

Studies on off-flavours in lamb

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Abstract

The trend across Europe is towards using rams in production due to welfare reasons, and because they reach slaughter weight faster. Two trials were conducted to determine the role of gender, breed and diet on the incidence and cause of off-flavour in lambs. Lambs were slaughtered and the loin subjected to sensory profiling and analysis of branched chain fatty acids was also conducted.

Results showed effects of breed and diet on flavour, but fewer effects of gender. Close examination of the data indicated that some animals from all treatments had elevated scores for off-flavour. These occurrences were apparent in rams and castrates across both trials. Analysis of branched chain fatty acids showed that for the three compounds studied, there was no clear link between diet or gender and a higher level of branched chain fatty acids.

Introduction

Across Europe, there is a move to produce lamb meat from entire males rather than castrates for welfare reasons and because they are more efficient [1]. They reach slaughter weight faster and produce a leaner carcass; the value of a lamb's carcass is determined mainly by the yield of lean meat [2]. Some studies found that meat from ram lambs is of inferior quality [2], whilst others conclude there are no differences in sensory quality [3] or that meat from ram lambs was actually of a superior quality than castrates or ewes [4, 5].

Research on off-flavour in sheep meat has identified a number of compounds that may contribute to the characteristic flavour of lamb and/or off-flavour. These include medium-chain branched fatty acids, namely 4-methyloctanoic acid, 4-ethyloctanoic acid and 4-methylnonanoic acid [3, 7], carboxylic acids, aldehydes, ketones, indoles (such as skatole) and sulphur-containing compounds [8]. It was proposed that off-odours and other sensory attributes may be associated with ram lambs as a result of them reaching sexual maturity [5], or that bacteria in the rumen may produce skatole, which may lead to a farmyard, slurry-like taint [6].

It is believed within the industry that there is a potential issue concerning the quality of ram lamb meat over castrated lambs and ewes. However, there appears to be little evidence to support this. Where there are claims that meat quality is lower in rams, it generally refers to colour, texture analysed by Warner Bratzler shear force, and higher ultimate pH, but it is accepted that if differences are apparent, they are small [2]. Lamb meat quality is influenced by breed, slaughter weight and sex according to Teixeira et al. [9], and the sensory characteristics of tenderness, juiciness and flavour [10] as well as aroma and taste [11] are most important, as these are what the consumer experiences.

This study compares the sensory evaluation of the meat from rams & castrates, from two breeds, fed on a variety of diets. It also investigates individual incidences of off-odour/off-flavour, as assessed by the trained panellists. Analysis of the branched chain fatty acids (BCFA) is also reported.

Experimental

Materials

Trial A (144 lambs), and Trial B (132 lambs) of two genders (entire male or castrate), two breeds (Suffolk cross (Trial A), Suffolk-Texel cross (Trial B), and Blackface-Swaledale) were reared on six diet housing regimes as follows: **Trial A** – concentrate C, grass silage, clover silage (indoors), grazed grass, rape and stubble turnip (outdoors), **Trial B** – concentrate A, concentrate B, grass silage (indoors), grazed grass, rape and stubble turnip (outdoors). There were 6 animals per treatment for Trial A, and the experimental design included 50 % rams and 50% castrates. Trial B used the same experimental design as Trial A but for the indoor lambs there was just one breed with 11 animals per treatment. Lambs were slaughtered between 8-10 months old (November to January) and the *longissimus dorsi* removed, aged for 9 days at 4°C after boning, before being cut into 25 mm steaks, blast frozen and stored for future analyses.

Sensory evaluation

The left loin from each animal was subjected to sensory profiling by eight trained assessors using quantitative descriptive analysis to evaluate the samples over an unstructured line scale from 0 - 100. Assessors developed a common vocabulary to describe the characteristics of the fat and lean meat (presented separately) during training and they agreed upon definitions for each descriptor. Sensory evaluation was carried out over 12 sessions according to a latin square design.

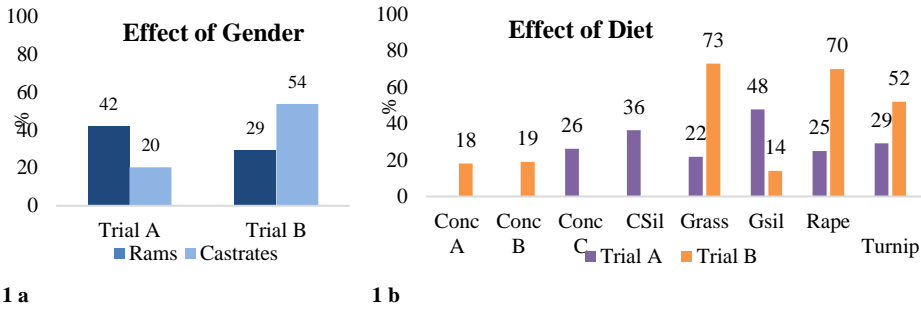
Samples were grilled to an internal temperature of 75°C with fat attached. Prior to serving, the fat was removed and served in a ceramic dish with a lid. Panellists assessed the aroma of the fat before assessing the lean meat for a number of attributes including aroma, texture, flavour and aftertaste. The results were statistically analysed using linear mixed methodology, using restricted maximum likelihood (REML) estimation. The incidences of off-flavours and off-odours in individual animals was also assessed by determining samples that were scored highly for particular attributes by assessors. Samples were defined as scoring highly if the score was greater than the mean + 2 x S.D for each individual panellist.

Branched chain fatty acids

Branched chain fatty acids were determined in adipose tissue attached according to an adaptation of the method of O'Fallon *et al* [12]. The limit of detection was 0.6 µg/g using mass spectrometry as the detector.

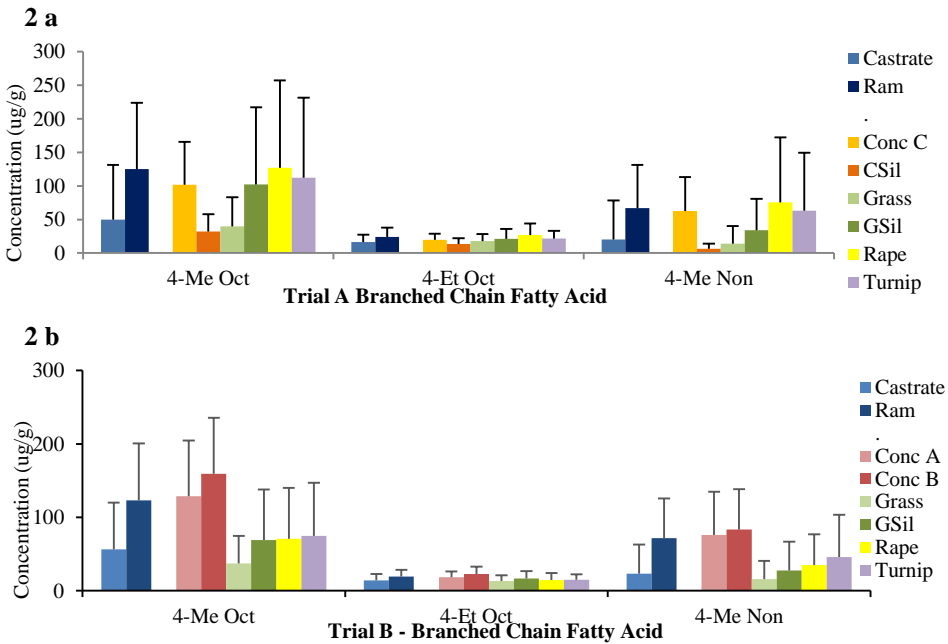
Results and discussion

Sensory profiling results (not shown here) did not show significant effects due to gender or breed that would suggest increased off-flavour or off-odour. There were some significant gender x breed interactions but they were small. Therefore, this paper focuses on the occurrence of sporadic incidences of off-flavour and off-odour in individual animals. Sensory evaluation showed that not all panellists were equally sensitive to off-flavours and that they used the scoring system differently. Therefore, detection of off-flavours in meat from an animal was defined as when an individual panellist scored more than two standard deviations above their mean score.



Figures 1 a & 1 b: Incidences of off-odour and off-flavour exceeding mean + 2*S.D for a minimum of 2 assessors. There were 2 genders (Ram and Castrate) and 8 diets (Conc A (Concentrate A), Conc B (Concentrate B), Conc C (Concentrate), CSil (Clover Silage), Grass, GSil (Grass Silage), Rape and Turnip).

Figure 1a illustrates that in Trial A the incidences of off-flavour and off-odour was higher for rams than castrates but, in Trial B, the opposite was true. Figure 1b shows that each diet had at least 14% of lambs which demonstrated off-odour/off-flavour, rising to more than 70% for some diets in Trial 2. However, there is no consistent effect of diet on sporadic off-flavours between trials, which may indicate a seasonal effect, or that off-flavours are caused by some other factor. Work is ongoing to establish if there is a link with sire line and the farms where the lambs were born.



Figures 2 a & 2 b: Branched Chain Fatty Acids from 2 genders; Ram and Castrate, and 6 diets; Conc (Concentrate), CSil (Clover Silage), Grass, GSil (Grass Silage), Rape and Turnip.

Figure 2 shows the mean concentrations of the three main BCFAs of interest. For all three compounds, loin from rams contained higher levels, although the relative difference was smaller for 4-ethyloctanoic acid than the other two. Quantities of 4-methyloctanoic acid were higher overall which is consistent with the findings of Young et al. [3]. These results were in keeping with other work which found that 4-ethyloctanoic

acid is present in much smaller amounts when compared to the more abundant 4-methyloctanoic acid. All BCFAs studied are present in quantities greater than the odour threshold values according to Brennan *et al.* [13] and Wong *et al.* [14]. The lambs in this study were slaughtered between late November and early January. It is possible that the BCFAs were highest in the rams due to them reaching sexual maturity by October when they were approximately 30 weeks old [15]. Previous studies indicated that lambs should ideally be slaughtered before October to avoid potential issues with off-flavour in the meat [5]. The incidence of high levels of BCFAs for both trials (Figure 2) did not correspond with high scores for off-flavours and off-odours (Figure 1). This suggests that, although BCFAs are detectable at above the threshold, they do not have a consistent effect on sensory quality. Therefore, there may be another cause of the sporadic off-odours/flavours in these lambs and research is ongoing.

Conclusion

There is no evidence from this study of any consistent off-flavour problem with ram lamb meat, and only small differences between meat from ram lambs and castrates. Therefore, there appears to be little argument from this data for castrating rams to improve meat quality. Incidences of off-odour/off-flavour occur in individual lambs, both rams and castrates and the influence of diet is variable. The evidence suggests that BCFAs alone are not responsible and other compounds may contribute.

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