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## CARCASS AND MEAT QUALITY IN LIGHT LAMBS FROM DIFFERENT CLASSES IN THE EUROPEAN GRADING SYSTEM

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### Background.

Fat, quantity and quality, are important aspects for consumers (Sendim *et al.*, 1997), who are more and more interested in healthy products, and usually prefer lean meat and carcasses, although fat is positively associated with acceptability. Thus, Jeremiah (1998) found that the percentage of unacceptable cuts was higher in lean than fat categories, similar findings being obtained by Paul *et al.*, (1964) and Smith *et al.*, (1970). For this reason practically all carcass classification systems around the world include fatness score as a criterion of quality and price (EEC n° 2137/92 and 461/93 regulations; Moxhan and Brownlie (1976)). Other characteristics such as age, sex, weight, carcass length, meat colour and specially conformation score are also used, but they have a lower market significance and a lower price influence. Inside the EU there are two different schemes for lamb classification: one for carcasses up 13 kg and other for light carcasses under 13 kg. In the latter scheme, since Mediterranean carcasses were systematically penalised because of their natural poor morphology (walker breeds), low subcutaneous/internal fat ratio and light weights, conformation score is not considered. Only weight (three categories: < 7.0 kg, 7.1-10.0 kg and 10.1-13.0 kg), meat colour and fat class are included. Several studies have shown weak relationships between lamb quality grades and palatability assessments in heavy or medium weight carcasses (Jeremiah *et al.*, 1972; Crouse and Ferrel, 1982), but there has been no investigation of this relationship in light lambs. On the other hand, it seems essential to know if any classification is, or is not, related with real carcass value and quality.

### Objectives.

The main aim of this study is to determine if fatness level, as described by the European regulation for light carcasses, is a good discriminator of meat quality.

### Material and Methods.

The lambs studied were mainly from the Rasa Aragonesa breed, a typical Mediterranean rustic breed, 50-60 Kg ewe mature weight, with a population of approximately 2.5 million head, located in North-eastern Spain. Lambs were kept with their dams for a minimum of 40-50 days and after weaning were fed with concentrate and cereal straw diet *ad libitum* until slaughter. Ninety animals were selected for the investigation in a commercial EU licensed abattoir. Cold carcass weight was between 9.0 and 11.0 kg, being typical of the European Mediterranean Area.

The carcasses were selected to cover the four fat levels included in the EU lamb classification system (Table 1) and then the left shoulder was excised and dissected, to provide an index of overall carcass composition, following the guidelines of Colomer *et al.*, (1988).

Table 1. Number of animals by class using the light lamb EU grading system (fatness).

| Fat class | 1-Low | 2-Slight | | | 3-Average | | | 4-High | |
|---|---|---|---|---|---|---|---|---|---|
| Subgroup | +1 | -2 | 2 | +2 | -3 | 3 | +3 | -4 | 4 |
| Number of animals | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| General fatness | None up to low fat cover. | Slight fat cover, flesh visible almost everywhere. | | | Flesh, with exception of hindquarter and shoulder, almost everywhere covered with fat. Slight deposits of fat in the thoracic cavity. | | | Flesh covered with fat, but on the hindquarter and shoulder still partly visible. Some distinctive fat deposits in the thoracic cavity. | |
| External fatness | Traces or no visible fat. | A slight layer of fat covers part of the carcass but may be less evident on the limbs. | | | A light layer of fat covering most or all the carcass. Slightly thickened fat in the tail base. | | | A thick layer of fat covering all of the carcass but may be thinner on limbs and thicker on the shoulders. | |
| Internal thoracic fatness | Traces or not fat visible between ribs. | Muscle clearly visible between ribs. | | | Muscle still visible between ribs. | | | Muscle between ribs may be infiltrated. Fat deposits may be visible on the ribs. | |

The entire left loin was removed to assess meat quality. Representative sub-samples of the M. *longissimus thoracis* ( between the 6$^{th}$ and 13$^{th}$ ribs) were allocated to each instrumental analysis. These instrumental quality traits were measured at 72 h *post mortem*. pH was obtained by a penetrating electrode. Water holding capacity (WHC) was measured using the modified Grau and Hamm technique, as described by Sañudo *et al.*, (1988). Cooking losses were evaluated after immersion of samples in a 75° C water bath for 15 minutes. This cooked sample was used to determine shear force using a Warner Bratzler device mounted in an Instron (4301). Haem pigments were estimated by the Hornsey (1956) method.

M. *longissimus lumborum* was used for sensory analysis. Vacuum-packed samples were aged for 72 h and frozen at –18° C until taste panel evaluation. The day of the panel session , samples were thawed under running tap water. The loins were grilled until the internal temperature reached 70° C. Samples were evaluated by a 10 member trained taste panel and served hot. Lamb odour intensity, tenderness, juiciness, lamb flavour intensity, flavour quality and overall acceptability were recorded using a non structured (1-100) scale. The left and the right ends of the lines (=1 and =100) were respectively labeled "no or very strong odour", "extremely tough or extremely tender", "extremely dry or extremely juicy", " no or very strong flavour", "very disagreeable or extremely agreeable flavour" and "dislike or like extremely". Data were analyzed using the GLM procedures of the Statistical Analysis Systems (1987). Fat class differences were tested by significance at the 0.05 probability level (LSD).

**Results and Discussion.**

Shoulder dissection results are shown in Table 2. The percentage of dissected fat increased with fat class score, as expected.

Table 2. Shoulder composition (%) in each fat class in the EU light lamb carcass classification system

| Fat class // n=() | 1-Low (10) | 2-Slight (30) | 3-Average (30) | 4-High (20) | s.e.d. | F |
|---|---|---|---|---|---|---|
| Muscle | 66.3 a | 64.6 ab | 61.9 bc | 60.1 c | 0.273 | 20.90 ** |
| Bone | 21.0 a | 19.6 ab | 18.9 bc | 17.8 c | 0.160 | 11.46 ** |
| Subcutaneous fat | 3.2 a | 5.8 b | 7.2 c | 9.6 d | 0.190 | 35.97 ** |
| Inter muscular fat | 9.5 a | 10.1 ab | 11.9 bc | 12.4 c | 0.109 | 9.63 ** |
| Total fat | 12.7 a | 15.9 b | 19.1 c | 22.0 d | 0.324 | 33.95 * |

Within the instrumental measurements of meat quality (Table 3), there were no significant differences between fat class in pH, myoglobin content, cooking losses or WHC, although the higher amount of losses were found in the lowest and highest fatness scores. Thus, meat cooking losses have been found to be positively associated with fatness (Kemp *et al.*, 1972), although with not very important relationships (Jeremiah *et al.*, 1972). On the other hand, in very lean animals there is a lack of protective fat, which could produce some extra alteration in the protein structure during chilling and cooking,. Pigment differences (P>0.05) show that the amounts of Mb are more related to age (Field *et al.*,1990) than to fatness level at the same age (Sañudo *et al.*, 1997).

Shear force and toughness differences were significant (P<0.05). In both cases a clear tendency to be reduced with fatness was observed. In ruminant meat various reports have indicated that greater amounts of fat, or high energy diets, were associated with lower shear force values (Jeremiah *et al.*, 1972; Devine *et al.*, 1993). However, other reports have indicated that marbling was not closely related to instrumental or sensorial measurements of tenderness (Woodhams *et al.*, 1966). In our study, in light carcasses with generally low subcutaneous fat thickness, some effect of the chilling rate could be expected and fatter carcasses could have had some noticeable protection.

Tenderness, flavour intensity and overall acceptability were the only palatability meat characteristics significantly different between fat classes. Tenderness was, in agreement with trade opinion and our instrumental results, higher in fatter carcasses. Similar results have been reported by Jeremiah (1996) in beef. Nevertheless, in lamb, the fat effect on palatability traits remains controversial (Jeremiah, 1998). Flavour intensity increased with fatness score, but many other authors have not shown a relation between fatness and flavour intensity (Woodhams *et al.*, 1966; Crouse and Ferrel, 1982). Probably the variation in palatability scores could be associated to the variation in fat composition, and not in quantities of fat, since the panel would be especially sensible to the increment of some specific fatty acid, phospholipids, to which the panel would be especially sensitive (Enser, 1995). The highest acceptability was for fat class 3, which was significantly different from the leanest carcasses. Similar findings were shown by Jeremiah (1998), who found a higher proportion of unacceptable meat from leaner carcasses than from fatter ones. It seems that a minimum of fat is required (Jeremiah *et al.*, 1972), but an optimum should be determined.

Table 3. Meat quality and fat class in the EU light lamb carcass classification system

| Class fat | 1-Low | 2-Slight | 3-Average | 4-High | s.e.d. | F |
|---|---|---|---|---|---|---|
| N | 10 | 30 | 30 | 20 | | |
| pH | 5.54 | 5.52 | 5.56 | 5.55 | 0.007 | NS |
| Cooking losses (%) | 13.1 | 11.5 | 11.3 | 12.1 | 0.405 | NS |
| WHC (%) | 18.5 | 22.5 | 20.7 | 22.8 | 0.673 | NS |
| Shear force (kg) | 7.11 a | 6.17 ab | 5.36 b | 5.16 b | 0.180 | ** |
| Toughness (kg/cm$^2$) | 2.03 a | 1.96 ab | 1.65 b | 1.59 b | 0.059 | * |
| Mb (mg/g) | 2.15 | 2.45 | 2.51 | 2.37 | 0.051 | NS |
| Odour intensity | 45.2 | 49.4 | 47.5 | 49.2 | 0.572 | NS |
| Tenderness | 45.9 a | 50.5 ab | 52.3 b | 54.9 b | 0.649 | ** |
| Juiciness | 41.2 | 44.1 | 43.9 | 42.2 | 0.631 | NS |
| Flavour intensity | 46.8 a | 52.00 ab | 53.0 b | 54.4 b | 0.600 | ** |
| Flavour quality | 45.7 | 48.5 | 49.6 | 48.3 | 0.588 | NS |
| Overall acceptability | 42.7 a | 45.3 ab | 47.0 b | 45.2 ab | 0.549 | * |

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