CASTRATION AND THE SENSORY CHARACTERISTICS OF LAMB

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Abstract – The aim of the research was to establish if a difference exists in the sensory characteristics of lamb from rams compared to castrates. Forty Texel cross lambs (20 rams, 20 castrates) were slaughtered at two ages (6.7 and 12.8 mo). Muscle samples which had been aged for 8 d were subjected to sensory analysis (triangle test and descriptive analysis) and compositional and volatile analysis. In the triangle test an untrained panel could discriminate ($p<0.001$) between ram and castrate lamb at both ages. Descriptive analysis using a trained panel found significant differences ($P<0.05$) in sensory descriptors in rams versus castrates ('animal/farmyard smell', 'grassy aroma' and 'fatty aftertaste') and due to age at slaughter ('grassy aroma' and 'metallic aroma'). While proximate composition was largely unaffected by gender and age, volatile compounds were significantly affected ($p\leq0.05$), with higher levels of 2-hexenal, 2-nonenal and methylphenol(s) in rams compared to castrates and benzaldehyde, benzeneacetaldehyde, 2-nonanone, 2-ethyl-dimethylpyrazine and methylphenol(s) in 6.7 mo compared to 12.8 mo samples. The results support the hypothesis that the sensory (flavour) quality of lamb is affected by gender and age.

Key Words – triangle test, descriptive sensory analysis, volatile analysis

I. INTRODUCTION

A subject of recurring interest among lamb meat producers, processors and retailers is the influence of farm production factors, such as gender, age and diet, on the sensory quality of lamb meat and ultimately on its consumer acceptability. The flavour character of lamb meat has specific descriptors associated with it, including 'sweaty-sour' ('soo'), 'pastoral/grassy', 'fatty', 'rancid', 'wooly/sheepy', 'sweet', 'gamey', 'cloying' and 'muttony' among others [1,2,3]. The extent to which these flavours prevail in lamb and how they may or may not be influenced by farm production factors could have a major influence on consumer preference for and acceptability of lamb. Among the important production factors to consider is whether male lambs remain entire (rams) or are castrated soon after birth (castrates). The benefits for lamb growth rate of maintaining male lambs as rams are established [4]. However, any potential detrimental effect on sensory quality of raising rams as opposed to castrates, remains a subject of debate. Hanrahan [4], in a review of the literature on the topic, concluded that "where lambs are reared on an all grass diet and slaughtered by the end of the grazing season, leaving male lambs entire has no negative effect on meat quality, whether assessment is laboratory based or through in-home consumer testing". In Ireland this view is disputed by some in the industry, and butchers report consumer unwillingness to purchase lamb from uncastrated animals particularly as the animals get older. A report from New Zealand concluded that differences in flavour and aroma are probably small [5]. In some studies, taste panel scores for flavour were less favourable in meat from rams compared to castrates [6] and evidence suggests some decrease in tenderness in entire males compared to castrates above 10 months of age [7].

The objective of the research was to establish (i) if a difference exists in the sensory (particularly flavour) character of lamb from rams compared to castrates raised in Ireland and (ii) if there is an age effect on any sensory differences.

II. MATERIALS AND METHODS

As part of a larger on-going study involving 200 Spring-born Texel cross lambs allocated to 20 treatment groups, 4 treatment groups (n=10/treatment, total 40 lambs) were used in the current study. Of the 40 lambs, 20 were rams and 20 castrates. The castrate lambs were castrated within 48h of birth using the rubber ring method. Lambs were raised at pasture from birth and they were assigned to either a slaughter date in October (6.7 mo old) or the following April (12.8 mo old), with the heaviest 10 ram and 10 castrate lambs assigned to the October date and the remaining lambs assigned to the April date. For 36 d pre-slaughter all lambs were housed individually in slatted pens and received *ad libitum* a finishing diet consisting of a barley/maize-based concentrate ration (95% of dietary dry matter (DM) intake) and grass silage (5% of DM intake). The 36 d finishing period was preceded by a 12 d adaptation period during which the lambs were gradually introduced to the concentrate ration and silage. At the end of the finishing period, lambs were transported to a commercial abattoir for slaughter. Carcasses were chilled overnight. *Longissimus thoracis et lumborum (LTL)* and *semimembranosus (SM)* muscles were excised from each carcass, vacuum packed, aged for 8 d at 4 °C and then frozen at -20 °C until required for analysis.

For sensory analysis, minced *SM* samples were formed into meatballs (~15g each, oven cooked to an internal temperature of 70 °C) and assessed by triangle test (Standard BS EN ISO 4120: 2004) using an untrained panel of 81 lamb meat consumers. Each panellist participated in two triangle tests in one sitting: (i) ram vs castrate samples at 6.7 mo and (ii) ram vs castrate samples at 12.8 mo. Panellists were given the option of making a comment on the sensory ballot.

Descriptive sensory analysis of *LTL* samples took place with a trained panel of 9 assessors. Seven samples per treatment were used in the descriptive analysis. Each sample was cooked to an internal temperature of 70°C using a Tefal OptiGrill clamshell grill and trimmed of adhering fat prior to presentation to panellists. Panellists assessed samples for 38 attributes, receiving 2 sets of 3 samples at each sitting. Proximate analysis of muscle samples used standard AOAC procedures. Volatile analysis of samples (5/treatment) took place using solid phase microextraction followed by GC-MS (Varian Saturn 2000-3800) with separation of volatiles on a DB5 column.

Sensory descriptive analysis, volatile and compositional data were analyzed using a mixed model with the fixed effects of gender, age and gender by age interaction. The sensory analysis session was considered as the random effect and a Bonferroni multiple comparison correction was used to reduce type I error. Analysis was conducted in the MIXED procedure of SAS (v9.3). For the triangle test the 'Critical Number of Correct Response in a Triangle Test" was used [8].

III. RESULTS AND DISCUSSION

Compositional analysis of *LTL* (Table 1) showed no significant difference in moisture, protein or fat between treatments while ash content was significantly higher in rams compared to castrates and in 6.7 mo samples compared to 12.8 mo samples.

Data from the triangle tests showed that untrained panellists perceived ram lamb to be different to castrate lamb at both slaughter ages ($p<0.001$). For both slaughter ages 41 of the 81 panellists correctly identified the odd sample [8]. The panel consisted of 43 males and 38 females; both males and females could identify the odd sample in 6.7 mo lamb samples ($p<0.05$ for both males and females) and in 12.8 mo lamb samples ($p<0.01$ for males and $p<0.05$ for females).

Table 1 Proximate composition (g/100g) of LTL muscle from rams and castrates at two slaughter ages.

	Age at slaughter						
	6.7 month		12.8 month		Significance (p values)		
	Ram	Castrate	Ram	Castrate	Gender	Age	Gender x Age
Moisture	74.7	74.3	74.9	74.8	ns[1]	ns	ns
Protein	21.5	21.6	21.6	21.7	ns	ns	ns
Fat	2.3	2.6	2.3	2.5	ns	ns	ns
Ash	1.23	1.13	1.13	1.10	p<0.01	p<0.05	ns

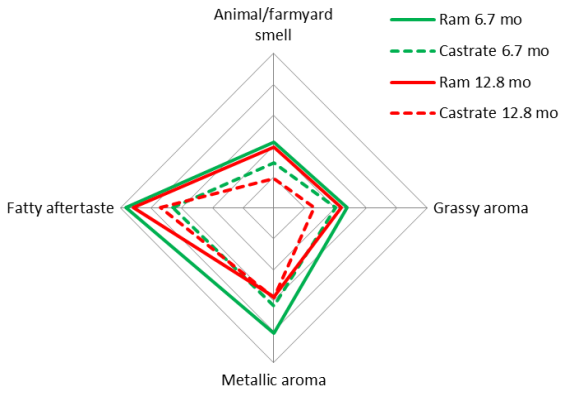
[1]not significant

Minced lamb samples were used in the triangle test to minimize possible texture differences between ram and castrate samples (7) with the aim of focusing the panel on detecting differences in other sensory attributes, including flavour. For the 6.7 mo lamb samples, 35 panellists who correctly identified the odd sample opted to make a comment. Of these, 20 commented on flavour, 3 on texture and 8 on juiciness/dryness. Of those who commented on flavour, 14 suggested that the flavour intensity of ram samples was greater while 6 suggested that the flavour intensity of castrate samples was greater. The results were similar for the 12.8 mo lamb samples. Of the 33 panellists who opted to make a comment, 25 commented on flavour, 4 on texture and 4 on juiciness/dryness. Of those who commented on flavour, 16 suggested that the flavour intensity of ram samples was greater while 9 suggested that the flavour intensity of castrate samples was greater.

Descriptive sensory analysis showed significant ($p<0.05$) effects of gender (ram vs castrate) and age (6.7 mo vs 12.8 mo) on several attributes (Figure 1). 'Animal/farmyard smell', 'grassy aroma' and 'fatty aftertaste' were significantly higher in ram compared to castrate lamb while 'grassy aroma' and 'metallic aroma' were rated higher in younger (6.7 mo) lambs compared to the older (12.8 mo) lambs.

Volatile analysis showed that levels of 2-hexenal, 2-nonenal and methylphenol(s) were higher ($p<0.05$) in rams than in castrates while benzaldehyde, benzeneacetaldehyde, 2-nonanone, 2-ethyl-dimethylpyrazine and methylphenol(s) were higher ($p<0.05$) in 6.7 mo samples with 2,4-decadienal higher in the 12.8 mo samples (Table 2).

Figure 1. Effect of gender (rams vs castrate) and age at slaughter (6.7 vs 12.8 month) on sensory descriptors of cooked *LTL* muscle.



From the results collected thus far in the study it appears that a difference exists in the sensory characteristics of lamb from rams versus castrates. Discrimination between ram and castrate minced samples appears to be strongly influenced, in an untrained panel, by differences in flavour perception. In addition, a potential difference in flavour between lamb from rams and castrates is supported, firstly, by descriptive sensory analysis showing significant differences in flavor characteristics such as 'animal/farmyard', 'grassy', 'fatty' and 'metallic' and, secondly, by significant differences in certain flavour volatile compounds. Indeed methylphenols have been linked to an 'animal/farmyard' character in lamb [9]. The effect appears not to be mediated through differences in the proximate composition of muscle as the major constituents (moisture, protein and fat) were not significantly different. While the

extent to which untrained panellists correctly identified the odd sample did not differ in 6.7 mo compared to the 12.8 mo samples, the results of the descriptive sensory analysis and volatile analysis suggest that there may be an age effect on flavour perception.

Table 2 Levels of selected volatile compounds in cooked *LTL* muscle of rams and castrates at two slaughter ages.

	Age at slaughter						
	6.7 month		12.8 month		Significance (p values)		
Volatile compound	Ram	Castrate	Ram	Castrate	Gender	Age	Gender x Age
2-hexenal (E)	1.1[1]	0.9	1.7	0.4	0.027	ns[2]	ns
Benzaldehyde	342	348	304	267	ns	0.014	ns
Benzeneacetaldehyde	28	29	18	21	ns	0.034	ns
2-nonenal (E)	12	6.6	14	8.4	0.051	ns	ns
2,4-decadienal (E,E)	2.7	1.6	5.5	3.9	ns	0.004	ns
2-nonanone	2.2	1.9	1.3	0.9	ns	0.013	ns
2-ethyl-3,5(or 3,6)-dimethylpyrazine	30	29	12	14	ns	0.024	ns
p-cresol and/or m-cresol (methylphenols)	40	11	2.6	1.4	0.015	0.001	0.02

[1]Values express the specific ion abundance of the compound (x 10^4 peak area units) [2] not significant

IV. CONCLUSION

The results support the hypothesis that a difference exists in the sensory quality, specifically the flavour characteristics, of ram versus castrate lamb. Whether or not the differences affect consumer preference for ram over castrate lamb, or vice versa, remains to be established.

ACKNOWLEDGEMENTS

The financial support of the Food Institutional Research Measure of the Irish Department of Agriculture, Food and the Marine (project 11/SF/310) and of the Teagasc Walsh Fellowship programme (award 2013058) is gratefully acknowledged.

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