DEVIATING SMELL IN DANISH ENTIRE MALE PIGS - RELATIVE TO SKATOLE AND ANDROSTENONE CONTENTS

STØIER S.

Danish Meat Research Institute, Roskilde, Denmark

W-3.12

SUMMARY

Experiments have been made with the aim to investigate the relation between skatole and androstenone and the existence of deviating smell in Danish entire male pigs.

Male pigs were divided into three groups according to weight: <70 kg, 70-80 kg and >80 kg. Fat samples from these pigs were analysed for skatole and androstenone contents. Subsequently, for the purpose of a smell evaluation, 16 groups of male pigs, a total of 171, were selected based on skatole and androstenone contents.

The results of the experiments show that in normal conditions it is the skatole contents that is the main contributor to the diverging smell whereas the androstenone contents is a less important factor where diverging smell is concerned.

A population screening comprising approx. 2200 pigs show that the average contents of skatole and androstenone in entire male pigs of a slaughter weight of 70-80 kg is 0.09 ppm and 0.65 ppm respectively. Analyses of fat samples from some 1900 entire male pigs from three weight groups furthermore show that the androstenone contents will increase with the increasing slaughter weight.

Previous experiments have shown that at a rejection limit of 0.25 ppm skatole, just above 1% of the approved male pigs will have a deviating smell. If the classification criteria are supplemented with androstenone limits, the frequency of erroneously approved male pigs can be reduced to approx. 1%. A similar improvement of the certainty in rejection of male pigs may be achieved by lowering the rejection limit of skatole. In the present Danish production conditions with the actual variance in age and weight of the pigs it is therefore regarded unnecessary to base a rejection of entire male pigs on both skatole and androstenone contents.

Introduction

Previous experiments have proved that skatole is the prime factor responsible for boar taint in Danish entire male pigs (Bejerholm & Gade, 1992). It explained for approx. 58% of the variation of odour score. If androstenone was added in the calculations, about 66% of the variation in odour score was explained. Discussions are, however, still going on with respect to which of the two smelling substances is the prime cause of boar taint. A Swedish experiment found that the correlation between androstenone and the degree of boar taint ($r = 0.53$) is slightly lower than the correlation between skatole and boar taint ($r = 0,65$) (Lundström et. al, 1982). Other experiments, however, show that the androstenone has a better correlation to boar taint than skatole (Bonneau et al., 1992).

Presumeably, the influence of the various smelling substances on the presence of the deviating smell in entire male pigs is related to production conditions, a.o. age and weight of the animal. It was thus found that both age and weight significantly influence the level of androstenone in backfat (Bonneau, 1987).

Experiments have been carried out to prove the impact of skatole and androstenone contents on the deviating smell in Danish entire male pigs. In this connection was evaluated the impact of the slaughter weight on both skatole and androstenone contents as well as on the smell.

Skatole and Androstenone Contents in Relation to Diverging Smell

Procedure: Male pigs were divided into three groups according to weight: <70 kg, 70-80 kg and >80 kg. Fat samples from these pigs were analysed for skatole and androstenone contents. Skatole was measured with the

Boar Taint Analysis Systems installed in Denmark (Mortensen & Soerensen, 1984), while androstenone was determined in a HPLC analysis (Hansen-Moeller, 1994).

Subsequently, for the purpose of a smell and taste evaluation, 16 groups of male pigs, a total of 171, were selected based on skatole and androstenone contents. Skatole and androstenone contents ranged from 0.0 - 0.5 ppm and 0.0 - 3.0 ppm. The average slaughter weight of the 16 groups was more or less identical and lay between 74 and 84 kg. Smell and taste intensities were evaluated on a scale from 0 to 10, with 0 indicting a very strong smell/taste.

Results: Smell and taste evaluations gave identical results. In the following we have chosen to focus on smell evaluation.

In general the odour scores decreased when both the skatole and the androstenone contents increased. Skatole is the smelling substance giving the best correlation to the evaluation of smell. Yet, the androstenone contents also contribute to the deviating smell. Residue spread deviation (RSD) is an expression of how well the smelling substances analysed explain the smell evaluations.

From Table 1 appears that the RSD is less for skatole than for androstenone. Skatole is therefore a more reliable indicator of deviating smell. An even better indication of smell is obtained by supplementing skatole measurements by androstenone measurements. When evaluating the RSD it should be noted however, that the odour score is an average of the evaluation by 9 panel members. Experience shows that RSD for panel members is approx. 0.5.

The effect of the slaughter weight correlates slightly to the odour score ($r = -0.15$), but does not contribute further to an explanation of the smelling deviation.

It has been investigated whether there is interaction between skatole and androstenone. It seems that the effect of skatole on the odour score is irrespective of androstenone content, just as the effect of androstenone on smell is irrespective of skatole contents. A possible hypothesis regarding synergi effect of the two smelling substances can thus not immediately be confirmed based on the material available.

In this respect should be mentioned that results are based on the findings of a professional taste panel trained in the evaluation of individual parameters. This means that their findings will often express an additive effect. Experience from consumer tests shows that their evaluations may to a greater extend be expressed in a multiple function of parameters evaluated. This relationship is expected further clarified in a planned consumer test.

The conclusion is that the smell can be described as a linear function of skatole and androstenone.

$$\text{smell} = a - b \times \text{skatole(ppm)} - c \times \ln(\text{androstenone(ppm)})$$

a, b and c being constants.

In case the rejection of Danish entire male pigs based on skatole content is to be supplemented by an androstenone analysis it would be relevant to make the androstenone level dependent on the skatole contents of the entire male pig in question.

The model drawn up for evaluation of the correlation between smell and skatole and androstenone level has been tested on pigs from a previous experiment with entire male pigs. This experiment provided a nice linear correlation between the predicted smell and the actual smell of the male pigs. The model is therefore considered satisfactory for male pigs produced under normal circumstances.

Skatole and Androstenone Contents in Danish Slaughter Pigs

Procedure: A population screening comprising approx. 2200 animals has been carried out with the purpose of investigating the level of androstenone in Danish entire males (Mejborn, 1994). Furthermore, the experiment investigated the contents of smelling substance in back fat from approx. 1900 entire male pigs distributed in three weight groups: <70 kg, 70-89 kg and >80 kg. Fat samples from these pigs were analysed for skatole and androstenone. Skatole was measured with the Boar Taint Analysis Systems (Mortensen & Soerensen, 1984), while androstenone was determined in a HPLC analysis (Hansen-Moeller, 1994).

Results: The screening has shown that the average skatole and androstenone contents in male pigs with a slaughter weight of 70-80 kg is 0.09 ppm and 0.65 ppm, respectively.

Table 2 shows the average contents and distribution of androstenone for the weight groups mentioned previously.

For comparison may be stated that the geometric average for the androstenone contents of the three weight groups is 0.40 ppm, 0.46 ppm and 0.54 ppm respectively.

There is a significant difference in the androstenone contents in the three weight groups. It should further be noted that the standard deviation is somewhat greater at a higher weight. Skatole does not depend on the carcass weight. The average skatole content is 0.09 ppm in all three groups.

There is a slight but significant, positive correlation between the skatole and androstenone contents. The correlation coefficient is about 0.3.

Significance of the Carcass Weight on the Smell Evaluations

Based on the tests it is concluded that the carcass weight by itself is not a measure of the frequency of the deviating smell in male pigs.

However, the slightly positive correlation between carcass weight and androstenone contents means that, all things being equal, the risk of male pigs with deviating smell increases at greater carcass weight.

By means of the equation described previously, the odour score expected for the three weight groups will be estimated based on the average contents of skatole and androstenone. The results show a slight difference in expected odour score between the three groups, see Table 3.

Within the normal weight range for Danish slaughter pigs (60-90 kg) it is not relevant to establish an upper weight limit for the purpose of minimizing the risk of producing male pigs approved but with a deviating smell. However, the age of the pigs appears to be significant.

Classification Accuracy and Rejection Percentages

The results of the experiments show that androstenone contributes to the deviating smell and taste of male pigs. Therefore, it must be presumed that the frequency of approved male pigs with deviating smell and taste will be reduced if androstenone is included as a classification criterion.

The previously described equation for the correlation between smell and skatole and androstenone contents is used in establishing classification criteria. There are no fixed rejection limits for the two smelling substances. The rejection limit for one smelling substance thus depends on the contents of the other smelling substance of the individual male pig. It is a condition though that the rejection must correspond to a skatole limit of 0.25 ppm.

Previous tests have shown that at a rejection limit of 0.25 ppm skatole, just above 1% of the approved male pigs will have a deviating smell. If the classification criteria are supplemented with androstenone limits, the frequency of erroneously approved male pigs can be reduced to approx. 1%. Likewise an improvement of the liability of the rejection may be obtained from lowering the limit for skatole.

Table 4 shows the results derived with different classification strategies. The accuracy of the estimates of classification accuracy has been calculated, and the listed intervals indicate upper and lower limits in an estimated 95% confidence interval.

The criteria for skatole and androstenone classification can be further tightened or loosened depending on the demands for classification accuracy. The rejection percentages will change correspondingly.

If classification is based on androstenone contents only, a classification limit of 0.5 ppm must be used to obtain the same classification accuracy as when using a skatole limit of 0.25 ppm. However, such a procedure would entail increasing the rejection rate to 48%. Of the pigs rejected the main part (approx. 95%) will **not** have a deviating smell. In Danish production it must therefore be considered unrealistic to use a fixed androstenone limit.

Conclusion

The results show that under normal circumstances primarly skatole contributes to explaining the deviation of smell while androstenone is less significant for the frequency of deviating smell.

Based on experiments it is concluded that the carcass weight by itself is not a measure of the frequency of the deviating smell in male pigs. However, the slightly positive correlation between carcass weight and androstenone contents means that, all things being equal, the risk of male pigs with deviating smell increases with greater carcass weight. Within the normal weight range for Danish slaughter pigs (60-90 kg) it is not relevant to establish an upper weight limit for the purpose of minimizing the risk of producing male pigs approved but with a deviating smell. However, the age of the pigs appears to be significant.

Previous experiments have shown that at a rejection limit of 0.25 ppm skatole, just above 1% of the approved male pigs will have a deviating smell. If the classification criteria are supplemented with

androstenone limits, the frequency of erroneously approved male pigs can be reduced to approx. 1%. Likewise an improvement of the liability of the rejection may be obtained from lowering the limit for skatole.

In the present Danish production conditions with the actual variance in age and weight of the pigs it is therefore regarded unnecessary to base a rejection of entire male pigs on both skatole and androstenone contents.

Literature:

Bejerholm, C. & Gade, P.B., 1992: The Relationship between Skatole/Androstenone and Odour/Flavour of Meat from Entire Male Pigs. Meeting of the EAAP Working Group on Production and Utilization of Meat from Entire Male Pigs, 12-14 October, Roskilde, Denmark.

Bonneau, M., 1987: Effects of age and live weight on fat 5.alpha-androstenone levels in young boars fed two planes of nutrition. Reprod. Nutr. Dev., **27**, 413-422.

Bonneau, M., Denmat, M.L., Vaudelet, J.C., Nunes, J.R.V., Mortensen, A.B. & Mortensen, H.P., 1992: Contibutions of fat androstenone and skatole to boar taint: I. Sensory attributes of fat and pork meat. Livestock Production Science, **32**, 63-80.

Hansen-Moeller, J., 1994: Rapid HPLC Method for Simultaneous Determination of Androstenone, Skatole and Indole Back Fat from Pigs. Submitted to Journal of Chromatography.

Lundstöm, K., Malmfors, B., Malmfors, G., Stern, S., Petersson, H., Mortensen, A.B. & Soerensen, S.E., 1988: Skatole, androstenone and taint in boars fed two different diets. Livestock Production Science, **18**, 55-67.

Mejborn, H., 1994. Unpublished work carried out at the Danish Meat Research Institute. Internal report.

Mortensen, A.B. & Soerensen, S.E., 1984: Relationship between boar taint and skatole determined with a new analysis method. Proc. 30th European Meeting and Meat Res. Workers, Bristol p. 364.