Effect of testosterone and estradiol added in the feed on skatole and boar taint level in entire male backfat

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SUMMARY: The aim of this work was to examine if adding testosterone or estradiol to the feed of entire male pigs had any effect on skatole deposition in backfat or the intensity of boar taint.

The experimental material consisted of five litters of three entires, divided into three groups. All pigs received basal feed for eight weeks. Then group 1 continued with the control ration; group 2 received in addition 20 mg testosterone per day and group 3 10 mg estradiol per day. Backfat was analyzed for skatole compounds, androstenone, testosterone, estradiol and the intensity of boar taint judged by a trained panel. The content of the large intestine (faeces) was analyzed for androstenone, testosterone and estradiol.

The results showed that testosterone increased backfat skatole content and the intensity of boar taint ($P<0.001$). The content of testosterone (ns) in faeces was increased. Estradiol only affected estradiol levels in the faeces ($P<0.001$). The backfat content of testosterone and estradiol was unaffected. Backfat skatole gave the best prediction for intensity of boar taint ($r = -0.74$). Testosterone in faeces showed a better correlation to boar taint ($r = -0.64$) than testosterone in backfat (ns).

It is not possible from this preliminary study to conclude if the skatole deposition is caused by testosterone in the faeces alone. But it is evident that testosterone added to the feed increases both the backfat skatole and intensity of boar taint.

The results confirm earlier Danish experiments with entires. Skatole is the best predictor for boar taint under Danish conditions.

INTRODUCTION: The use of entire male pigs for meat production has now been introduced in Denmark and is expected to increase rapidly from 1992. The main problem is a strong boar taint intensity in 5-10 percent of the entire male pigs. The main contributing component to boar taint has long been considered to be androstenone (Bonneau, 1991), but skatole has also been demonstrated in tainted boar fat (Mortensen et al., 1986). Walstra et al. (1986) and Lundström et al. (1988) found skatole to be a better predictor for boar taint than androstenone. In Denmark all entire male pigs are analysed for skatole. The method is adapted to a fully automated system in which 150-180 samples per hour can be analysed (Mortensen and Sørensen, 1984). Entire male pigs containing more than 0.25 ppm skatole in the backfat are sorted out as boars.

Skatole is found in all pigs but the level is higher in entire male pigs than other pigs. No explanation for the occurrence of skatole in boar fat has been found in the literature but Pedersen et al. (1986) showed that use of liquid yeast from beer production gave a higher skatole level than barley-soybean feed. On castration the production of male hormones almost ceases, because the main production takes place in the testes. It is natural to suppose that skatole deposition in backfat is influenced by hormones.

There are no references in the literature, where hormones are used as feed additives.

The purpose of the present investigation was to study the effect of hormones added in the feed on skatole and boar taint in the backfat of entire male pigs.

MATERIALS AND METHODS: The experimental material consisted of five litters with three entires, divided into three groups. All pigs received basal feed for eight weeks. Group 1 = control; group 2 received in addition 20 mg

testosterone per day and group 3 10 mg estradiol per day. The pigs were kept individually in pens and were given feed according to scale. The pigs were slaughtered at a live weight range of 58 - 100 kg.

Samples of backfat and faeces (large intestine) were analysed for skatole, androstenone, testosterone and estradiol. The androstenone analysis and skatole analysis in the faeces are not yet available. Boar taint intensity of backfat was evaluated by a panel consisting of 7 persons. The panel members were selected for sensivity to both skatole and androstenone, and for the ability to repeat the same judgements on different occasions. Each sample was judged on a 10 point scale, ranging from 10 (extremely good) to 0 (very bad). All calculations were performed with the Statistical Analysis System (SAS Institute Inc., 1985). The effect of litter and treatment were tested using the following model:

$$Y_{ijk} = \mu + l_i + n_j + l_{ijk}$$

where Y_{ijk} = the ijk'th observation; μ = general mean; l_i = effect of the i'th litter; n_j = effect of the j'th treatment and l_{ijk} = residual effect

RESULTS AND DISCUSSION: The individual initial liveweight, liveweight at slaughter and the skatole concentration in back fat is shown in Table 1. There was a big variation for the range in weight, mainly for practical reasons. The skatole content differed a great deal, and no correlation was found between live weight at slaughter and skatole content. This has also been demonstrated by Mortensen (1989). Means and standard deviations are given in Table 2. The boar taint intensity and skatole content in backfat was strongly influenced by adding testosterone in the feed ($P>0.01$). On the other hand the hormone content in backfat was not affected. In the faeces higher concentrations of hormone were found when it was present in the feed; testosterone slightly but estradiol content five times higher than control ($P>0.01$).

In Table 3 the overall correlations are given between subjectively-evaluated boar taint in backfat, skatole content in backfat and hormones in backfat and faeces. Boar taint and skatole in backfat were strongly correlated ($r = -0.74$). A somewhat lower correlation was obtained between boar taint and testosterone in faeces ($r = -0.64$) and skatole in backfat and testosterone in faeces ($r = 0.59$). On the other hand there were no significant correlations between hormones in backfat and boar taint. The present study has demonstrated a closer relationship between skatole and the subjective impression of boar taint than has previously been found for androstenone - boar taint by Bonneau (1990), Lundström et al (1988) and Walstra et al. (1986). The two last authors found skatole as a better predictor for boar taint than androstenone.

CONCLUSION: The results in this study indicate that the Danish method for determination of skatole in backfat is the best single predictor for boar taint under present conditions. The sex hormone testosterone plays an important role in the deposition of skatole in backfat and thereby also for the intensity of boar taint. The high incidence of boar taint/skatole in some entire male pigs can possibly be solved by a reduction the hormone levels in the faeces, but further investigations are needed.

Table 1 Live weight initially and at slaughter and skatole in backfat

Treatment	Litter	Initial weight	Weight at slaughter	Skatole
1	1	43.0	90.0	0.09
	2	46.0	93.5	0.10
	3	34.0	80.0	0.09
	4	31.0	83.5	0.15
	5	29.0	78.0	0.08
Average		36.6	85.0	0.10
2	1	56.5	113.0	0.35
	2	48.5	100.0	0.37
	3	32.0	74.0	0.71
	4	26.0	77.5	1.29
	5	22.0	57.5	0.64
Average		37.0	84.0	0.67
3	1	54.0	109.5	0.07
	2	38.0	81.0	0.07
	3	28.0	73.0	0.14
	4	34.0	80.5	0.16
	5	29.0	76.5	0.12
Average		36.6	84.1	0.11

Table 2. Means, standard deviations (SD) and range

Treatment	1	2	3		
Additives	-	Testosterone	Estradiol	SD	Range
Boar taint, score	5.8[a]	1.7[b]	5.2[a]	0.69	0 - 8
Skatole in backfat, ppm	0.10[a]	0.67[b]	0.11[a]	0.08	0.07 - 1.29
Testosterone in backfat, ppb	6.69	5.71	5.59	0.88	2.54 - 8.70
Estradiol in backfat, ppb	5.12	5.79	9.16	1.47	2.26 - 13.50
Testosterone in faeces, ppb	10.49	13.35	10.34	1.09	5.51 - 16.90
Estradiol in faeces, ppb	638[a]	944[a]	3550[b]	423	256 - 5334

a, b Values in the same row with different superscripts, differ significantly (P<0.01).

Table 3. Overall correlation

Variable	1	2	3	4	5
1. Boar taint, backfat	-				
2. Skatole, backfat	-0.74***				
3. Testosterone, backfat	-0.06	-0.18			
4. Estradiol, backfat	-0.19	0.05	0.13		
5. Testosterone, faeces	-0.64**	0.59**	-0.13	0.10	
6. Estradiol, faeces	-0.03	-0.07	-0.10	0.69***	0.01

Level of significance: * = (P< 0.05); ** = (P< 0.01); *** (P< 0.001)

REFERENCES:

Bonneau, M., 1990: Sexual odour in pork from entire males. Compounds responsible for boar taint and physiological basis of androstenone production and storage in young entire male pigs. Workshop on the production of pork from entire males, Ottawa, Canada, June 5-6.

Lundström, K., Malmfors, B., Malmfors, G., Stern, S., Petersson, H., Mortensen, A.B., og Sørensen, S.E., 1988: Skatole, androstenone and taint in boars fed two different diets. Liv.Prod.Sci., 18: 55-67.

Mortensen, H.P., 1989: Practical results from a small scale production of entire male pigs: Symposium on boar taint, Gerona, Spain, May 11-12.

Mortensen, A.B. and Sørensen, S.E. 1984. Relationship between boar taint and skatole determined with a new analysis method. Proc. 30th European Meeting of Meat Research Workers, Bristol. pp. 394-396.

Mortensen, A.B., Bejerholm, C. and Pedersen, J.K., 1986. Consumer test of meat from entire males, in relation to skatole in backfat. Proc. 32nd European Meeting of Meat Research Workers, Ghent, pp. 23-26.

Pedersen, J.K., Mortensen, A.B., Madsen, A., Mortensen, H.P. and Hyldgaard-Jensen, J., 1986. Foderets indflydelse på ornelugt i svinekød. Statens Husdyrbrugsforsøg. Meddelelse No. 638.

Walstra, P., Engel, B. and Mateman, G., 1986. The androstenone-skatole dilemma as applied in a consumer test. Proc. 32nd European Meeting of Meat Research Workers, Ghent, pp. 27-29.

SAS Institute Inc., 1985. SAS User's Guide: Statistics version, 5th Edition, SAS Institute Inc., Gary, NC, 956 pp.