# Effect of different production systems on lamb sensory quality

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## Abstract

The influence of four different production systems (thereafter, treatment) on lamb meat sensory characteristic measured by a trained panel test was analysed. The treatments were: INT, lambs were kept indoor with free access to concentrate while dams were only indoor from 15:00 to 08:00 h. EST, lambs and ewes were kept indoor with free access to concentrate. GR, lambs and ewes grazed alfalfa without concentrate, GR+S, animals grazed alfalfa and lambs had cereal supplement. Lambs from DRL-GRE and DRL were weaned at 45 days old. Six entire male lambs from each treatment were slaughtered at 20-22 kg live weight and theirs carcasses were cooled at 4 °C. At 24 hours *post mortem*, *Longissimus lumborum* were excised, vaccum packed and aged for a total period of three days. Samples were grilled to an internal temperature of 70 °C. A trained nine-member panel valued lamb odour intensity, tenderness, juiciness, lamb flavour intensity, liver flavour intensity, fat flavour intensity, metallic flavour intensity and overall liking using a 10-point scale. An ANOVA procedure, means and standard deviation for each attribute in each treatment and Pearson correlation analysis were carried using SPSS v.13.0 software. No differences between treatments were found for any variable. All variables were closely related one each others. Overall liking was positively correlated with tenderness and juiciness and negatively correlated with liver, fat or metallic flavours. From a sensorial point of view, alfalfa grazing is a workable alternative to traditional concentrate feeding for rearing lambs.

*Keywords: feeding system, panel test, lamb*

## Introduction

In the European Mediterranean countries lambs are traditionally reared with their dams in indoor conditions until weaning (about 45 days of age) and thereafter fattened with concentrate until slaughter, around 20-24 kg live weight. Consumers are used to this kind of meat and they consider it as a high quality product (Sañudo *et al.*, 1998). Nowadays, this production system has been altered because there are many factors that constraint it. First, preferences of consumers are changing requiring meat with low fat content, as it is associated to a healthier meat in comparation to meat rich in fat. Second, EU Common Agricultural Policy promotes the landing of production systems and, third, the recent and constant increases of cost of cereals have aggravated the situation causing many farms to become unprofitable. Under these circumstances, an alternative to indoor production systems would be grazing systems. Nevertheless, feeding system can affect meat characteristics. Therefore, the present trial pretend asses the effect of feeding system on sensorial meat quality.

## Material and methods

Twenty-four single male lambs were used. After birth, lambs were provided a complement of selenium and remained drylot with their dams for some days to ensure maternal bonding and randomly allocated to four treatments (n=12):

1. Grazing (GR): lambs and ewes were continuously stocked on a permanent pasture. No concentrate was available to dams or lambs. Lambs suckled their mothers and grazed until slaughter.
2. Grazing with supplement for lambs (GR+S): the same management as GR, but these lambs received concentrate *ad libitum* in lamb creep feeders until slaughter.

3. Indoor lambs with grazing ewes (DRL-GRE): lambs remained indoors and fed creep while ewes grazed during eight hours a day (08:00 to 16:00 h). Thereafter, they received a supplement of 0.5 kg fresh matter of barley meal/day (119 g CP, 248 g NDF, on dry matter basis). This system aimed to reply the commonly used management in that region.
4. Drylot (DRL): lambs and ewes were kept always in confinement. Ewes had free access to dry unifeed (110 g CP, 681 g NDF, on dry matter basis) and lambs had concentrate *ad libitum*.

In treatments DRL-GRE and DRL lambs were weaned at 45 days old, while in GR and GR+S lambs were unweaned. In all treatments, lambs were weighed on weekly intervals and slaughtered, accordingly to the guidelines of the Council Directive 86/609/EEC (European Communities, 1986) when they reached 22-24 kg of live weight. The day after slaughter carcasses were split along the spine and the m. *Longissimus dorsi* from 4$^{th}$ to 6$^{th}$ *lumbar vertebrae* were removed of the left half carcasses, vacuum-packed, aged for a total period of three days and frozen (-20 °C) until their analysis.

The day of the panel session, samples were thawed under tap water until they reached an internal temperature of 17-19 °C, over wrapped by aluminium foil and cooked (grilled) in a preheated double plate grill (SAMMIC P8D-2; 200 °C) to an internal temperature of 70 °C, which was monitored by an internal termocouple (JENWAY 2000). Every loin was then trimmed of any external connective tissue, cut into samples that were 2 × 2 cm, wrapped in codified aluminium foil and stored in a warm cabinet at 50 °C until tasted. A comparative multi-sample test, with four samples each, was used to detect differences in sensory attributes among treatments. Samples were served to a trained (ISO-8586-1) nine-member panel (with panel members in individual booths) under red lighting to mask any differences in meat colour. Panellist was asked to evaluate on a 10-point scale the following attributes: lamb odour intensity, tenderness, juiciness, lamb flavour intensity, liver flavour intensity, fat flavour intensity, metallic flavour intensity and overall liking, with a score of 1 the lowest and 10 the highest possible for each attribute. A total of 54 juices per treatment were obtained.

Statistical analyses were performed using SPSS v.13.0 software. An ANOVA procedure was carried with treatment as main effect. Means and standard deviation for each attribute in each production system were calculated. Finally, Pearson correlation analysis was carried out in order to study variable relationships.

## Results and discussion

Table 1 shows significance of the main effect on sensory variables (*P* value), as well as means and standard deviation for each attribute in each treatment. The feeding system did not affect any sensory characteristics of meat lamb. In literature, diet effect on sensory characteristic was not clear and results were frequently contradictory. Regarding tenderness, Paul *et al.* (1964) found slight differences between animals finished on concentrate or grass, presenting the firsts higher values on tenderness. Nevertheless, neither Summers *et al.* (1978) nor Kemp (1981) detected significant differences when comparing animals fed-grass, concentrate or both. Concerning level of energy of the diet, Solomon *et al.* (1986, 1988, 1996) found that meat from lambs reared with low-level of energy diet was more tender that meat from animals reared in a high-level diet, whereas Crouse *et al.* (1978) demonstrated just the opposite. Protein content of the diet was important only if differences between diets were significant (10% vs. 16%), and in this case, higher the protein level, higher the tenderness (Kemp *et al.*, 1976). Nevertheless, Fhamy *et al.* (1992) did not found differences in tenderness when difference between diets was only of 3 points (13 vs. 16%). Finally, neither type of forage (Field al., 1978, Vipond *et al.*, 1995, Hopkins *et al.*, 1999) nor weaned (Summers *et al.*, 1978, Sañudo *et al.*, 1998) affected tenderness.

Similarly, juiciness is not affected by feeding system: neither energy level of the diet (Crouse *et al.*, 1978; Solomon *et al.*, 1986; Bosman *et al.*, 1994), nor protein content (Kemp *et al.*, 1976, 1981) nor

*Table 1. Effect of treatment on lamb sensory variables (scale 1-10).*

| | *P* | GR[1] | | GR+S[2] | | DRL-GRE[3] | | DRL[4] | |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | St.dev | Mean | St.dev | Mean | St.dev | Mean | St.dev |
| Lamb odour intensity | 0.839 | 5.1 | 1.4 | 4.9 | 1.5 | 5.0 | 1.6 | 4.8 | 1.4 |
| Tenderness | 0.594 | 7.2 | 1.3 | 7.1 | 1.0 | 7.4 | 1.1 | 7.2 | 1.0 |
| Juiciness | 0.838 | 6.4 | 1.3 | 6.4 | 1.2 | 6.3 | 1.3 | 6.2 | 1.1 |
| Lamb flavour intensity | 0.983 | 6.0 | 1.4 | 6.0 | 1.2 | 5.9 | 1.5 | 5.9 | 1.2 |
| Liver flavour intensity | 0.365 | 2.9 | 1.4 | 2.6 | 1.3 | 3.1 | 1.5 | 3.0 | 1.6 |
| Fat flavour intensity | 0.980 | 4.2 | 1.7 | 4.3 | 1.9 | 4.3 | 1.8 | 4.3 | 1.8 |
| Metallic flavour intensity | 0.680 | 3.3 | 1.6 | 3.3 | 1.7 | 3.7 | 1.7 | 3.4 | 1.6 |
| Overall liking | 0.313 | 6.4 | 1.3 | 6.3 | 1.3 | 6.0 | 1.4 | 6.1 | 1.1 |

[1] Grazing.

[2] Grazing with supplement for lambs.

[3] Indoor lambs with grazing ewes.

[4] Drylot.

type of forage (Field *et al.*, 1978; Vipond *et al.*, 1995; Hopkins *et al.*, 1999) nor weaning (Summers *et al.*, 1978; Vipond *et al.*, 1995; Sañudo *et al.*, 1998) affected juiciness of lamb meat.

As regards odour and flavour, Paul *et al.* (1964) did not find differences between animals finished with pastures or with barley and alfalfa hay concentrate. Similarly, Solomon *et al.* (1996) did not find differences between diets (alfalfa vs. concentrate). Nevertheless, evidence exists that a diet based on pastures promotes odours slightly stronger that maize concentrate (Rousset-Karim *et al.*, 1997) and that the substitution of forage by concentrate reduces the meat flavour intensity (Field *et al.*, 1978). Forage type can affect odour and flavour. Cramer *et al.* (1967) demonstrated that odour and flavour was higher when animals were reared with *Trifolium repens* than when animals were reared with *Lolium perennes*. Nevertheless, Vipond *et al.* (1995) in a study comparing the same species did not find differences on flavour. Park *et al.* (1972) found that meat from animals reared with *Medicago sativa* was more flavoured and less acceptable than meat from animals reared on *Phalaris tuberosa*, but Hopkins *et al.* (1999), comparing meat from animals reared with *Medicago sativa* or *Atriplex nummularia* found that meat from the last diet has a stronger aroma, whereas no differences in acceptability were found. Regarding flavour acceptability, results were also contradictory. Summers *et al.* (1978) or Kemp *et al.* (1981) pointed out that flavour acceptability was superior in animals supplemented concentrate than in animals reared only on pasture, but others authors concluded that neither energy level of the diet (Crouse *et al.*, 1978; Solomon *et al.*, 1986, 1988; Bosman *et al.*, 1994) nor protein content (Kemp *et al.*, 1976, 1981) affected flavour acceptability.

Finally, and considering overall liking, it was demonstrated that neither energy level of the diet (Crouse *et al.*, 1978), nor protein content (Kemp *et al.*, 1976) nor species of pasture (Vipond *et al.*, 1995; Hopkins *et al.*, 1999) nor weaning (Sañudo *et al.*, 1998) affected overall liking.

Table 2 shows Pearson's correlation coefficients. In general, all variables were closely related to each other. Lamb odour was positively related with lamb flavour, which was in agreement with results by Alfonso (2000). Tenderness was positively correlated with juiciness and overall liking as well as juiciness and overall liking were positively correlated among them. Nevertheless, overall liking was negatively correlated with liver flavour, fat flavour and metallic flavour, which were positively

*Table 2. Pearson's correlation coefficients between sensory variables from lamb meat. Only significant coefficients were shown*[1].

| | Tenderness | Juiciness | Lamb flavour | Liver flavour | Fat flavour | Metallic flavour | Overall liking |
|---|---|---|---|---|---|---|---|
| Lamb odour | -0.18** | | 0.39** | 0.14* | -0.16* | | |
| Tenderness | | 0.39** | | | | | 0.37** |
| Juiciness | | | 0.36** | 0.19** | 0.14* | 0.14* | 0.16* |
| Lamb flavour | | | | 0.33** | | | |
| Liver flavour | | | | | 0.25** | 0.49** | -0.42** |
| Fat flavour | | | | | | | -0.30** |
| Metallic flavour | | | | | | | -0.41** |

[1] ** Correlation is significant at 0.01 (bilateral); * correlation is significant at 0.05 (bilateral).

correlated one each other. Hence, it seemed that main problems in lamb meat sensory quality were odour/flavour related.

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