Small Ruminant Research 114 (2013) 97–104

Contents lists available at SciVerse ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Effects of age and season of slaughter on meat production of light lambs: Carcass characteristics and meat quality of Leccese breed

Angela Gabriella D'Alessandro[a,*], Giuseppe Maiorano[b], Marco Ragni[a], Donato Casamassima[b], Giuseppe Marsico[a], G. Martemucci[a]

[a] Dipartimento di Scienze Agro-Ambientali e Territoriali, Università degli Studi di Bari, Via G. Amendola, 165/A, 70126 Bari, Italy
[b] Dipartimento Agricoltura, Ambiente e Alimenti, Università degli Studi del Molise, Via F. De Sanctis snc , 86100 Campobasso, Italy

ARTICLE INFO

Article history:
Received 9 January 2013
Received in revised form 22 April 2013
Accepted 9 May 2013
Available online 24 June 2013

Keywords:
Light lamb
Age
Slaughter season
Carcass traits
Meat quality

ABSTRACT

The effects of the slaughter season (winter and spring) and the age at slaughter (45 and 60 days) on the carcass characteristics and physico-chemical quality of meat were investigated on 40 Leccese lambs. In each season, 20 lambs were subdivided into two groups corresponding to the experimental ages. All lambs received maternal milk and a supplementation of hay and commercial concentrate from 30 days to slaughter. The ewes were fed a basal mixed diet (unifeed) and commercial concentrate and were allowed to graze for 5 h a day on polyphytic cultivated grassland. The increase of the lambs' slaughter age from 45 to 60 days resulted in an improvement in live weight, some commercial cuts (shoulder and loin), the majority of the carcass measurements, adiposity and conformation of shoulder and leg and the muscle/fat ratio. Intramuscular collagen properties were also affected by slaughter age. Considering the slaughter seasons, the best results have been obtained in spring and have been maximised in lambs slaughtered at 60 days that showed the greatest live weight (16 kg), good percentages of commercial cuts and carcass measurements, the greater levels of adiposity and better conformations of shoulder and leg and the lowest Warner–Bratzler (WB) shear force, without substantial difference in relation to colorimetric indices of meat. In conclusion, age and season of slaughter should be considered for the traditional production of light lambs. Lambs slaughtered in spring at 60 days of age showed the better characteristics of the carcasses and quality of meat.

In recent years, with increasing emphasis on sustainable farming systems, the use and exploitation of local breeds have elicited particular attention. These breeds are known to be less productive than allochthonous and/or more selected breeds, but the growing demand for animal products due to economic, political and social pressures has led to the consideration of local breeds that are not suitable for current needs or those of the immediately perceived future (Barker, 1999).

Leccese sheep is an endangered Italian local breed that was once widespread in the Apulia region but suffered a drastic contraction in population size during the past three decades (Siculella et al., 2008; Cecchi et al., 2008). The current count of this breed is approximately 2000 animals (Castellana et al., 2008). The strengths of this breed are its adaptability also in marginal areas, high resistance to local parasites and high quality of both lamb meat and milk production (Castellana et al., 2008; D'Alessandro et al., 2012). These characteristics of the Leccese breed

* Corresponding author. Tel.: +39 0805442524; fax: +39 0805442828.
E-mail address: angelagabriella.dalessandro@uniba.it (A.G. D'Alessandro).

0921-4488/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.smallrumres.2013.05.006

imply its potential use in an eco-sustainable or organic breeding system based on pasture and the obtaining of products having peculiar characteristics closely linked to the territory. Recently, meat from the Leccese breed has been considered within the collective quality brand with the indication of origin 'Prodotti di Qualità Puglia', submitted to the European Union for the recognition. For the ewes, semi-extensive or semi-stabled systems using pasturage are the most frequent practises. Lambs are traditionally reared under a milking–suckling system and are fed exclusively with maternal milk or with a moderate supplementation of feeding at the end of the breeding period. Lambs stay with their mothers all night after the afternoon milking and are separated from them in the morning. The traditional consumption peaks of lamb meat are Easter and Christmas, with slaughters occurring in the winter (December–January) and in the spring (March–April). The lamb production system follows closely that which is widely used for dairy breeds in Mediterranean countries. However, in lamb meat production systems, higher productivity and more flexibility may be gained by a small increase in the lamb's weight (Santos-Silva et al., 2002).

There is very little information available on meat production from light lambs of autochthonous breeds reared in southern Italy. Therefore, the aim of this study was to determine whether the age and season at slaughter affect the carcass traits and meat quality (as defined by physical and chemical characteristics) of Leccese light lambs reared under common management and in the traditional periods.

1. Materials and methods

The animal handling followed the recommendations of European Union directive 86/609/EEC and Italian law 116/92 regarding animal care.

1.1. Experimental design, location and animal management

The study was conducted on a farm located in southern Italy (latitude: 40°49′48″72 N, longitude: 16°33′16″20 E) at 500 m above sea level. The climate of this area is sub-coastal, with approximately 600 mm of annual rainfall and moderately cold winters (an average temperature of 5.5 °C) and hot, dry summers (an average temperature of 22 °C).

The trial was carried out on 40 Leccese male lambs in the winter and spring, during the traditional consumption peaks, Easter and Christmas. In the autumn and spring, 20 lambs born as singles from dams homogeneous for age (3.5 years), weight (51 ± 2.0 kg) and milk yield were considered. At birth, the lambs were divided into two groups of 10 animals each, homogeneous for weight (4.10 ± 0.2 kg) and corresponding to the experimental slaughter ages, according to a factorial scheme of 2 × 2 (two seasons – winter and spring and two slaughter ages – 45 and 60 days). Each group was then subdivided into two subgroups of five animals each. The lambs stayed with their respective mothers between 18:00 and 08:00 of the following day and received maternal milk and a supplementation of hay and commercial concentrate (barley, corn and faba beans; 20% protein, 2.5% fat, 4% cellulose and 6.9% ash) from 30 days to slaughter. Throughout the trial, the ewes were fed a basal mixed diet (unifeed; 1400 g head^{-1} day^{-1}) that consisted of chopped oat hay, clover, vetch and rye grass (800 g), commercial feed (200 g) and water (400 g). In addition, the ewes were allowed to graze for 5 h a day on polyphytic cultivated grassland (40% barley, 40% oats, 10% wheat, 2% rye grass and 8% clover) and received a commercial concentrate (barley, corn and faba beans; 15% protein, 2.5% fat, 6% cellulose and 6.7% ash; 140 g head^{-1} day^{-1}) during milking.

1.2. Animal slaughtering and assessment of carcass characteristics

In each season, one group of lambs was slaughtered at 45 days of age and the other group was slaughtered at 60 days. The animals were slaughtered after 12 h fasting at a local slaughterhouse and processed according to the Animals (Scientific Procedures) Act (ASPA) (1991) procedures. Hot and cold carcass weights were recorded, and the dressing percentages were calculated after dressing and chilling at 2–4 °C for 24 h. The carcass shrink losses, calculated as the difference between the hot and cold carcass weights, were expressed as a percentage of the hot carcass weight. Linear carcass measurements were taken on the cold carcasses 24 h post mortem. The shoulder, loin and leg were scored for the adiposity rate on a scale of 1–5 (1 = very lean, 5 = very fat). Moreover, the shoulder and leg conformation were rated on a ranking from 1 (poor) to 5 (excellent).

The left side of the carcass was dissected into commercial cuts (neck, cutlet and breast, shoulder, loin, bacon and leg), kidney and perirenal fat. The hind leg, loin and shoulder were then dissected into their main tissue components (lean, subcutaneous and intermuscular fat and bone) (ASPA, 1996). The lean/bone and lean/fat ratios were determined.

1.3. Meat analyses

1.3.1. Physical characteristics

The pH of the longissimus dorsi (LD) muscle was measured 45 min and 24 h (ultimate pH) after slaughter using a portable pH meter (Eutech Instruments, mod. XS pH 600, Singapore) equipped with a penetrating glass electrode.

The colorimetric indices (lightness, L^*; redness, a^*; yellowness, b^*) on the LD muscle were determined using a HunterLab MiniScan™ XE spectrophotometer (mod. 4500/L, 45/0 LAV, 3.20 cm diameter aperture, 10° standard observer, focussing at 25 mm, illuminant D65/10; Hunter Associated Laboratory, Inc.; Reston, VA, USA), taking three readings for each sample. The reflectance measurements were performed after the samples had oxygenated in air for at least 30 min, by which time the measurements were stable (Škrlep and Čandek-Potokar, 2006).

1.3.2. Chemical composition

The chemical composition was analysed on homogenised raw meat samples (250 g) from the longissimus lumborum (LL) muscle. Moisture, protein, lipid and ash content in each sample were determined according to the ASPA procedures (1996).

1.3.3. Collagen analyses

The intramuscular collagen (IMC) analyses were performed on the semimembranosus muscle (SM). Samples of SM were removed from the left leg of each carcass (after 24 h at 2–4 °C), vacuum packaged and stored in a freezer (−40 °C) until analysis. For the IMC analyses, the SM samples were thawed overnight at 4 °C, trimmed of fat and epimysium, lyophilised for 48 h, weighed and hydrolysed in Duran tubes in 6 N HCl at 110 °C for 18–20 h (Etherington and Sims, 1981) to determine the hydroxyproline (Woessner, 1961) and crosslinking. All of the analyses were performed in duplicate. The IMC concentration was expressed as μg hydroxyproline/mg of lyophilised tissue. The hydroxylysylpyridinoline (HLP) concentration, the principal non-reducible crosslink of muscle collagen (McCormick, 1999), was determined as described by Maiorano et al. (2012) and expressed as both moles of HLP per mole of collagen and μg HLP/mg of lyophilised tissue (Maiorano et al., 2007).

1.4. Statistical analyses

The data were analysed using the GLM procedure of SAS (2002). For the data on the slaughter performance, the carcass characteristics and the chemical composition of the meat, the model considered the effects of the season (two levels: winter and spring, with the error term being individual within a given season), the lambs' slaughter ages (two levels: 45 and 60 day of age, with the residual error being the error term), their interaction and the random effects of individual and residual. The means were compared using the t-test and the significance was declared at $P < 0.05$.

2. Results and discussion

2.1. Slaughter performance

The final live weight achieved by the lambs was affected by the slaughter season ($P < 0.01$) and, as expected, by the slaughter age ($P < 0.05$; Table 1). The live weight of the lambs at 45 days of age is consistent with that reported