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Effect of dietary chicory on boar taint

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Introduction

Young entire male pigs have a better commercial performance than castrates, mainly due to more efficient food conversion and higher lean meat percentage of the carcass. In most countries, however, male pigs are still castrated at a young age to avoid the potential problem of boar taint. Boar taint is a distinctive and unpleasant taint perceived through a combination of sensory odour, flavour and taste in pork and pork products during cooking and eating. It has been described as 'animal', 'urine', 'faecal' and/or 'sweat' like in character. It is mainly caused by accumulation in the fat of at least one of the two compounds, androstenone or skatole. Androstenone (5 α -androst-16-ene-3-one), a testicular steroid exhibiting a urine-like odour, was isolated from boar fat by Patterson (1968). Skatole (3-methyl indole), a product of the degradation of the amino acid tryptophan in the lower gut, exhibiting a faecal-like odour, was isolated from boar fat by Vold (1970).

Currently, there are several possible methods to reduce the incidence of boar taint in slaughter pigs. Some methods have significant effects, others seem to have only marginal effects, and androstenone and skatole do not always respond in the same way to the measures. Skatole levels can be reduced by modulating nutrition, feeding, rearing and management conditions (including hygienic), whereas genetic selection is more efficient at lowering androstenone content (Bonneau, 2006; Jensen, 2006).

Skatole is possibly the most important taint compound, ie it is more closely related to sensory scores than androstenone, so reducing skatole alone may be an effective way to control boar taint. Skatole is a product of bacterial degradation of tryptophan which occurs in the large intestine. Its levels in fat are influenced by diet, possibly through changes in bacterial activity affecting tryptophan (Hansen et al., 1997; Jensen et al., 1997). Additions to the diet of non-digestible oligosaccharides including fructo-oligosaccharides (FOS) like inulin have reduced skatole levels in faeces, backfat and blood (Claus et al., 1994; Jensen and Jensen, 1998).

The current project was therefore undertaken to see if a short feeding period with inclusion of chicory (*Cichorium intybus* L.), a source of inulin, before slaughter will be sufficient to significantly reduce the level of skatole and improve the sensory aspects of pork from entire males.

Materials and methods

In a preliminary study, samples of subcutaneous fat from the dorsal neck region (referred to as backfat) of entire male pigs from 30 farms were obtained in a commercial abattoir in the UK. The farms were operated in a similar way including the use of common diets and similar genetics. Each farm provided 50 samples that were combined and minced together to obtain a single sample tested for androstenone and skatole levels using the procedures of Whittington et al. (2004). This study provided baseline information on the levels of taint compounds in this farming group.

In a first feeding trial, on 7 of the farms, 50g/kg dried chicory (FIBROFOS 60) was incorporated in the finishing diet for 2 weeks. A further 6 farms were used as controls. Backfat samples were tested with the same methods as in the preliminary study.

After this came the main feeding trial in which only one of the 30 farms was tested. The pigs were divided into 4 groups fed different levels of dried chicory: 0, 30, 60 and 90g/kg diet. For each group, 30 entire pigs were sampled at slaughter at 3 different times: a first time (called week 0) to determine the baseline level of skatole and androstenone in all the pigs, then the supplement of chicory was introduced and the pigs were sampled after 1 and 2 weeks on the test diet. All 360 backfat samples were tested for skatole concentration; androstenone was measured in 110 pigs (all 90g/kg pigs and 20 pigs of 0 chicory, week 2), using the same procedures as before. All the samples were presented to a 10 - member taste panel (all female) for “sniff” tests to determine pork odour intensity and abnormal odour intensity using 8 point category scales (1 = extremely weak, 8 = extremely strong). In addition, certain descriptive terms for specific odours were assessed on 0-100 scales. For cooking, each fat sample was cut into 10 approximately equal cubes, placed in a foil container covered with foil, and cooked in pre-heated ovens set at 200⁰C for 15 minutes. Each cube was then removed and placed in a bottle set at 60⁰ C and presented to each member of the panel.

Data were statistically analysed using general linear models (GLM), comparing the different levels of chicory in the diet and the duration of feeding.

Results

The preliminary study showed a high variation in the concentration of skatole and androstenone between farms, with levels generally high in comparison with the normally accepted thresholds for

the taint compounds (0.2µg/g for skatole and 1µg/g for androstenone). On average the androstenone concentration was 0.71µg/g, and skatole was 0.19µg/g (Figure 1).

In the first feeding trial the skatole level was reduced in the farms given the chicory diet (from 0.15µg/g in controls to 0.10µg/g in those given chicory) so we proceeded to the final stage of the project. In the main trial, 32% of the control pigs (week 0) were above the threshold level for skatole (0.2µg/g). Feeding 90g/kg chicory for 2 weeks was successful in reducing skatole to a level well below the ‘threshold’ for this compound, with only 1 pig (3% of the total) with a skatole value over the threshold (Figure 2). In the 90g/kg group there was a downward trend in skatole by 1 week and 55% of pigs had levels between 0 and 0.05, typical of levels in castrated males. The other levels of chicory (30 and 60g/kg) were not effective (Table 1).

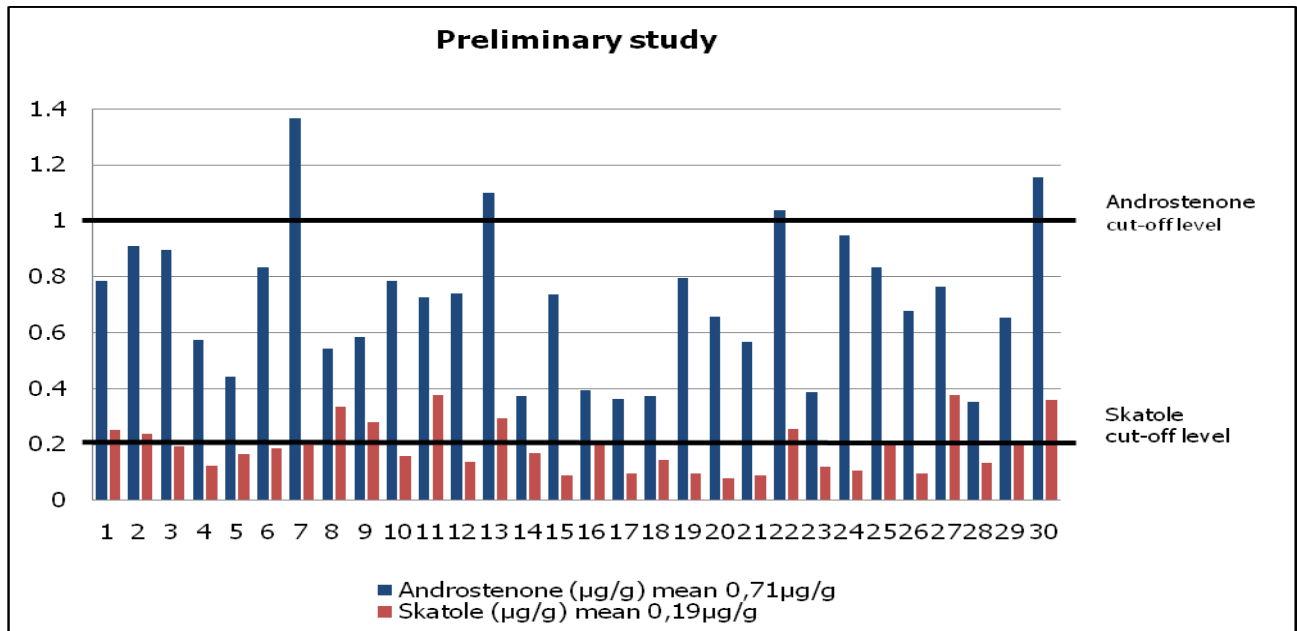


Figure 1 skatole and androstenone concentrations for the 30 farms

Table 1 Effect of feeding chicory on skatole levels (µg/g)

Week	Chicory levels				Sig
	0g/kg	30g/kg	60g/kg	90g/kg	
0	0.149 ^a	0.226 ^b	0.131 ^a	0.137 ^a	*
1	0.111	0.085	0.080	0.108	ns
2	0.237 ^b	0.129 ^b	0.124 ^b	0.047	***

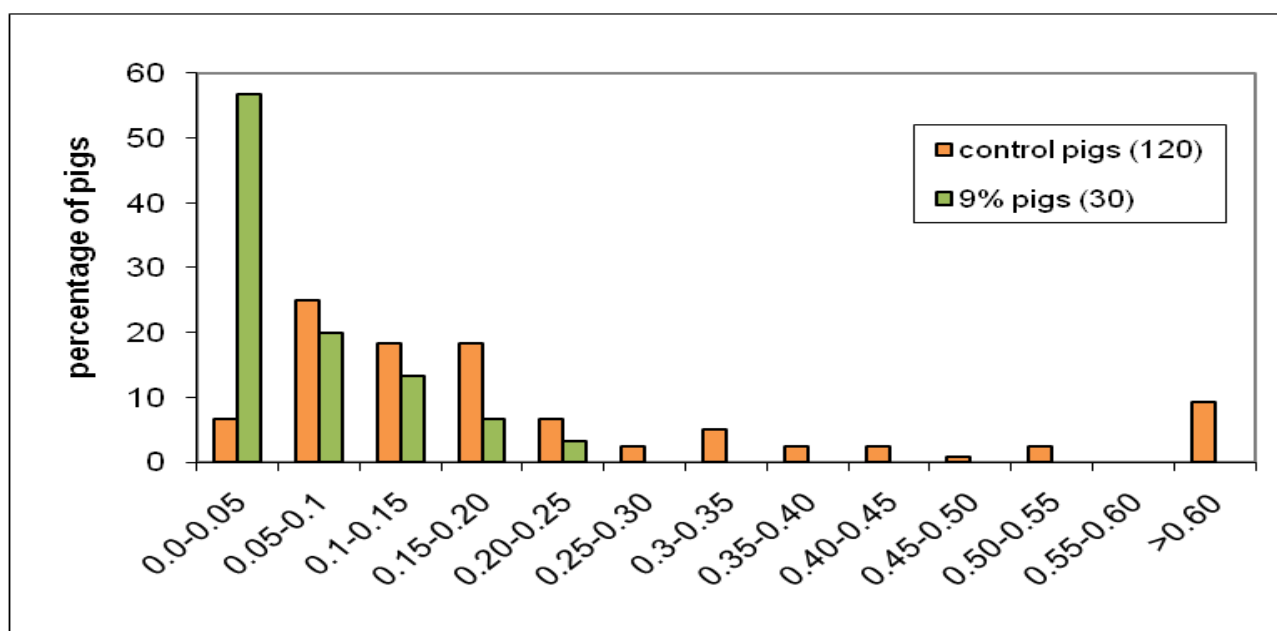


Figure 2 Comparison of skatole levels ($\mu\text{g/g}$ of fat) of all control pigs (week 0) with those fed 90g/kg for 2 weeks

The concentration of androstenone increased slightly in the pigs fed 90g/kg chicory after 2 weeks. Table 2 shows the sensory results after 2 weeks feeding. The values for pork odour are similar to those in other recent work conducted at Bristol (e.g. Zammerini, 2009). However the values for abnormal odour are higher than in these other studies and were not different between the treatments. There was no trend in the abnormal odour scores from 0 to 2 weeks. A clue to the reason for this is shown by the increase in the score for the term ‘parsnips’, used to describe the odour of androstenone. The 90g/kg chicory group, in which skatole had been reduced, had values as high as in the other treatments. However, the chicory addition reduced the typical odour notes of skatole, i.e. mothballs and musty. The other 2 chicory groups (30 and 60g/kg) also show a shift away from skatole, but to a lesser degree.

Table 2 Main sensory results after 2 weeks

	Chicory levels				Sig
	0 g/kg	30 g/kg	60 g/kg	90 g/kg	
Pork odour ^x	3.53	3.72	3.58	3.70	NS
Abnormal ^x	4.30 ^a	3.90 ^c	4.22 ^{ab}	4.04 ^{bc}	***
Mothballs ^y	11.2 ^a	8.2 ^b	9.2 ^{ab}	7.4 ^b	*
Parsnip ^y	16.3	17.7	18.4	19.6	NS

^x1-8 scales, ^y0-100 scales

Conclusions

The results show that the inclusion of 9% dried chicory in the diet for 2 weeks before finishing reduced skatole concentrations in backfat to a level typical of castrates. However no improvement in odour scores occurred, probably because androstenone remained high. It is possible that as skatole declined, the perception of androstenone increased, causing no change in overall abnormal odours.

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