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Dairy and Meat Potentialities of Indigenous Goat under Pastoral and Oasian Herd Management in the Tunisian Arid Zone

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ABSTRACT

Data carried out from 10 local goat herds' survey was analyzed to establish the impact of the management mode upon local goat performances in the aim to identify the possibilities to improve goat milk and meat production via the flock management handling. A total of 8257 kids' weights and 3461 dairy performances were elaborated and statistically analyzed meaning a comparison of the performances registered on pastoral breeding toward those realized in oases under intensive feeding modes. On rangelands in extensive husbandry, the local population registered low performances similar to those known for indigenous caprine breeds of marginal zones. The average kid's weight was 5.1 kg at 1 month age and the average daily milk was reduced to 0.7 kg day⁻¹. Oasian intensive conditions improve the kids' growth performance both on weights average and their respective variation magnitude. The kid's birth weight increased with about 21% but the oasian kids' superiority seems progressively elapsed with the age to be only 2% at 4 months age. However, lactation performances remain low and similar even though under intensive feeding mode and indigenous goat seems genetically unable to produce more milk under favourable conditions. Thus, the genetic evolution promoted growth performances as a biological priority to produce caprine meat which remains the principal herd output. Whereas, dairy performances needing high nutritive requirements was seriously reduced by the natural selective process.

Key words: Indigenous goat, dairy performances, kid growth, management mode, arid zone, natural selection

INTRODUCTION

The caprine specie presents a wide world distribution and goats were raised within almost animal husbandry modes thanks to its particular capacities to survive and to produce even though under severe and restrictive conditions (Serradilla, 2001). Since its oldest domestication, among livestock species, goats acquired genetic capacities to guaranty its' survival and economic role within a wide breeding area. Indeed, goats seem able to valorise most natural and technical resources by a diversified animal production (Najari *et al.*, 2006) and goats were nowadays raised in intensive modes as well as in the marginal zones where animals strive to ensure the animal group continuity (Gaddour and Najari, 2008a).

In Tunisia, the national caprine herd, estimated at about 1 500 000 does, is mainly raised on the arid rangelands (Najari *et al.*, 2006; Gaddour *et al.*, 2008b). With scarce resources and harsh irregular climatic environment local goat population remains the suitable animal to valorise the arid pastures (Gaddour *et al.*, 2008c) and the main product of ambulant herds is the kids' meat

(Gaddour *et al.*, 2007a; Sghaier *et al.*, 2007; Najari *et al.*, 2007). Kids were not weaned till their separation in summer when they were slaughtered and the weaned kid's meat contributes with about 75% in the regional meat production (Gaddour *et al.*, 2007b).

Rather than the pastoral extensive mode, goats are traditionally raised in the oases in small flocks under intensive management and the goat husbandry plays a key role by its significant various contributions in the farmer's incomes (D' Aquino *et al.*, 1995; Jamali and Villemeot, 1996).

Performance records allow the evaluation of management procedures and how it affects animal performance and herd cash flow because most herd expenses are directed towards doe management. To success the herd production exercise, does are expected to become pregnant, deliver live newborns and raise multiple kids with good growth to weaning. Although the primary focuses, after kidding, has been on pre-weaning kid growth and doe milking kinetic (Browning, 2009).

Nowadays, the goat production improvement seems urgent to satisfy the increasing animal protein demand. The improvement strategy has to be apprehended by some parameters relative to animal resources potentialities and their genetic limits towards the management and the feeding resources. In fact, each animal performances vary dependently to the population genetic structure and its' specific behavior towards its production environment.

The present study, aims to identify the local goat meat and milk potentialities in two different breeding modes through a statistical comparison between performances realized in pastoral system on rangelands towards those registered in the intensive oasian mode. Results should set the possibilities to improve each goat performance by acting on genetic and/or environmental factors. Understanding the goat performances variation towards the management intensification helps seriously to apprehend the genetic improvement regarding each breeding mode characteristic and moreover, to establish the local population genetic structure.

MATERIALS AND METHODS

Study zone: The study was achieved in the Tunisian arid zone delimited between the Great Eastern Erg and the Mediterranean coast. The area is ecologically definite arid with a Mediterranean climate, hard and precarious (Najari, 2005). With an annual average of 140 mm, rainfall presents a large spatial and seasonal irregularity. The local goat data concerning intensive management was collected at Chenchou experimental station (Gabes, southern Tunisia).

Indigenous goat population: The indigenous goat population constitutes an animal group adapted to the arid rangelands harsh conditions (Najari *et al.*, 2006). The complex adaptation criteria were acquired by a long natural and human selection process under local hard conditions (Najari, 2005). The indigenous goat population shows a large variability both in morphology and in performances (Najari *et al.*, 2006). Local goat is characterised by its small size, it's walking ability and its water and forage shortage resistance. Such adaptative qualities allow the survival and production of the local goat on sparse rangelands with restrictive resources. Native goat is hairy and basically black coat coloured with spots on the head horned and has bread and dewlap on the neck (Najari *et al.*, 2006; Sghaier *et al.*, 2007).

Data base editing and analysis: Data analyzed corresponds to records of goat lactations and kids' growth registered separately on pastures in extensive breeding mode and in oases where herds were intensively fed. An annual periodic kids' weighing and does milking protocol allowed recording

dairy and growth performances of 10 herds during 16 years. Data base relative to the pastoral mode contains 722 annual kids' weight control files and 322 goat lactation data files. Whereas in oases for the intensive mode we used 1928 kid's growing data and 1123 lactation files.

After files editing, data base was used to estimate the individual performances as follow:

- **Growth performances:** For each kid, the weight curve was established by Gompertz model to estimate individual weight at typical ages; birth, 30, 60, 90 and 120 days age. Also, the daily average gains (g/day) till 1 and 3 months age were estimated in each breeding system
- **Dairy performances:** The average daily production, total milk per lactation and milking period were estimated for each goat by the Gamma model
- Individual kids' and does' variables were analyzed by the ANOVA procedure and the Student Newmann Keuls means comparison test (SNK, $\alpha = 5\%$)

RESULTS AND DISCUSSION

Kid's growth in pastoral and oasian breeding modes: Table 1 compares the kids growth and their variation magnitude from birth till 4 months age in the pastoral mode on rangelands. Figure 1 illustrates the respective daily average gain of kids' weight during 1 and 3 months of age.

Since the birth, the indigenous kid's weight manifests significant difference according to husbandry mode. Oasian kids have about 21% of birth weight as superiority towards their

Table 1: Kids' growth parameters in oases and on rangelands with the percentage of averages improvement

Weights at	Oasian mode			Pastoral mode			(%)*
	Mean	Min	Max	Mean	Min	Max	
Birth	2.92 ^{a**}	1.20	3.00	2.41 ^b	0.78	2.63	121
30 days	6.69 ^a	3.30	10.40	5.06 ^b	1.78	5.56	119
60 days	9.47 ^a	5.80	16.30	8.05 ^b	2.46	8.77	117
90 days	11.88 ^a	6.80	20.90	10.64 ^b	3.35	11.45	112
120 days	12.85 ^a	7.00	22.30	12.58 ^a	4.47	13.37	102
Total kids	1928			722			

*: Average improvement percentage; **: The same letter corresponds to the statistical homogenous classes (Test SNK)

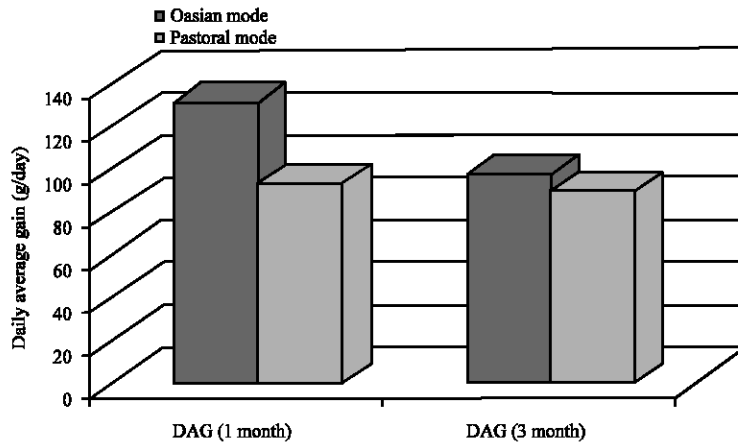


Fig. 1: Kids' daily average gain (g/day) from birth till 1 or 3 months of age in oases and on rangelands

colleagues raised on rangelands. It seems that better feeding conditions leads to a higher foetal growth as it was confirmed by El-Abid and Nikhaila (2009). Non-genetic factors such as management mode are largely expected to affect kid survival and prenatal growth (Ameh *et al.*, 2000; Nnadi *et al.*, 2007). After the birth, the oasian kids' weight superiority is progressively elapsed with the kids' age (Table 1); in fact, the kid's weight average becomes statistically similar within the two studied husbandry modes since 3 months age. Indeed, differences in weight average were reduced to only 270 g at the 120 days age, always in favour of the oasian kids. Figure 1 illustrates that the observed DAG of oasian kids reaches 130 g day⁻¹ during the first months of age and becomes more and more similar among management modes at later age. This early rapid growth of the oasian kids can be explained by better does' dairy performances under intensive conditions.

Rather than feeding conditions, this aspect illustrates the local kids' growth kinetic with regards to the age; in fact, Najari *et al.* (2007) concluded that the local kid's growth rate decreases significantly with the age due to genetic potentialities of the indigenous animal group. Thus, indigenous kid becomes progressively not able to valorise intensive conditions by an additive meat production and the asymptotic weight seems reached since an early age (Sghaier *et al.*, 2007).

Moreover, results show that the weight at birth can be improved by acting on some environmental factors. In fact, the local goat mating period is summer when the arid area conditions were the worst during the year (Najari, 2005). The aestival temperatures were known as the hottest and the forage resources become very scarce. Consequently, having low birth weight is mainly due to non genetic factors and can be improved under intensive mode (Najari, 2005; Sghaier *et al.*, 2007; Najari *et al.*, 2007). On another hand, several indigenous caprine breeds and populations register a reduced weight at birth under extensive pastoral grazing. Equally, a low birth weight is usually considered as a genetic adaptation criterion to harsh environment because this weight is high correlated with the adult weight (Najari, 2005).

Regarding the weights variation magnitude, the performances maxima seem largely higher under oasian conditions where some kids were able to realize a sufficiently heavy weight which can reaches 22.3 kg at four month age (Table 1). Such high weights could not be observed in extensive mode even for reduced cases.

Dairy performances in pastoral and oasian breeding modes: Table 2 and 3 illustrate the local goat dairy performances as lactation period, total milk production and daily average, respectively in intensive and in extensive husbandry modes. For each performance, the whole average and the variation magnitude were estimated. An SNK test between performances means was applied to identify the averages differences significance.

In fact, the total milk produced in intensive mode was only 103 kg and a daily average production no reached 1 kg in both breeding systems (Table 2). According to the literature, such potentialities seem similar to those known of local breeds raised in marginalized zones (Serradilla, 2001). Under pastoral conditions on range lands, the local goat produces in average about 97.9 kg per lactation and these dairy reduced performances seem to be slightly improved under the oasian conditions (Table 3).

So, milking potentialities of the indigenous goat can't reach high levels even when the environment is favourable with sufficient feeding resources. Consequently, we conclude that the reduced performances of the local goat express low genetic capacities of the local population. Najari (2005) confirmed that the genetic evolution of the local goat promoted adaptation gene and the

Table 2: Local goat dairy performances in oasian intensive management

Dairy performances	Oasian mode		
	Mean	Min.	Max.
Milking period (days)	130 ^b	41.0	230
Total milk per lactation (kg)	103.4 ^a	30.0	315
Average daily milk production (kg/day)	0.78 ^a	0.3	1.70
Observations	1123		

The same letters with in column corresponds to statistical homogeneous (test SNK)

Table 3: Local goat dairy performances on rangelands under extensive management

Dairy performances	Pastoral mode		
	Mean	Min.	Max.
Milking period (days)	146 ^a	62.00	189
Total milk per lactation (kg)	97.9 ^a	17.10	320.1
Average daily milk production (kg/day)	0.66 ^a	0.12	1.770
Observations	322		

The same letters with in column corresponds to statistical homogeneous (test SNK)

same selective process reduced the gene pool of the dairy potentialities. In fact, high milk production exposed animals to high requirements during lactation phases which are not guaranteed under arid harsh conditions.

The dairy performances maxima value shows that some local goats produce more than 300 kg of milk per lactation even though under pastoral conditions (Table 3). Consequently, even though the genetic level of the local goat is low in average the population contains some high productive individuals. These high-performance goats allow constituting a selection nucleus to produce a specialized herd able to valorise the intensive conditions by a high milk production.

It is well-known that the adapted populations are above lactating breeds and the main product is the almost herds the kids' meat (Alexandre *et al.*, 1999). So, the natural selection process acted during centuries to favourite the flock numeric productivity and the kids' weight till slaughtering. Especially under harsh and irregular conditions, the success of the extensive husbandry needs some particular adaptation and reproductive potentialities to temporize stress and restrictions effects to promote the foetus survival and to produce a sufficient number of heavy kids. Whereas, the does' milking potentialities becomes only considered at the selective process a nutritive resource of young kids till weaning. For thus, all rustic animal population rose under harsh conditions try to reproduce successfully and afterwards to produce meat. However, the milk performances are not strategically important for all arid zone livestock resources because the high relative requirements. This production strategy oriented the specific genetic evolution priorities to adapt the animal group, slowly and during long time, to its zone natural characteristic. It is indeed a kind of genomic specialization since the evolution of these populations directed the genome to ensure a compromise, on the level of the AND, between survival, genetic continuity and the products diversity.

The study results illustrate that to build genetic improvement program of the local goat, we have to consider that this animal group have a specific genetic potentialities which differ for each performance. Under intensive production mode, without restrictive conditions, animals improve their production until a level defined by its genome. This last biological level varies with the performance and the animal group genetic structure. Consequently, both production objectives and improvement programming have to consider such genetic characteristics issued from long natural

selection process. When the herd meat output seems able to be improved meaning a management program, there're a serious genetic limits to produce more milk from the local goat. Never the less, the existences of reduced number high-performance goats keep possible to constitute a selection nucleus in the aim to produce local goat dairy specialized in the intensive breeding modes.

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