Carcass and meat parameters in Cornigliese sheep breed as affected by sex and age-class

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ABSTRACT
A total of 72 animals from Cornigliese sheep breed were reared under homogeneous conditions, with the aim to assess the effect of sex (males, females) and age-class (heavy lambs, adults) on carcass and meat parameters. A model with fixed effects of herd, sex, slaughtering session, age-class and interaction (sex*age-class) was used; for slaughter data, the carcass weight was used as a covariate. The age-class effect was significant for most of the carcass measurements, indicating a late development in animals. Also, slaughter performance was significantly affected by age-class, with higher values ($p<0.05$) of hot carcass yield shown by heavy lambs than by adults. Carcass compactness index was lower in heavy lambs than in adults ($p<0.001$), and the lowest value (0.283; $p<0.05$) appeared in female heavy lambs. The percentage of fat trimmings in carcass and the tissue composition of sample cut were influenced by a significant interaction between age-class and sex ($p<0.05$): in males the age-class never affected the tissue composition of sample cut, as in females the muscle and fat percentages increased with age while the bone percentage decreased. The fat content of loin meat increased with age in females ($p<0.05$) and decreased in males ($p<0.05$). The poly-unsaturated fatty acids (FA) content of loin meat was higher in males than in females ($p<0.001$), with saturated FA and mono-unsaturated FA revealing significant interactions between age-class and sex ($p<0.05$). In conclusion, future implementation of genetic selection, oriented towards the improvement of meat production characteristics that are potentially present in the breed, is important.

Introduction
Local breeds are important as a reservoir of genetic variability and as a source of income in the environments, in which more productive cosmopolite breeds have difficulty in being reared, because of their higher requirements and maintenance costs. In this context, it is necessary that the production of local breeds is analysed and known, so that it can be properly exploited and can provide an economic return for farmers. Therefore, an exhaustive overview on breed characteristics and product quality represents the starting point for the development of and the adherence to a preservation program (Verrier et al. 2005; Canali 2006; Lauvie et al. 2011). Aside from having a main role as a food source, local breeds also provide non-food benefits, such as grazing in areas that are unsuitable for crop production, maintaining the landscape (grazing activity, thus reducing the risk of fire and increasing wildlife biodiversity), and providing animal hair for the production of fibers (Gregory et al. 2010; Barnes et al. 2012).

In Italy during 2014, the number of sheep reared per year was about 7 million (Eurostat 2015a), producing approximately 27 000 tons of meat (Eurostat 2015b). The percentage of self-sufficiency is around 48%. In relation to the consumption in other countries, the consumption of sheep meat in Italy is generally low (1.4 kg/person/year) (mean of Greece: 10.2 kg; mean of EU: 2.4 kg) (Faravelli & Basile 2010) and is especially concentrated during the periods of Christmas and Easter (53% of slaughtering are in March, April and December). The main commercial category is the light lamb (80.8% of slaughtered animals), followed by heavy lambs and castrated lambs (9.7%) and adult males and females (9.5%). Over the past years, the number of light lambs consumed remained stable, while the number of heavy lambs tended to increase (Faravelli & Basile 2010), probably due to the lower price point. Most heavy lamb carcasses are imported from foreign countries, but it would be interesting to utilise the local breeds, to meet the requirements of the market.
On the basis of these premises, we are interested in deepening the knowledge on Cornigliese sheep, an autochthonous breed reared in the Emilia-Romagna region (northern Italy). The breed is used for the production of meat and it offers the potential for a project of restoration and preservation. The total number of individuals in Cornigliese breed dropped down in the 1990s to 50 head (Food and Agriculture Organization 1994), but in the last years it recovered to 1035 (Cecchini 2006) and recently, 2013, to 1582 (ASSONAPA 2014a). The increasing number of individuals was a result of following a strong policy set by institutional authorities aimed at the preservation of biodiversity. The regulations were financially supported by the allocation of funds for the maintenance of the breed and for studying the characteristics of its meat (Sabbioni et al. 2013; Ceccobelli et al. 2015). Apart from meat production, which is the main objective of rearing this breed (Beretti et al. 2006), as well as that of the wool (Beretti et al. 2004), the production of milk is quite interesting in terms of quantity (ASSONAPA 2014b) and quality (Franceschi et al. 2006). In the last centuries, the breed was strongly crossed with other breeds (Spanish Merino during the nineteenth century and Bergamasca during the twentieth century). A recent study, using 29 microsatellite markers, was carried out to investigate the genetic variability in the Cornigliese breed, confirming the historical information about its origin, with Bergamasca, Appenninica, Spanish Merino breeds and Spanish Palmera breeds as an outbreed (Ceccobelli et al. 2015), but the authors concluded that today it can be considered a well-defined breed.

The aim of this study was to describe some traits related to carcass and meat production and quality in the Cornigliese sheep breed.

Materials and methods

The trial was carried out under the control of the public veterinary service and in line with the rules on animal welfare (Legislative Decree n. 146/2001); the slaughtering took place in an approved facility.

Animals

The study was carried out on 72 animals from Cornigliese breed (sex: 47 females, 25 males; age-class: 43 adults, aged from 1 year to 3 years, 29 heavy lambs, aged between 6 months and 1 year; 33 ewes, 10 rams, 14 female heavy lambs, 15 male heavy lambs). At birth, animals were individually marked and submitted to standard rearing conditions for Cornigliese lambs in the hill-mountain area (fully open air throughout the day during spring, summer, and autumn and in closed facilities during winter) in four medium to large size herds (flocks of 50–200 heads), located at 600–800 m altitude. The lambing season of the breed is typically from October to February. The suckling period lasted, on average, at two-three months of age, in correspondence with the natural drying off of ewes. Animals grazed on natural meadow grass pastures from spring to autumn (mean ± SD of monthly samplings from each herd: 8.7 ± 2.4% crude protein, 51.1 ± 8.7% NDF, 27.5 ± 4.8% ADF, 3.2 ± 1.2% ADL and 20.0 ± 7.7% NSC, on d.m.) and were fed grass hay (10% crude protein, 51% NDF, 27% ADF, 2.5% ADL and 20% NSC, on d.m.) given ad libitum during winter (Association of Official Analytical Chemists 1990; Van Soest et al. 1991). A limited supply of a commercial concentrate (0.2–0.4 kg/head/day, in relation to body weight), with 17.5% crude protein, 4% crude fat, 8.5% ash, 25% NDF, 12.5% ADF, 2.5% ADL, was used from weaning to slaughter and during lactation of ewes. Slaughter took place during three different sessions, in November, March and May, that is the period, as previously stated, in which the consumption of sheep meat is higher; animals to be slaughtered were chosen at each session within all herds in a balanced way, and represented, for each session, all interactions between sex and age-class. On the day of slaughter, a truck loaded in all herds the animals and transported them to the slaughterhouse. The maximum distance from the farms was 40 km. After their arrival at the slaughterhouse, the time of housing and fasting lasted later than 3 hours.

Measures

Before slaughtering, body weight (BW) was recorded with the use of a dynamometer (model CCS-300K, UWE, Taiwan). The animals were consistently slaughtered and sectioned by the same staff. At slaughter, the weights of hot carcass (HCW), skin (plus wool), head, and offal (liver, heart and lungs) were recorded. Carcass yield was calculated as (HCW/BW)*100. The carcass was then measured to assess the length (BL-C: from the midpoint of the front face of the atlas to the articulation of the last sacral vertebra with the first caudal vertebra), the croup width (CrW-C: maximum width at the level of trochanters), the chest width (ChW-C, maximum width at the level of the ribs), the chest depth (CD-C: from the dorsal margin of the fifth thoracic vertebra, at the point of articulation with the sixth, to the midpoint of the ventral margin of the penultimate sternebra) and the thigh length (TL-C: from the
cranial margin of the pubic symphysis to the medial malleolus (Borghese et al. 1991) (Figure 1). A carcass compactness index (CI) was calculated as HCW/(BL-C).

After chilling for one week at 4°C, the cold carcass weight was recorded. Then, the left half-carcass was sectioned and the shoulder, neck, thigh, ribs, loin, and lean and fat trimmings were weighed (Borghese et al. 1991).

A sample cut (first 4 thoracic vertebrae) was collected during sectioning and refrigerated to be transported to laboratory facilities. Within 3 hours of sectioning, and after 1 h of blooming, on a freshly removed 2 cm thick slice, the pH, by means of a portable pH meter (HI 9812-5, Hanna Instruments, USA) and the colour (Minolta Chromameter Reflectance CR-300, Japan) were measured on the loin muscle at the level of the posterior part of the sample cut. Meat color was recorded by means of the Commission Internationale de l’Eclairage (1976) (CIE L* a* b* method; hue was calculated as [arctan(b*/a*)] as chroma, or saturation index, was calculated as [(a*² + b*²)⁰⁵]. The sample cut was then separated into its tissue components to assess the incidence of lean meat, fat and bone.

**Laboratory analysis**

Lean meat from the sample cut was then analysed to assess the content of moisture, ash, protein, fat (Association of Official Analytical Chemists 1990) and the fatty acid content of lipid fraction. To this aim, the lipid extraction was performed according to a modified Folch method (Folch et al. 1956) with a 2:1 chloroform:methanol mixture. The samples (weighed to contain about 1 g of lipids) were homogenised in a mixer at high velocity with 50 ml of anhydrous methanol and 25 ml of moisture (avoiding overheating), for 2 minutes. The solution was added to 50 ml of water and homogenised for 0.5 min; the solution was then separated into three phases. The deepest phase (solution of chloroform containing the lipids) was drawn and filtered on sodium sulphate-anhydrous in a vacuum flask in order to be dried under vacuum evaporation. A rate of 200 mg was taken and trans-esterified with KOH 2N/MeOH, using pentane as solvent, and 1 ml was injected in gas-chromatograph Perkin-Elmer mod. Clarus 500 (Perkin-Elmer Inc., Waltham, MA, USA), equipped with a SUPELCO SP — 2560 Capillary Column (100m x 0.25mm x 0.2μm film thickness) (Supelco, Bellefonte, PA, USA). The carrier was He, linear speed 20 cm/s, the temperature of injector and detector (FID) was 260°C and the oven temperature was 100°C for 5 min, until 240°C at 4°C/min, then 240°C for 20 min. Fatty acids were identified using external standards (FAME Mix 37, Supelco, Bellefonte, PA, USA).

**Statistical analysis**

Data were analysed by a General Linear Model procedure (SAS 2008) with herd, sex, slaughtering session, age-class and interaction between sex and age-class as fixed factors; for slaughter data, the carcass weight was used as a covariate. The significance level was set at \( p < 0.05 \). Comparisons with a \( p \) value \( >0.05 \) and \( <0.10 \) were considered as trends.

**Results and discussion**

**Carcass parameters**

The ‘herd’ and ‘slaughtering session’ factors within the statistical model were always significant \( (p < 0.05) \) on carcass and meat parameters, as expected. The inclusion of those factors in the statistical model had only the meaning to minimise the variance of the error term

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**Figure 1.** Carcass measurements (modified from Borghese et al. 1991): 1: length of body (BL-C); 2: width of croup (CrW-C); 3: width of chest (ChW-C); 4: depth of chest (CD-C); 5: tight length (TL-C).
and, consequently, to better estimate the significance of the other factors in the model; so ‘herd’ and ‘slaughtering session’ factors will not be considered in tables and in the following discussion. The animals sampled during the trial represented over 10% of total Cornigliese animals in the Parma province (actually 703 heads).

The slaughter data (Table 1) highlighted the significant effect of age on all parameters except on the head yield; the latter parameter was affected rather significantly by sex, with males having shown an average head yield 6.7% tending to be higher than that of females (p = 0.054). The carcass weight (covariate) significantly affected (p < 0.001) the yield at slaughter (+0.39% for every additional kilogram of carcass; data not tabulated).

Carcass measures (Table 2) revealed that sex significantly influenced CD-C (p = 0.006) and ChW-C (p < 0.001); on the contrary, age-class did not significantly influence (p > 0.05) some carcass measures, such as ChW-C, TL-C and CrW-C/BL-C. The compactness index was significantly affected by age-class (p < 0.001), showing higher values for adults than for young animals. An interaction between sex and age-class was observed for BL-C, ChW-C and TL-C (p < 0.05 for the first two parameters and p = 0.002 for the latter).

As recently reported (Ceccobelli et al. 2015), during the last centuries the Bergamasca breed was used in crosses with the Cornigliese breed, with the aim to increase body size and meat production. The influence of the Bergamasca breed is probably still present at a phenotypic level, as assessed by the analysis of carcass weights and measures (Tables 1 and 2). Carcass traits describe the Cornigliese breed as a late developing animal. Males develop later than females, giving carcasses significantly shorter, less thick at the chest and with shorter legs; moreover, the breed is actually characterised by a low carcass yield, which is negatively affected by increasing the BW at slaughter. The reason for this could be found in the incidence of gastro-intestinal content on live weight. In fact, as assessed by Marichal et al. (2003), differences in carcass yield between young and adult animals disappear if dressing percentage is based on empty body weight.

Low values of hot carcass yield (45.6–45.9%) were recorded in Cornigliese heavy lambs, regardless of sex. Heavy lambs from other Italian breeds showed higher values of hot carcass yield: from 46.75% to 47.95% (Morbidini et al. 2009) in the Appenninica breed and from 45.59% to 50.13% (Sarti et al. 1991) and from 45.59% to 50.13% (Morbidini et al. 2009) in the Appenninica breed slaughtered at about 100–150 d of age; from 51.79% to 54.53% and from 50.06% to 53.02% in

Table 1. Least square means of slaughtering performance of Cornigliese sheep breed as affected by sex and age.

| Sex  | Females | Males | p value |
|------|---------|-------|---------|
| Age  | <6–12 Months | >1 Year | 6–12 Months | >1 Year | SEM | S | A | S*A | b | R² |
| BW, kg | 59.3⁣⁺ | 82.0⁣⁻ | 63.0⁣⁺ | 82.8⁣⁻ | 8.4 | 0.509 | <0.001 | 0.684 | – | 0.771 |
| HCW, kg | 25.4⁣⁺ | 35.5⁣⁻ | 27.1⁣⁺ | 36.9⁣⁻ | 4.8 | 0.440 | <0.001 | 0.932 | – | 0.686 |
| CCW, kg | 24.0⁣⁺ | 33.7⁣⁻ | 23.1⁣⁺ | 33.8⁣⁻ | 5.4 | 0.907 | 0.009 | 0.873 | – | 0.704 |
| Hot carcass yield, % | 45.9⁣⁺ | 40.9⁣⁻ | 45.6⁣⁺ | 41.5⁣⁻ | 2.3 | 0.855 | 0.006 | 0.610 | <0.001 | 0.694 |
| Yield of skin and wool, % | 11.3⁣⁺ | 11.9⁣⁻ | 11.2⁣⁺ | 14.8⁣⁻ | 1.9 | 0.095 | 0.047 | 0.062 | 0.093 | 0.834 |
| head, % | 5.1 | 5.3 | 5.4 | 5.7 | 0.4 | 0.054 | 0.047 | 0.044 | 0.731 | <0.001 | 0.622 |
| offal, % | 3.0⁣⁺ | 3.8⁣⁻ | 2.8⁣⁺ | 3.6⁣⁻ | 0.6 | 0.483 | 0.016 | 0.901 | 0.041 | 0.590 |

S: sex effect; A: age-class effect; S*A: sex-age-class interaction; b: regression coefficient with carcass weight; BW: body weight; HCW: hot carcass weight; CCW: cold carcass weight.

Table 2. Least square means of carcass measures of Cornigliese sheep breed as affected by sex and age.

| Sex  | Females | Males | p value |
|------|---------|-------|---------|
| Age  | <6–12 Months | >1 Year | 6–12 Months | >1 Year | SEM | S | A | S*A | b | R² |
| BL-C, cm | 88.1⁣⁺ | 89.2⁣⁻ | 82.5⁣⁻ | 91.2⁣⁺ | 4.9 | 0.302 | 0.021 | 0.027 | <0.001 | 0.773 |
| CW-C, cm | 29.3⁣⁺ | 31.3⁣⁻ | 28.3⁣⁻ | 30.6⁣⁻ | 1.5 | 0.125 | 0.002 | 0.069 | <0.001 | 0.927 |
| CW-C, cm | 29.5⁣⁺ | 31.5⁣⁻ | 24.1⁣⁺ | 27.1⁣⁻ | 2.8 | <0.001 | 0.668 | 0.015 | <0.001 | 0.797 |
| CD-C, cm | 23.0⁣⁺ | 24.6⁣⁻ | 21.5⁣⁺ | 23.2⁣⁻ | 1.5 | 0.006 | 0.011 | 0.847 | <0.001 | 0.745 |
| TL-C, cm | 42.9⁣⁻ | 44.0⁣⁻ | 41.5⁣⁻ | 44.5⁣⁻ | 1.9 | 0.453 | 0.222 | 0.002 | <0.001 | 0.644 |
| CI | 0.283⁣⁺ | 0.378⁣⁻ | 0.321⁣⁻ | 0.371⁣⁻ | 0.04 | 0.292 | <0.001 | 0.146 | – | 0.645 |
| CrW-C/BL-C | 0.345⁣⁺ | 0.364⁣⁻ | 0.334⁣⁻ | 0.348⁣⁻ | 0.03 | 0.154 | 0.133 | 0.815 | – | 0.740 |

S: sex effect; A: age-class effect; S*A: sex * age-class interaction; b: regression coefficient with carcass weight; BL-C: body length (carcass); CW-C: croup width (carcass); CW-C: chest width (carcass); CD-C: chest depth (carcass); TL-C: thigh length (carcass); CI: compactness index, calculated as HCW (kg)/BL-C (cm).

 Different letters in the same row indicate statistical difference (p < 0.05).
crossbreds × Sopravissana slaughtered at 75 and 105 d of age, respectively (Borghese et al. 1982; Gigli et al. 1982); and 47.58% in the Zerasca breed slaughtered at 60 d of age (Verità et al. 2001). In this study the reason for differences in carcass yield of Cornigliese heavy lambs, compared to other breeds, could be the higher BW of animals, which is related to their late development. Heavy lambs from other breeds in Italy are, in fact, slaughtered at a BW ranging about 30–40 kg (Dal Prà et al. 2009), whereas the Cornigliese heavy lambs in the present study reached a mean BW of about 60 kg at slaughter.

With reference to the slaughter yield of adults, the values of 40.9% for females and 41.5% for males are in line with the results reported by Pascal et al. (2010) for adult sheep of different breeds, reformed and reconditioned through grazing. As the sample of adults used in the present trial was represented by ewes and rams, which were reformed into flocks for grazing, based on age and infertility, and not submitted to a fattening period before slaughtering, it is possible to argue that adults from the Cornigliese breed are able to maintain a good condition over time. Contrary to what was stated by Zvonko Antunovic et al. (2010), the yield at slaughter was not significantly affected by gender. On the contrary, sex significantly affected the neck yield (Table 3), showing that males had higher values than females, independent of age. This finding has already been described by Zvonko Antunovic et al. (2010).

Other carcass parameters are able to differentiate the Cornigliese breed from other sheep breeds reared in Italy. The compactness index (ratio between carcass weight and carcass length) in Cornigliese heavy lambs was higher than in the Appenninica slaughtered at 33 kg BW (0.302 vs 0.211, respectively) (Sarti et al. 1991), seeing as the former were 72% heavier and only 18% longer than the latter; on the contrary the ratio between carcass croup width and carcass length was similar (0.340 vs 0.347, respectively), because the carcass croup of Cornigliese was only 15.2% wider than Appenninica. Compared to Zerasca heavy lambs, slaughtered at an average BW of 22.5 kg (Verità et al. 2001), the mean CI of Cornigliese heavy lambs was higher (0.302 vs 0.180, respectively), as their carcasses were 158% heavier and only 28.6% longer than Zerasca.

The carcass composition was slightly affected by sex as well as age-class (Table 3), particularly for the cuts with the highest price (thigh, shoulder, lean trimmings) (p > 0.05). Regardless of age-class, males showed a higher incidence of neck (p = 0.009) than females, as their lower thigh weight/TL-C ratio (p = 0.055) must be considered as just a trend.

Regardless of age-class, males showed a higher muscle content (p = 0.012), muscle/fat ratio (p < 0.001), and a lower fat content (p = 0.011) in the sample cut than females (Table 4). Female heavy lambs presented a higher incidence of bone in the sample cut (p < 0.05) and, consequently, a lower muscle/bone and (muscle + fat)/bone ratios (p < 0.05) than other categories.

The analysis of tissue composition of carcasses was carried out with objective measurements, rather than with a subjective evaluation of fatness, because, as reported by Cabassi (1990), the use of subjective prediction systems may lead to errors associated with the evaluators, which should receive previous training, to avoid a great variability in the results. In the case of Cornigliese breed, the low number of slaughtered animals did not allow, at the moment, for the introduction of a subjective system of the evaluation of carcasses. Adult females revealed higher values of fat trimmings, fat percent in sample cut and fat content of loin muscle than female heavy lambs and, for the last two parameters, also than males of all ages. These results can lead to a lower value of the carcasses from adult females and reveal the need for a correct reconditioning of animals at the end of their productive period, to avoid excess fat (Pascal 2010). The differences in carcass fat content between females and males do not agree with the results reported by Pinheiro et al. (2007), which indicated that in both sexes a
higher fat content was found in adults than in lambs. This could be attributed to the later development of carcasses from males observed in Cornigliese breed. This result is confirmed by the percentage of bone in the carcass which has an opposing trend with fat in females with age, while in males it remains stable regardless of age.

**Meat parameters**

Proximate analysis (Table 5) revealed a lower moisture content in female loin meat than in male \( (p = 0.014) \). A highly significant interaction between sex and age-class was shown for meat fat content. The parameter increased with age in females and decreased in males \( (p < 0.001) \); as a consequence, the moisture content decreased with age in females and increased in males \( (p = 0.012) \). Also, protein content revealed a significant interaction \( (p < 0.001) \); the values were stable with age in females and increased in males. Males showed higher lightness \( (L^*) \) and yellowness \( (b^*) \) values than females \( (p < 0.001) \), and as a consequence, a higher hue \( (p = 0.005) \) and chroma \( (p = 0.023) \), as redness \( (a^*) \) was not significantly different \( (p = 0.058) \). A highly significant interaction between sex and age-class was observed for hue \( (p < 0.001) \) and yellowness \( (p = 0.007) \), that increased with age in females and remained stable in males.

Meat color in the Cornigliese breed was darker, had higher values of redness and hue, and had lower values of chroma than in the Suffolk and Bergamasca (Sirtori et al. 2009), Appenninica and Sopravissana (Morbidini & Rossetti 2007) and Garfagnina (D’Agata et al. 2008) breeds. Meat yellowness was lower in Cornigliese than in Suffolk and Bergamasca, but higher than in Appenninica, Sopravissana and Garfagnina.

Although poly-unsaturated fatty acids (PUFA) (Table 6) were higher in males than in females \( (p < 0.001) \), due to a significantly higher content of C18:3 \( (p = 0.003) \) and C18:2 \( (p = 0.001) \), both saturated fatty acids (SFA) and mono-unsaturated fatty acids (MUFA) revealed a significant interaction between age-class and sex \( (p = 0.015 \) and \( p = 0.019 \), respectively): SFA decreased with age in females and increased in males, while MUFA increased in females and decreased in males.

Fatty acid composition of loin meat from Cornigliese heavy lambs revealed differences from the Bergamasca breed (Sirtori et al. 2009), with a higher content of SFA and MUFA and a lower content of PUFA. Also, the ratio

### Table 4. Least square means of tissue composition of sample cut of Cornigliese sheep breed as affected by sex and age.

|        | Sex     | Females | Males       | p value | SEM | S A S*A | R²   |
|--------|---------|---------|-------------|---------|-----|---------|------|
| Age    |         | 6–12 Months | > 1 Year | 6–12 Months | > 1 Year |       |
| Muscle, % |        | 58.86ab | 63.99b     | 65.40b  | 65.58b | 3.50   | 0.012 | 0.136 | 0.012 | 0.320 |
| Fat, %  |        | 9.29a   | 12.41b     | 7.89a   | 8.84a  | 2.13   | 0.011 | 0.061 | 0.025 | 0.691 |
| Bone, % |        | 27.71b  | 23.63a     | 24.94a  | 22.64a | 3.21   | 0.193 | 0.012 | 0.009 | 0.556 |
| Ratios |         |         |            |         |       |        |      |      |      |      |
| Muscle/Fat |      | 5.73a   | 4.45b      | 7.84a   | 9.19b  | 1.54   | <0.001 | 0.961 | 0.059 | 0.831 |
| (Muscle + Fat)/Bone | | 2.22a   | 3.52b      | 3.09b   | 3.25b  | 0.48   | 0.170 | 0.004 | 0.010 | 0.609 |
| Muscle/Bone |    | 1.93a   | 2.95b      | 2.74b   | 2.84b  | 0.43   | 0.080 | 0.013 | 0.022 | 0.500 |

S: sex effect; A: age-class effect; S*A: sex * age-class interaction.

### Table 5. Least square means of physical–chemical parameters of loin meat of Cornigliese sheep breed as affected by sex and age.

|        | Sex     | Females | Males       | p value | SEM | S A S*A | R²   |
|--------|---------|---------|-------------|---------|-----|---------|------|
| Age    |         | 6–12 Months | > 1 Year | 6–12 Months | > 1 Year |       |
| Proximate analysis, % | | 73.74b | 70.38a | 73.68b | 75.83b | 2.38 | 0.014 | 0.612 | 0.012 | 0.610 |
| Moisture |       | 0.95     | 0.95       | 0.94    | 0.98   | 0.06   | 0.859 | 0.533 | 0.498 | 0.414 |
| Ash    |        | 19.00ab  | 19.08b     | 18.86b  | 19.57b | 0.67   | 0.561 | <0.001 | <0.001 | 0.408 |
| Protein |       | 5.22ab   | 8.71c      | 6.41b   | 4.68b  | 1.91   | 0.103 | 0.899 | <0.001 | 0.638 |
| Fat    |        | 5.86     | 5.86       | 5.87    | 5.84   | 0.10   | 0.803 | 0.741 | 0.764 | 0.913 |
| pH     |        | 36.11a   | 37.72a     | 39.88b  | 40.02b | 1.90   | <0.001 | 0.326 | 0.388 | 0.677 |
| Colour |       | 22.54    | 23.39      | 24.45   | 24.71  | 1.84   | 0.058 | 0.544 | 0.724 | 0.566 |
| L*     |        | 9.70b    | 12.59b     | 12.98b  | 12.96b | 1.18   | <0.001 | 0.017 | 0.007 | 0.692 |
| a*     |        | 0.415a   | 0.501b     | 0.493b  | 0.482b | 0.024  | 0.005 | 0.005 | <0.001 | 0.872 |
| b*     |        | 24.65a   | 26.57b     | 27.72b  | 27.89b | 2.10   | 0.023 | 0.320 | 0.353 | 0.540 |

S: sex effect; A: age-class effect; S*A: sex * age-class interaction; L*: lightness; a*: redness; b*: yellowness.

**a, b, c:** Different letters in the same row indicate statistical difference \( (p < 0.05) \).
SFA/(MUFA + PUFA) was higher in the Cornigliese breed. In both studies, because the animals grazed on natural pastures and the composition of concentrates fed to the animals was similar, the recorded differences are probably of genetic origin and are linked to the already mentioned higher adiposity.

Conclusions

In conclusion, the Cornigliese sheep breed, in the current conditions of utilisation, can be considered an extremely late maturing breed, with high weights at slaughter, low carcass yields and high incidence of fat in the carcass and in the meat of animals, particularly in adult females. Fatness should be reduced in future, by selection and by a correct management system, oriented towards the slaughtering of younger animals, with a lower final weight. Aside from the maintenance of the genetic variability in this local population, it is important that future genetic improvements target characteristics of meat production, which are potentially present in the breed and take into account the enhancement of the products.

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