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Short communication

Carcass traits and meat quality differences between a traditional and an intensive production model of market lambs in Brazil: Preliminary investigation

H.A. Ricardo[a,*], A.R.M. Fernandes[b], L.C.N. Mendes[c], M.A.G. Oliveira[d], V.M. Protes[e], E.M. Scatena[c], R.O. Roça[a], N.B. Athayde[f], L.V.C. Girão[g], L.G.C. Alves[h]

[a] Faculdade de Ciências Agronômicas (FCA), Universidade Estadual Paulista (UNESP), 18610-307 Botucatu, SP, Brasil
[b] Faculdade de Ciências Agrárias (FCA), Universidade Federal da Grande Dourados (UFGD), Caixa Postal 533, 79804-970 Dourados, MS, Brasil
[c] Faculdade de Medicina Veterinária de Araçatuba (FMVA), Universidade Estadual Paulista (UNESP), 16050-680 Araçatuba, SP, Brasil
[d] Associação Paulista de Criadores de Ovinos (ASPACO), 18650-000 São Manuel, SP, Brasil
[e] Faculdade de Medicina Veterinária e Zootecnia (FMVZ), Universidade Estadual Paulista (UNESP), 18618-970 Botucatu, SP, Brasil
[f] Embrapa Acre, Caixa Postal 321, 69900-970 Rio Branco, AC, Brasil
[g] Faculdade de Medicina Veterinária (FAMEV), Universidade Federal de Uberlândia (UFU), 38400-902, Uberlândia, MG, Brasil
[h] Centro de Ciências Agrárias (CCA), Universidade Estadual de Londrina (UEL), 86051-990 Londrina, PR, Brasil

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ABSTRACT

The objective of this study was to determine the differences of carcass traits and meat quality of market lambs between a traditional and an intensive production model. Eighty lambs were obtained from four commercial farms. At the Traditional model 20 lambs were Dorper × Santa Inês and 20 Ile de France. Farms from intensive model provided 20 Texel lambs and 20 Dorper × Santa Inês lambs. Animals from intensive model had access to creep feeding until weaning and were fed with a total mixed ration with 90% of concentrate at the finishing. The intensive model provided higher loin eye area and fat thickness, and lower shear force of the loin ($P < 0.0001$). The Traditional model presented higher rate of polyunsaturated fatty acids ($P < 0.01$) and lower ω6:ω3 rate ($P < 0.0001$). The loin of the animals from the intensive model presented more intense aroma and taste and higher juiciness and chewiness ($P < 0.05$). The intensive model produced carcasses with better conformation and fatness and soft meat with better color, taste and texture.

1. Introduction

Sheepmeat production is considered an activity with great growth potential in Brazil. Data from FAO (2013) point out that the country has approximately 17.7 million sheep, what represents a growth of 20% in a period of ten years and a proof of the importance of the activity for the national agribusiness. However, the sectors of the productive chain must search for a higher integration to reach the consolidation of the activity, seeking the economic efficiency for the breeder, stability of the production scale and certificate of quality of the meat products offered to the consumers.

The agricultural production system of the State of São Paulo (southeast region) is made up by 77.7% of farms with less than 50 ha. The sheep herd has 507,694 heads, made up by dual-purpose and specialized breeds for meat production in commercial herds and breeders. The size of the farms and the high prices of the lands for agricultural purposes require the adoption of intensive practices of management and production of the animals, aiming to increase the productivity.

Our objective was to evaluate if the technical criteria related to the production system, slaughter and carcass traits obtained by an intensive model of lamb meat production, called Cordeiro Paulista, promote the production of quality carcass and meat.

2. Material and methods

Animal procedures were not reviewed and approved by the Universidade Federal da Grande Dourados (UFGD) and Universidade Estadual Paulista (UNESP) Animal Care and Use Committee because this experiment did not involve animals originating from or under the control of UFGD and UNESP.

* Corresponding author at: Fazenda Experimental Lageado, Caixa Postal 237, UNESP Campus de Botucatu, Botucatu, SP, Brasil.
E-mail address: haricardo@gmail.com (H.A. Ricardo).

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Table 1
Description of the production models.

Item	Characteristic	Traditional	Cordeiro Paulista
Production	Sex	Entire male	Entire male
	Breed	Dorper × Santa Inês and Ile de France	Dorper × Santa Inês and Texel
	Suckling period	Under pasture[a]	With creep feeding
	Finishing period	Under pasture	Feedlot
Weight	Birth	4.7 ± 0.8 kg	4.3 ± 0.7 kg
	Weaning	22.4 ± 2.9 kg	20.4 ± 4.3 kg
Age	Weaning	73.6 ± 5.9 days	60.1 ± 6.9 days
	Slaughter	179.5 ± 27.4 days	120.4 ± 9.7 days

[a] *Brachiaria* spp. for Dorper × Santa Inês lambs, and *Cynodon* spp. for Ile de France.

2.1. Sampling and production models

The experiment was carried out in the cities of Araçatuba (21°12′32″S, 50°25′58″O) and São Manuel (22°43′52″S, 48°34′14″O), in the State of São Paulo (southeast region), Brazil. Four farms were used, where two were considered as Traditional production model and the other two employed the Cordeiro Paulista intensive production model. The description of the production models is shown in Table 1. Twenty entire male lambs from each farm were randomly chosen at the moment of trading to slaughter, resulting in 40 lambs from Traditional model and 40 from Cordeiro Paulista to be evaluated. Generally, for market lambs the slaughter weight ranges between 30 and 35 kg, but each farm decided the moment of trade. At the slaughter all lambs showed milk teeth.

Within Traditional production model, both farms maintained the lambs with their moms until the weaning, without access to creep feeding. One farm raised Dorper × Santa Inês lambs which were finished under *Brachiaria* spp. pasture. The other farm raised Ile de France lambs finished under *Cynodon* spp. pasture. The average age of weaning and slaughter was 73.6 ± 5.9 and 179.5 ± 27.4 days, respectively. The two farms produced their lambs from the breeding season of 2012. The average birth and weaning weight for Traditional model were 4.7 ± 0.8 and 22.4 ± 2.9 kg, respectively.

Each farm of Cordeiro Paulista model followed the technical criteria of production presented in Table 1. One farm raised Texel lambs and the other Dorper × Santa Inês lambs. At both farms for the creep feeding and feedlot the lambs received commercial diets ad libitum. The concentrate used in the creep feeding and in the feedlot diet was the same, made up with crushed corn, soy bean meal, extruded whole soy, mineral and vitamin premix, limestone and sodium bicarbonate. At finishing lambs were fed with a total mixed ration with roughage to concentrate ratio of 10:90, with Coast cross (*Cynodon* spp.) hay. Both farm made the breeding season at the same year that the two farms of Traditional production model. The average birth and weaning weights and age at weaning and slaughter of Cordeiro Paulista were 4.3 ± 0.7 and 20.4 ± 4.3 kg, and 60.1 ± 6.9 and 120.4 ± 9.7 days, respectively.

2.2. In vivo and carcass evaluations

The body weight (BW, kg), the body condition (BC) according to the methodology described by Russel et al. (1969), the ultrasound loin eye area (ULEA, cm^2) and subcutaneous fat thickness (USFT, mm) were recorded at the moment of trading the animals for slaughter. ULEA and USFT were determined by the analysis of ultrasound images (Chison 8300 VET with multifrequential linear transducer of 3.5 MHz, Chison Medical Imaging Co. Ltd., Jiang Su province, China) collected on the m. *Longissiumus*, between the 12th and the 13th rib, with the aid of the open code software ImageJ (http://rsbweb.nih.gov/ij/). ULEA values were used to determine the relative ULEA, calculated in relation to the BW of the animals (ULEA:BW, cm^2/kg).

The slaughter of the animals was carried out in commercial slaughterhouses commonly used by the farms used in the experiment. Hot carcass weight (HCW, kg) and hot carcass yield (HCY, %) were recorded after slaughtering, determined by the ratio between HCW and BW (HCY = [HCW ÷ BW] × 100). Each carcass was subjectively evaluated as for conformation and fatness by a trained technician, according to the European scheme of sheep carcass classification (EEC Regulation no. 22, 2008). Only the percentage in function of the conformation and fatness class was determined, obtained in relation to the number of carcasses evaluated in each production model.

2.3. Meat quality

Following the chilling of the carcasses and the production of the commercial cuts, the boneless loin (m. *Longissiumus*) from left and right side, placed between the first and the last lumbar vertebra, was used to determine colour components, subjective colour, water holding capacity (WHC) of cooked meat, shear force (SF, kg), fatty acids profile and sensorial properties. The loins were vacuum packaged and frozen for laboratory analysis. The colour components, WHC and SF were determined according to Honikel (1998) methodology using loins of left side of carcasses. One week after slaughter samples were thawed overnight and slices of 2.5 cm were taken for each analysis, resulting into 40 samples of each production model for colour, WHC, and SF.

CIE L*a*b* coordinates ("L*" lightness, "a*" redness, "b*" yellowness) were measured on the surface of m. *Longissimus*, after removal of the connective tissue band (Chroma Meter CR-400 colorimeter with standard illuminant D65; KONICA MINOLTA Sensing Inc., Japan). The subjective color was determined by comparing the samples to color standards varying from pink to brown, in a growing scale from 1 to 7 points.

Loin samples from right side of the carcasses were used to fatty acid profile and sensorial analysis. Fatty acids were analyzed by extraction of total lipids from 4.0 g of wet samples, using chloroform/methanol (2/1; v/v) by a period of ten minutes, according to Folch et al. (1957). One microliter of fatty acid methyl esters pipetted from supernatant were quantified by gas-chromatography (SHIMADZU – GC 17A), using a flame ionization detector, "Split/splitless" injector, DB-Wax capillary column (60 m × 0,25 mm; J&W Scientific). For all saponification process were used methanol, chloroform, and KCL 0.88% as chemicals.

The initial column temperature was held at 80 °C for 2 min at a rate of 3 °C/min and then raised to 180 °C at a rate of 30 °C/min, kept at this temperature for 30 min, and after this time, raised to 200 °C at a rate of 3 °C/min, remaining at this temperature for 108 min. The detector temperature 240 °C with helium carrier gas total flow of 8.0 mL/min; splitter ratio 1:50. For the identification of fatty acids were compared with the retention times of the methyl esters of standards (Sigma–Aldrich), while the measurement was carried out by area normalization expressing the result as a percentage area of each acid on the total area fatty acids (%), according to the methodology of Hartman and Lago (1973).

The sensorial analysis was carried out by ten trained panelists. The samples were prepared according to the methodology described by Sañudo et al. (1998) and the evaluation comprehended aroma intensity, strange aroma, flavor, strange flavor, tenderness, juiciness and chewiness. A 9 cm, non-structured scale was used for aroma, flavor and chewiness and a structured scale from 1 to 9 points was used for strange aroma, strange flavor, tenderness and juiciness.

The sensorial characteristics were described as: aroma intensity – from absent to very intense and typical aroma of the sheep meat;