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Relationship between slaughtering age, nutritional and organoleptic properties of Altamurana lamb meat☆

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ABSTRACT

Relationship between age at slaughter (40 *vs.* 75 days), nutritional and organoleptic properties were investigated on two different commercial cuts (loin and leg) from 24 Altamurana lambs. Meat chemical composition, fatty acid profile, color parameters, Warner–Bratzler share force (WBSF), Texture profile analysis (TPA) and sensory analysis were estimated. Significant differences were observed due to slaughtering age on meat chemical composition, in particular, meat from lambs slaughtered at 75 days of age showed higher fat percentage than meat from the youngest lambs. Meat from lambs slaughtered at 40 days of age was characterized by a better fatty acid profile, in terms of lower content of saturated fatty acids (SFA), higher content of polyunsaturated fatty acids (PUFA) and lower ω6/ω3 ratio, atherogenic and thrombogenic indices. Leg cut showed higher value of SFA and lower percentage of ω6 compared to loin. WBSF value was affect by age at slaughter and commercial cut, particularly, meat from younger lambs showed the lowest value of WBSF, while, loin resulted more tender than leg. Results of the sensory analysis showed that meat from lambs slaughtered at 40 days was more tender and chewable but less juicy and fatty than meat from lambs slaughtered at 75 days. Significant correlations were found between some fatty acids and flavor, odor and tenderness sensory scores, highlighting that the knowledge of the relationship between the fatty acids profile and sensory attributes may be useful in lamb meat production.

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1. Introduction

In lamb meat production, more than in other species, each country or region has its own specific weight/age at slaughter and type of carcass criteria, depending on its own production system as well as the culture and the customs of the people (Oliver et al., 2006; Sanudo et al., 1998). Traditionally in Italy, consumers demand light carcasses which are commonly produced by dairy breed lambs slaughtered at very light weights and young ages (Cifuni et al., 2000), reared under a milk suckling system (Sañudo et al., 2000; Santos-Silva et al., 2002). In recent years, a growing interest of consumers is shifting on the relationship between the proportion of lipid consumption and effects on human health (Wood et al., 2003; Scollan et al., 2006; World Cancer Research Fund/American Institute for Cancer Research, 2007). Scientific evidence and nutritional guidelines recommend not only a reduction in total fat intake, particularly of saturated fatty acids (SFA) but also a high consumption of polyunsaturated fatty acids (PUFA), especially ω3 PUFA rather than ω6 PUFA (World Health Organization, 2003).

Although fatty acid composition plays a remarkable role on the meat nutritive value and consequently on perception of healthiness, the consumer's decision to purchase meat is guided also by a variety of sensory traits including color, tenderness, juiciness, and aroma or flavor (Verbeke and Viaene, 1999). In particular, flavor and tenderness are the most appreciated characteristics in meat by consumers. Tenderness is probably the most important factor that determines acceptability in beef (Boleman et al., 1997), while flavor is very important for lamb meat (Martínez-Cerezo et al., 2005). Indeed, one of the main reasons why some consumers reject lamb meat is its characteristic flavor, which is very appreciated; on the other hand, by other consumers that prefer lamb meat for it is more tasty than meat from other species (Alfonso, 2000).

A large number of genetically distinct sheep breed are reared in Italy and this genetic diversity produces meat with many differ-

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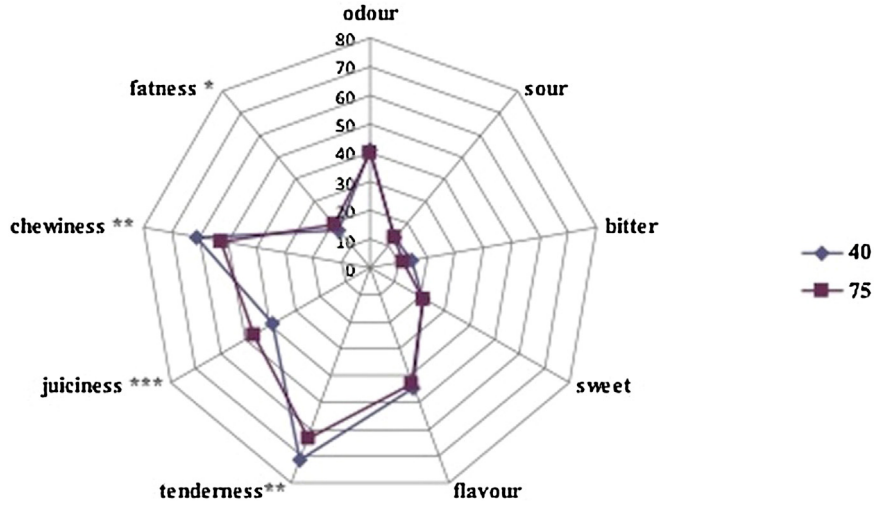

Fig. 1. Plot of sensory properties of meat from loin of Altamurana lambs as affected by age at slaughtering (40 *vs.* 75 days; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$).

ent qualities. Altamurana sheep is an Italian autochthonous breed which originates from Apulia region (Southern Italy), it is a triple purpose breed with a medium-size, closely linked to the territory due to its peculiar characteristics as the adaptability in marginal areas, the good grazing ability and the high resistance to local parasites (Portolano, 1987). These characteristics 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. Previous studies have shown that information on the animal production system is highly relevant to many European consumers of lamb meat (Martínez-Cerezo et al., 2005). Therefore, information on nutritional and organoleptic features of the productions of local breeds as Altamurana sheep could be important for the promotion of a sustainable development of otherwise marginal areas of Southern Italy and for the biodiversity safeguard. In the last years, several studies were focused on milk and cheese from Altamurana breed (Signorelli et al., 2008), while, few information are available on meat quality from lambs of this local breed.

The aim of this study was to evaluate the effect of the slaughtering age on meat nutritional and organoleptic characteristics of Altamurana lambs. Correlations between fatty acid composition and sensory characteristics of meat were also investigated.

2. Materials and methods

2.1. Animals and Experimental Design

The experiment was carried out from October to December 2013 in Apulia region (Southern Italy) at the Segezia research station of the Council for Research and Experimentation in Agriculture (latitude: 41°27′6″ and longitude: 15°33′5″). Twenty-four Altamurana male lambs born in October were involved in the study. All animals were suckled throughout the experimental period by their dams which grazed on natural pasture, and, starting from 33 days of age, lambs received *ad libitum* alfalfa hay (7.4 MJ ME/kg dry matter (DM)); 18.1% crude protein DM; 32.4% crude fiber DM and a pelletted concentrate (18.5% barley, 18% wheat bran, 17.7% maize meal, 17.5% soya, 16.2% sunflower 7% wheat meal, 2% molasses, and 3.1% vitamin mixture and minerals; 11.8 MJ ME/kg DM; 20.7% crude protein DM). Feed samples were collected and air-dried at 105 °C to a constant weight prior to determine their chemical composition according to AOAC methods (1990). Lambs were slaughtered at two different age, twelve subjects at 40 ± 0.25 days while the other twelve lambs were slaughtered at 75 ± 0.42 days. On the morning of slaughtering, after 12 h of fasting, lambs were weighed to record full-body weight (BW) and transported to a local slaughterhouse according to industrial routines used in Italy and to the EU rule no. 119/1993. Carcasses were chilled at 2–4 °C, weighed and pH was measured at 1, 6 and 24 h using a portable pH meter combined with glass electrode (Hanna Instruments, Woonsocket, RI) inserted in *longissimus dorsi* muscle between the eleventh and thirteenth ribs. After 24 h of refrigeration from each half carcass loin and leg cuts were collected, vacuum packaged and stored at −20 °C until analysis. Meat nutritional and organoleptic properties were estimated at each age at slaughter.

2.2. Meat chemical composition

Meat sample was ground to homogeneous consistency using a food processor. Moisture, protein, lipid and ash contents were determined according to AOAC methods (1995). All the chemical determinations were performed in duplicate.

2.3. Fatty acid methyl esters (FAME) analyses

Lipids were extracted according to O'Fallon et al. (2007). Briefly, 1 g of sample was added into a screw cap reaction tube in which 0.7 mL of 10 N KOH in water, 5.3 mL of MeOH and 0.5 mg of C13:0/ml of internal standard were added. The tubes were incubated in a 55 °C water bath for 1.5 h with vigorous hand shaking for 5 s every 20 min to properly permeate, dissolve, and hydrolyze the sample. After incubation, the tubes were cooled in a cold tap water bath for 15 min and 0.58 mL of 24 N H_2SO_4 was added. The tubes were mixed by inversion and incubated again in a 55 °C water bath for 1.5 h. After cooling 3 mL of hexane was added into each tube and vortex for 5 min. The tubes were centrifuged at 500 × *g* (Eppendorf 5810 R, Eppendorf AG, Hamburg, Germany) for 5 min at 21 °C, and lipid extracts were transferred into a GLC vial. Fatty acid profile was quantified using an Agilent 6890 N instrument equipped with a HP-88 fused-silica capillary column (length 100 m, internal diameter 0.25 mm, film thickness 0.25 μm). Operating conditions were: a helium constant pressure of 175 kPa; a FID detector at 250 °C; a split–splitless injector at 250 °C with an injection volume of 1 μl. The temperature program of the column was: 4 min at 70 °C, with a subsequent increase to 175 °C (13 °C/min), 27 min at 175 °C, a subsequent increase at 215 °C (4 °C/min) and held for 45 min. Retention time and area of each peak were computed using the 6890 N NETWORK GC system software. Individual FAME peaks

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