Estimation of daily milk production from some body measurements in local goat population under Tunisian arid conditions

ATOUI AHLEM*[1], LAROUSSI AICHA[2], ABDENNEBI MOLDI[1], BEN SALEM FARAH[1], NAJARI SGHAIER[1]

[1]*Laboratory of Livestock and Wildlife, Institute of Arid Regions, Medenine, University of Gabès, Tunisia*
[2] *National Agronomic Institute of Tunisia, University of Tunis, Tunisia.*

*Corresponding author: ahlematoui@gmail.com

Abstract – In order to estimate some equations of daily milk production from linear body measurements of 85 local lacting goats were used in the present study. The morphostructural parameters included body length, withers height, heart girth and hip height, the body weight and the daily milk were recorded weekly from from the 7th postpartum day up to the end of lactation period. Four models were tested to estimate daily milk from some body measurements. A high correlation between daily milk and all linear body measurements was obtained. A significant correlation ($p<0.05$) were obtained between all linear body measurements and daily milk yield. The high value of correlation was presented between body weight and the daily milk (r=0.66). A estimates equation with coefficient of determination (44%) has been got to estimate daily milk with (R^2). The daily milk of local goat could be estimated from linear body measurements and it could be use the goats' body weight and withers height as a good measurements to predict daily milk with reasonable R^2.
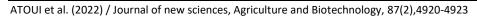
Keywords: Local goats, daily milk production, regression coeffecient, body measurement, prediction.

1. Introduction

Dairy production is a significant source of income of farmers in the southern regions of Tunisia. Goats products such as milk are some of the important factors contributing to the economy of farmers living in developing countries. The study of dairy performance of goat breed under harsh environment leads to know about the interaction between the animal and its irregular environment. Thus, the characterization needs the study of the manifestations of adaptation skills and the specifics of the action of aridity factors on the expression of genotypes. Such aspects manifest particular importance for the discussion of technical and scientific methodologies for feasible and sustainable improvement program (Najari, 2005). The production of goat milk has come to be a useful strategy to tackle the problem of under nutrition of the infant population (Haenlein 2004). The linear body measurements are frequently used to estimate the weight of animals (Anonymous 2005). In fact, knowledge of linear body measurements is important first for the characterization of animals and also, to optimize milk production (Capote et al. 2006). The study of correlation between milk production and linear measurements in goats serves to identify the correlations between morphological characters and milk production and to test the ability of this population to milk.

In arid regions, many studies were conducted in the dairy sector of goats to evaluate the effects of environmental factors on milk yield (Najari 2005) and livestock practices on animal well being and milk quality (Najari 2005). Other research aimed to assess the relation ship between dairy production and mamary traits but unfortunately, to our knowledge, no studies have looked at the relation between daily production of local goats and linear body measurements. The present work aims to understand the dairy potentiel of local goats and to develop some equations to estimate the daily milk production from some body measurements.

2. Materials and Methods

Animals and management

All experimental goats were raised in the Arid Areas Institute of Médenine (IRA), in the South-East of Tunisia with an arid continental Mediterranean climate, with irregular and sporadic rains. The local goat population is a very heterogeneous group of animals from a genetic and morphological point of view. It is known for its small size, the average height is around 73cm for males and only 60cm for females. As for the average adult weight, it is 35 kg for males and 24 kg for females [19,20]. The reproductive management of the flock is planned to obtain one kidding per year. The main mating period is from June to August. The season of kidding begins in October and continues until February, with a concentration during November and December. The suckling period lasts for 120 days on average. The female kids are mated for the first time between 12 and 18 months of age, depending on their season of birth. The number of goats mated per

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sire varied from 5 to 17. Goats were randomly assigned to bucks. Bucks were replaced every 5 years with replacements coming from outside flocks in order to control inbreeding or from the experimental flock. Animals grazed in natural pastures during the day. In general, grazing pasture grasses covered about 70% of breeding animals feed requirements. The remaining 30% was covered by a supplementation provided during the mating (600 g/day), the last month of pregnancy and the beginning of lactation (750 g/day). All animals were provided with water allowed twice a day.

Daily milk production recording
Daily milk (DMP) of each goat was estimated after separation of kids during the night (16h). This record was carried out periodically every 14 days.

Linear body measurements parameters
The body weight of goats was recorded on the day of parturition then weekly. The assessment of the other linear traits was performed before each milk recording. All body measurements are applied while animals are standing in normal pose. Linear body measurements included :
  - Body Length (BL) : The distance from the tip of sternum to the tail base
  - Heart Girth (HG) : The circumference of the chest just behind the forelegs
  - Withers Height (WH) : the distance from ground to the shoulder-blades
  - Hip Height (HH) : Height from ground to the spina illiaca

Statistical Analyses
For each goat, the final analysis file contains the following information : number of the goat, date of kidding, values of the 4 measurements, and quantity of milk collected during each record. In order to test the correlation between the studied traits, Pearson correlation coefficients for linear measurements and daily milk were calculated. The correlation was considered significant at 5% level ($p < 0.05$). Four models were used in the present study to estimate the daily milk production, the model with high coefficient of regression will be considered as the best model.

3. Results and Discussion
Average daily milk production and all studied linear body measurements for goats are presented in table 1. The percentages of variation for milk production were moderate (21.80 %) but the difference between minimum and maximum were high ranged from 200 to 1200ml. Similar result has been reported in most breeds and local populations raised under arid environments. (Alexandre et al. 1999). Such a low milk production of local goats corresponds to low energetic needs, which could be considered as epigenetic strategy of adaptation to the difficult environmental conditions. In this regard, low milk production can be regarded are indeed specific mechanisms of adaptation to the restrictive and irregular environment as shown by Gandy et al. (2012). The adaptation mechanism could be either genetic or epigenetic as these harsh and limiting environments may result in epigenetic marks oriented to limit the size of animals to endure starvation and heat-stress, as it has been observed in some African human population (Haenlein 2004). Thus, the maxima value of daily milk shows that even though the genetic level of local goat is lower on average, the population contains some highly productive invidious. These high-performance goats can constitute a selection nucleus to produce a specialized herd able to valorize the intensive conditions by a high milk production.

Table 1. Basic statistics for daily milk production(ml) and body measurements (cm) of local goats.

Variable	Mean	Minimum	Maximum	sd	CV(%)
Av. Daily milk production (ml)	780	200	1200	170	21.80
Body weight (kg)	24.27	19.25	32	3.20	13.18
Body measurements (cm)					
Body length	64.71	30	80	6.33	9.78
Wither Height	61.86	48	98	5.66	9.15
Hip Height	40.80	35	54	1.32	3.23
Heart girth	62.54	57	70	2.55	4.07

sd : standard deviation ; CV : Coefficient of Variation, Av : average.

Local goats were characterized by low weights (24.27kg). Similar results have been reported in most breeds and local populations raised under arid environments (Gandy et al. 2012; Goonewardene et al. 1999). Such a low weight of local kids corresponds to low energetic needs, which could be considered as epigenetic strategy of adaptation to the difficult environmental conditions. In this regard, low weights can be regarded

are indeed specific mechanisms of adaptation to the restrictive and irregular environment as shown by (Aboul-Naga et al. 2012; Abdel-Raheem 1998; Shaat and Maki-Tanila 2009) The adaptation mechanism could be either genetic or epigenetic as these harsh and limiting environments may result in epigenetic marks oriented to limit the size of animals to endure starvation and heat-stress (Abdel-Moneim 1986; Hamed 2005), as it has been observed in some African human population.

Pearson correlations between daily milk production and linear measurements are shown in table 2. A positives and moderates correlations between daily milk and linear measurement were found in our study. For linear parameters, the Pearson correlation for the same animal ranged from 0.33 between HH and WH to 0.93 between BW and BL.

Table 2. Pearson correlations between daily milk production and linear body measurements of local goat.

	DMP	HG	BW	BL	WH	HH
DMP	1	0.21*	0.66*	0.38*	0.48*	0.31*
HG		1	0.42**	0.90**	0.35NS	0.83*
BW			1	0.93*	0.92*	0.44*
BL				1	0.91*	0.65*
WH					1	0.33NS
HH						1

* : significant correlation ($p<0.05$), ** : highly significant correlation ($p<0.01$),
NS : non significant correlation ($p>0.05$)

The significant correlation between the mean DMP indicated the interest of linear traits in the estimation of daily milk yield in local goat population goat and those traits can be used as selection criterion in improvement program. Several studies have also pointed at the importance of linear body records to obtain reliable estimates of milk production (Loeje and Van Vleck 1978). Gall (1980) in the study of the German improved goat found a correlation coefficient of 0.36 between body weight and milk performance. (Žujović et al. 1993) had observed a similar result when analysing the relation betweenmilk yield and body measurement and mentionned a positive correlation betweenb body weight and height to withers, breast girth and shank circumference, as well as height to withers and breast girth and shank circumference.

The studied regression model and the coefficient of determination (R^2) values for prediction of daily milk production from the different studied measurements are given in table 3.

Table 3. Coefficients of determination values to estimate daily milk production (DMP) in local goat population

Models	Equations	R^2
1	DMP= - 1.32 + 0.03HG	9
2	DMP = - 0.21 + 0.03HH	21
3	DMP = - 1.33 - 0.03 BW + 0.045 WH	44
4	DMP = 0.80 - 0.08 BL + 0.09 WH	36

The coefficients of determination obtained from different models in order to estimate daily milk production of local goats does not exceed 50%. The coefficient of determination reaches its maximum value by increasing the number of variables included in the model. The highest R^2 value was obtained when used two goat's variables (WH and BW). From goats' model, it could be use the body weight and the weither height as a good measurement to predicate daily milk production with reasonable R^2.

4. Conclusion

The performances of local goat show a low milk production which remains consistent with its genetic profile adapted to the pastoral husbandry under arid harsh conditions, Milk production was positively correlated with all body measurement. The present results shows that the body weight and the weither height can be considered as a good measurement to predicate daily milk production with reasonable R^2 and opens a opportunity to establish a genetic evaluation program in this experimental farm, with the goal of been a genetic resource for farmers of the breed.

5. References

Abdel-Moneim AU (1986) Studies on milk yield of Egyptian Nubian goats. M.Sc. Thesis, Faculty of Agriculture, Cairo University, Giza, Egypt

Abdel-Raheem AA (1998) Genetic studies on Zaraibi goats. Ph.D. Thesis, Faculty of Agriculture, Ain Shams University, Egypt

Aboul-Naga AM, Hamed A, Shaat I, Mabrouk MMS (2012) Genetic improvement of Egyptian Nubian goats as sub–tropical dairy prolific breed. Small Ruminant Research, 102: 125-130

Anonymous (2005) Body measurements as a management tool for crossbred dairy cattle at a smallholder farm condition. Prepared by Msangi BSJ, Bryant MJ, Kavana PY, Msanga YN, Kizima JB, www.ihh.kvl.dk/htm/php/Tsap99/15- msangi.htm; Date of Connection, 11 Jan 2011

Atoui A, Carabaño JM, Diaz C, Najari S (2019) Genetic analysis of live weight of local kids to promote genetic evaluations in the arid areas of Tunisia . Tropical Animal Health and Production. 52,955–968

Atoui A, Carabaño MG, Díaz C, Abdennebi M, Najari S (2020) Characterisation of Tunisian local goats' response to heat stress in arid region. Journal of New Sciences

El-Gandy HH, Marwa SM, Alsheikh MA, Magdoub MNI (2012) Activity of some enzymes of Egyptian desert goat milk affected by different feeding systems. The proceeding of the 11 Conference of Agriculture th Development Researches, Cairo, 27 30 March. Special Issue, Vol. 58(1). Annals of Agricultural Science. Published by Faculty of Agriculture, Ain Shams University, Cairo, Egypt

Gall C (1980) Relationship between body conformatiion and production in dairy goats. Journal of Dairy science, 63, 10, 1768-1781

Goonewardene LA, Okinea E, Patrick N, Scheer HD (1999) The relationship between multiple births and milk yields in non-suckled intensively managed dairy goats. Small Ruminant Research, 32: 181-185

Hamed A (2005) Non-genetic factors and genetic parameters for total milk yield and growth in Zaraibi goats. M.Sc. Thesis, Faculty of Agriculture, Al-Azhar University, Egypt

Iloeje MU, Van Vleck ID (1978) Genetics of dairy goats. A. Review. Jorunal Dairy Sci., 61, 1521-1528

Najari S (2005) Caractéristiques zootechnique et génétique d'une population animale : Cas de la population caprines locale des régions arides tunisiennes. Thèse de doctorat d'état en sciences agronomiques, Institut National Agronomique de Tunisie. 192p

Peacock C (2008) Dairy goat development in East Africa: A replicable model for smallholders, Small Ruminant Research, 77: 225-238

Semakula J, Mutetikka D, Kugomza R, Donald V, Mpairwe D (2010) Variability in body morphometric measurements and their application in predicting live body weight of mubende and small east African goat breeds in Uganda. Middle-East Journal of Scientific Research, 5, 2, 98-105

Shaat I, Maki-Tanila A (2009) Variation in direct and maternal genetic effects for meat production. traits in Egyptian Zaraibi goats, J. Anim. Breed Genet., 126: 198-208

Žujović M, Žujović M (1993) Fenotipske korelacije izmedju mase tela i nekih telesnih mera u tri genotipa koza. Savremena poljoprivreda, 1-2, IX Seminar o savremenoj stočarskoj proizvodnji, Novi Sad