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ANIMAL PRODUCTION

# Zootechnic and economic indicators of termination in feedlot of different genetic groups of lambs

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**ABSTRACT.** The objective of this work was to evaluate the performance, carcass traits and economic indicators of Santa Inês lambs and their crossings finished in feedlot. Thirty whole lambs (10 Santa Inês, 10 ½ Dorper + ½ Santa Inês and 10 ¾ Dorper + ¼ Santa Inês) were used, with 115 days of age and initial live weight of 20.07 kg. The lambs were kept for 60 days receiving sorghum silage and concentrate, after which they were slaughtered. The ¾ Dorper + ¼ Santa Inês lambs and the ½ Dorper + ½ Santa Inês lambs showed higher of dry matter intake and water intake, greater daily weight gain and body score in relation to Santa Inês lambs. The carcasses of ¾ Dorper + ¼ Santa Inês lambs showed better conformation, finishing and marbling. The gross profit margin showed positive values for all genetic groups, covering the effective operating cost. Dorper crossbred lambs had a higher gross margin compared to Santa Inês lambs. The cost of the diet represented on average 61.35% of the price paid per kilo of sheep meat. In the sheep meat production system, the genetic group influences the zootechnical and economic indicators of finishing feedlot of lambs.

**Keywords:** performance; Dorper; genotype; Santa Inês.

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## Introduction

The sheep farming has been pointed as an activity with potential to impact the economic and social development of Semiarid regions, contributing to the generation of employment and income of the families, mainly those connected to the familiar based agriculture. Though this potential, the activity does not present a defined system of production and able to attend the necessities required by the consumer market, be because the quality or regularity in the offer of lambs for slaughtering.

The production system of lambs with late weaning propitious the slaughter of animals with advanced age, consequently compromising the quality of the carcass and meat due to changes in the muscle fiber frequency and the solubility of the collagen, as well increases the interval between the matrices, and, consequently, the productivity of the herds (Pinheiro, Silva Sobrinho, Souza, & Yamamoto, 2009).

Other ways of intensify the meat of sheep production are the termination in feedlot (Cartaxo et al., 2017) and the breeding of the genetic groups (Warner, Greenwood, Pethick, & Ferguson, 2010) using those which have more aptitude for cutting. This way, the reduction in the lambs weaning age and then the termination in feedlot may provide to the market carcasses and meat with higher quality. According to Ribeiro et al. (2009), the feedlot of lambs is strategic in management of the property, allowing increasing the enjoyment rate, the productivity, the profitability, reducing the grazing pressure during the drought and guaranteeing the providing of sheep meat during all the year.

The genetic group used termination in feedlot may influence in zootechnic and economic indicators of the herds, in this sense, it is necessary an evaluation of the crossbreeding among the genetic groups used the most in these regions, from different breeding, because there is a few knowledge about these characteristics (Fernandes Júnior et al., 2013).

Beyond biologic evaluation, it is extremely important to economically analyse the production system, because, through it, the producer starts to know in details and optimizes the production factors. This way, the main points of the bottleneck are evidenced, what allows further concentration of management and technologic efforts to improve the biologic efficiency, increasing the profitability of the activity (Barros et al., 2009).

The objective of this study was to evaluate the performance, carcass traits and economic indicators of lambs of different genetic groups in finished in feedlot.

## Material and methods

The experiment was conducted in Experimental Station Benjamim Maranhão, belonging to State Agricultural Research Company of Paraíba (EMEPA-PB), located in Tacima City, Paraíba State, Brazil, altitude 188 m and an average weather of 24°C.

The lambs were from a hundred twenty ewes of a production system of cut sheep, being 80 ewes of Santa Inês breed and 40 ½ Dorper + ½ Santa Inês. The Santa Inês ewes were divided in two groups, one with 40 ewes which were cross with to ram of pure Dorper breed and 40 ewes were cross with to ram of pure Santa Inês breed. By its turn, the 40 ½ Dorper + ½ Santa Inês ewes were crossed with Dorper pure ram. The ewes were submitted to sumplementar feeding (*flushing*) 14 days before the breeding season, with 42 days long, receiving 330 g day$^{-1}$ of a ration containing 16.0% of crude protein, 2.90Mcal of metabolizable energy for kilogram of dry matter.

In the breeding phase the lambs had access to private trough (*creep feeding*) since 10 days old until the weaning which occurred at 0 days old, receiving beyond the breast-feeding a solid diet containing 23.3% of crude protein, 2.95 Mcal of ME kg$^{-1}$ of DM, and 20.9% of fiber in neutral detergent, 4.80% of ether extract and 6.15% of mineral matter.

After weaning, at 60 days old, the lambs were stored in fold receiving sorghum silage *ad libitum* and 150 g day$^{-1}$ of concentrated, during the recreation of 55 days.

To the next termination phase, corresponding to experimental period, they were selected the heaviest lambs of each genetic group to compose the three experimental treatments. Then, they were used 30 lambs, being 10 of Santa Inês, 10 ½ Dorper + ½ Santa Inês and 10 ¾ Dorper + ¼ Santa Inês, which were stored in three collective bays for genetic group, staying one bay with four lambs and two with free access to troughs and water troughs. The average age and the average living weigh of the lambs at the beginning of the experiment were, respectively, 115.0 days and 20.07 kg. These animals were initially vaccinated against clostridiosis and dewormed with subcutaneous application of vermifuge at 1% ivermectin based.

The experimental period was preceded of seven days for adaptation of the animals to the installations, feeding and management. As slaughter criteria, it was established the experimental period of 53 termination days. It was used a unique diet provided twice a day from 7 to 15 hours, which food and chemical composition are presented in Table 1. The diet was calculated to meet requirements for lamb with an average initial weight of 20.0 kg to gain 300 g animal$^{-1}$ day$^{-1}$, in accordance with the National Research Council [NRC] (2007).

**Table 1.** Food and chemical composition of the experimental diet dry matter based.

| Food composition | |
|---|---|
| Hay aerial part of manioc (g kg$^{-1}$) | 300.0 |
| Ground corn (g kg$^{-1}$) | 548.0 |
| Soybean meal (g kg$^{-1}$) | 120.0 |
| Soy oil (g kg$^{-1}$) | 20.0 |
| Mineral Salt (g kg$^{-1}$) | 5.0 |
| Calcitic limestone (g kg$^{-1}$) | 7.0 |
| **Chemical composition** | |
| Dry matter (g kg$^{-1}$) | 889.2 |
| Crude protein (g kg$^{-1}$) | 143.4 |
| Metabolizable energy (Mcal kg$^{-1}$ DM) | 2.78 |
| Fiber in neutral detergent (g kg$^{-1}$) | 255.5 |
| Total digestible nutrients (g kg$^{-1}$) | 768.0 |
| Ether extract (g kg$^{-1}$) | 52.5 |
| Mineral matter (g kg$^{-1}$) | 54.7 |

*Represents the mineral composition per kilogram as follows: 147 g of Na; 120 g of Ca; 87 g of P; 18 g of S; 3.8 mg of Zn; 3500 mg of Fe; 1.3 mg of Mn; 870 mg of Fl; 590 mg of Cu; 300 mg of Mo; 80 mg of I; 40 mg of Co; 20 mg of Cr; 15 mg of Se; 250 mg of vitamin A (UI); 100 mg of vitamin D (UI); and 500 mg of vitamin E (UI).

Feed and water were available ad libitum. The diet was supplied twice daily and orts were harvested and weighed daily to calculate voluntary intake and then readjust the amount offered to ensure 10% orts of the offered to further calculations of dry matter intake (DMI). The animals, when attach the pre-established period of feedlot, were weighted and sacrificed, in way to allow the calculation of the total weight gain (TWG), average daily weight gain (ADWG) and feed conversion (FC).

It was also calculated the metabolic weight gain (MWG) obtained by the average daily weight gain (g) related to metabolic weight ($kg^{0.75}$) and the body weight gain (BWG) through the average daily weight gain (g) divided by the average live weight during the feedlot (kg).

Water intake was evaluated weekly during the entire experimental period by quantifying the offer and leftovers for 48h. Determination of the water intake began at 7:00 AM when 7.5 L of water were offered in 10-L plastic containers. After 24h, the remanining water was weighed to estimate daily intake, and this process was repeated for an additional 24h.

Corporal score evaluation was carried out by three examiners according to the methodology described by Cezar and Sousa (2006). For the attribution of scores, evaluations were made before slaughter by visual examination and manual palpation of the lumbar and tail insertion areas of the lambs using a scale of 1 to 5 with intervals of 0.5.

To the slaughter procedures the animals were submitted to a fasting food for 16 hours. Posteriorly, they were weighted for obtaining the live weight at slaughter (LWS) and numbed by cerebral concussion. Then, they were suspended by hind legs and their jugular veins and carotid arteries were cut for sangria.

After sangria and skinning, they were taken the viscera, the head, the paws and the genital organs. After these procedures, it was realized the weighting to obtain the hot carcass weight (HCW), and then the carcasses were transported to a cold chamber at 4°C, where remained for 24 hours to be determined the cold carcass weight.

After the cooling period, they were determined the qualitative traits of the carcasses in refrigerated environment, through evaluation of conformation and finishing of the carcass and quantity of pelvic-kidney fat.

The carcass conformation was evaluated with emphasis on anatomical regions (leg, rump, loin, shoulder, and their muscles) and the exterior visual impressions of the carcass were performed with emphasis on thickness and distribution of fat in relation to the skeleton according to the categories and scores (1 to 5) demonstrated by Cezar and Sousa (2007), as well as by determining the amount of kidney-pelvic fat. After this procedure, the carcasses were split longitudinally.

To determine marbling, visual examination was performed on the surface of the *longissimus dorsi*, and scores of 1 to 3 (nonexistent, little, and medium) were given.

It was realized a transverse cut between the 12th and 13th ribs in the left half-carcass, exposing the cross section of the *Longissimus dorsi* muscle, being made the evaluation of the marbling, texturing and coloring of the meat, respecting a scale of 1 to 5, always done by two trained evaluators, according to the methodology described by Cezar and Sousa (2007).

After the qualitative evaluation of the carcass, it was obtained the empty body weight (EBW) by the difference between LWS and the weight of gastrointestinal content. After it, the carcasses were weighted to obtain the cold carcass weight (CCW). Posteriorly, they were determined the hot carcass incomes (HCI), of cold carcass (CCI) and the biologic incomes (BI), respectively, by the following formulas:

$HCI = \left(\frac{HCW}{LWS}\right) x\ 100$, $CCI = \left(\frac{CCW}{LWS}\right) x\ 100$ , and $BI = \left(\frac{LCW}{EBW}\right) x\ 100$

The percentage of cold loss (PCL%) were obtained by the formula:

$$PCL = HBW - \left(\frac{CCW}{HBW}\right) x\ 100$$

In the left half-carcass, it was made a cross section between 12th and 13th ribs and using a transparent plastic film in cross section of *Longissimus dorsi* muscle it was determined the loin eye area (LEA), through measurement, with ruler, of maximum width (A) and of the maximum depth (B), according to the formula: $LEA = \left(\frac{A}{2} x \frac{B}{2}\right) \pi$

At the same section, the fat thickness (FT) was measured in digital caliper and the GR site (GR) was determined by the depth of the fat over the 12th rib at 11 cm of distance from middle line sirloin, using the same equipment.

In the right half-carcass, it was made, with the help of a measuring tape, the measuring of internal carcass length, measure used to divide the cold carcass weight (CCW) and, then, determine the carcass compactness index (CCI).

As economic indicator, it was calculated the gross margin (GM), measuring the total weight gain during the feedlot, the average of dry matter intake, the feedlot period and the diet cost. These calculations were according to what was determined by Cartaxo, Sousa, Cezar, Gonzaga Neto, and Cunha (2008) and the gross margin of profit was obtained through the following equation:

$$GM = (TWG\ x\ 5.50) - (ACDN\ x\ CP\ x\ DC) - VME$$

In which: GM: gross margin (R$ animal$^{-1}$); TWG: total weight gain in feedlot; 5.50: price for kg of live animal practiced in region (R$); ACDM: average of dry matter intake; DC: diet cost; CP: feedlot period; VME: vaccines and medicine expenses.

It was also calculated the economic evaluation of the diet, calculating the price of the kilogram of the experimental ration multiplied by the respective feed conversion obtained by the lambs, according adaptation of the methodology described by Silva et al. (2016). To obtaining the price of lamb meat it was taken in account the price paid for the kilogram of the live animal in the region, assuming the yield of the carcass of 50% obtained in the present study.

The data of studied variables were submitted to variance analysis, in an entirely randomized design with 10 repetitions by genetic group. Using the F test to compare the means squares of factors tested and was used, in which the initial weights (p) used as a covariate.

For those qualitative carcass traits in the lambs was used the Kruskal – Wallis nonparametric test.

The statistic model used was:

$$Yij = \mu + Gi + Pj + \varepsilon ij$$

in that: *Yij* = value observed of the dependent variable studied; *μ* = general average; *Gi* = effect of genetic group i; *Pj* = effect of the initial weight covariate, and *εij* = aleatory mistake associated to each observation. The averages were compared by Tukey test at 5% of probability.

## Results and discussion

The lambs Santa Inês obtained less ($p < 0.05$) live weight at weaning, in beginning and at the end of feedlot period, when compared to breed Dorper (Table 2). It demonstrated that in a production system of meat sheep when were evaluated genetic groups the crossing between Santa Inês and ½ Dorper + ½ Santa Inês ewes with Dorper ram propitious with higher live weight lambs, probably because of the possible effects of direct heterosis and breed effects.

**Table 2.** Weights, dry matter intake (DMI) and water intake (WI) of lambs in function of genetic group.

| Parameters | Genetic group | | | SEM | P |
|---|---|---|---|---|---|
| | SI | ½ DP + ½ SI | ¾ DP + ¼ SI | | |
| Weaning weight (kg) | 11.60b | 16.37a | 18.61a | - | 0.0001 |
| Initial weight (kg) | 17.46b | 20.68a | 22.08a | - | 0.0030 |
| Final weight (kg) | 30.62b | 37.74a | 39.32a | 2.23 | 0.0029 |
| DMI (kg day$^{-1}$) | 1.197b | 1.504a | 1.545a | 0.05 | 0.0001 |
| DMI (g kg$^{-1}$ LW) | 4.81 | 4.99 | 4.89 | 0.30 | 0.0690 |
| DMI (g kg$^{-0.75}$) | 107.47b | 116.91a | 115.87a | 6.09 | 0.0002 |
| WI (kg day$^{-1}$) | 3.16c | 3.84b | 4.14a | 0.16 | 0.0001 |
| WI (g kg$^{-1}$ LW) | 12.74 | 12.76 | 13.16 | 0.84 | 0.0660 |
| WI (g kg$^{-0.75}$) | 284.35b | 298.83ab | 311.50a | 17.26 | 0.0004 |
| WI (kg kg$^{-1}$ DM) | 2.64a | 2.55b | 2.68a | 0.05 | 0.0001 |

SI = Santa Inês; ½ DP + ½ SI = ½ Dorper + ½ Santa Inês; ¾ DP + ¼ SI = ¾ Dorper + ¼ Santa Inês. Averages followed by diferente letters differ ($p < 0.05$) among themselves by Tukey test; SEM = standard error mean; P= probabilidade.

The genetic group did not influence the dry matter intake (g kg$^{-1}$ LW) and water intake (g kg$^{-1}$ LW), however the other variables were affected. When it is observed the DMI (kg day$^{-1}$) there was effect of genetic group, being the less intake to Santa Inês lambs. This behavior may be explained because the Dorper breed present higher body weight.

When it is analyzed the of dry mater intake expressed in metabolic size unit, the Dorper breed showed higher ($p < 0.05$) ingestion when compared to Santa Inês lambs. This intake is important because the metabolic weight homogenizes the animals by superficial area, pulling out the live weight effect.

The water intake in kg day$^{-1}$ was higher ($p < 0.05$) to Dorper breed. Probably, the higher of dry matter intake observed to these lambs explain this value, taking in account that there is high and significant correlation between the of dry matter and water intakes.

The water intake in kg $kg^{-1}$ DM was smaller ($p < 0.05$) to ½ Dorper + ½ Santa Inês lambs, and in relation to metabolic weight it was similar to the others. The NRC (2007) suggests a correlation between the dry matter intake and the water intake, of 1 kg DM to 2.87 liter of water. In this study it was observed that the Santa Inês lambs and the ¾ Dorper + ¼ Santa Inês lambs ingested similar and superior quantities of water than the ½ Dorper + ½ Santa Inês lambs, however inferior to the intake recommended by referred paper.

There was effect of genetic group ($p < 0.05$) on total weight gain, average daily gain and final corporal condition score of the lambs (Table 3). The increasing in weight gain of Dorper breed in relation to Santa Inês is explained by higher of dry matter intake, mainly in metabolic size unit. The crossbred Dorper lambs obtained an average daily weight gain superior to pre-establish at the beginning of the feedlot, which was of 300 g $day^{-1}$. On the other hand, the Santa Inês lambs did not obtain the expected average daily weight gain, however, it may be consider that the three genetic groups showed satisfactory averages and it is an important characteristic to animal performance, because it is determinant in slaughter precocity. Similar results to weight gain were reported by Cartaxo et al. (2017), Sousa et al. (2012), and Araújo Filho et al. (2010), who evaluate the performance of Santa Inês and ½ Dorper + ½ Santa Inês lambs.

**Table 3.** Total weight gain (TWG), average daily weight gain (ADWG), metabolic weight gain (MWG) and live weight gain (LWG), feed conversion (FC), and initial (IBS) and final corporal score (FCS) of the lambs in function of genetic group.

| Parameters | Genetic group | | | SEM | P |
|---|---|---|---|---|---|
| | SI | ½ DP + ½ SI | ¾ DP + ¼ SI | | |
| TWG (kg) | 13.16b | 17.06a | 17.24a | 2.23 | 0.0029 |
| ADWG (g $day^{-1}$) | 248.30b | 321.89a | 325.28a | 0.04 | 0.0029 |
| MWG (g $kg^{-0.75}$) | 22.15b | 25.08a | 24.34ab | 2.57 | 0.0018 |
| LWG (g $kg^{-1}$ PV) | 9.90 | 10.72 | 10.27 | 1.00 | 0.0962 |
| FC (kg $kg^{-1}$) | 4.90 | 4.77 | 4.79 | 0.66 | 0.5378 |
| IBS (1-5) | 2.60 | 2.65 | 2.72 | 0.28 | 0.8567 |
| FCS (1-5) | 3.35b | 4.15a | 4.32a | 0.26 | 0.0001 |

SI = Santa Inês; ½ DP + ½ SI = ½ Dorper + ½ Santa Inês; ¾ DP + ¼ SI = ¾ Dorper + ¼ Santa Inês. Averages followed by different letters differ ($p < 0.05$) among themselves by Tukey test; SEM = standard error mean; P = probability.

When it was analyzed the weight gain in relation to metabolic weight and in relation to live weight of the lambs it was observed effect ($p < 0.05$) of genetic group. The ½ Dorper + ½ Santa Inês lambs showed higher weight gain in relation to Santa Inês and ¾ Dorper + ¼ Santa Inês lambs were similar to the others. It demonstrates the potential of Santa Inês breed, as maternal breed in industrial crosses and absorbing with specialized breed to meat production as Dorper in meat intensive production system in semiarid regions.

The feed conversion did not differ ($p > 0.05$) among the genetic groups evaluated presenting an average value of 4.82 kg of dry matter consumed by kilogram of live weight gain. It indicates that the lambs showed similarity in transformation of dry matter containing in diet in body weight. The forage source used in this research was the hay aerial part of manioc with the results obtained to the performance presented good potential to compose the diet sheep finished in feedlot.

Nascimento et al. (2012), evaluating the intake of nutrients and of carcass traits of lambs Dorper + Undefined Breed (UB), Santa Inês + UB and Somalis + UB did not find difference among the genetic groups to feed conversion too.

The lambs ½ Dorper + ½ Santa Inês and ¾ Dorper + ¼ Santa Inês showed final corporal score similar ($p > 0.05$) with average of 4.23, which was 20.8% superior to the one verified by Santa Inês animals. Possibly this difference may be attributed to higher accumulation of muscle tissue and, mainly, adipose tissue during the feedlot observed to breed Dorper which presented in its racial genetic composition meat characteristics more pronounced.

Araújo Filho et al. (2010), evaluating the performance of different genetic groups, also verified that breed Dorper + Santa Inês lambs showed corporal score at slaughter superior (3.68) to observed to Santa Inês lambs (2.92).

There was effect ($p < 0.05$) of genetic group on the weights and carcasses yield, except for percentage of cold loss (Table 4). The carcasses of ¾ Dorper + ¼ Santa Inês lambs showed yield of hot and cold carcasses superior ($p < 0.05$) to the Santa Inês lambs, and the carcasses of ½ Dorper + ½ Santa Inês had results similar to the others. For the biologic yield, the carcasses of crossbred Dorper lambs showed best averages ($p < 0.05$) than Santa Inês. The biologic yield is what best represents the body components, it suggests that the usage of breeds that presented potential to meat production in crossing with adapted breeds aiming the complementarity among the breeds may attend the demand of the consumers for quality products in Semiarid regions.

The average yields for hot and cold carcasses, as well the biologic yield, were 50.80, 50.30, and 59.55%, in the same order. These carcass yields can be considered very good, due being attributed to average weight at slaughter of lambs that was 35.90 kg, due to high and significant correlation between live weight at the slaughter and the carcass yields.

Carcass yields lower to the ones found in the present study were reported by Garcia et al. (2010), who evaluated the carcass traits of pure Santa Inês lambs, Dorper + Santa Inês and Texel + Santa Inês submitted to different systems of management. These authors verified to the animals submitted to intensive management average hot and cold carcass yields and biologic yields of 47.81, 46.17, and 53.13%, respectively.

Percentage of cold loss was not affected ($p > 0.05$) by genetic groups, with average of 1.02% and can be considered low, probably the fat thickness varying from 1.97 mm to 3.56 mm had been enough to avoid more losses during the cooling of the carcasses. It is important to highlight that this tissue is responsible for avoid these losses, protecting the carcasses during the cooling, functioning as a thermal insulation.

**Table 4.** Weights of hot (HCW) and cold carcass (CCW), hot carcass yields (HCY), cold carcass yields (CCY), biologic yield (BY), percentage of cold loss (PCL), fat thickness (FT), GR site (GR), carcass compactness index (CCI), and loin eye area (LEA) in function of genetic group.

| Parameters | Genetic group | | | SEM | P |
|---|---|---|---|---|---|
| | SI | ½ DP + ½ SI | ¾ DP + ¼ SI | | |
| HCW (kg) | 15.22b | 19.23a | 20.13a | 1.22 | 0.0001 |
| CCW (kg) | 15.05b | 19.03a | 19.95a | 1.22 | 0.0001 |
| HCY (%) | 49.63b | 50.93ab | 51.14a | 1.14 | 0.0034 |
| CCY (%) | 49.07b | 50.39ab | 50.68a | 1.20 | 0.0031 |
| BY (%) | 57.38b | 59.09a | 59.62a | 1.14 | 0.0021 |
| PCL (%) | 1.13 | 1.05 | 0.90 | 0.49 | 0.5251 |
| FT (mm) | 1.97b | 2.58b | 3.56a | 0.62 | 0.0008 |
| GR (mm) | 10.37c | 13.74b | 16.16a | 1.91 | 0.0002 |
| CCI (kg $cm^{-1}$) | 0.23b | 0.29a | 0.31a | 0.01 | 0.0002 |
| LEA ($cm^2$) | 13.99b | 15.79ab | 17.34a | 1.95 | 0.0028 |

SI = Santa Inês; ½ DP + ½ SI = ½ Dorper + ½ Santa Inês; ¾ DP + ¼ SI = ¾ Dorper + ¼ Santa Inês. Average followed by different letters differ ($p < 0.05$) among themselves by Tukey test. SEM = standard error mean; P = probability

The effect of genetic group over the fat thickness and the GR site showed the same behavior ($p < 0.05$), in way the carcasses ¾ Dorper + ¼ Santa Inês lambs obtained superior results. The carcasses ½ Dorper + ½ Santa Inês and Santa Inês lambs were similar for fat thickness. On the other hand, the carcasses ½ Dorper + ½ Santa Inês lambs showed higher ($p < 0.05$) GR site when compared to Santa Inês carcasses.

The carcasses of crossbreed lambs Dorper were more compact ($p < 0.05$) than the carcasses Santa Inês lambs. This fact can be justified by the higher weight of cold carcass obtained by the crossbred, in view of the internal length of the lambs carcass was similar. The Dorper breed is specialized to producing meat, and animals with this characteristic tend to present compact carcasses, justifying the obtained result.

The carcasses ¾ Dorper + ¼ Santa Inês lambs showed higher ($p < 0.05$) loin eye area when compared to Santa Inês carcasses ones, and the carcasses ½ Dorper + ½ Santa Inês lambs were similar to the others. In the same way, Costa et al. (2010) observed higher loin eye area Dorper + Santa Inês lambs in comparison to Santa Inês.

In the analysis of non-parametric variance (Kruskal-Wallis test) the qualitative traits of the carcasses lambs were influenced ($p < 0.05$) by the genetic groups, except the texture (Table 5). The carcasses ¾ Dorper + ¼ Santa Inês lambs showed Wilcoxon mean score superior to conformation and finishing in relation to genetic groups ½ Dorper + ½ Santa Inês and Santa Inês. The carcasses ½ Dorper + ½ Santa Inês lambs obtained higher ($p < 0.05$) Wilcoxon mean score than the Santa Inês lambs. Probably, this difference might be attributed to absorbent breed crossing of Santa Inês by the Dorper, which gradually provided more quantity and better distribution of muscle and adipose tissue. Is is highlighted that the same effect was observed to the objective measures of fat coverture (fat thickness and GR site).

This result shows that the objective and subjective measures of subcutaneous fat coverture showed similar results, and the crossbred of Dorper to Santa Inês until the genetic composition evaluated in the present study (75%) increases the subcutaneous adiposity and, consequently, improving the finishing of carcasses lambs. According Peixoto, Batista, Bonfim, Vasconcelos, and Araújo Filho (2011), the usage of breed for meat producing influences the carcasses traits of the lambs, mainly the finishing and qualitative traits of the meat.

**Table 5.** Means and Wilcoxon mean scores the qualitative traits of carcasses the lambs in function of the genetic group.

| Parameters | Genetic group | | | P > Chi-Square |
|---|---|---|---|---|
| | SI | ½ DP + ½ SI | ¾ DP + ¼ SI | |
| Conformation | 2.95 (6.45) | 3.33 (16.40) | 3.64 (23.60) | 0.0001 |
| Finishing | 3.02 (6.60) | 3.35 (15.70) | 3.77 (24.20) | 0.0001 |
| Pelvic-kidney fat | 2.85 (22.55) | 2.72 (16.15) | 2.27 (7.80) | 0.0007 |
| Texture | 4.16 (14.15) | 4.21 (16.25) | 4.23 (16.10) | 0.8245 |
| Marbling | 0.82 (11.10) | 0.89 (12.05) | 1.46 (23.35) | 0.0023 |
| Color | 3.99 (11.10) | 4.02 (12.25) | 4.31 (23.15) | 0.0019 |

SI = Santa Inês; ½ DP + ½ SI = ½ Dorper x ½ Santa Inês; ¾ DP + ¼ SI = ¾ Dorper + ¼ Santa Inês. Statistical analysis was performed using non-parametric analysis of variance (Kruskal-Wallis test); P = probability.

Similar results were reported by Costa et al. (2010), who evaluated the carcass traits Morada Nova lambs, Santa Inês and Dorper + Santa Inês, and by Cartaxo et al. (2011), who studied the same traits Santa Inês lambs, Santa Inês + UB and Dorper + Santa Inês, and both papers verified that the carcasses of crossbred Dorper + Santa Inês showed better conformation and finishing.

About the texture, there was not difference ($p > 0.05$) among genetic groups. According to Osório, Osório, and Sañudo (2009), texture characteristics such as firmness, tactile sensations, are related to the ability to water retention, pH, grease state and tissue characteristics connective tissue and muscle fiber.

The carcasses ¾ Dorper + ¼ Santa Inês lambs showed smaller ($p < 0.05$) Wilcoxon mean score to pelvic-kidney fat, suggesting smaller accumulation of internal fat, in relation to carcasses ½ Dorper + ½ Santa Inês and Santa Inês lambs. However, the carcasses of lambs with 75% of Dorper breed obtained higher values for marbling and meat color, important characteristics and which are related, respectively, with flavor and succulence of the meat, as well as the coloration of the meat. According Araújo Filho, Amorim, Monteiro, Fregadolli, and Ribeiro (2015) the marbling can be and important characteristic from the commercial point of view, increasing the quality of sheep meat.

The gross profit margin showed positive values for all genetic groups, evidencing that the revenue generated was enough to cover the effective operational cost (Table 6). It means that the genetic groups, evaluated by the fact of they have presented positive balance in the gross margin have usage potential as alternative in sheep meat production in feedlot in Semiarid regions.

Related to genetic groups, the lambs ¾ Dorper + ¼ Santa Inês and ½ Dorper + ½ Santa Inês showed economic results very close to each other, being, however, pretty superior to Santa Inês lambs, in way that they showed a gross margin superior in 26.10 and 27.40%, respectively.

The costs with diet in dry matter in relation to the price of sheep meat kilogram represented 62.72, 60.45, and 60.90% to genetic groups Santa Inês, ½ Dorper + ½ Santa Inês and ¾ Dorper + ¼ Santa Inês, in the same order. The cost with feeding during the feedlot may vary between 50% and 70% from total cost of meat kilogram, therefore, the diet used in the present study was inside the pre-established percentage (61.35%) and can be then recommended to lambs termination.

**Table 6.** Economic indicators of lambs terminated in confinement in function of the genetic group.

| Parameters | Genetic group | | |
|---|---|---|---|
| | SI | ½ DP + ½ SI | ¾ DP + ¼ SI |
| Number of animals | 10 | 10 | 10 |
| Initial weight (kg) | 17.46 | 20.68 | 22.08 |
| Final weight (kg) | 30.62 | 37.74 | 39.32 |
| Total weight gain (kg) | 13.16 | 17.06 | 17.24 |
| Live lamb price (kg) | 5.50 | 5.50 | 5.50 |
| Average of dry matter intake (kg) | 1.19 | 1.50 | 1.54 |
| Feedlot period (days) | 53 | 53 | 53 |
| Diet cost [DM kg (R$)] | 0.70 | 0.70 | 0.70 |
| Expenses with vaccines and medicines (R$) | 0.90 | 0.90 | 0.90 |
| Gross profit margin / lamb (R$) | 24.17 | 33.30 | 32.70 |
| Price of kg of produced meat (R$) | 6.90 | 6.65 | 6.70 |

SI = Santa Inês; ½ DP + ½ SI = ½ Dorper + ½ Santa Inês; ¾ DP + ¼ SI = ¾ Dorper + ¼ Santa Inês.

Results inferior of this study were reported by Rocha et al. (2016) with different lambs of different genetic groups finished in feedlot and slaughtered with average weight of 33.40 kg, in which there were found values of gross profit margin of R$ 10.52 animal$^{-1}$ for Dorper + Santa Inês R$ 9.13 animal$^{-1}$ for lambs Santa Inês + UB and R$ 1.48 animal$^{-1}$ for genetic group UB. The highest proportion of hay and the lowest concentration of energy used in the diet apparently have influenced the highest gross profit margin observed for the crossbred lambs from the Dorper and Santa Inês breeds.

The impact of feedlot costs may vary according to the number of animals number of employees kind of installations and provided diet. Simulating the obtained results with the gross margin for a pattern producing system with 100 lambs, it would be generated in 53 days of feedlot an income of R$ 2,400.00 to Santa Inês, R$ 3,330.00 ½ Dorper + ½ Santa Inês and R$ 3,270.00 to ¾ Dorper + ¼ Santa Inês. respectively.

## Conclusion

The use of Dorper ram in crossbreeding system with Santa Inês e and ½ Dorper + ½ Santa Inês ewes in sheep production system increases the weaning weight, express better performance of the lambs finished in feedlot, more compact carcasses with higher yields and with better conformation and finishing carcasses, influencing positively in economic indicators of the adopted system.

## References

Araújo Filho, J. T., Amorim, P. L. D., Monteiro, I. A., Fregadolli, F. L., & Ribeiro, J. D. M. (2015). Características da carcaça de cordeiros submetidos à dietas com inclusão de levedura seca de cana-de-açúcar. *Revista Brasileira de Saúde e Produção Animal*, *16*(2), 337-349. DOI: http://dx.doi.org/10.1590/S1519-99402015000200009

Araújo Filho, J. T., Costa, R. G., Fraga, A. B., Sousa, W. D., Cezar, M. F., & Batista, A. S. M. (2010). Desempenho e composição da carcaça de cordeiros deslanados terminados em confinamento com diferentes dietas. *Revista Brasileira de Zootecnia*, *39*(2), 363-371. DOI: http://dx.doi.org/10.1590/S1516-35982010000200020

Barros, C. S., Monteiro,. A. L. G., Poli, C. H. E. C., Fernandes, M. A. M., Almeida, R., & Fernandes, S. R. (2009). Resultado econômico da produção de ovinos para carne em pasto de azevém e confinamento. *Acta Scientiarum. Animal Sciences*, *31*(1), 77-85. DOI: http://dx.doi.org/10.4025/actascianimsci.v31i1.3995

Cartaxo, F. Q., Sousa, W. H., Cezar, M. F., Gonzaga Neto, S., & Cunha, M. G. G. (2008). Efeitos do genótipo e da condição corporal sobre o desempenho de cordeiros terminados em confinamento. *Revista Brasileira de Zootecnia*, *37*(8), 1483-1489. DOI: http://dx.doi.org/10.1590/S1516-35982008000800021

Cartaxo, F. Q., Sousa, W. H., Costa, R. G., Cezar, M. F., Pereira Filho, J. M., & Cunha, M. D. G. G. (2011). Características quantitativas da carcaça de cordeiros de diferentes genótipos submetidos a duas dietas. *Revista Brasileira de Zootecnia*, *40*(10), 2220-2227. DOI: http://dx.doi.org/10.1590/S1516-35982011001000023

Cartaxo, F. Q., Sousa, W. H. D., Cezar, M. F., Cunha, M. D. G. G., Menezes, L. M. D., Ramos, J. P. D. F., & Viana. J. A. (2017). Performance and carcass traits of Santa Ines pure lambs and crosses with Dorper finished in feedlot. *Revista Brasileira de Saúde e Produção Animal*, *18*(2), 388-401. DOI: http://dx.doi.org/10.1590/s1519-99402017000200017

Cezar, M. F., & Sousa, W. D. (2006). Avaliação e utilização da condição corporal como ferramenta de melhoria da reprodução e produção de ovinos e caprinos de corte. *Revista Brasileira de Zootecnia*, *35*(especial), 541-565.

Cezar, M. F., & Sousa. W. H. (2007). *Carcaças caprinas e ovinas: obtenção. avaliação e classificação*. Uberaba, MG: Agropecuária Tropical.

Costa, R. G., Araújo Filho, J. T. D., Sousa, W. H. D., Gonzaga Neto, S., Madruga. M. S., & Fraga, A. B. (2010). Effect of diet and genotype on carcass characteristics of feedlot hair sheep. *Revista Brasileira de Zootecnia*, *39*(12), 2763-2768. DOI: http://dx.doi.org/10.1590/S1516-35982010001200029

Fernandes Júnior, G. A., Lôbo, R. N. B., Madruga, M. S., Lôbo, A. M. B. O., Vieira,. L. D. S., & Facó, O. (2013). Genotype effect on carcass and meat quality of lambs finished in irrigated pastures in the semiarid Northeastern Brazil. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, *65*(4), 1208-1216. DOI: http://dx.doi.org/10.1590/S0102-09352013000400037

Garcia, I. F. F., Costa, T. I. R., Almeida, A. K. D., Pereira, I. G., Alvarenga, F. A. P., & Lima, N. L. L. (2010). Performance and carcass characteristics of Santa Inês pure lambs and crosses with Dorper e Texel at different management systems. *Revista Brasileira de Zootecnia*, *39*(6), 1313-1321. DOI: http://dx.doi.org/10.1590/S1516-35982010000600021

Nascimento, E. N. D., Rogério, M. C. P., Batista, A. S. M., Carneiro, M. S. D. S., Vasconcelos, A. M. D., Leite, E. R., ... Costa, H. H. A. (2012). Nutrient intake and quantitative aspects of carcass of finishing sheep fed with diets containing cashew nut meal. *Revista Brasileira de Saúde e Produção Animal*, *13*(4), 1099-1111. DOI: http://dx.doi.org/10.1590/S1519-99402012000400013

National Research Council [NRC]. (2007). *Nutrient requirements of small ruminants: sheep, goats, cervids, and new world camelids* (7th ed.). Washington, D.C.: National Academy Press.

Osório, J. C. D. S., Osório, M. T. M., & Sañudo, C. (2009). Características sensoriais da carne ovina. *Revista Brasileira de Zootecnia*, *38*(especial), 292-300. DOI: http://dx.doi.org/10.1590/S1516-35982009001300029

Peixoto, L. R. R., Batista, A. S. M., Bomfim, M. A. D., Vasconcelos, Â. M., & Araújo, F. (2011). Physicochemical and sensory attributes of lamb meat from different genotypes feedlot finished. *Revista Brasileira de Saúde e Produção Animal*, *12*(1), 117-125.

Pinheiro, R. S. B., Silva Sobrinho, A. G. D., Souza, H. B. A. D., & Yamamoto, S. M. (2009). Qualidade de carnes provenientes de cortes da carcaça de cordeiros e de ovinos adultos. *Revista Brasileira de Zootecnia*, *38*(9), 1790-1796. DOI: http://dx.doi.org/10.1590/S1516-35982009000900022

Ribeiro, E. L. D. A., Oliveira, H. C., Castro, F. A. B. D., Mizubuti, I. Y., Silva,. L. D. D. F. D., & Barbosa, M. A. A. D. F. (2009). Performance in feedlot and non carcass components in crossbred lambs from three genetic groups. *Ciência Rural*, *39*(7). 2162-2168. DOI: http://dx.doi.org/10.1590/S0103-84782009000700032

Rocha, L. P., Cartaxo, F. Q., Sousa, W. H. D., Pimenta Filho, E. C., Cunha, M. D. G. G., Viana, J. A., & Pereira Filho, J. M. (2016). Desempenho produtivo e econômico de cordeiros de diferentes genótipos terminados em confinamento. *Revista Brasileira de Saúde e Produção Animal*, *17*(2), 262-271. DOI: http://dx.doi.org/10.1590/S1519-99402016000200013

Silva, E. G. B., Marinho, A. L., Moreira, J. A., Novaes, L. P., Silva, A. D. L., & Mota, L. C. (2016). Bran palm giant with exogenous enzymes addition in pig nutrition on growth. *Acta Veterinaria Brasilica*, *10*(4), 314-321. DOI: http://dx.doi.org/10.1590/S1519-99402016000200013

Sousa, W. H. D., Cartaxo, F. Q., Costa, R. G., Cezar, M. F., Cunha, M. D. G. G., Pereira Filho, J. M., & Santos, N. M. D. (2012). Biological and economic performance of feedlot lambs feeding on diets with different energy densities. *Revista Brasileira de Zootecnia*, *41*(5), 1285-1291. DOI: http://dx.doi.org/10.1590/S1516-35982012000500028

Warner, R. D., Greenwood, P. L., Pethick, D. W., & Ferguson, D. M. (2010). Genetic and environmental effects on meat quality. *Meat Science*, *86*(1), 171-183. DOI: http://dx.doi.org/10.1016 /j.meatsci.2010.04.042