Scientific Paper

Some performance indicators of the Mozambican Landim in the Angónia plateau

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Abstract

Objective: To characterize the indicators of the reproductive and productive performance of Mozambican Landim goats in the Angónia plateau, in Mozambique.

Materials and Methods: The performance of a flock of Landim goats, made up of 135 does, six bucks, 114 kids and 95 growing animals, was studied. They were established as a single flock, based on natural pasture. The age and weight of reproductive incorporation, age at the first and second parturition, interval between parturitions, weights at birth and at thirty days (comparing sex), at six months, after one year, after one and a half, after two years, after two years and a half, as well as the average daily gain per periods, were analyzed during eight years.

Results: The females reached puberty at 20 months of age, as average (variation between 16 and 24 months). The first parturition occurred between 21 and 26 months, weighing 32,5 kg. Incorporation weight was variable, between 24 and 40 kg (31,3 kg as average). The period between the first and second parturition was 12,4 months as average. The kids were born weighing 2,13 kg. At 30 days of age, the live weight of males (5,1 kg) exceeded that of females (4,8 kg). After one month of life, the growth curve tended to decrease as the age of the animals increased.

Conclusions: The Landim goat shows late incorporation to reproduction and lengthening of the period between the first and the second parturition. From the productive point of view, it shows low potential, which is reflected on low daily gain and low live weight at two years of age, proving the low potential of the breed under these conditions.

Keywords: goat, reproductive performance, weight at birth, body weight

Introduction

There are approximately one billion goats in the world, and their population has more than doubled in the last four decades. According to the Food and Agriculture Organization (FAOSTAT, 2018), more than 90 % of goats are found in developing countries. Asia has the largest share of the world's goat population compared with other continents, accounting for 55,4 % of the world's goat population, followed by Africa. This continent has a great diversity of indigenous breeds, adapted to different agroclimatic and geographical conditions, including the high temperatures of desert zones. According to Skapetas and Bampidis (2016), goats are the oldest domesticated animals, and one of the most used species for meat production in the world. About 95 % of the total stock is in tropical developing countries, located in Africa and Asia.

Alsace *et al*. (2017) reported that in the Republic of Mozambique, agriculture and animal husbandry constitute the source of income and employment for approximately 85 % of the population that lives in rural areas. More than 95 % of the goat stock (around four million) are in the hands of small farmers, who generally use the goat for meat production and for additional income, for which this animal plays an important socioeconomic and cultural role, because the surplus is sold or exchanged for other products and also contribute to financing the costs of health, education, parties and traditional ceremonies.

Although this genetic resource, heritage of Mozambique, represented by the Landim and Pafuri breeds, traditionally makes enormous contributions to the food and nutritional security of this people, it remains unknown, considering the small number of studies of which it has been the object, a situation for which Mozambique does not have programs for its conservation and breeding.

Based on the above-described antecedents, the objective of this study was to characterize the

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indicators of the reproductive and productive performance of Mozambican Landim goats, in the Angónia plateau, Mozambique.

Materials and Methods

Location of the study zone. The work was conducted at the Angónia Zootechnical Station, which is on the plateau of the same name, located in the North-Northeast end of the Tete province, at an altitude that varies between 700 and 1 655 m.a.s.l.

Edaphoclimatic characteristics. The soils are of Ferralitic type, between red and brown red, of heavy texture, deep and moderately well-drained, with slight or strong lixiviation and good water holding capacity. The climate of the zone is humid temperate, influenced by altitude. The rainfall values varied form 725 mm to 1 149 mm. Of the rainfall 90 % is concentrated between November and early April. The average annual rainfall is 20,9 ºC (INE, 2017).

Experimental procedure. The flock was made up by 135 does, six bucks, 114 kids and 95 growing animals of the Mozambican breed Landim, managed as single flock, in open areas of naturalized pastures, during eight hours per day. They did not receive water in the grazing area or energy-protein supplement in the confinement sheds.

Measurements. The performance of some reproductive indicators (age and weight of incorporation to reproduction, age at first and second parturition and interval between parturitions) was evaluated. Productive indicators were also analyzed (weight at birth, at thirty days of age, comparing sex, at six months, at one year, at one and a half years, at two years, at two and a half years of life, as well as mean daily gain (MDG) in these periods. Data recorded from the station flock for eight years were used.

The live weight of the kids at birth was estimated with a scale of 10 ± 0,01 kg capacity. Subsequently, until weaning, a scale of 25 ± 0,02 kg was used. For the live weight of the does, another scale of 100 ± 0,05 kg was used. Weaning was done at 120 days of age.

Statistical analysis. The data were taken from the individual records of each animal. To determine the influence of the parturition trimester on birth weight, a simple classification variance analysis was performed. The comparison among means was done using Duncan's test. To study the performance of weight at birth and at 30 days of age, in both sexes, a Student's t-test was performed. All variables were processed with the statistical package SPSS® 23.

Results and Discussion

Table 1 shows aspects related to the incorporation to the reproductive activity of the goat flock under study. Puberty was reached at an average age of 621 days (20,7 months of age), with a wide variation range, between 16 and 24 months. This determines that the first parturition occurs between 21 and 26 months of age. The incorporation weight is also very variable, with minimum and maximum values, which range between 24 and 40 kg, respectively, for an average of 31,3 kg.

The recorded values, of age and weight at incorporation indicate a native genetic resource, which has not undergone any selection process and is highly influenced by the environment. It is characterized by a climate with very cold temperatures and low availability of pastures, which conditions the goats to present poor somatic and neuroendocrine development, causing a lengthening of the period to initiate the reproductive activity. Meneses (2017) assured that temperature and feeding have a high influence on the reproductive activity of tropical breeds of lower seasonality.

European goats and those from the American continent show, in general, much lower incorporation ages. Some of the goat breeds, recognized as native in the United States, show their first heat at six months. However, the variability is very high,

Table 1. Some reproductive indicators of Landim goats in the Angónia plateau.

Variable	Average	Minimum	Maximum	SE ±	n
Age at incorporation, months	20,7	16,3	24,7	0,3	135
Weight at incorporation, kg	31,3	24,5	40,3	0,5	135
Age at first parturition, months	25,5	21,9	26,2	0,4	130
Age at second parturition, months	32,9	29,0	43,0	0,5	123
Period between the first and second parturition, months	12,37	10,82	13,55	0,2	123

depending on climate and tenancy conditions (Sponenberg and Edmundson, 2016).

Variability is also observed in insular America. Valerio *et al*. (2010) reported that Dominican goats received their first mating at 6,5 months of age. Ships *et al*. (2016) reported 9,5 and 12,5 months for the reproductive incorporation of creole goats from Haiti and Guadeloupe, respectively. Chacón-Marcheco *et al*. (2016) stated that the Cuban creole goat reaches puberty between 9,5 and 12,5 months.

In Oaxaca, Mexico, Echavarría-Cháirez *et al*. (2013) pointed out that the goats of that region can reach puberty at approximately 10 months, with an average weight of 19,0 kg, and that their first birth occurs around 15 months of age. In South America, in Argentina, the reproductive cycle of goats begins when they reach 28 kg of weight or are one year old (Mate, 2018). Vargas-Bayona *et al*. (2016), in creole goats from Colombia, indicated values closer to those recorded in this study, where the first conception was at 15 months; while parturition was achieved at 20.

The period between the first and second parturition was also prolonged. In this study, it had an average value of 12,4 months. This performance shows the impossibility of obtaining three parturitions in two years, which is the aspiration of goat farmers at international level. In Cuban creole goats, the time that elapses between the first and second parturition averages just over nine months (Chacón-Marcheco *et al*. 2016). In Colombian creole goats, Vargas-Bayona *et al*. (2016) indicated that this period lasts 396 days. A much shorter interval (8,5 months) was reported by Naves *et al*. (2016) for creole goats from Guadalupe.

Table 2 analyzes the performance of the weights at birth and at thirty days of age, as well as the MDG of the kids.

The Landim kid is born with average weight of 2,1 kg, with no differences between females and males. This value is similar to that reported for multiple goat breeds at international level. Echavarría-Cháirez *et al*. (2013), in kids from Oaxaca, indicated birth weight in single birth between 2 and 3 kg; while in multiple births the values decrease by 1-2 kg. Ships *et al*. (2016) reported 2,2 and 2,5 kg as average for creole kids born in Guadeloupe and Haiti, respectively. These values are slightly higher than those recorded in this research. The values reported by Rosa *et al*. (2016) are also higher, in terms of the average weight of kids of the Argentinean red breed (without discriminating by type of parturition), who indicate values of 2,7 ± 33,0 g. In this case, the males exceeded the weight of females by 14,0 %. Vargas-Bayona *et al*. (2017) in Colombian meat breeds recorded weights higher than 3 kg (3,9 and 3,5 kg), in males and females, respectively.

At 30 days of age, Landim kids reached an average weight of 4,9 kg, with significant differences in favor of males (5,1 kg) compared with females (4,6 kg), equivalent to 7,5 % more in the former. At the same age, the creole kids from Guadeloupe were slightly heavier than the Landim kids, with an average weight of 5,3 kg, according to the values indicated by Naves *et al*. (2016).

The average value obtained of the MDG for the kids of both sexes was 0,095 kg, with significant differences in favor of the males, which gained 0,101 kg, higher than the females, with only 0,086 kg. Much higher values than those found in this study (0,143 ± 0,051 kg/day) were found by Rosa *et al*. (2016), although until 60 days of age, in red kids from Argentina. Fernández *et al*. (2016) reported for the Spanish breeds Murciano Granadina, Blanca Celtibérica, Retinta and Verata, an average value that varied between 0,125 and 0,175 kg/day. Meanwhile, in the creole goats of Guadeloupe, this indicator behaved in 0,107 kg as average, in animals from 10 to 30 days of age; by 0,077 kg between 30

Table 2. Performance of the weight at birth and at 30 days of age in both sexes.

Sex	Average weight at birth, kg	Average weight at 30 days, kg	MDG, kg
Males	2,2	5,1	0,101
Females	2,1	4,8	0,086
Both sexes	2,1	4,9	0,095
SE ±	0,41	0,32	1,85
P - value	0,9688	0,0412	0,0341

MDG: mean daily weight gains

and 70 days, and by 0,084 kg from birth to weaning (Naves *et al*., 2016).

Due to the presumed effect that the edaphoclimatic conditions prevailing in the Angónia plateau could cause on the development of pregnancy and, consequently, due to its influence on birth weights, an analysis of the performance of this indicator was carried out, taking into account the trimester in which the delivery took place (table 3).

This analysis showed that the best weights at birth were obtained by the kids born in the first, second and fourth trimesters, with a significantly higher performance ($p \leq 0,05$) than those born in the third. This performance may be due to the fact that in the Angónia plateau, the rains are concentrated between November and April, when the temperatures are higher, which favors the higher growth of pastures. However, during the harsh winter months (June, July, August and September), with very low temperatures, the rainfall regime becomes practically null and the availability of feedstuffs for animals such as goats, raised on pasture, is so low that barely allows it to meet the requirements to support itself.

The above-explained fact means that in pregnancies that occur between May and September, mothers do not acquire the necessary nutrients to meet the requirements for the growth of the fetus or fetuses, and thus the weight indicator of the kids at the time of birth is affected. Meneses (2017) considered that the needs for pregnancy increase exponentially from conception to delivery, and that the highest fetal development occurs in the last 50 days of the process, so the joint contribution of nutrients in the ration is necessary. Sahlu *et al*. (2004) propose that a good diet for dairy goats in the last phase of pregnancy should contribute between 2,5 and 2,75 Mcal ME/kg DM and 120-140 g CP/kg DM. To achieve these energy and protein contributions with the pre-partum diet, the formulas must include forages with high palatability (legumes) and excellent quality. That is: high digestibility of organic matter and adequate levels of concentrate feeds in the diet.

Table 4 shows the evolution of the weights of the growing animals, from birth to 2,5 years of age.

A gradual decrease in daily gains was shown as the age of the animals increased, for which the maximum weight (36,40 kg) is achieved when they reach two and a half years. From the second year of life, the gains did not exceed 0,022 kg per day as average, which shows the low growth rate that these animals have under the above-described rearing conditions. It is important to take into account the behavior of these animals, which spend half the year grazing in places with very little availability of natural pastures, which limits their inquisitive feeding behavior, with a marked instinct to choose to consume their diet, and discriminate among plant

Table 3. Influence of the trimester of the year on the weight at birth.

Trimester	n	Average weight, kg	SE ±	P - value
I	18	2,5[a]	0,32	0,034875
II	39	2,3[a]		
III	29	1,6[b]		
IV	28	2,2[a]		

Different letters in the same column significantly differ, according to Duncan ($p \leq 0,05$)

Table 4. Performance of weight at different ages.

Age		Average weight, kg	Minimum	Maximum	SE ±	MDG, kg	Minimum	Maximum	SE ±
Birth	114	2,13	1,3	3,0	0,03	-			
1 month	102	4,94	3,8	5,7	0,04	0,094	0,075	0,111	1,53
6 months	98	14,93	12,9	16,4	0,03	0,067	0,049	0,084	1,42
1 year	135	21,95	17,8	25,6	0,04	0,039	0,030	0,048	1,36
1,5 years	128	28,68	25,4	31,8	0,03	0,037	0,028	0,047	1,57
2 years	120	33,78	30,4	36,3	0,04	0,028	0,022	0,035	1,63
2,5 years	112	36,40	33,5	39,4	0,05	0,014	0,006	0,023	1,85

parts or feedstuff particles that appear identical (Mate *et al*., 2018).

In Brazil, Caldas *et al*. (2011) monitored crossbred kids (Boer x native breeds) and pure native kids, fed breast milk, grass and mineral salts *ad libitum*. These authors obtained live weight and MDG values higher than those achieved in this work. The crossbred kids, which were born with 3,2 kg of live weight, reached 5,8 kg at 30 days of age; 9,6 kg at 60 and 14,2 kg at 90 days. They showed an average MDG of 0,122 kg from birth to three months of age; while the kids of native breeds, which were born with an average weight of 2,3 kg, achieved 4,1 kg at 30 days; 7,0 kg at 60 and 10,6 kg at 90 days, with an average MDG of 0,092 kg in the stage. Although the latter shoed lower growth rates than the Boer crossbreds, their results exceed those found in this study with the Landim breed.

The average weight in adult animals here was between 33,7 and 36,4 kg, for ages between two and two and a half years, respectively. This corroborates the low growth rate that this breed shows with regards to Saanen, Alpine and Boers. Weight values close to these were reported by Sponenberg and Edmundson (2016) in the local American breed San Clemente (30 and 45 kg in females and males, respectively). This breed, like the Landim, has not undergone any breeding program, because its flock of approximately 357 females and 204 males is only kept for conservation. However, another local American breed, the Tennessee Goat or Myotonic Goat, whose purpose is meat, has female specimens weighing between 30 and 50 kg and, in some flocks, the weight can reach up to 70 kg. Very high weights are also obtained by the Spanish Negra Serrana, whose females reach between 50 and 60 kg, and males between 80 and 90 kg (Fernández-de-Sierra *et al*., 2016).

Conclusions

The Landim goat, kept in the Angónia plateau, shows low reproductive performance, which is manifested in the late start of its reproductive life and the lengthening of the interval between the first and second parturition. This leads to fewer births and lactations, compared with most European and American goats. From the productive point of view, it shows low potential, which is reflected on low live weight at two years of age, with an average MDG of only 0,038 kg during the studied stage.

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Conflict of interests

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

Authors' contribution

- Alfeu Cavele. Research conception and design, analysis and interpretation of results and paper writing.
- Eliecer Pérez-Pineda. Research conception and design, analysis and interpretation of results and paper writing.
- Norge Fonseca-Fuentes. Research conception and design, analysis and interpretation of results and paper writing.
- Juraj Grizelj. Research conception and design, analysis and interpretation of results and paper writing.

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