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Organic vs Conventional Suckling Lamb Production: Product Quality and Consumer Acceptance

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Abstract

Samples of suckling lambs (n=40) of two breeds reared under conventional and organic conditions were analysed to assess physico-chemical characteristics, including instrumental texture, and nutritional quality in terms of fatty acid composition. Consumer acceptance was also studied using the home-use test. Results revealed that organic suckling lamb meat is healthier as shown by the lower saturated fatty acid levels, the higher polyunsaturated fatty acid contents and the higher $\omega 6/\omega 3$ ratio. The organic meat had lower instrumental hardness, received higher scores in all sensory parameters, and had statistically better fat sensation and higher ratings for overall liking. These results lend support to the notion among consumers that organic products are healthier and tastier.

Introduction

In recent decades world meat consumption has increased, but the economic, ecological and ethical sustainability of meat production is being questioned. However, organic meat production based on natural pastures, by-products and feed produced without artificial fertilisers and chemical pesticides might be more sustainable than conventional meat productions, because it can be produced on land where pasture and grass improve fertility, using by-products of vegetable crops or even wastes from the forest industry (Kum, 2002). It is true that production costs are usually higher in organic than conventional systems, and the higher meat price is the major reason given by consumers for not buying organic products (Angood et al., 2007). However, regular purchasers of organic foods believe they are healthier and taste better than conventional foods (Heaney, 2001).

Although there is a growing volume of literature comparing conventionally and organically produced meat, there have been few studies investigating the nutritional

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and eating quality of lamb (Nurnberg et al., 2006). Angood et al. (2007) found that organic lamb had better eating quality than conventional lamb in terms of juiciness, flavour, and overall appeal, thus providing some evidence for the perception among consumers that organic products “taste better”, but in suckling lamb there are no studies on this question. In the Mediterranean area, and more specifically in the “Castilla y León” region of Spain, fresh suckling lamb meat is a typical and traditional product, regarded by consumers as having high eating quality. Taking that into account, the aim of this work was to compare the two production systems for suckling lambs in terms of physico-chemical composition, including fatty acid composition, and sensory properties as perceived by consumers.

Materials and methods

The material included 40 suckling lambs, ten animals per production system (organic or conventional) and breed, of two Spanish sheep breeds, all from the same production area (Fariza, Zamora, Spain). Suckling lambs did not receive any kind of feed and were raised exclusively on maternal milk from birth to slaughter. The suckling lambs reared under organic conditions spent the day on pasture with their dams. The organic ewes' diet (pasture of fresh oats) was supplemented (30% of the ration) with a certified organic mixture (17% oats, 13% barley, 10% sunflower seeds, 25% peas, 35% alfalfa forage). Suckling lambs reared under conventional conditions remained in a dry lot where their dams were fed with commercial concentrate (18% beetroot pulp, 26% alfalfa, 22% barley, 12% corn, 12% soy, 10% cotton). The animals were slaughtered at 11 kg (± 0.5) live weight (20-25 days) in abattoirs licensed, inspected and certified by the Castilla y León Organic Agriculture Council (CAECYL). Carcasses were chilled under commercial conditions at 4°C and 80% RH for 24 hours.

Meat pH was measured on fresh meat 24 h after slaughter in the muscle *Longissimus dorsi* by means of a pH-meter HI8314 (Hanna Instruments) equipped with a penetrating electrode. Intramuscular fat (ether-extractable), was determined according to standard AOAC (1990) procedures. Water-holding capacity (WHC), expressed as the proportion of expressible juice was measured as described by Pla (2000). Lipids were extracted from meat using a standard chloroform/methanol procedure. Fatty acid composition of lipids was methylated and analysed by gas chromatography according to the method described by Revilla et al. (2005). Fatty acids were expressed as a fraction of total weight. Analyses were performed in triplicate. For instrumental texture analysis *L. dorsi* (9th-12th rib level) were grilled on a pre-heated double hot plate grill at 200°C until the internal temperature reached 70°C. The internal temperature was measured using a digital thermometer Checktemp1 (Hanna Instruments). Six rectangular parallelepipeds, 1x1 cm across and 2-3 cm long, were then cut parallel to the muscle fibres. A TX-T2iplus (Stable Micro Systems) equipped with Warner-Bratzler probe was used. The crosshead speed was 1 mm/s and maximum peak force was recorded.

The sensory analysis was carried out using a home-use test (Lawless & Haymann, 1998) involving 35 families (4 to 5 members) from the province of Zamora. Three-day mature half carcasses were delivered to each family with the instructions that the samples should be prepared by roasting at 175°C for two hours, with only salt added. Consumers were asked to taste the samples in a quiet setting, with no consumption of alcohol. Assessment characteristics of meat were collected from individual questionnaires delivered to each consumer. A 9-point hedonic scale, in which 1 corresponded to “I don't like it at all” and 9 corresponded to “I like it a lot” was used to

measure the global relative preferences for the colour, taste, aroma, hardness, juiciness, fat sensation and overall appreciation.

Data of each variable were analysed by one-way analysis of variance (ANOVA). The statistical significance of a factor was calculated at the $\alpha=0.05$ level using the *F*-test. In tables and figures, different letters (^{a,b}) mean statistically significant differences.

Results and discussion

The results showed no statistically significant differences between conventional and organic meat for pH, intramuscular fat, or water holding capacity (Table 1). This is in agreement with results previously reported for Churra and Castellana suckling lambs. The organic meat has lower Warner-Bratzler Shear Force (WBSF), indicating the higher tenderness of this meat. Organic production implies more mobility, and it may produce greater muscle volume and greater tenderness because of the higher ratio of myofibrillar protein to total collagen (Aalhus et al., 1991).

Statistically significant differences were observed between production system for fatty acid composition. The organic meat showed lower values for the sum of saturated fatty acids (SFA), and higher values for the sum of mono and polyunsaturated acids (PUFA); the differences were significant for SFA and PUFA. The ratio polyunsaturated/saturated acids (P/S), which was relatively low for both meat types (ideally >0.4), did not show statistical differences, although it was higher for the organic meat. **[THE TABLE SAYS THE DIFFERENCE IN P/S WAS STATISTICALLY SIGNIFICANT.]** Finally, the ratio $\omega 6/\omega 3$ was lower than 5 (maximum recommended value) for both conventional and organic meat, and significantly lower for organic meat. **[NOTE: THE TABLE SAYS THAT THE RATIO WAS HIGHER IN THE ORGANIC, BUT NOT SIGNIFICANTLY SO: P=.709. BUT THE LETTERS NEXT TO THE INDIVIDUAL VALUES SHOW THAT THE DIFFERENCE WAS SIGNIFICANT, WHICH IT CLEARLY WAS NOT.]** These results indicate that the intramuscular fat from organic meat was healthier. In lambs reared on pasture, as with organic ewes, the percentage of PUFA, especially of the n-3 series, increased compared with lambs fed the concentrate diet. There is a correlation between fatty acid composition of suckling lambs and the ewes' diet, so that the intramuscular fat of suckling lambs also had higher levels of these compounds.

Tab. 1: Mean and (SD) of meat quality characteristics and fatty acid composition

| | Conventional | Organic | p-value |
|-----------------------------|---------------|----------------|---------|
| pH | 5.6 (0.2)a | 5.6 (0.1)a | 0.661 |
| Intramuscular fat % | 5.8 (2.5)a | 6.5 (2.2)a | 0.582 |
| WHC % | 15.8 (2.7)a | 15.3 (1.7)a | 0.325 |
| WBSF (k) | 2.02 (0.61)b | 1.65 (0.48)a | 0.000 |
| Saturated fatty acids | 68.54 (6.12)b | 63.53 (6.93) a | 0.001 |
| Monounsaturated fatty acids | 23.97 (5.47)a | 25.96 (3.69)a | 0.060 |
| Polyunsaturated fatty acids | 7.48 (2.27)a | 9.25 (2.91)b | 0.003 |
| P/S | 0.11 (0.04)a | 0.15 (0.05)b | 0.000 |
| $\omega 6/\omega 3$ | 3.35 (0.92)b | 3.47 (1.62)a | 0.709 |

Regarding consumer appreciation, organic meat showed higher values for all the evaluated parameters, and the differences were statistically significant for fat

sensation due to the higher unsaturation of the fat. As the fat unsaturation increases, the melting point decreases, improving the mouthfeel of the product. The hardness of organic meat received higher scores by consumers, although the difference was not statistically significant. Spanish consumers prefer pale, tender and less intense lamb flavor. The results for hardness indicated that consumers found this meat tenderer, which correlated with the lower WBSF of this meat. Finally, the scores for overall appreciation were significantly higher for organic meat.

Conclusions

Organic meat is healthier as showed by the lower saturated fatty acid levels, the higher polyunsaturated fatty acid contents and the higher $\omega 6/\omega 3$ ratio. Indeed, it had lower instrumental hardness, received higher scores in all sensory parameters and had statistically better fat sensation and had higher ratings for overall appreciation. These results lend support for the notion among consumers that organic products are healthier and tastier.

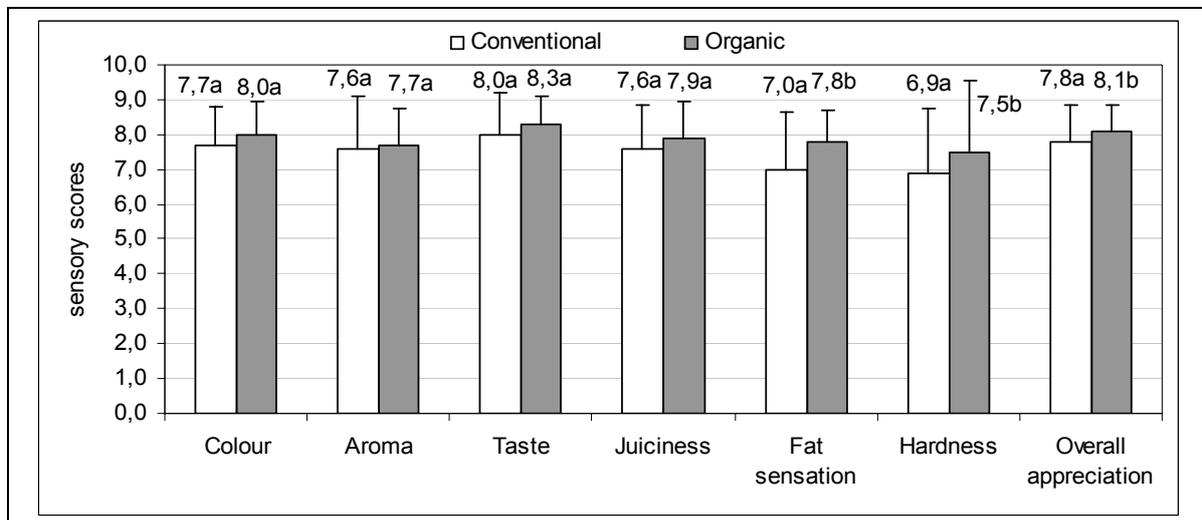


Figure 1: Sensory scores for the parameters evaluated by consumers

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