

## Productive indicators of Murciano-Granadina goats under post-quarantine conditions in Cuba

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### Abstract

**Objective:** To characterize the performance of some productive indicators of Murciano-Granadina goats under post-quarantine conditions in western Cuba.

**Materials and Methods:** To evaluate the production and quality of milk, 10 lactating females and 12 kids of their offspring were selected during a period of 30 days. The quality indicators were: density, fat, nonfat solids, acidity and reductase. A semi-intensive production system was established, with controlled grazing and feeding trough supplementation with the protein forage plant *Cratylia argentea* (Desvaux O. Kuntze).

**Results:** Survival of 97,4 % and 1,2 kids per birth were obtained during the study. Birth weight of the kids was 1,7 kg and daily gain was 0,08 kg. Average daily milk production was higher than 1,4 kg/goat.

**Conclusions:** The analysis of the evaluated indicators allowed the characterization of the productive performance of the first genetic nucleus of Murciano-Granadina breed goats established in Cuba. In addition, the production and quality of milk produced by these goats comply with the genetic potential of this breed.

**Keywords:** adaptation, goats, potential production

### Introduction

Goats were among the first ruminants domesticated by humans more than ten thousand years ago, which justifies their frequent presence in liturgical texts and historical documents from ancient times. Since the 16<sup>th</sup> century, they have inhabited the Americas, having been introduced in the islands of the Caribbean Sea as well as in the rest of the world. It has been one of the most useful species to humans, especially as a provider of milk (Bidot and Muñoz, 2016).

Its importance as a domestic species, with great productive and reproductive potential (Robles-Rebollo *et al.*, 2020), offers enormous development prospects, mainly in terms of milk and meat production for the so-called developing countries. In recent decades, a change that favors the South over the North is the increased use of goats in food production instead of other functions to which they were previously destined (Miranda-Miranda *et al.*, 2023).

In 2021, there was a stock of approximately 1 million 443 thousand sheep, and only 707 thousand goats (MINAG, 2021) that were dispersed in

the different existing productive forms, with the predominance of non-state production, where there is less cultural attention.

The Cuban goat herd is little productive and has a high degree of inbreeding. Its development is carried out under rustic conditions. The feed basis is not very efficient, due to the quality of the pastures and infestation of the paddocks. Under these conditions, the production of milk and its derivatives is limited (MINAG, 2021).

Increasing milk and meat production in Cuba is part of the policies of the Cuban State, as defined in the Cuban Economic and Social Model of Socialist Development (MINAG, 2021) and in the Law of Food Sovereignty, Food and Nutritional Security (MINJUS, 2022). In this context, small livestock is of special importance because of the possibility of achieving greater production increase, in less time and with better use of the area.

In the international context, the Murciano-Granadina breed is widely distributed due to its well-defined dairy biotype, adaptability, hardiness, prolificacy, productivity and milk quality, among other indicators (Saavedra *et al.*, 2023).

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Through the Sustainable Agriculture Support Program (PAAS, for its initials in Spanish) project, in August 2022, the Center for Research on Protein Plants and Bionatural Products (CIPB, for its initials in Spanish) began working with the first genetic nucleus of Murciano-Granadina goats introduced in Cuba, with the purpose of increasing milk production, because in recent years goat milk and its products are given great attention in several countries of the world (Pal *et al.*, 2017; Pérez-Sánchez *et al.*, 2020). The objective of this research was to characterize the productive performance of Murciano-Granadina goats under post-quarantine conditions in western Cuba.

### Materials and Methods

**Location.** The characterization was developed under post-quarantine conditions in a herd of Murciano-Granadina goats (27 females and 12 sires) in areas belonging to the Basic Production Unit (UBP, for its initials in Spanish) Futuro Lechero of the CIPB, located in Playa municipality, Havana province, Cuba.

**Animals.** The animals that formed the herd, coming from Murcia, Spain, showed black color, thin and short coat and thin and pigmented skin, small head, provided with horns that extend backwards and upwards. Their ears are small or medium-sized, erect and horizontal, and their legs are short and strong. For the collection of the samples, 10 females and the production of the first 30 days of lactation were selected. The goats were in lactation for more than 30 days. They were clinically healthy, with live weights ranging between 36 and 38 kg and adequate body condition, which corresponded to category 4 on a scale of 1-4 (Urrutia-Morales and Gámez-Vázquez, 2006).

**Feeding and management system.** A semi-intensive production system was established (stabled-controlled grazing). The animals grazed for three to four hours, in a controlled manner, in the morning, in a pasture of *Urochloa* hybrid cv. BR02/1752 (yacaré) with a floristic composition of 85 %, associated with *Moringa oleifera* (Lam) for browsing. In addition, each goat was offered 1,2 kg of *Cenchrus purpureus* (Schumach.) Morrone cv. OM-22 forage, 1 kg of *Cratylia argentea* (Desv.) O. Kuntze forage, 0,7 kg of concentrate feed and hay *ad libitum*. Kid feeding was based on restricted suckling, two hours per day and hay *ad libitum*.

**Herd evaluations.** During the experimental period, the following herd performance variables

were evaluated: adult and offspring mortality rate, parturition (single or double births), sexual balance, kids' weight gain and milk production/day.

**Physical-chemical quality of milk.** The characterization of the indicators of the physical-chemical quality of goat milk was carried out, collected in the sample of 10 lactating females, every 15 days during milking at 7:00 a.m. The density (g/ml) was determined with a Quevenne lactodensimeter and the reading was made with the milk at  $15 \pm 2$  °C, according to the procedure established in the Cuban norm NC 119-2006 (INN and ONN, 2006). As for the determination of acidity, the colorimetric method of lactic acid quantification was used, which establishes that it should not exceed 0,02 g of lactic acid/100 mL of the sample to express optimum quality NC ISO 2446-2003; NC 71-2000 (INN and ONN, 2000; 2003). Fat was estimated by the Gerber method, corresponding to the amount of fat by weight per 100 mL of milk. The percentage of nonfat solids was obtained by subtracting the fat content of the milk from the total solids NC ISO 6731-2001 (INN and ONN, 2001) and by the procedure described by Carrisoza-Urbina (2022). Reductase was determined according to the procedure described by CANILEC (2011). All analyses were performed at the specialized dairy laboratory of the Food Industry Research Institute (IIIA).

**Statistical analysis.** Statistical analyses were performed on the mean determinations, with confidence intervals of 95 % and the corresponding standard deviation. The specific statistics are shown in the tables and figures where the results are presented.

### Results and Discussion

The adaptability of this first genetic group of Murciano-Granadina goats to Cuban conditions was manifested in a survival rate of 97,4%, with no losses due to diseases. In terms of productivity, 1,2 kids were produced per birth, which is close to the expected average of 1,5 for first births under the environmental conditions of their original environment, characterized by an annual reproductive cycle (Ovigen, 2020). In addition, a high fecundity rate was recorded (12 kids per 100 births), with 40 % twins and a sexual balance of 50 %. The newborns weighed an average of 1,7 kg; while their daily growth reached 0,08 kg (figure 1).

The Murciano-Granadina goat is a continuous polyestrian animal with low reproductive seasonal-

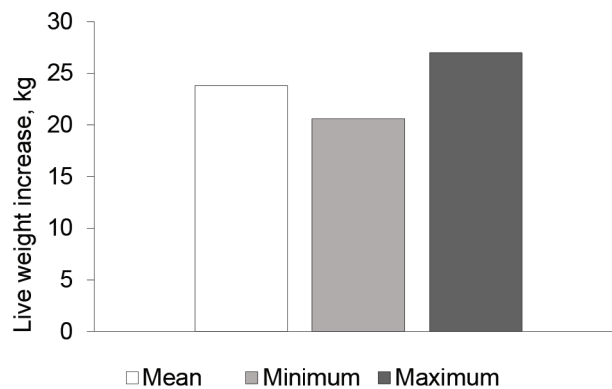


Figure 1. Body weight increase of kids from the first birth of Murciano-Granadina goats.

ity, unlike other Central European breeds (Teichert *et al.*, 2020). This reproductive quality confers a homogeneous milk production throughout the year, which is highly appreciated and allows, in turn, to further enhance the value of animal husbandry with this goat, currently considered one of the most important dairy goat breeds in the world.

The performance of the milk production of this Murciano-Granadina herd in the first 30 days of lactation is shown in figure 2.

The lactation curve begins with a slightly higher production than that reported by León *et al.* (2007) and also differs in its trajectory, which should ascend more rapidly than in this case. This indicates the need to characterize this aspect in

subsequent lactations, with larger numbers of animals and a higher degree of adaptation to the environment. The curve was similar to that reported by Martínez *et al.* (2018) with this goat breed in Argentina, although with the same trends. Results above 1,4 kg/goat showed that the yields of this breed under Cuban conditions were similar to those obtained in its place of origin for the first lactation (Martínez *et al.*, 2018).

Dairy yields experience a steady increase from the first to the fourth lactation. This increase is mainly due to the growth of the mammary gland, whose size is directly proportional to the animal's live weight gain, as well as to the improvement in rumen capacity and feed intake efficiency. In ad-

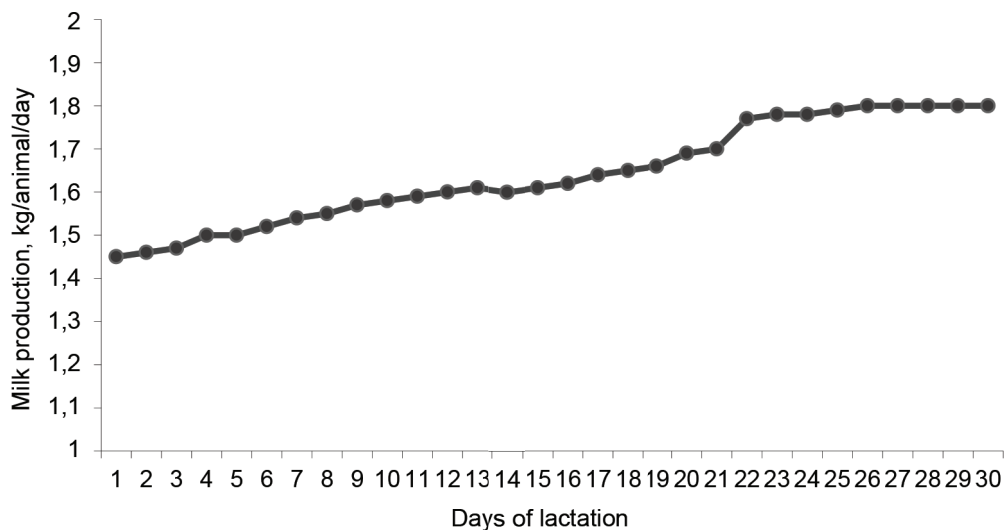


Figure 2. Milk production performance of Murciano-Granadina goats during the first 30 days of lactation.

dition, the progressive development of mammary alveoli with each lactation also plays a crucial role in the rise of milk production (López *et al.*, 2021).

The Murciano-Granadina breed is not as demanding in feeding as the Saanen or Alpine breeds (Rodríguez-Carías *et al.*, 2020; Cedeño *et al.*, 2022), because the rusticity and adaptation capacity of its animals allows them to feed under conditions in which others are not able to.

Since the purpose of introducing the Murciano-Granadina breed in Cuba is milk production, it was considered important to carry out a preliminary evaluation of its quality (table 1), subject to the above-described habitat and feeding conditions (Baquero-Saldarriaga and Chacón-Villalobos, 2022).

Table 1. Milk quality of Murciano-Granadina goats in western Cuba.

Variable	Value
Density, g/mL	1,025
Fat, %	3,0
Nonfat solids, %	7,0
Acidity, °D	15,0
Reductase, hours	2,50

The results of the density indicator in this research are close to the recognized values of milk density, which vary between 1,030 and 1,033 on average (INN and ONN, 2006; Miranda *et al.*, 2021), despite the low values of fat and nonfat solids that the milk showed (Miranda-Miranda *et al.*, 2021). In general, the figures for quality indicators correspond to those of good quality raw milk (Arrieta *et al.*, 2019).

Milk density is influenced by environmental variables. Of these, temperature is determinant (Rodríguez-Rodríguez *et al.*, 2014). Milk density is not constant, but depends on two opposing factors: the concentration of dissolved and suspended nonfat solids and the proportion of fatty matter. Milk density increases in proportion to the former, and decreases in proportion to the latter, because fat has a lower density than water (Álvarez-Figueroa *et al.*, 2022).

Currently, goat milk and its products receive great attention in several countries around the world (Muñoz-Alfárez *et al.*, 2020), as they are useful as functional foods (Robles-Rebollo *et al.*, 2020) for the maintenance of nutrition and health of young and long-lived people, especially for those suffering from cow's milk allergies (Álvarez-Figueroa *et al.*, 2022).

The milk of the Murciano-Granadina breed has a medium density and qualitative composition (5,5-5,8 % fat; 3,6-3,8 % protein; 4,5 % lactose and 14,1 % dry matter), which influences the excellent yields for cheese production.

The results could augur the insertion of this breed in the goat value chain model with agroecological approach proposed by Pérez-Lamas *et al.* (2023) and also contribute to improve goat milk production in Cuba and to develop high quality dairy products and incursion into local trade with small farmers (Chacón-Villalobos and Mora-Valverde, 2019).

### Conclusions

The evaluated indicators characterized the productive performance of the first goat genetic nucleus of the Murciano-Granadina breed introduced in Cuba. Milk production and quality were in accordance with the reports for this breed.

### Conflict of interests

The authors declare that there is no conflict of interests among them.

### Authors' contribution

- María del Carmen Pérez-Hernández. Led the research and participated in the design and execution of the experiment. She took part in the interpretation of the experimental results and in the writing of the paper.
- José Carlos González-Torrecilla. Participated in the execution of the experiment and in the interpretation of the results.
- Juan Francisco Ramirez-Pedroso. Participated in the execution of the experiment, in the design and interpretation of the experimental results and in the statistical processing and writing of the paper.
- Ernesto Ramirez-Cordero. Conducted the research task and participated in the design of the experiment and interpretation of the results.
- Boris Ramos-Serrano. Conducted the research task and participated in the design of the experiment and interpretation of the results.

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