | *Cutandia dichotoma* | p | 0.00 | 4 |
| 8 | *Cynodon dactylon* | a | 1.19 | 5 |
| 9 | *Dactylis glomerata* | p | 0.00 | 5 |
| 10 | *Daucus bisutorta* | | 0.00 | 3 |
| 11 | *Deverra tortuosa* | a | 0.27 | |
| 12 | *Diplotaxis harra* | a | 0.92 | 2 |
| 13 | *Emex spinosa* | p | 0.00 | 2 |
| 14 | *Erodium glaucophyllum* | a | 2.47 | 1 |
| 15 | *Erodium triangulaire* | a | 0.09 | 3 |
| 16 | *Hordeum mirunum* | p | 0.18 | 3 |
| 17 | *Hedysarum spinosissimum* | a | 0.00 | 3 |
| 18 | *Launaea resedifolia* | a | 44.00 | 5 |
| 19 | *Lolium multiflorum* | a | 29.79 | 5 |
| 20 | *Malva aegyptiaca* | a | 0.64 | 3 |
| 21 | *Mathiola longipetala* | a | 3.39 | 2 |
| 22 | *Medicago minima* | p | 0.00 | 3 |
| 23 | *Medicago truncatula* | p | 0.00 | 5 |
| 24 | *Phalaris minor* | a | 2.29 | 3 |
| 25 | *Plantago albicans* | p | 1.37 | 5 |
| 26 | *Plantago ovata* | a | 0.00 | 3 |
| 27 | *Shismis barbatus* | a | 1.28 | 4 |
| 28 | *Stipa retorta (capensis)* | a | 0.00 | 2 |

BT: Biological type. a: annual species; p:perennial species.
IP: Index of palatability reported by Le Héourou and Inesco (1987).
SC: specific contribution.

# III – Results and discussion

## 1. Chemical composition of the diets

Table 2 lists results of the analyses for dry matter, crude protein, crude fiber (NDF, ADF), ash, for the samples using in experimental period. The lowest DM content was observed in *khortane* (86.63 %). The highest value was observed in the *gueddim* and dried olive leaves (92.87 and 92.33 % respectivey). The value of dry matter obtained for *khortane* was similar to that reported by Ayeb *et al.* (2010) who have found a content of 90.4% in samples of *khortane* after three ecological zones (mountains, plains and coast). The average DM content of oat hay (89.3%) is lower than that reported by Selmi *et al.* (2011) (92%). The DM in *S. tenacissima* was similar to

that reported by Genin *et al.* (2007) who found 92.7%. The DM content was high, which can be explained by the late stage of maturity of the foliages at the time of collection as the DM increase with maturity of forage (Moore and Jung, 2001).

**Table2. Chemical composition of the experimental feeds (% DM)**

| Samples | Oat hay | Dried olive leaves | *Gueddim* | *Khortane* | p |
|---|---|---|---|---|---|
| DM* | 89.35 | 92.33 | 92.87 | 86.63 | <0.027 |
| Ash | 3.09 | 8.74 | 4.91 | 7.99 | <0.016 |
| CP | 6.34 | 10.16 | 6.33 | 9.44 | <0.207 |
| $NDF_{om}$ | 60.06 | 34.59 | 85 | 42.18 | <0.019 |
| $ADF_{om}$ | 42.72 | 30.35 | 55.51 | 29.32 | <0.024 |

DM*: % fresh matter.

For the forage using, the levels of crude protein were slightly higher in dried olive leaves and *khortane* (10.16 ad 9.44% DM respectively). In the case of *khortane*, floristic composition is an important role in the variation of the chemical composition of which the increase in the proportion of species of the leguminosae and compositae family causes an increase in the level of nitrogen. In our experience, the CP content of *khortane* is close to that mentioned by Ayeb *et al.* (2009) for *khortane* and Longo Hammouda *et al.* (2007) for a mixture of annual species and small perennial that recorded levels of about 9.5 and 12% DM respectively for the two authors. The CP content obtained for dried olive leaves is higher than that reported by Alibes and Berge (1983) where CP content is of the order of 7.7% DM. The content CP was lower for *S. tenacissima* and oat hay. CP content of oat hay is higher to that reported by Selmi *et al.* (2011), which was about 4.9% DM. But, it is comparable to that obtained by Jarrige (1988) (6.0% DM). CP content of *S. tenacissima* is similar to that reported by Genin (2005, 2007), which varies from 5.0 to 7.0% DM and similar to the value (6.02% DM) reported bay Laudadio *et al.* (2009). By comparing between feeds, we can see that the analysis of fibers showed that *S. tenacissima* and oat hay were significantly higher in NDF compared to other feeds studied (Table 2).

We can conclude that the *khortane* and the dried olive leaves have the advantage of providing a richer animal ration (higher content in nitrogen), so they may be associated with forage poor in nitrogen as straw; *S. tenacissima* and oat hay to improve the rate of protein in the ration.

## 2. Intake and growth performance

Average Intake and growth performance are shown in Table 3. Total dry matter intake was significantly higher ($p<0.001$) in diet 2 and 3 (*gueddim* + olive leaves and *khortane*) compared to diet 1 (619.23 ± 16.70 and 591.51 ± 23.08 *vs* 488.82 ± 21.92 g DM /day respectively). This can be explained by the fact that goats prefer shrubs like *gueddim* and that *khortane* has higher palatability due to its rich floristic composition where the majority of species have a high index of palatability (Table 1). Values of oat hay intake (containing 59 g/kg DM of crude protein) recorded are slightly lower than those found by Atti *et al.*, (2009) (500g DM /day) for indigenous goat kids (aged 7 months) reared in Northern Tunisia. The low value of DMI for all groups may illustrate the adaptation of this breed to the specific natural factors and production system (Mahjoub *et al.*, 2005).

DM intake per metabolic weight is affected ($P<0.0001$) by the type of diets. The mean is 59.31 ± 6.73; 71.68 ± 2.76 and 70.56 ± 4.52 g/kg $W^{0.75}$ for diets 1, 2 and 3 respectively. Crude protein intake (g/d) was higher ($p<0.001$) in diet 2 and 3. This is related to the level protein in *khortane* and dried olive leaves compared to the oat hay.

**Table 3. Mean values for growth rate and intake in kids receiving *S. tenacissima* + dried olive leaves (diet 2) and khortane (diet 3) comparison of oat hay (diet 1)**

| | Diet 1 | Diet 2 | Diet 3 | SEM | P |
|---|---|---|---|---|---|
| Initial live weight (kg) | 15.77 ± 1.46 | 15.85 ± 1.17 | 15.93 ± 1.37 | 0.24 | <0.9657 |
| Final live weight (kg) | 18.00 ± 2.29 | 18.94 ± 1.51 | 18.74 ± 2.02 | 0.37 | <0.5720 |
| Average daily gain (g/d) | 24.8 ± 34.38 | 34.3 ± 20.27 | 35.2 ± 20.63 | | |
| DM intake (g/d) | | | | | |
| Concentrate | 304.5 | 304.5 | 304.5 | | |
| Oat hay | 184.32 ± 21.92 | - | - | | |
| *Gueddim* | - | 103.97 ±10.83 | - | | |
| Dried olive leaves | - | 210.76 ±7.52 | - | | |
| *Khortane* | - | - | 286.01± 23. 08 | | |
| Total | 488.82 ± 21.92[b] | 619.23 ± 16.70[a] | 591.51 ± 23.08[a] | 73.08 | <0.0001 |
| DM intake (g/ kg live weight /d) | 29.36 ± 2.04[b] | 34.93 ± 1.82[a] | 34.77 ± 2.68 [a] | 4.06 | <0.0001 |
| DM intake (g/kg0.75/d) | 59.31 ± 6.73 [b] | 71.68 ± 2.76 [a] | 70.56 ± 4.52 [a] | 7.90 | <0.0001 |
| Crude protein intake (g/d) | 52.53 ± 2.97[b] | 69.75 ± 2.21 [a] | 71.79 ± 3.75[a] | 9.74 | <0.0001 |

Values on the same line with different letters are significantly different (P <0.05).

Body weight progress by each group is presented in Table 3. Initial body weight was similar for all groups; the mean for three diets was 15.85± 1.28. In fact, body weight increases during the experimental period, the average final weight is comparable for all three regimes (18.56±1.93 kg). Growth responses were related to intake.

Although there were no significant differences among the three groups, average daily gain appeared to be higher for *khortane* and *gueddim* + olive leaves (35.20 and 34.38 g respectively) than the oat hay group (24.81 g). This change in values is due to large deviations explained by the presence of negative values during the experiment, due to the loss of some weight of kid's

The results obtained were close to those found by Bunyeth and Preston (2006) in which the initial and final body weight and average daily gain of goats receiving grass hay were respectively 14.1 and 17.4 kg (Wildeus *et al.*, 2007), and Bunyeth and Preston (2006) reported similar average daily gain (37 g/day) for kid's goats receiving grass hay. Najari *et al.* (2007) showed that the weight of the kids attained an average weight of 15.65 kg at age = 8 months and their average daily gain was 14.71 g/day with a maximum of 34.83 g/day.

The low performances in our experience are explained by the low of protein content of the local feed resources (Table 2). Negesse *et al.* (2001) have shown that increasing crude protein level (80 to155 CP/kg DM) in the diet of male Saanen kids (initial weight = 12.1± 0.18 kg), the feed intake increased from 448 to 608 g DM/day and the weight gain from 94 to 181g/day. Indeed, these forages are used to develop local resources in southern Tunisia and their use by agro-pastoralists in animal feed in order to minimize the cost of purchasing hay in the market.

## IV – Conclusions

This work has allowed us to have a clear idea about the chemical composition of the most used livestock feed in southern Tunisian. In this area, local resource forage harvesting aims at making available low-cost forage for periods of scarcity. Crude protein was 10.16; 9.44 and 6.33 % DM respectively for dried olive leaves *khortane* and *S. tenacissim*a. However, using only *S. tenacissima* is not recommended, because this forage is a poor due to its chemical structure and cannot on its own meet nutritional requirements of even dry ruminants. It is better to mix the feeds to get a balanced ration.

The average body weight was equal in three groups, but there was a trend to be higher in the groups receiving *gueddim*+olive leaves and *khortane*. The DM intake was higher for animals receiving the local resources (*gueddim* + olive leaves dried*, khortane*) than in those receiving commercial oat hay (means where 619.23 ± 16.70 and 591.51 ± 23.08 *vs* 488.82 ± 21.92 g DM /day respectively). These local resources present an effective mean of drought management. They can be produced with little equipment, at a low cost and they are distributed almost without waste. So raising kids under local resources feeding regimes could be economically more efficient than using the classic regime.

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