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Torres Geraldo, André; de Azevedo Maia Júnior, Jonhny; Lopes Dias da Costa, Ricardo; Travassos Beltrame, Renato; Azevedo, Adriano; Santos Júnior, Alexandre Cristiano; Madella-Oliveira, Aparecida Fatima; Quirino, Celia Raquel

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ANIMAL PRODUCTION

Estimated correlations of ultrasound carcass measurements and physical-chemical components of Santa Ines sheep meat

André Torres Geraldo[1], Jonhny de Azevedo Maia Júnior[2], Ricardo Lopes Dias da Costa[3*], Renato Travassos Beltrame[4,5], Adriano Azevedo[6], Alexandre Cristiano Santos Júnior[6], Aparecida Fatima Madella-Oliveira[6] and Celia Raquel Quirino[1]

[1]Universidade Estadual do Norte Fluminense Darcy Ribeiro, Campos dos Goytacazes, Rio de Janeiro, Brazil. [2]Prefeitura de Macaé, Macaé, Rio de Janeiro, Brazil. [3]Centro de Pesquisa em Ciência Animal Diversificada, Instituto de Zootecnia, Rua Heitor Penteado, 56, 13380-011, Nova Odessa, São Paulo, Brazil. [4]Faculdade Pitágoras, Linhares, Espírito Santo, Brazil. [5]Faculdade Multivix, Colatina, Espírito Santo, Brazil. [6]Instituto Federal do Espírito Santo, Alegre, Espírito Santo, Brazil. *Author for correspondence. E-mail: rldcosta@sp.gov.br

ABSTRACT. The evaluation of the carcass composition of livestock generates relevant information on the quality and final yield of the meat products. The objective of this work was to evaluate correlations the ultrasound measurements *in vivo* of the *Longissimus lumborum* with the physical-chemical components of one-year-old Santa Ines sheep bred in extensive systems. The ultrasound evaluation was performed of the rib eye area (USrea), loin depth (USld), loin width (USlw) and subcutaneous fat thickness (USsft). After slaughter, meat cuts were weighed and carcass yield was calculated. The 12th rib on the left side was separated from the carcass and dissected, after which individual bones, muscles and fat were separated and weighed. The components were regrouped, ground and collected for centesimal evaluation. Significant positive correlations ($p < 0.05$) were found between the ultrasound measurements and meat metrics, except for the loin length, which had low correlation. Significant correlations ($p < 0.05$) were found between muscles and the measurements of USld, USrea and USsft. The correlations ($p < 0.05$) between the bones and USld and USrea were negative and significant. USsft presented correlation ($p < 0.05$) with carcass yield. Thus, the ultrasound measurements associated with the *Longissimus lumborum* could constitute a valuable tool for evaluating the physical-chemical components and carcass of one-year-old Santa Inês sheep created in extensive systems.

Keywords: association; centesimal analysis; loin; fat; non-invasive evaluation.

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Introduction

Meat is the main source of protein in human diets, and meat consumption has increased rapidly in recent decades, with global production about five times greater than it was 60 years ago. Among the reasons, we can mention the increase in world population from 3 billion to almost 8 billion in the same period, and the increase in purchasing power, allowing greater consumption of meat. In this scenario, until the year 2050, there will be a need to increase food production in general by more than 60% to accompany yearly population growth of 0.33%, with an estimated 9 billion people in 2050 (Food and Agriculture Organization [FAO], 2013).

The Brazilian sheep industry is based, for the most part, on inefficient production systems and low use of technology, with consequent low production. The Santa Ines breed, native to northeastern Brazil, in the 90s, was spread throughout Brazil, is considered a rustic, well adapted to different environments (Freitas et al., 2020), medium-sized, medium/high prolificity, non-seasonal, resistant to gastrointestinal parasites, and an excellent option for use as a maternal breed for crosses, being extremely important in a socio-economic context. Despite the Santa Ines breed being the basis of the Brazilian herd, in practically all regions of the country, it is still a breed in the process of improvement, especially concerning weight gain and carcass quality, which determines, in most cases, lower productive performances when compared to exotic breeds, such as the Dorper (Figueiredo et al., 2019).

According Oliveira et al. (2021) lamb is one of the most important products from sheep production system. Defining clear goals to a sheep breeding programs improve the quality and productivity of the final product, optimizing the profitability of the herd. Some traits are essential to be taken into account in sheep production systems and breeding programs.

The trend of the current market, focused on better quality meat products, and the presence of consumers willing to pay more for this quality, increases the need to use modern technologies to analyze the qualitative and sensory characteristics of meat (Maciel, Amaro, Lima Júnior, Rangel, & Freire, 2011). The quality of lamb carcasses can be influenced by factors such as breed, age, slaughter weight, and sex, production systems, among other factors (Geraldo et al., 2020a). In this context, it is noteworthy that the predominant productive system in Brazil is extensive. Thus, the evaluation of the carcass composition of livestock can generate relevant marketing information, since the studied variables are related to the quality and yield of the final product (Sousa et al., 2008).

The basic tissues that make up the carcass (muscle, bone and fat) are fundamental for determining the quality of the carcass and its cuts (Osório et al., 2012). To evaluate the tissue composition of the carcass, the most used technique is dissection of the basic components of the animal's body, but this technique is extremely slow and costly, in addition to the need to dispose of the carcass. An alternative method for assessing tissue composition, to avoid complete dissection of the carcass, is the dissection and chemical analysis of the 12th rib, which simplifies the processing of samples due to the lower demand for tissues for evaluation, in addition to presenting high correlations with the various carcass components (Menezes et al., 2008).

However, these assessments can only be carried out after the animals are slaughtered. Therefore, real-time ultrasound (RTU) is a tool widely used for *in vivo* evaluation of animals destined for slaughter or in genetic selection programs, since it is a cheap and fast technology that represents good results compared to the same measurements performed on the carcass (*Longissimus lumborum* muscle) (Grill, Ringdorfer, Baumung, & Fuerst-Waltl, 2015).

However, there is little information on correlations between ultrasound measurements on the one hand and physical-chemical composition of the 12th rib and carcass components on the other hand in sheep. In this way, our objective was to evaluate correlations the ultrasound measurements *in vivo* of the *Longissimus lumborum* with the physical-chemical components of one-year-old Santa Ines sheep bred in extensive systems.

Material and methods

Animals and facilities

The experiment was carried out at the Universidade Estadual do Norte Fluminense Darcy Ribeiro (UENF), located in the municipality of Campos dos Goytacazes, state of Rio de Janeiro. It was approved by the animal use ethics committee (CEUA-UENF) under protocol 317/2015.

Inicially, twenty one males of the Santa Inês breed received supplementation with commercial concentrate feed® (dry matter 88.9%, crude protein 19.8%, ether extract 1.9%, mineral matter 13.5%, nitrogen-free extract 54.0%, acid detergent fiber 15.2%, neutral detergent fiber 37.6%, hemicellulose 22.4%, and total digestible nutrients (NDT) 67.8%) through creep feeding from birth until weaning, which occurred at 90 days of age. After that, the animals were kept exclusively in a extensive grazing of Coastcross grass (*Cynodon dactylon* (L.) Pers), with *ad libitum* access to water and mineral salt, where they stayed until the end of the experiment (Geraldo et al., 2020b). The animals were maintained in this system and were evaluated from weaning until reaching the average age of 12 months. The animals were weighted using electronic scales (sheep mobile scale, ITC of Brazil®, mod. 602SM).

Of the 21 males studied, were selected seven 12-month-old male Santa Ines sheep, weighing 26.87 ± 4.6 kg. The animals were raised in an extensive regime, being allowed to graze in pasture planted with coast-cross grass (*Cynodon dactylon* (L.) Pers), having unlimited access to water and mineral salt.

Carcass evaluation

On the day before slaughter, the animals underwent ultrasound examination (SCAN VET 200, Pie Medical), with a 6 cm linear transducer and frequency of 7.5 MHz, positioned perpendicular to the dorsal midline on the left side of the animal. Trichotomy was performed in the region between the 12 and 13th ribs, over the Longissimus lumborum muscle, and gel was applied to ensure the best contact between the transducer and the skin, improving the image quality.

Ribeye area measurements (USrea) were taken using the muscle contour imaging; width of the *L. lumborum* muscle (USlw) was measured as the maximum distance of the muscle from the medial line to the lateral extremity of the thoracic and lumbar; depth of the *L. lumborum* muscle (USld), was measured as the maximum distance perpendicular to the width, located adjacent to the lateral border of the vertebrae; and thickness of subcutaneous fat (USsft).

At end of the examination, animals were deprived of solid food for 12h, weighed (slaughter weight) and slaughtered. After removing and weighing the non-carcass components, the carcasses were weighed (hot carcass weight - HCW) and refrigerated for 24h at a temperature of 2 - 4°C (cold carcass weight - CCW). The hot (HCY) and cold (CCY) carcass yields were obtained as follows: (HCW / slaughter weight) * 100 and (CCW / slaughter weight) * 100, respectively (Issakowicz et al., 2018).

Subjective evaluations, by visual assessment, of conformation and fat cover of the carcass were carried out using the method mentioned by Gurgeira et al. (2022), in which grades 1 to 5 were assigned to the carcasses.

To obtain the weight of the meat cuts, the left half carcass was sectioned as follows: Neck (referring to the seven cervical vertebrae, making an oblique cut between the seventh cervical and the first thoracic vertebrae); Covered Rack (1^{st} chop division, between the 6 and 13^{th} thoracic vertebrae and 2^{nd} chop division, between the 1^{st} and 5^{th} thoracic vertebrae); Shoulder (region that has the scapula, humerus, ulna, radius, and carpus as its anatomical base); Rib (comprises the region located between the 1^{st} and 12^{th} ribs, separated from the rails by the line parallel to the spine, which has the rib joint and sternun as reference); Belly (anatomical region of the abdominal wall); Loin (cut between the last thoracic and the first lumbar vertebrae and another between the last lumbar and the first sacral vertebrae, which includes the *L. lumborum* muscle, psoas muscle, and the corresponding vertebrae); and Leg (sectioned in the last lumbar vertebra).

The *Longissimus lumborum* muscle, at the height of the 12^{th} rib, was photographed together with a scale, and subsequently the rib eye area (REA), depth (DEP), width (WID), and subcutaneous fat thickness (SFT) were measured using the ImageJ® software.

Physical-chemical analysis

For the physical-chemical analysis, the section of the 12^{th} rib of the carcass was removed and the components (muscles, fat and bones) were dissected and weighed. The calculation of the percentages of muscles, fat, and bones was performed by applying equation 1, according to the method proposed by Menezes et al. (2008).

Equation 1. Calculation of components:

$$\text{Components (muscle, fat and bone) (\%)} = (\text{kg of component / kg of } 12^{th} \text{ rib}) \times 100$$

All constituents were regrouped and kept in a greenhouse (65°C) for 72 hours to analyze the dry matter (DM) content. The components were ground to carry out the analysis of moisture content (direct drying in an oven at 105°C), ash (residue by burning in a muffle furnace at 550°C), proteins (Kjeldahl method), lipids (direct extraction in a Soxhlet apparatus), and t non-nitrogenous extract, determined by difference in relation to the other parameters. The physical-chemical analyses were carried out in triplicate as described by Cecchi (1999) and Association of Official Analytical Chemists (AOAC, 2000).

Statistical analysis

Data on ultrasound assessments and carcass characteristics were analyzed using SAS (Statistical Analysis System University Edition). The means and standard deviations of the characteristics were calculated and pairwise Pearson correlation coefficients were estimated among the studied characteristics. In the correlation analysis, $p < 0.05$ was considered significant. Pearson´s correlations are presented with a Heatmap (ISLR package in R), thath shows a correlation matrix between two discrete dimensions, using colored cells to represent the data in a monochromatic scale. Blue means positive correlations, red means negative correlations and at the stronger the color, the larger the correlation magnitude.

Results

The means and standard deviations of the ultrasound measurements and the weight of the animals are shown in Table 1.

The correlations between the ultrasound measurements were high, and for the variable USld, significant positive correlations were found ($p < 0.05$) with USrea (0.95) and DEP (0.84). The USlw variable obtained a correlation of 0.85 with USrea ($p < 0.05$).

Table 1. Means and standard deviation of ultrasound measurements of the rib eye area (USrea); loin width (USlw); loin depth (USld), thickness of subcutaneous fat (USsft), and the weight of Santa Ines sheep measured between the 12 and 13th ribs.

Variable	Means±SD
USrea (cm^2)	4.98±1.37
USlw (cm)	4.00±0.42
USld (cm)	1.66±0.31
USsft (mm)	0.80±0.22
Weight (kg)	26.87±4.65

USrea= Ribeye area; USlw= width of the *L. lumborum* muscle; USld= depth of the *L. lumborum* muscle; USsft= thickness of subcutaneous fat.

Table 2 shows the means and standard deviations of the cut weights and the subjective evaluation of carcass and yield.

Table 3 shows the means of dissection and physical-chemical analysis data for the 12th rib area.

Table 2. Means and standard deviation for cut weights, subjective carcass evaluation, and carcass yield of Santa Ines sheep.

Variable	Means±SD
HCW (kg)	10.85±2.32
CCW (kg)	10.81±2.32
HCY (%)	40.23±3.26
Conformation	1.42±0.35
Fat cover	1.29±0.39
Shoulder (kg)	1.11±0.21
Leg (kg)	1.83±0.35
Rib (kg)	0.54±0.12
Belly (kg)	0.27±0.05
Neck (kg)	0.47±0.17
Loin (kg)	0.34±0.09
Covered Rack (kg)	0.82±0.31
Filet (kg)	0.09±0.12
REA (cm^2)	11.31±2.9
WID (cm)	4.53±2.04
DEP (cm)	3.12±0.74
SFT (mm)	1.02±0.68

HCW= hot carcass weight; CCW= cold carcass weight; HCY= hot carcass yields; REA= rib eye area; WID= width loin; DEP= depth loin; SFT= thickness of subcutaneous fat.

Table 3. Means and standard deviation of dissection and physical-chemical analysis of the 12th rib of Santa Ines sheep.

Variable (%)	Means±SD
Muscle	53.72±8.69
Bone	31.89±8.82
Fat	14.39±2.76
Crude Protein (CP)	65.98±4.24
Ethereal extract (EE)	7.46±2.59
Ash	25.43±4.36

For the DEP variable, significant positive correlations were found with all ultrasound muscle measurements, respectively 0.84, 0.90, and 0.89 for USld, USrea, and USlw ($p < 0.05$). The live weight coefficients were not significant with the ultrasound measurements, but the hot and cold carcass weights had high and positive correlations with the USld and USrea measurements, while CCW also had a high coefficient with USsft (Figure 1). The measurements of the *Longissimus lumborum* muscle did not show significant correlations when compared to those performed by ultrasound(Figure 2).

Muscles and bone showed a high positive correlation (0.95). However, these components did not present a significant correlation with crude protein and ether extract, but did have high correlation with mineral matter (0.93 and 0.83, respectively). Pearson's correlation coefficients between the components of the physical-chemical analysis on the 12th rib and ultrasound measurements are shown in Figure 3.

For the % muscle variable, high positive correlations were found between USld USrea and USsft. However, the correlations between bones (%) and the variables USld and USrea were negative. The ultrasound measurements did not show significant correlations with the physical-chemical data on protein and ether extract, but the correlations between the MM variable and the ultrasound measurements of USrea, USsft, and USld were also positive and high.

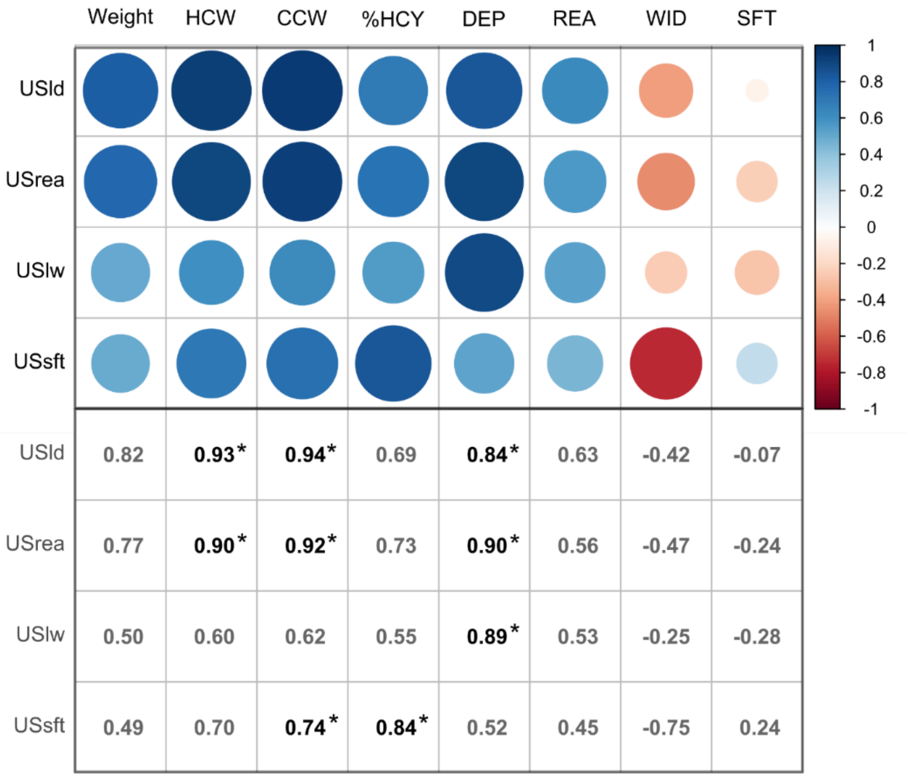

Figure 1. Heatmap of phenotipycs Pearson's correlations between ultrasound measurements. carcass yields, and measurements performed on the *Longissimus lumborum* muscle of Santa Ines sheep. HCW = hot carcass weight; CCW = cold carcass weight; % HCY = carcass yield in %; DEP = muscle depth; REA = rib eye area; WID = muscle width; SFT = thickness of subcutaneous fat; USld = muscle depth measured by ultrasound; USrea = rib eye area measured by ultrasound; USlw = muscle width measured by ultrasound; USsft = fat thickness measured by ultrasound; * p < 0.05.

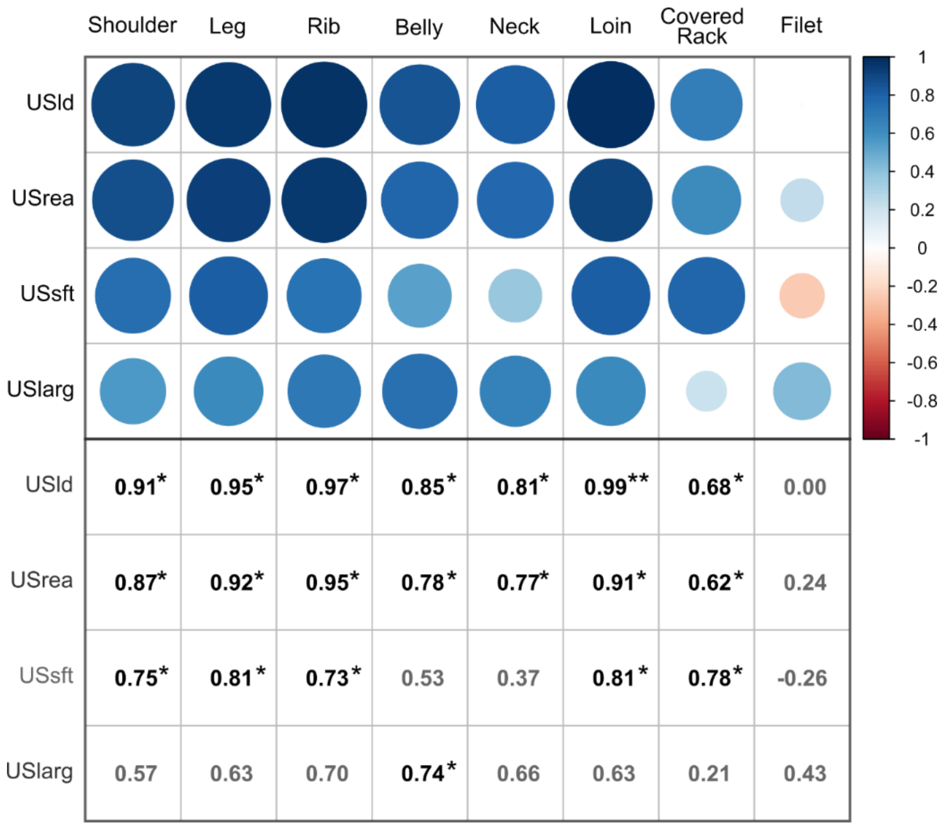

Figure 2. Heatmap of phenotipycs Pearson's correlation coefficients for ultrasound measurements and meat cuts of Santa Ines sheep. USld = muscle depth measured by ultrasound; USrea = rib eye area measured by ultrasound; USlarg = muscle width measured by ultrasound; USsft = fat thickness measured by ultrasound; * p < 0.05 ; ** p < 0.001.

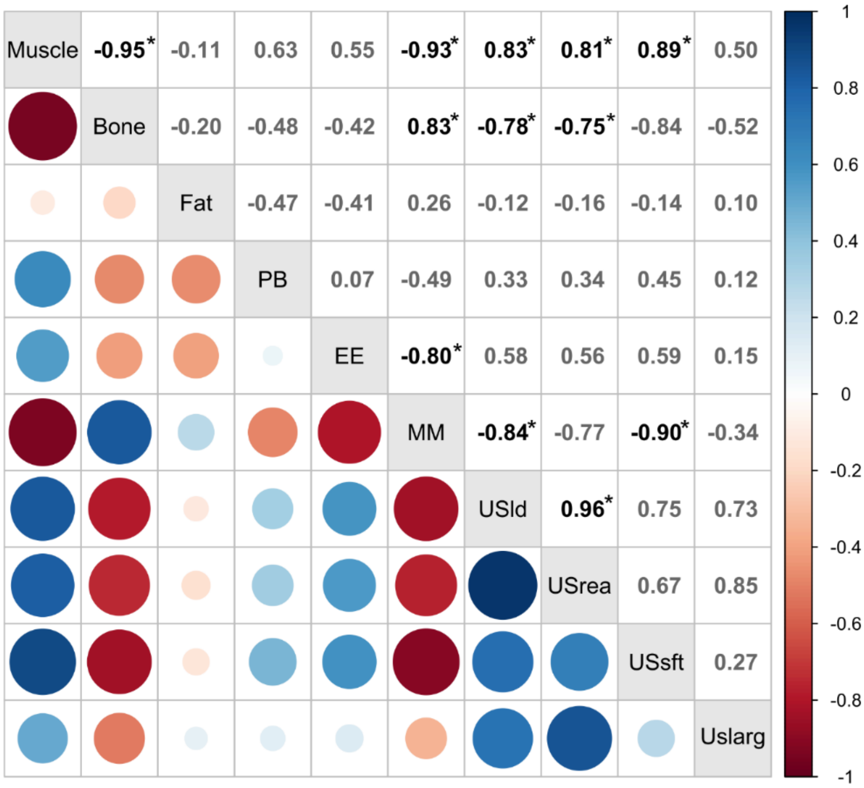

Figure 3. Heatmap of phenotipycs Pearson's correlations between the components of the physical-chemical analysis of the 12th rib and ultrasound measurements. PB = crude protein; EE = ether extract; USld = muscle depth measured by ultrasound; USrea = rib eye area measured by ultrasound; USlw = muscle width measured by ultrasound; USsft = fat thickness measured by ultrasound * $p < 0.05$.

Discussion

Several factors can affect lambs weight gain and performance. such as genotype. sex. type of birth and nutrition. Supplementation can influence performance characteristics when diet levels do not reach the minimum level required for the body to perform normal functions (Geraldo et al., 2020a). The present work was carried out with male Santa Ines sheep raised in an extensive regimen (coast-cross grass (*Cynodon dactylon (L.) Pers*)). only having unlimited access to water and mineral salt, without protein supplementation. This system supports and explains the average age (12 months) and average weight (26.87 ± 4.6 kg) evaluated in the animals used in the project.

The main characteristics studied in carcass evaluation are weight, yield, state of greasiness, and conformation (Silva et al., 2018), while the rearing system affect more directly the quality of carcass (Silva et al., 2020). The use of cultivated pastures, in extensive systems in sheep production, could contribute to reducing costs (Emerenciano Neto et al., 2017), being an alternative to improve the quantity and quality of muscles and fat deposition, with an earlier termination. However, there are few regions in Brazil that perform the correct management of pastures, which can interfere with the performance of the lambs and, consequently, the quality of the final product.

The results of ultrasound measurements were lower than those found in the literature and can be considered low for the species. Jucá et al. (2014) reported an average rib eye area of 6.45 cm^2 in Santa Ines sheep at 240 days, while Cartaxo et al. (2009) evaluated the rib eye area of Santa Ines lambs and found averages of 20.4 kg and 7.53 cm^2. However, in these studies the animals received supplemented diets, which increases the amount of protein and energy offered. In the present study, the fact the animals were kept in pasture without supplementation may have led to less muscle growth, and consequently smaller rib eye area in the ultrasound examination.

Araújo et al. (2022) evaluated different forage species cultivated for extensive production of lambs (without supplementation) and did not report differences in the loin eye area (13.22 ± 0.86 cm^2) and lamb's leg tissue composition (mean±standard errors of 23.01 ± 0.76, 69.49 ± 0.75, and 4.63 ± 0.02% for bone, muscle, and fat percentage, respectively). The lowest values found in our work for rib eye were due to the slaughter by Araújo et al. (2022) having been carried out according to the commercially recommended weight for finished animals.

The average value for USsft recommended for sheep destined for slaughter is a minimum fat thickness of of 3 mm to guarantee the protection of the carcass during cooling and prevent cold shortening. Therefore, the average found of 0.8 mm is below the desirable level and also below the results reported in the literature. Araújo Filho et al. (2010) reported mean values of 1.6 mm for Santa Ines sheep under confinement. Animals reared in a confinement regime achieve better production rates since the performance of a herd depends on the availability of food in proportions and quantities appropriate to their requirements (Barros, Vasconcelos, Araújo, & Martins, 2003). The lower EGS found in the present study can be explained by the fact that the animals were raised in an extensive regime without supplementation, which reduced the energy supply of the diet, and consequently reduced the fat deposit in the carcass.

According to Paulino et al. (2009), fat deposits develop in preferential order: first, the deposition of visceral fat occurs, followed by intermuscular, subcutaneous, and finally intramuscular fat. Araújo et al. (2022) reported that the Santa Ines lambs, reared extensive system, deposited little fat (0.98 mm), a value that would be below that considered as "scarce fat carcass" (1–2 mm), according to the proposed classification by Silva Sobrinho (2001).

Osório et al. (2012) explain that the link for understanding between what the consumer wants from fat and what the producer can achieve, is expressed through the covering of fat in the carcass. In this sense, ultrasound is considered an effective tool, since it is possible to estimate the fat cover even in live animals, without the need to carry out the slaughter.

Carneiro et al. (2022) reported, for Santa Inês lambs, with an average weight of 24.82 kg, receiving corn silage and concentrate supplementation, loin eye area of 12.61 cm^2, and a range of fat cover from 0.52 to 2.86 mm.

The HCY found in this work can be considered low for the species. Quirino et al. (2016) evaluated the carcass yield of Santa Ines sheep slaughtered at average weight of 34.49 kg and found a higher yield (53.65%). However, Castro et al. (2017). researching lighter sheep (21.76 kg), found values similar to those reported in the present study. Age has a direct effect on carcass yield. where older (or heavier) animals tend to achieve better yields. since they have greater amounts of fat and muscle tissue. decreasing the proportion of non-carcass muscles and tissues (Paulino et al., 2009).

The low yield can also be explained by the fact that the animals were raised under extensive management, which generally leads to lower consumption of protein and energy, decreasing the deposition of fat in the carcass and muscle growth, causing lower carcass yields (Peripolli, Barcellos, Olmedo, Lampert, & Velho, 2013).

The proportions found for the carcass components in the dissection were different than those found in the literature. Louvandini, McManus, Dallago, Machado, and Antunes (2006) evaluated the composition on the 12^{th} rib in male Santa Ines sheep supplemented with phosphorus and found mean values of 66.2% for muscle, 20.9% for bone, and 9.55% for fat. Likewise, Menezes et al. (2015) evaluated the composition of the 12^{th} rib of lambs of the Texel breed and obtained values of 40.6% for muscle, 19.3% for bones, and 39.9% for fat. These contrasting results occur because the proportions of the carcass components are highly influenced by characteristics such as the breed, sex, and age. Fat is the component that can vary the most and is strongly influenced by genetics and nutrition (National Research Council [NRC], 1996). Fur breeds have the characteristic of depositing less fat in the carcass when compared to breeds developed or improved for meat production (Araújo Filho et al., 2010). The proportion of muscle found in this study can also be considered low, but this again can be explained by the extensive management of the animals (Bezerra et al., 2016).

The averages of the physical-chemical analyses in the 12^{th} rib were similar to those found by Menezes et al. (2008) in Santa Ines sheep. The authors reported averages of 60% CP, 13% EE, and 19% ash. In contract, evaluating the Texel breed, Menezes et al. (2015) found values of 30% CP and 58.5% EE. These results can be explained by the fact that Santa Inês sheep have less carcass fat deposition when compared with genetically improved breeds for meat production (Bueno, Cunha, Santos, Sanchez Roda, & Leinz et al., 2000). The fact that the animals in the present study are slaughtered with low weight at at 12 months can also explain the lower amount of EE found, since lighter animals tend to deposit less fat than heavier ones, which are closer to reaching their adult weight, when the deposition of adipose tissue becomes more intense and muscle growth slows down (Osório et al., 2012).

DEP was the only carcass measure that obtained positive correlations with the muscle characteristics measured by ultrasound. This measure is considered one of the best to indicate the total musculature of the carcass (Landim, 2005). Due to the process of transformation of the muscle into meat that occurs after slaughter, the muscle measurements are altered, so the measurements taken directly from the carcass after rigor mortis will not be the same as those obtained from live animals through ultrasound. Likewise, the thickness of subcutaneous fat may show low correlations when measured by ultrasound, and later in the carcass measurements. This may occur due to the low amount of fat in the carcass, which makes reading and measurement difficult, and may lead to differences in analyses. Thus, it can be said that the greater the thickness of subcutaneous fat, the easier measurement is and the lower the probabilities of error are (Silva et al., 2004)

The high correlations found between the ultrasound measurements and the weights of the cuts indicated that ultrasound is an efficient method to estimate the yield of the cuts. According to Moreno et al. (2010), ultrasound measurements cannot, in isolation, define the carcass characteristics, although they allow predicting some productive characteristics such as weight and the yield of meat cuts. However, in this study, the correlations between the ultrasound measurements of the *L. lumborum* muscle and weight were not significant.

USlw showed a positive correlation only with the belly. This result probably occurred due to the low deposition of fat in the carcass, making it difficult to determine the boundary of the *L. lumborum* muscle, which can compromise this measure (Silva et al., 2004).

The positive and high-magnitude correlations found in the present study between USsft and HCY can occur because greater the deposition and proportion of fat in the carcass is associated with greater the carcass yield. This fact is best observed when comparing animals of different ages, where younger animals have less fat, and consequently lower carcass yield compared to older animals (Claffey et al., 2018). USld and USrea also obtained high positive correlations with carcass weights (HCW and CCW), which demonstrate that these measures can be used to estimate carcass or tissue yields.

The study of Pearson's correlations showed that the only significant correlation ($p < 0.05$) between carcass components was between muscles (%) and bones (%). The bones have allometric growth characteristic, so that after the animal reaches maturity, they stop growing, not undergoing great variations due to external influences. In contrast, muscle tissue after maturity can vary depending on the management conditions and the physiological period and nutritional status of the animal (Paulino et al., 2009). The negative correlation between the components indicates that the greater the muscle growth is, the lower the proportion of bones in the carcass of the animals will be.

The high positive correlation found between USrea and muscles (%) demonstrates that ultrasound analysis is an efficient method to assess the proportions of muscle tissues in the carcass. This anatomical region (12th rib) is chosen because it is considered late maturing, and faithfully represents the development of the carcass, allowing the analysis of the proportions of its components (Taylor, 1985).

The correlations between ultrasound measurements (USrea and USlw) and bones (%) were significant and positive, which shows that larger rib eye area and length of the *L. lumborum* muscle is associated with a lower proportion of bones in the carcass.

The correlations found between ash and ultrasound measurements (USld, USrea, and USsft) were also significant and positive. The ash is obtained after heating the sample (550 and 570°C), and what results from this burning are minerals. In the analysis of the 12th rib, it corresponds mainly to the proportion of bones present in the carcass. Thus, the results indicate that the higher the carcass ultrasound measurements are, the lower the proportion of bones in the carcass and the greater the proportion of muscle will be.

Conclusion

The ultrasound measurements associated with the *L. lumborum* muscle could constitute a valuable tool for evaluating the physical-chemical components and carcass of one-year-old Santa Ines sheep created in extensive systems.

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