S4P22.WP

FACTORS AFFECTING THE DEVELOPMENT OF "SEX-TAINT" IN ENTIRE FEMALE PIGS

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INTRODUCTION

Recent interest shown in the use of entire males for fresh pork production is a result of the increased lean meat yield and reduced feed consumption of boars when compared to castrated pigs. Furthermore, acceptance of entire males for fresh pork production could allow for increased selection intensity and improved accuracy of selection, as the seedstock producer would have an economically viable market for cull boars. Sather *et al.* (1991) have demonstrated that entire male pigs can produce carcasses with pig meat that is similar to or exceeds the quality obtained from female pigs. The single most important impediment to marketing entire male pigs is the risk of "sex-taint". The risk is even greater in Canada, than in many other countries, since the desirable live animal market weight of pigs is now in excess of 100kg and close to 30% of the national production of pork exported.

Two compounds have been suggested which affect the presence of "sex-taint":
(1) androstenone with a "urine-like" odour (Patterson, 1968), and
(2) skatole with a "faecal-type" odour (Mortensen and Sørensen, 1984).

The objective of this study was to determine the importance of skatole and androstenone in the development of "sex-taint" as determined by a trained taste panel.

MATERIALS AND METHODS

The Animals and Experimental Design

Thirty-five entire male and twenty female pigs had data profiles that included salivary gland weight, bulbourethral gland weight (males only), and androstenone/skatole colorimetric assays. These pigs were from a sub-sample from a larger project (Sather *et al.*, 1993). A unique feature of this project is that the genotype at the halothane locus of all animals is known to be NN (Sather and Murray, 1989). Eight pigs were placed on performance test, within sex, at 56 days of age, in 2.4x4.8m pens with concrete floors and fed a 14% crude protein wheat/barley-based diet with 3150MJ of digestible energy. They were taken off test when average off-farm weight, within the pen, was 100kg. Free access to food and water was provided prior to the withdrawal of feed only, 24 hours prior to shipping.

Androstenone and Skatole Determinations

Bulbourethral gland length was recorded (BL). The submaxillarily salivary glands were weighed and expressed as a proportion of commercial carcass weight (SW). They were retained for subsequent colorimetric analysis to determine androstenone (AN) concentrations (Squires, 1990). Skatole (SK) concentrations were determined from the backfat by

colorimetric (Mortensen, 1986). This assay is not entirely specific for skatole and the results are thus expressed as skatole equivalents.

Sensory Evaluation

Loins were roasted to an internal temperature of 75°C. Upon removal from the oven, each loin was cut into cubes (18x18x18mm) taking care to avoid large pieces of fat and connective tissue. They were placed onto covered glass containers in a circulating water bath (50°C) until evaluated (within 10 to 15 minutes) by a highly trained flavour-texture profile panel (Civille, 1982). The texture profiling techniques and definition of character notes were previously described (Jeremiah, 1990). Two loins, chosen at random, were evaluated at each panel session.

While the panel was highly trained, this was their first exposure to pork from entire males. To avoid potential bias, they were given no instruction or indication, as usual, about the product they were evaluating. After the trial was completed, an informal panel was conducted with purified androstenone and skatole in a neutral vegetable fat carrier. The panel again was not instructed as to the intent of the second trial. The pure skatole samples were immediately identified as the "barnyard aromatic", while androstenone was identified as different from skatole. Although the panel did not immediately associate androstenone as "sex-taint", several panel members acquainted it with eating "wild meat", subsequently descried it as containing a urine-like "sex-taint", not unlike that found in the meat of "wild game".

No female pigs were associated with either descriptor of "sex-taint". Therefore, the panel was considered competent to evaluate pork for the presence of "sex-taint" compounds. However, a panel trained specifically for the recognition of "sex-taint" compounds would be more useful for calibration and verification of the colorimetric assay.

An extensive and complete texture and colour profile suggested the most important difference between male and female carcasses was the exclusive occurrence of the "barnyard" flavour within certain male carcasses. The analysis and discussion of the present paper was therefore exclusively limited to these 35 male carcasses. The report is available from the senior suthors upon request.

Statistical analysis

Multiple regression models included various combinations of SW, BL, SK and AN, their squares and cross products terms were developed (SAS, 1989) to predict taste panel response on a 15-point scale (0 no detectable "barnyard" flavour note).

RESULTS AND DISCUSSION

Flavour Profile

The most salient feature of the flavour profile was the general lack of sex effects. This would imply little difference exist in the pork coming from entire male or female pigs. The most notable exception to this generalization is the detection of the "barnyard" flavour note found only from entire male pigs (Figure 1). It is also noteworthy that the trained taste panel did not describe a flavour note typical of "urine" usually attributed to androstenone. The "barnyard" aromatic was usually perceived as the first or one of the first sensations and found in 24% of the samples. Gilts had a higher flavour amplitude, indicating a more appropriate, well balanced and well blended flavour, than samples from entire males ($P<0.05$). Presumably this difference arose from the occurrence of the objectionable "barnyard", common only to entire males.

Relationship of skatole and androstenone with "sex-taint"

Opinion on the relative importance of skatole and androstenone in the development of "sex-taint" is controversial. Certain experiments (e.g., Bejerholm and Barton-Gade, 1992) implicate skatole as a primary contributor to the development of "sex-taint", but other studies (e.g., Bonneau *et al.*, 1992) suggest androstenone is responsible for the development of "sex-taint".

From the examination of the parameters used to develop the surface response for the "barnyard" aromatic by the taste panel (Table 1), adjusted for sexual maturity (SW and BL), the effect accounting for the greatest proportion of the variation in the "barnyard" aromatic was the (AN*SK) interaction, while AN or SK alone had little or no effect on the development of "sex-taint". This observation was also confirmed by simpler models based on AN and/or SK alone that had R^2-values of 0.15 or less. This was interpreted to indicate that neither AN nor SK, alone, would be satisfactory for predicting the potential development of "sex-taint". The terms such as BL, BL^2 and SG^2 were interpreted as indicators of sexual maturity. Slaughter weights of the animals in this study suggest they are in the peri-pubertal period, and as such, indicators of "sex-taint" such as AN and SK concentrations in the salivary glands and fat, may not directly reflect the concentration the "sex-taint" compounds in the carcass.

The present study suggest in the presence of low levels of either skatole or androstenone the development of "sex-taint" regardless of the level of the other "sex-taint" compounds is reduced (Figure 2). When androstenone levels remained low (<50µg/g), the ability of the taste panel to respond to "sex-taint" also remained low, regardless of skatole levels. Though, somewhat less evident, at lower levels of skatole (0.10.15µg/g) the taste panel was also indifferent to "sex-taint". The taste panel only became responsive to "sex-taint" when both skatole and androstenone levels were moderate to high. While the concentration of 0.25µg/g of skatole may be a reasonable limit to screen pork carcasses, this criterion should be used only if the concentration of total "sex-taint" steroids can be expected to be less than 50µg/g.

CONCLUSION

The implications of these results are two:

(1) skatole may be the primary contributor to "sex-taint", but "sex-taint" can only be manifested in the presence of androstenone-like steroids, and
(2) control of "sex-taint", a prerequisite prior to the implementation of policy permitting the use of entire male pigs for fresh pork production, can be attempted through the modification of factors that influence both skatole and androstenone concentrations.

ACKNOWLEDGEMENTS

This work was supported, in part, by the Alberta Agriculture Research Institute through a grant from Farming For the Future (#91-0887).

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Table 1. Surface analysis of the steroid/skatole interaction on taste panel evaluation of the "barnyard" aromatic.

Source of variation	DF	Sum of squares	F	Pr>F	Est.	SE
Intercept	1				-33.284	10.495
Total corrected	34	75.4694				
AN	1	0.2072	0.28	0.6052	0.037	0.071
SK	1	2.3998	3.19	0.0891	30.942	17.315
SG	1	2.7678	3.68	0.0693	-26.334	13.721
BL	1	8.9561	1.92	0.0025	6.789	1.966
AN^2	1	0.5920	0.79	0.3853	0.000	0.000
SK^2	1	1.8870	2.51	0.1287	31.902	20.132
SG^2	1	8.0990	0.78	0.0037	31.491	9.592
BL^2	1	7.0343	9.36	0.0062	-0.301	0.098
AN*SK	1	19.4740	5.91	0.0001	0.613	0.120
AN*SG	1	6.7022	8.92	0.0073	-0.223	0.074
AN*BL	1	0.3724	0.50	0.4896	0.004	0.006
SK*SG	1	10.6669	4.19	0.0012	-140.327	37.245
SK*BL	1	1.1913	1.59	0.2225	3.597	2.856
SG*BL	1	0.0008	0.00	0.9733	0.050	1.474
Error	20	15.0294	0.050			