PASTORAL FLAVOUR IN LAMB: HIGH OUTLIERS X SENSITIVE CONSUMERS THE PRACTICAL ISSUE

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Introduction

Finishing sheep on pasture has been associated with pastoral flavour and odours in sheepmeat. These flavours and odours have been linked to indoles, particularly skatole in meat (Young et al., 2003). A number of trials were conducted at AgResearch over a period of four years to determine the effect of various forage diets on skatole formation and accumulation and the flavour and odour of sheepmeat (Schreurs et al., 2007a, 2007b; Farouk et al., 2007). Dietary effects on the skatole content of rumen fluid, blood and fat in sheep were observed, but this did not extend to the flavour and odour of sheepmeat assessed by an expert sensory panel. However concentrations in fat and panellist responses to skatole varied widely. We have investigated the relationship between the sensory responses of individual panellists and the concentrations of skatole in the fat in these trials and present the hypothesis that the pastoral flavour and odour effects of skatole become an issue when a sensitive consumer encounters sheepmeat with high outlier levels of skatole.

Methods

The data are from three separate trials with lambs grazing different forages (Schreurs et al. (2007a, trial 1, 2007b, trial 2; Farouk et al., 2007, trial 3), and from an investigation of skatole odour thresholds in a grain-fed beef fat background (O. Young, T. Cummings, unpublished). Please refer to these studies for materials and methods. The Anderson-Darling Normality Test and Spearman's rank correlation coefficients were determined using MINITAB Release 14 Statistical software.

Results and Discussion

Individual panellists varied widely in their skatole sensory threshold and their responses to skatole in meat (Table 1 & 3). There was a 16 fold difference between the most and least sensitive panellists. Skatole concentrations in the fat of animals raised on pasture from the three trials used in this study also showed a skewed distribution with a long upper tail (Table 1). The high outliers occur more often for ryegrass based treatments relative to the other pastures.

Table 1. Anderson-Darling Normality Test for skatole (ng/g) detection among panellists and its distribution (ng/g) in sensory lamb samples from the three trials used in this study.

Trials	Anderson-Darling Normality Test indices						
	Mean	Range	Skewness	A^2	*P* value	95% CI	N
Panellist skatole thresholds	132.9	25.0-600.0	1.3	0.72	0.04	49.5-272.1	10
Schreurs et al., 2007a, trial 1	72.2	30.7-154.6	1.0	0.71	0.05	54.6-89.9	18
Schreurs et al., 2007b, trial 2	82.0	24.4-163.0	0.6	0.63	0.09	70.1-93.9	37
Farouk et al., 2007, trial 3	61.4	9.0-231.9	2.1	1.39	0.01	37.1-85.8	20

Table 2. Panellists assessment of cooked lamb odour and flavour intensities in trial 3. These mean scores are typical for the lamb samples assessed in trials 1 and 2.

Sensory attributes	Attribute descriptors	Finishing diet			SED	*P* level
		LP	RG	WC		
Sheepy odour	muttony, roast lamb, fatty lamb	3.9	4.2	4.5	0.4	0.6
Barnyard odour	silage, wet dirty animal, cowshed	3.3	3.3	3.4	0.4	0.2
Sweet flavour	fresh, oily, fatty, beefy	3.1	3.5	3.8	0.4	0.2
Sheepy flavour	muttony, roast lamb, fatty lamb	4.0	4.3	4.2	0.3	0.2
Earthy flavour	muddy, mushroomy, fresh rain on hot ground	1.8	1.6	1.9	0.3	0.7
Camphor flavour	mothballs, acidic/biting 'feel' - nose reaction	0.5	0.4	0.8	0.4	0.7
Faecal flavour	urine, poo, manure, cat piss, cowshit	1.0	0.5	1.0	0.3	0.3
Musty flavour	damp, stale, old/rancid, dirty socks, sweaty	1.4	1.2	1.3	0.3	0.5
Barnyard flavour	silage, wet dirty animal, cowshed	2.0	1.8	2.3	0.3	0.2

SED = standard error of difference for comparing means within a row; Sensory scale: 0 = none; 10 = intense. LP = *Lotus pedunculatus*; RG = Rye Grass; WC = White clover

Table 2 shows the mean flavour and odour responses of the panel in trial 3 as a typical example. For half of the panellists, the skatole levels in the fat varied sufficiently and to a high enough levels to affect sensory responses (see individual thresholds in Table 3), although these panellists differed in how this effect was perceived. However the variance in the panel responses was large enough to prevent the detection of any significant effect of diet on the flavour and odour of the sheepmeat from these forage trials. The scores of some individual panellists in each trial suggest a response to high skatole concentrations but the sensory attributes were not consistent between trials and panellists. When the responses of panellists were compared across trials (Table 3), some indication emerged of consistency in panellists' response to a stimulus but not in naming the stimulus. Thus, considering the frequency of detection of significant correlations and outlier differences associated with skatole across the three trials (Table 3), panellist 105 detected some sensory effect in all the three trials while panellists 407 and 553 detected none and the remaining panellists were somewhere in between. When the typical descriptors of skatole odour such as barnyard, camphor, faecal or sheepy are considered, scores of one of the most sensitive panellists (121) showed negative correlations while two medium to least sensitive panellists (105 and 551) showed a positive correlation with skatole concentration in the samples tested. This demonstrates the complexity of detecting and benchmarking skatole-linked odour and flavour in sheepmeat, but also suggests that with pasture fed animals, there is likely to be a proportion with skatole levels in the fat high enough to have a sensory impact on a proportion of consumers.

Table 3. Panellist skatole (ng/g) detection thresholds in beef fat and Spearman's Rank Sum correlations of individual panellist scores and skatole concentrations in lamb from trials 1,2 & 3.

Trials	Trained panelist identification code									
	102	105	121	123	125	132	407	551	553	621
1	SH -*	CA +* SH -**	BA -* FA -* MU -*	NC	NC	NC	NC	CA +* EA +** MU +*	NC	CA +*
2		BA +*		MU -* SW +*		NC	NC	NC	NC	BA -*
3		EA +*	SW +**			SHF +* SH +**	NC	NC	NC	NC
Panel skatole threshold	158	150	25	150	25	380	208	400	150	25
Frequency	1/1	3/3	2/2	1/2	0/1	1/3	0/3	1/3	0/3	2/3

Trials 1-3 described in Table 1. SH, BA, SW, EA, CA, FA & MU are sheepy, barnyard, sweet, earthy, camphor, faecal and musty odours respectively. BAF & SHF are barnyard and sheepy flavours respectively. NC = not correlated. Blank cells means panellist did not take part in that trial. - & + are negative and positive correlations respectively. * & ** = $P < 0.05$ and 0.01 respectively

Conclusions

It might be inferred from the data presented here that pastoral odours and flavours in sheepmeat linked to skatole do not constitute a significant problem for the sheepmeat industry, as mean levels of skatole in fat from pasture-fed lambs did not exceed the mean panel threshold. However this disregards the variation in skatole levels and individual panellists' sensitivities. A problem is likely to arise when meat from a sheep with high outlier skatole levels is consumed by a consumer highly sensitive to these odours and flavours. Because retailers have a zero tolerance for quality issues that could potentially turn one customer out of 100 from their stores, the industry needs to find ways of preventing sheepmeat with high skatole content from being exported in order to avoid the risk of that meat being purchased by a sensitive consumer. Possible solutions under investigation by AgResearch include online techniques for detecting skatole in sheepmeat early during processing and the use of feeding strategies with high tannin–containing diets such as *Lotus corniculatus* or *L. pedunculatus* to reduce the chances of producing sheep with high outlier skatole levels in their meat.

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