Statistical analysis of meat and fat colour characteristics in carcasses of “Appenninica” and “Sopravissana” lambs fed diets with different protein source (soybean or faba bean)

L. Morbidini, E. Rossetti

Dipartimento di Biologia Vegetale e Biotecnologie Agroambientali e Zootecniche. Università di Perugia, Italy

Corresponding author: Luciano Morbidini. Dipartimento di Biologia Vegetale e Biotecnologie Agroambientali e Zootecniche. Facoltà di Agraria, Università di Perugia. Borgo XX Giugno 74, 06121 Perugia, Italy - Tel. +39 075 5857105 - Fax: +39 075 05857122 - Email: morbidini@agr.unipg.it

ABSTRACT: Thirty-six male lambs of Appenninica and Sopravissana breeds, were finished with two isoprotein and isoenergetic diets (hay/concentrate ratio: 30/70) differing by protein source: soybean or faba bean. After slaughtering (at about 25 kg live weight), CIEL*a*b* meat and fat colours parameters at Rectus abdominis and, after dissection, at Longissimus dorsi, and at tail root were measured using a Minolta Chromameter CR-100. Results showed high and significant difference among tissues in colour parameters (L*= 56.73, 45.99 and 72.63 in RA, LD and TF respectively, P<0.001) and low correlation coefficients between colour parameters in different tissues (the highest value: 0.33). The two first axis obtained by principal component analysis, performed with only CIEL*a*b* colour parameters, explained about 95% of total variability and discriminating different tissues but not differentiating breeds or diets.

Key words: Lamb, Appenninica, Sopravissana, Meat, Fat, CIEL*a*b* colour, PCA.

INTRODUCTION – Meat colour is one of most deciding factor for purchaser. Colour of lamb carcasses and meat strongly influence their quality in Italian market dominated by milk and light carcasses. The subjective evaluation of these carcasses is executed, in the UE, following regulations n.2137/92 and n.461/93, which consider their weight, fatness and subjective colour of meat at the internal face of Rectus abdominis muscle. Despite literature reported small differences between breed for meat and fat colour, Hopkins et al., 1998 suggested that Merino lambs produced darker meat than crossbred. There are also few information about the influence of diets with different protein source on the colour of fat and meat of lambs. This work, aiming to find differences in CIEL*a*b* colour parameters useful for discriminate carcasses in slaughtering house, is part of an articulated research looking for qualitative differences between Sopravissana and Appenninica lambs, fed diets with two different protein sources: faba bean and soybean.

MATERIAL AND METHODS – Thirty-six male lambs, 18 Appenninica (AP) and 18 Sopravissana (SO), an Italian Merino derived breed, were submitted, after weaning (15 kg), to two isoprotein and isoenergetic diets (hay/concentrate ratio: 30/70) with same hay and two different concentrates, differing for a protein source: soybean meal (SH) or flaked faba bean (FH). Composition and chemical analysis of diets (average concentrate values: 20.7% of crude protein and 0.99 MFU/kg of dry matter) together with in vivo performance were reported in a previous study (Morbidini et al., 2004), while slaughtering and dissection performance were reported in Morbidini et al., 2005. After slaughtering, at about 25 kg of live weight, three replicate measurements of colour on CIEL*a*b* system (CIE, 1986), in which L* is lightness, a* is redness and b* is yellowness, using a MINOLTA CR100 Chromameter (Illuminant D65, 0° viewing and a white tile standard) were taken on the following areas of the carcass: internal face of Rectus abdominis muscle (RA) and subcutaneous fat from the tail root (TF). After dissection, the same
CIEL*a*b* measurement were performed on Longissimus dorsi (LD) muscle. Chromaticity (C*=(a*2+b*2)1/2, as quantity of colour) and Hue angle (H*=tan⁻¹(b*/a*) (180/π), real colour) were also calculated. The relations between the three tissue colour characteristics in lamb carcasses of different breed and diet were tested using the following SAS procedure (SAS, 1999): GLM (using a model with breed nested in tissue, diet nested in tissue and tissue as factors), CORR for correlation analysis, REG and and by finally PRINCOMP for principal component analysis (PCA).

RESULTS AND CONCLUSIONS – CIEL*a*b* meat characteristics of all tested lambs were similar to those reported in literature by Lanza et al., 2003, Russo et al., 2003 and Santos-Silva et al., 2002, that worked with similar but different breeds. Subcutaneous fat colour of all tested lambs showed small differences with respect to those found by Priolo et al., 2002, measured in different sides and in other breeds. Colour parameters were strongly influenced by the considered tissue (Tab. 1).

Breed did not influence CIEL*a*b* parameters, as Santos-Silva et al., 2002 and Texeira et al., 2005 observed in previous work with other breeds. Conversely, concerning lightness (L*) of Rectus abdominis (RA) SO showed meat significantly lighter than AP ones (57.7 vs 55.7 respectively: P<0.05). The contrary was found by Martinez-Cerezo et al., 2005, in an experiment with more different breeds and higher sample size and by Alcalde et al., 2001, in a larger experiment whereas Spanish breeds showed no differences.

Diets did not influence colorimetric parameters, as found also by Diaz et al., 2002. Only L* in LD muscle of soybean fed lambs (SH) was lighter than those fed FH and Hue angle (H*) of RA, that showed in FH carcasses significantly more purple than SH ones (345.5 vs 351.5 respectively).

There was practically null correlation between CIEL*a*b* parameters in different tissues (maximum value: 0.33 between L* in RA and a* in TF).

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PCA performed on colour parameter showed the first two axis explaining 95.48% of total variability. Principal component 1 (Prin1) (about 64% of variability) is strongly and positively correlated with L* (0.91) and negatively with a* (-0.96) and C* (-0.97), while Principal component 2 (Prin2) is strongly and positively correlated with b* (0.99) and Hue angle (0.94). Fig. 1 showed the distribution of scores in the multivariate space defined by the first two axis, grouped and well discriminated by tissue. RA and LD meat colour was well separated by fat on the basis of Prin1 axis, due to less L* but higher a* and Chromaticity. Differences between Rectus abdominis (RA) and eye muscle (LD) meat colour were pointed out on the basis of Prin2 axis, in which RA meat colour (ellipse below) were characterized by less yellow intensity (b*) and more purple (H*) colour meat with respect to LD one (ellipse above). More evident discrimination by breeds were found by Alcalde et al., 2001, but using X,Y and Z as parameters and studying different muscles.

Colour parameter and specially L* of LD, indicated good carcass quality, considering that only values of L* below 34 are regarded by consumers too dark (Hopkins, 1996). On the other hand PCA did not seems to discriminate lamb of different breed or diet on the basis of only colour parameters, even if it differentiated powerfully different tissues. Probably PCA could discriminate better carcass quality if CIEL*a*b* parameters were used together with other carcass and meat parameters, as found by others (Alcalde et al., 2001). Moreover the in-slaughtering-house use of CIEL*a*b* color measurements, in different tissues, in order to differentiate carcasses of different breeds or diets should be verified with a larger number of carcasses.

Table 1. Least square means of colour parameter in different tissues

| Items | RA | Tissue | LD | TF | SE |
|-------|----|--------|----|----|----|
| L*    | 56.73 A | 45.99 B | 72.63 C | 0.64 |
| a*    | 15.34 A | 17.60 B | 8.56 C | 0.24 |
| b*    | -2.93 A | 4.95 B | 8.01 C | 0.26 |
| C*    | 15.93 A | 18.38 B | 11.81 C | 0.26 |
| H*    | 348.75 A | 15.10 B | 42.51 C | 1.35 |

A,B,C: P<0.01.

There was practically null correlation between CIEL*a*b* parameters in different tissues (maximum value: 0.33 between L* in RA and a* in TF).
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