Rev. Bras. Saúde Prod. Anim., Salvador, v.19, n.1, p.125-135 jan./mar., 2018 ISSN 1519 9940
http://dx.doi.org/10.1590/S1519-99402018000100012

Performance and carcass characteristics of lambs ½ Dorper + ½ Santa Inês, slaughtered with different thicknesses of subcutaneous fat

Desempenho e características de carcaça de cordeiros ½ Dorper +½ Santa Inês abatidos com diferentes espessuras de gordura subcutânea

NASCIMENTO, Urias Fagner Santos[1*]; SANTOS, Gladston Rafael de Arruda[1]; AZEVEDO, Camilo Santos[1]; MACEDO, Francisco de Assis Fonseca[1]; GONÇALVES, Telisson Ribeiro[1]; BOMFIM, Lorena Emily de Lemos Mota[1]; FARIAS, Juliana Santos[1]; SANTOS, Anselmo Domingos Ferreira[2]

[1]Universidade Federal de Sergipe, Campus Professor José Aloísio de Campos, Departamento de Zootecnia, São Cristóvão, Sergipe, Brasil.
[2]Universidade Federal de Sergipe, Campus Professor José Aloísio de Campos, Departamento de Medicina Veterinária, São Cristóvão, Sergipe, Brasil.
*Endereço para correspondência: uriasfagner@hotmail.com

SUMMARY

The aim of this study was to evaluate the effect of subcutaneous fat thickness (SFT) on slaughter in lambs ½ Dorper + ½ Santa Inês (DSI) on performance, carcass characteristics and commercial cuts. It was used twenty-four lambs, slaughtered with 2mm, 3mm and 4mm SFT. There was an effect of SFT on performance: for days of confinement (2mm = 51.38, 3mm = 66.50, 4mm = 91.63 days), age at slaughter (2mm = 139.38, 3mm = 159.88, 4mm = 171.00 days), final body weight (2mm = 33.50, 3mm = 42.81, 4mm = 46.19 kg), total weight gain (2mm = 18.75, 3mm = 25.08, 4mm = (2mm = 0.44, 3mm = 0.39, 4mm = 0.28kg), slaughter weight (2mm = 32.76, 3mm = 39.79, 4mm = 44.88 kg), body condition score (2mm = 2.97, 3mm = 3.13, 4mm = 3.56); for carcass characteristics: warm carcass weight (2mm = 15.33, 3mm = 19.16, 4mm = 21.90 kg) and cold (2mm = 15.03, 3mm = 18.75, 4mm = 21.47), cooling losses (2mm = 0.00234; 3mm = 0.00333; 4mm = 0.00201 kg), carcass yields: in the refrigerator (2mm=46,79; 3mm=48,30; 4mm= 48,79%); commercial (2mm = 45.88, 3mm = 47.25, 4mm = 47.82%) and true (2mm = 52.93, 3mm = 54.51, 4mm = 55.67%); carcass compactness index (2mm= 0,250; 3mm=0,30; 4mm=0,33 kg/cm) for cut weights; neck (2mm=0,44; 3mm=0,55; 4mm=0,56 kg); palette (2mm=1,38; 3mm=1,61; 4mm=2,14 kg), flank steak (2mm=2,16; 3mm=2,73; 4mm=3,19 kg), loin (2mm=0,93; 3mm=1,14; 4mm=1,25 kg), and leg (2mm=2,68; 3mm=3,20, 4mm=3,76 kg). For the tissue composition of only the muscular cuts of the neck (2mm = 50.24, 3mm = 51.44, 4mm = 55.34%), bone of the neck (2mm = 30.24, 3mm = 29.63, 4mm = 25.91%), of the loin (2mm=15,05; 3mm=24,63; 4mm=24,71%) and the leg (2mm=11,38; 3mm=13,33; 4mm=13,13%), they presented differences between the SFT ($p > 0.05$). It is recommended to slaughter lambs ½ Dorper + ½ Santa Inês with 3mm of SFT.

Keywords: carcass yield, sheep, tissue composition, ultrasonography

RESUMO

Objetivou-se avaliar o efeito da espessura de gordura subcutânea (EGS) ao abate em cordeiros ½ Dorper + ½ Santa Inês (DSI) sobre o desempenho, as características da carcaça e dos cortes comerciais. Foram utilizados 24 cordeiros, abatidos com 2mm, 3mm e 4mm de EGS. Houve efeito da EGS sobre o desempenho: para dias de confinamento (2mm=51,38; 3mm=66,50; 4mm= 91,63 dias), idade ao abate (2mm=139,38; 3mm=159,88; 4mm=171,00 dias), peso corporal final (2mm=33,50; 3mm=42,81; 4mm=46,19 kg), ganho de peso total (2mm=18,75; 3mm=25,08; 4mm=46,19 kg), ganho de peso diário (2mm=0,44; 3mm=0,39; 4mm=0,28 kg), peso corporal ao abate (2mm=32,76; 3mm=39,79; 4mm=44,88 kg), escore de condição corporal (2mm=2,97; 3mm=3,13; 4mm=3,56); para características de carcaças: pesos da carcaça quente (2mm= 15,33; 3mm=19,16; 4mm=21,90 kg) e fria (2mm=15,03; 3mm=18,75; 4mm=21,47), perdas por resfriamento (2mm=0,00234; 3mm=0,00333; 4mm=0,00201 kg), rendimentos de carcaça: no frigorifico (2mm=46,79; 3mm=48,30; 4mm= 48,79%); comercial (2mm= 45,88; 3mm=47,25; 4mm=47,82%) e verdadeiro (2mm= 52,93; 3mm=54,51; 4mm=55,67%); índice de compacidade da carcaça (2mm= 0,250; 3mm=0,30; 4mm=0,33 kg/cm), para pesos dos cortes; pescoço (2mm=0,44; 3mm=0,55; 4mm=0,56 kg); paleta (2mm=1,38; 3mm=1,61; 4mm=2,14 kg), costilhar (2mm=2,16; 3mm=2,73; 4mm=3,19 kg), lombo (2mm=0,93; 3mm=1,14; 4mm=1,25 kg), e perna (2mm=2,68; 3mm=3,20, 4mm=3,76 kg). Para a composição tecidual dos cortes apenas o muscular do pescoço (2mm=50,24; 3mm=51,44; 4mm=55,34%), ósseo do pescoço (2mm=30,24; 3mm=29,63; 4mm=25,91%), do lombo (2mm=15,05; 3mm=24,63; 4mm=24,71%) e da perna (2mm=11,38; 3mm=13,33; 4mm=13,13%), apresentaram diferenças entre as EGS (p>0,05). Recomenda-se o abate dos cordeiros ½ Dorper + ½ Santa Inês com 3mm de EGS.

Palavras-chave: composição tecidual, ovinos, rendimento de carcaça, ultrassonografia

INTRODUCTION

In recent years, sheep farming has been prominent in Brazil as a livestock activity of great economic potential, mainly in the northeast and south regions, which are traditional producers of these animals (ÁVILA et al., 2013).

In addition to the increase in the number of animals, we can see the use of new production technologies. These advances are intended to provide the consumer market with a high quality product so that the meat of sheep has the potential to compete with the meat traditionally consumed by Brazilians, such as beef, chicken and pork (POLI et al., 2008).

One of the main obstacles of this chain is to offer to the market a young animal, with a good conformation of carcass and continuously, making the consumption of ovine meat a frequent habit, without there is seasonality in the offer (ÁVILA et al., 2013).

An alternative to supply the demand of the consumer market is the crossing between races, which favors the producers to obtain animals with better performance and earlier. Among the possible crosses to obtain animals that meet the demand of producers and consumers, the Dorper breed and the Santa Inês breed have shown promising results for this purpose in the Brazilian Northeast (AMARAL et al., 2011).

The use of subcutaneous fat thickness as a parameter to determine the degree of carcass finishing is an interesting tool for producers or refrigerators, considering that based on this parameter can select animals that, after slaughter, will supply carcasses with the same standardization and fat coverage, regardless of the live weight or age of the animal. In this way, when working with the subcutaneous fat thickness as a tool to select animals that will be slaughtered, it is aim to standardize cuts and carcasses, in order to bring to the final market a product with similar characteristics, regardless of the animal that originated it.

The development of more modern ultrasound devices has led to the technique being used more frequently, being used today in several parts of the world (NUBIATO et al., 2013).

The technique is little invasive and allows the animal to be submitted to it several times to monitor muscle development, subcutaneous fat thickness or measurement of tissue measurements. It can be used to determine the point of slaughter of the animals, having as parameter the subcutaneous fat thickness, being a useful tool for the production systems, as it allows to

standardize batches and facilitates the handling of the properties in the most varied aspects (GERALDO et al., 2016).
The goal of this article is to evaluate the performance of ½ Dorper + ½ Santa Inês sheep, slaughtered with different thicknesses of subcutaneous fat, as well as to determine the carcass yields, cuts and tissue composition of carcass cuts of these sheep.

MATERIAL AND METHODS

The experiment was carried out at Fazenda Canafístula, in the city of Nossa Senhora das Dores, Sergipe. It was harvested eighty Santa Inês sheep with Dorper breeders in order to obtain lambs ½ Dorper + ½ Santa Inês.
The lambs were weighed and identified at birth. From the beginning of the third week of life, the lambs received food in the creep feeding. The animals were weighed at 30 days and weaned at 86 ± 24 days of age, and the weaning weight was considered as initial body weight (IBW) for confinement. Ultra-sonographies of the Subcutaneous Fat Thickness were carried out between the 12th and 13th ribs at the time of weaning of the animals.
After weaning, eight lambs were selected by homogeneous weight, for each group composition, totaling 24 lambs ½ Dorper + ½ Santa Inês. The lambs were housed in covered collective pens, receiving water at will throughout the experimental period and fed with corn silage at will and 2% of the body weight of a mixture with 75% ground corn, 19% soybean meal, 1% urea and 5% commercial core. Being that the diet was adjusted fortnightly, after the weighing of the animals. At weaning the lambs were divided into three groups, with the subcutaneous fat thickness evaluated in vivo by ultrasonography as treatment (2.0, 3.0 and 4.0 mm). In order to obtain the subcutaneous fat thickness, it was used an ultrasonic device, HONDA model HS-1500 VET with a linear multi-frequency transducer of 50mm wide using a frequency of 7.5 MHz.
Ultra-sonographies were performed fortnightly, after trichotomy and mucilage application in the evaluated regions. All measurements were made by the same technician, on the left side, between the 12th and 13th ribs, four centimeters from the spine. The pressure of the transducer head was kept minimal to avoid compression of the fat. After the image was captured, the thickness of the subcutaneous fat at this point was measured using the ultrasound electronic pointer.
On reaching the subcutaneous fat thickness (SFT) for slaughter, the animals were weighed and the days of confinement (DC) and it was calculated the body condition score (BCS) trough measured by palpating the transverse processes of the lumbar vertebrae. We also calculated the total weight gain = LWS-PVI and the average daily weight gain (DWG) = LWS / DC. The lambs were weighed at the farm (WF), transported to a refrigerator with Federal Inspection Service, in Propriá, SE. After 16 hours, under fasting solids were weighed for recording body weight at slaughter (BWS). After evisceration, the gastrointestinal tract was weighted full, emptied and weighted empty, to estimate empty body weight (EBW). After evisceration, the carcasses were weighed, the carcass weight hot (CWH) and the pH measured. The carcasses were transferred to a cold chamber at 4ºC, remaining for 24 hours and the pH (pH 24h) and weighed (CWC) again measured. They were divided lengthwise into two half-carcasses and measured the internal lengths of the carcasses (ILC),

Rev. Bras. Saúde Prod. Anim., Salvador, v.19, n.1, p.125-135 jan./mar., 2018 ISSN 1519 9940
http://dx.doi.org/10.1590/S1519-99402018000100012

the rump width (RW) and the legs length (LL).

It was calculated: Carcass yield in the refrigerator = (CWH/LWS)*100; Commercial carcass yield = (CWC/ LWS)*100; True Carcass yield = (CWH/TCY)*100; Losses due to cooling = (CWH-CWC/CWH)*100; Carcass compactness index = CWH/ILC and the Compass Index of Leg = RW/LL. The left half carcasses were preserved, where the thickness of subcutaneous fat at slaughter was measured with caliper rule, between the 12th and 13th ribs. Then, the half-carcasses were sectioned into five anatomical regions (neck, palette, ribs, loin and leg) and weighted, according to the methodology proposed by Colomer-Rocher et al. (1987) and adapted by Araújo Filho et al. (2010) and calculated the yield of each cut in relation to the half carcass, according to the methodology described by Osório et al. (2002). The cuts were conditioned in polyethylene packages, identified and transported to the Meat Technology Laboratory of the Federal University of Sergipe, where they were frozen and then dissected to determine the tissue composition of each cut. To perform statistical analysis was used the GLM procedure from SPSS. For comparison of means, the significance level of 5% was considered by the Tukey test.

RESULTS AND DISCUSSION

There was no effect ($P > 0.05$) of the Subcutaneous Fat Thickness (SFT) on the pH of the carcase zero and twenty four hours after slaughter, internal carcass length and leg compactness index. The fact that the pH of the carcase zero and twenty four hours were not influenced by the SFT is related to the deposition of glycogen in the muscle, which may decrease especially by the ante-mortem stress, as the animals of the three experimental groups were submitted to the same pre-management and during slaughter, the pH values behaved in a similar way. The internal length of the carcass was similar ($p > 0.05$) for the three subcutaneous fat thicknesses, this can be explained by the effect of the heterosis caused by the Dorper genetic group, which has a shorter carcass profile when compared to other breeds as the Santa Inês, and transmit this to their offspring (Table 1), thus because animals with Dorper genetics have shorter carcasses and this does not change over time, the carcass coating, be it muscular or adipose, is which will increase or decrease over the existing bone base. The leg compatibility index, which indicates how much the leg is able to store muscle tissue, was also not influenced ($p > 0.05$). This indicates that fat thickness is not a determinant factor for the deposition of muscle tissue, but the deposition of musculature will adapt to the existing bone base in the region prevents the deposition of muscular tissue in the leg, it is recommended that sheep legs, with close weights, are shorter in order to increase the values of leg compactness.

The final body weight of the animals differed ($p < 0.05$) between treatments, increasing as the subcutaneous fat thickness also increased. This fact may be due to the greater number of days of confinement of these animals and, consequently, higher food intake. Due to the body weight at slaughter derive from factors such as the final live weight, which is influenced by a larger number of days of confinement that also suffered interference from the treatments ($p < 0.05$), the live weight at slaughter varied similarly due to the high correlation between these measures. However, it must be taken into account that the longer stay of the confined animals leads to more production costs, and it is necessary to evaluate to what extent the fattening of animals is profitable to the producer.

Regarding the total weight gain lambs belonging to the 3mm and 4mm treatments were similar, but both differed from the 2mm treatment (p <0.05). As the animals of groups 3 and 4 mm were slaughtered older, the physiological response of these animals to growth was decreased, so its rate of weight gain is more related to the increase in confinement time and consequent higher food intake, in comparison to the 2mm group, than to their average daily weight gain. Thus, it can be affirmed that the total weight gain of lambs belonging to groups 3 and 4mm was higher because they remained longer in confinement, compared to the 2mm group.

Table 1. Average and standard deviations for performance of lambs ½ Dorper + ½ Santa Inês slaughtered with different thicknesses of subcutaneous fat

Variables	Subcutaneous Fat Thickness			p- value
	2mm	3mm	4mm	
Subcutaneous Fat Thickness RTU (mm)*	2,36±0,41[b]	2,74±0,49[b]	3,73± 0,79[a]	0,000
Subcutaneous Fat Thickness at slaughter (mm)	2,19± 0,76[b]	3,52± 0,54[a]	3,75± 0,88[a]	0,001
Days of confinement	51,38±31,29[b]	66,50±36,97[ab]	91,63±23,55[a]	0,052
Age at slaughter (days)	139,38± 17,28[b]	159,88± 18,01[a]	171,00±6,14 [a]	0,001
Initial Living Weight (Kg)	14,75± 3,66	17,33± 5,32	18,71± 1,25	0,085
Final Living Weight (Kg)	33,50±2,20[c]	42,81± 2,28[b]	46,19± 2,40[a]	0,000
Total Weight Gain (Kg)	18,75± 2,85[b]	25,08± 5,60[a]	27,43± 2,42[a]	0,000
Daily Weight Gain (g/dia)	0,44±0,16[a]	0,39±0,17[ab]	0,28± 0,02[b]	0,046
Live Weight at Slaughter (Kg)	32,76± 2,25[c]	39,79± 1,49[b]	44,88± 2,17[a]	0,000
Body condition score	2,97± 0,31[b]	3,13± 0,18[b]	3,56± 0,46[a]	0,006
Body Weight Empty (Kg)	28,99± 2,40[c]	35,17± 1,49[b]	39,36± 2,55[a]	0,000
Hot Carcass Weight (Kg)	15,33± 1,14[c]	19,16± 0,64[b]	21,90±1,39[a]	0,000
Cold Carcass Weight (Kg)	15,03± 1,11[c]	18,75± 0,63[b]	21,47± 1,37[a]	0,000
Losses due to cooling (%)	2,34 ±0,20[a]	2,22 ± 0,20[ab]	2,01 ± 0,09[b]	0,003
Carcass pH 0 hour after slaughter	6,64± 0,33	6,60± 0,20	6,48± 0,37	0,569
Carcass pH 24 hours after slaughter	5,57± 0,19	5,65± 0,11	5,67±0,12	0,336
Carcass yield in the refrigerator (%)	46,79± 1,13[b]	48,30± 1,13[ab]	48,79± 1,40[a]	0,024
Commercial carcass yield (%)	45,88± 1,13[b]	47,25± 1,09[ab]	47,82± 1,75[a]	0,027
True carcass yield (%)	52,93± 1,38[b]	54,51± 1,41[a]	55,67± 2,25[a]	0,016
Internal Length of the Carcass (cm)	60,25± 2,96	62,50± 3,78	64,88±4,82	0,086
Carcass Compaction Index (Kg/cm)	0,25± 0,02[c]	0,30± 0,02[b]	0,33± 0,02[a]	0,000
Rump Width (cm)	20,15± 2,17[b]	22,25± 2,12[ab]	23,29± 2,55[a]	0,036
Length of leg (cm)	31,25± 3,15[b]	33,88± 1,96[ab]	34,50± 2,45[a]	0,045
Leg Compaction Index (Kg / cm)	0,65± 0,08	0,66± 0,06	0,68± 0,08	0,748

Averages followed by different letters, in the lines, indicate that there was difference by the Tukey test (P <0.05).
*RTU = Real-time ultrasonography measured in the waiting corral for the slaughter of the animals.

There were treatments (p <0.05) for the empty body weight and warm and cold carcass weight, which presented higher values as the subcutaneous fat thickness of the experimental groups increased. A fact that can be considered as explanatory for this parameter is the age of the animals, taking into account that animals slaughtered with 4 mm of subcutaneous fat thickness were older than the others. Medeiros et al. (2008) expose this fact, where the author explains that the increase in age at slaughter leads to increased carcass weight due to the decrease in the percentage of some extra carcass components such as bones, head and feet. Both statements are running with the results observed in this study, allowing claiming that the subcutaneous fat thickness increases with age and live weight of the animal, preponderating the increase of carcass weight. Thus, lambs belonging to the 3 mm and 4 mm group were older and slaughtered with a higher live weight, compared to the animals that were in the 2 mm group and the body weight empty, carcass weight warm and weight of the cold carcass, have high correlation with the live weight of the animal, these weights are expected to behave in this manner, varying according to the live weight of the animals.

Cooling losses are obtained after 24 hours of slaughter, during which time the animal is cooled and the biochemical transformations responsible for transforming the muscle into meat occur. In this work, the cooling losses behaved inversely proportional to the subcutaneous fat thickness. This fact can be better understood when one considers that fat acts as a thermal insulation for the carcass, thus preventing the excessive shortening of muscle fibers by cold, resulting in greater retention of water inside the cells and consequently less weight loss. Thus, the animals belonging to the group 2mm presented higher losses by cooling, the group 3mm behaved in an intermediate way and the group slaughtered with 4 mm was the one that suffered the greatest effect of the subcutaneous fat thickness and consequently lower losses due to cooling.

Carcass yields of sheep can be expressed in several ways, such as carcass yield in the refrigerator, true carcass yield and commercial carcass yield, which are given as a percentage, being very important indexes for the economic evaluation of sheep production. In the present study, all carcass yields evaluated were influenced by the thickness of subcutaneous fat at slaughter, with lambs in the 4mm group always presenting higher yields than those belonging to the 2mm group. Taking into account that lambs with SFT 4 mm presented a higher age at slaughter and that their muscular conformation expressed in a superior way to the others, it can be affirmed that because they remained confined for longer, these animals deposited greater muscle mass and consequently higher yields of the carcass.

The body condition score estimates how much muscle and fat the animal accumulated, suffered interference from the treatments (p <0.05), and its growth was proportional to the subcutaneous fat thickness. The animals of the group 4mm had higher values of body score than those belonging to group 3mm and those larger than those of group 2mm.

The rump width was influenced by SFT (p <0.05) probably due to the increase in carcass compactness as the lambs increased the carcass compactness and deposited more muscles in the croup region by raising the rump.

The length of the leg was influenced by

Rev. Bras. Saúde Prod. Anim., Salvador, v.19, n.1, p.125-135 jan./mar., 2018 ISSN 1519 9940
http://dx.doi.org/10.1590/S1519-99402018000100012

SFT ($p < 0.05$) and was larger in the animals of group 4mm. Because this work was carried out with animals that were still growing, this difference can be explained by the age at slaughter of the animals. Thus lambs belonging to the group 4mm that were slaughtered with approximately 30 days more than those with 2 mm, being favored in time for body development and consequently there was the increase of leg length verified between treatments. This fact can still be better understood when one considers the physiological growth waves of the animals, where the animals even visually have reached the adult size, still present a small growth rate, which occurs at a slower rate than the growth rate animals.

The carcass compactness index presented a difference between the treatments ($p < 0.05$) and their growth occurred as the subcutaneous fat thickness increased. This index is a strong indicator of conformation of the carcass, considering that it evaluates the amount of muscular tissue deposited in the carcass in a unit of length. Thus, it can be observed in this study that slaughtered animals with greater of subcutaneous fat thickness present a greater deposition of muscle tissue, which is an interesting characteristic in economic terms, since the market has preference for more compact carcasses and more deposited of muscle tissue in commercial cuts. Similar results were described by Macedo et al. (2014) that working with sheep ½ Dorper + ½ Santa Inês slaughtered with 2mm, 3mm and 4mm of subcutaneous fat found superior values for animals slaughtered with 3mm and 4mm when compared to animals slaughtered with 2mm, the authors affirm that the largest weights to slaughter explain the increase in the index of compactness of the carcass of these animals and these two parameters are related in a directly proportional way. In this work, the fact that carcass increase in weight, without increasing its length, led to an increase in the carcass weight of these animals. This fact is due to the profile of the Dorper breed that presents early development and has a compact body, in addition to accelerated muscular development, characteristics that manage to transmit their progeny. Thus, the deposition of accelerated muscle mass, associated to the compact carcass profile and the early muscle deposition, leads to an increase in the carcass compactness of these animals.

The leg compatibility index was not influenced by SFT ($p > 0.05$), regardless of the subcutaneous fat thickness. The results differ from those observed by Queiroz et al. (2015) who worked with Santa Inês male lambs slaughtered with 2 mm, 3 mm and 4 mm of subcutaneous fat thickness. The authors found differences between the treatments, with the leg compactness being higher for the group 4mm than the 2mm, and the 3mm lamb behaved in an intermediate manner, leading the authors to conclude that increases the subcutaneous fat thickness, the amount of muscle deposited in the leg increases. In the present study, as the animals increased the width of the rump, they also increased the leg length and this made the leg compactness accompany these indicators, since the leg compatibility index is a product of the division of both.

The data referring to weights and percentage of cuts are shown in Table 2. The thicknesses of subcutaneous fat did not influence ($p > 0.05$) the yields of the cuts (Table 2), confirming that the animals belonging to the experimental groups had a proportionality in the deposition of tissues in the carcass.

There was no difference ($p < 0.05$) for neck cut weight between groups 4mm and 3mm and for the palette groups 3mm and 2mm. The loin of the group 2 mm differed from the group 4 mm and both were similar to the 3 mm group. The fact that lambs belong to the same genetic group leads one to believe that they tend to deposit the musculature proportionally in the different regions of the body, thus reducing the difference between the proportions of the cuts, in relation to the carcass.

Table 2. Averages and standard deviations for carcass weights and yields of lambs ½ Dorper + ½ Santa Inês, slaughtered with different subcutaneous fat thicknesses

Variables	Subcutaneous fat thickness			p-value
	2mm	3mm	4mm	
Neck (Kg)	0,43±0,06^{b}	0,55±0,08^{a}	0,55±0,08^{a}	0,007
Neck (%)	5,78± 0,74	5,96± 0,90	5,13± 0,73	0,190
Palette (Kg)	1,36±0,19^{b}	1,63± 0,20^{b}	2,10± 0,37^{a}	0,000
Palette (%)	18,13±1,50	17,45± 2,30	19,64± 2,72	0,080
Flank Steak (Kg)	2,13± 0,35^{c}	2,77± 0,12^{b}	3,14 ±0,40^{a}	0,000
Flank Steak (%)	28,39±4,22	29,58± 2,55	29,26± 2,01	0,83
Loin (Kg)	0,93± 0,14^{b}	1,15± 0,18^{ab}	1,23 ± 0,19^{a}	0,007
Loin (%)	12,48±1,67	12,35± 1,78	11,47± 1,66	0,510
Leg (Kg)	2,64± 0,24^{c}	3,24±0,18^{b}	3,70± 0,37^{a}	0,000
Leg (%)	35,22±1,10	34,66±1,32	34,50± 2,33	0,21

Averages followed by different letters in the lines indicate that there was difference by the Tukey test (P <0.05).

There was effect of SFT on the weight of the flank steaks (p <0.05), and the weight was increased as the subcutaneous fat thickness increased. However, this variation was not verified in the yield of the flank steaks. This fact develops during the period of confinement in which the animals were submitted, and the lambs with SFT 4mm remain longer in confinement and consequently are heavier. The fact that there is no difference between the yields of the flank steaks can be explained by the slaughter of the animals before reaching the maximum of their body development and as the fat accumulates with higher speed in the flank steks their percentage in the carcass increase the weight of the animal weight.

The weights of the legs varied between the subcutaneous fat thicknesses (p> 0.05), the same did not occur for the yield. The fact of the variation in weight can be explained by the increase in the days of confinement of the lambs belonging to the group 4mm, when compared to those belonging to the group 3mm and 2mm. The fact that there is no variation in the yield of the legs in relation to the carcass can be explained by the fact that the limbs present an early development, which results in the reduction of their percentages in relation to the carcass, as the weight of the carcass increases, as reported by Furusho- Garcia et al. (2006) in an allometric study of the carcass of Santa Inês sheep and their crosses.

The data on the tissue composition of sheep carcass cuts are shown in Table 3. There was no effect of the subcutaneous fat thickness on the composition for any pallet tissue and flank steak. There was also no difference for muscle, fat and leg waste; for muscle, fat, and loin waste and for fat and neck wastes (Table 3).

There was a difference (p> 0.05) for the bones of the neck, loin and leg, in all subcutaneous fat thicknesses. The fact that bones present a difference between treatments in the leg, neck and loin cuts is due to the fact that the bone tissue continues to grow in thickness after the decline of muscle tissue growth, especially bone thickness increase (KÖNIG, 2011).

Table 3. Averages and standard deviation for tissue composition of carcass cuts of lambs ½ Dorper + ½ Santa Inês, slaughtered with different subcutaneous fat thicknesses

Variables	Subcutaneous Fat Thickness			p-value
	2mm	3mm	4mm	
Neck (%muscle)	50,24± 2,14[b]	51,44± 4,17[ab]	55,34± 4,94[a]	0,040
Neck (%fat)	10,94± 3,31	12,21± 3,36	12,89±1,99	0,420
Neck (%bone)	30,24± 2,61[a]	29,63± 3,22[ab]	25,91± 3,74[b]	0,030
Neck (% waste)	8,58± 1,59	6,72± 2,59	5,85± 2,74	0,080
Palette (% muscle)	62,77±1,94	56,26± 15,21	63,21± 1,76	0,240
Palette (%fat)	13,07± 2,83	16,98± 5,99	15,46± 2,44	0,180
Palette (%bone)	22,44± 2,44	24,50± 8,99	19,87± 1,96	0,260
Palette (%waste)	1,71± 0,22	2,26± 1,11	1,45± 0,19	0,060
Flank Steak (%muscle)	43,67± 7,46	38,67±6,13	36,30±9,53	0,200
Flank Steak (% fat)	34,60±7,39	40,96± 7,69	42,18± 8,13	0,140
Flank Steak (%bone)	17,71± 2,50	15,66± 2,19	18,32±3,96	0,060
Flank Steak (%waste)	4,03± 2,17	4,62±4,95	3,20±4,46	0,990
Loin (% muscle)	63,77± 4,79	58,94± 5,11	59,70± 2,81	0,060
Loin (%fat)	3,60± 1,09	3,53±0,20	3,88± 0,86	0,170
Loin (% bone)	17,35± 6,24[b]	24,62± 6,41[a]	24,71± 4,24[a]	0,003
Loin (% waste)	15,20± 4,08	13,12± 1,49	11,70± 3,23	0,100
Leg (% muscle)	66,11± 1,18	65,45± 1,55	66,30± 1,40	0,080
Leg (%fat)	5,58± 1,59	5,32± 2,59	4,85± 2,75	0,200
Leg (%bone)	11,02± 1,73[b]	11,33± 1,54[a]	11,93± 1,17[ab]	0,030
Leg (% waste)	17,29±1,36	17,89± 0,81	17,27± 0,90	0,220

Averages followed by different letters, in the lines, indicate that there was difference by the Tukey test (P <0.05).

There was a difference (p<0.05) for neck musculature among animals slaughtered with 4 mm and 2 mm of subcutaneous fat thickness. However, the animals slaughtered with 3 mm were similar to the others. The difference observed between lambs with 2mm and 4 mm may have been mediated by the anabolic effect of testosterone as affirmed by Rocha et al. (2007). In this study, the animals of group 4mm, older animals showed a greater deposition of muscles in the neck, probably due to the longer period of action of testosterone on the body. Another fact to be taken into account is that lambs belonging to the group 4mm were slaughtered near the beginning of puberty, where the animals usually begin to present hypertrophy of the musculature and present male profile due to hormonal action.

Considering that lambs slaughtered with 3mm thick subcutaneous fat had carcass yields similar to those slaughtered at 4mm, and that there were no differences between cut yields and tissue composition in carcasses of lambs slaughtered with 2mm, 3mm and 4mm. It is recommended to slaughter lambs ½ Dorper + ½ Santa Inês with 3mm of subcutaneous fat thickness.

REFERENCES

AMARAL, F.M.; MACEDO, F.A.F.; MACEDO, F.G.; LINO, D.A.; ALCALDE, C.R.; DIAS, F.B.; GUALDA, T. P. Deposição tecidual em cordeiros Santa Inês, ½ Dorper-Santa Inês e ½ White Dorper-Santa Inês avaliados por ultrassonografia. **Revista Brasileira de Saúde e Produção Animal** [online], v.12, n.3, p.658-669, 2011

ARAÚJO FILHO, J.T.; COSTA, R.G.; FRAGA, A.B.; SOUSA, W.H de; CEZAR, M.F.; BATISTA, A.S.M. Desempenho e composição da carcaça de cordeiros deslanados terminados em confinamento com diferentes dietas. **Revista Brasileira de Zootecnia**, v.39, n.2, p.363-371, 2010.

ÁVILA, V.S.; FRUET, A.P.B.; BARBIERI, M.; BIANCHINI, N.H.; DÖRR, A.C.O Retorno da ovinocultura ao cenário produtivo do Rio Grande do Sul. **Revista Eletrônica em Gestão, Educação e Tecnologia Ambiental**, v.11, n.11, p.2419-2426, 2013.

COLOMER- ROCHER, F.C.; MORAND- FEHR, P, KIRTON, A.H.; Standart methods and procedures for goat carcass evaluation, jointing and tissule separation. **Livetock Production Science**, v.17, p.149-159, 1987.

FURUSHO-GARCIA, I.F.; PEREZ, J.R.O.; BONAGURIO, S.; SANTOS, C.L. Estudo alométrico dos cortes de cordeiros Santa Inês puros e suas cruzas. **Revista Brasileira de Zootecnia**, v.35, n.4, p.1416-1422, 2006.

GERALDO A.T.; QUIRINO C.R.; BELTRAME R.T.; COSTA R.L.D.; ANTUNES F.; MENDES, L.R.; FREITAS A.C.B.; DAVID C.M.G.; RUA M.A.S.; VEGA W.H.O.; VIEIRA G.S. Avaliação das características de carcaça de ovinos Santa Inês com auxílio de ultrassonografia e tomografia computadorizada. **Actas Iberoamericanas en Conservación Animal**, v.7, p.37-43, 2016.

MACEDO, F.A.F.; GUALDA, T.P.; MEXIA, A.A.; MACEDO, F.G.; DIAS, F.B.; MORA, N.H.A.P. Performance and carcass characteristics of lambs with three subcutaneous fat thicknesses in the loin. **Archives of Veterinary Science**, v.19, n.2, p.52-59, 2014.

MEDEIROS, G.R.; CARVALHO, F.F.R.; FERREIRA, M.A.; ALVES, K.S.; MATTOS, C.W.; SARAIVA, T.A; NASCIMENTO, J.F. Efeito dos níveis de concentrado sobre os componentes não-carcaça de ovinos Morada Nova em confinamento. **Revista Brasileira de Zootecnia**, v.37, n.6, p.1063-1071, 2008.

MORA, N.H.A.P.; MACEDO, F.A.F.; MEXIA, A.A.; DIAS-SENEGALHE, F.B.; OLIVEIRA, E.Q.; RADIS, A.C. Características de carcaça de cordeiras Pantaneiras abatidas com diferentes espessuras de gordura subcutânea. **Arquivo Brasileiro de. Medicina Veterinária e Zootecnia**, v.67, n.1, p.290-298, 2015.

NUBIATO, K.E.Z.; FERNANDES, A.R.M.; ALVES, L.G.C.; OSÓRIO, J.C.S.; OSÓRIO, M.T.M.; CUNHA, M.C.; CORNÉLIO, T.C.; NETO, A.P.C. A técnica do ultrassom para avaliação da carcaça em tempo real. **PUBVET**. v.7 n.8,2013.

KÖNIG, H.E. **Anatomia dos animais domésticos**. 4.ed. Porto Alegre, RS: Artemed, 2011.

OSÓRIO, J.C.S.; OSÓRIO, M.T.M.; JARDIM, P.O.; PIMENTEL, M.; POUEY, J.L.; LUDER, W.E.; CARDELLINO, R.A.; OLIVERIA, N.M.; BORBA, M.F.; MOTTA, L.; ESTEVES, R. **Métodos para avaliação de produção da carne ovina: "*In vitro*", na carcaça na carne**. 1.ed. Pelotas, RS: UFPEL, 1998. 107p.

OSÓRIO, J.C.S.; OSÓRIO, M.T.M.; OLIVEIRA, N.R.M.; SIEWERDT, L. **Qualidade, morfologia e avaliação de carcaças**. Pelotas, RS: UFPEL, 2002. 195p.

POLI, C.H.E.C.; MONTEIRO, A.L.G.; BARROS, C.S.; MORAES, A.; FERNANDES, M.A.M.; PIAZZETTA, H.L. Produção de ovinos de corte em quatro sistemas de produção. **Revista Brasileira de Zootecnia**, v.37, n.4, p.666-673, 2008.

QUEIROZ, L.O.; SANTOS, G.R.A.; MACEDO, F.A.F.; MORA, N.H.A.P.; TORRES, M.G.; SANTANA, T.E.Z.; MACEDO, F.G. Características quantitativas da carcaça de cordeiros Santa Inês, abatidos com diferentes espessuras de gordura subcutânea. **Revista Brasileira Saúde Produção Animal** [online], v.16, n.3, p.712-722, 2015.

ROCHA, F.L.; ROQUE, F.R.; OLIVEIRA, E.M. Esteroides anabolizantes: mecanismos de ação e efeitos sobre o sistema cardiovascular. **O mundo da Saúde,** v 31, n. 7, p.470-477, 2007.

Receipt date: 11/10/2017
Approval date: 22/02/2018