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THE PRODUCTION OF ENTIRE MALE PIGS IN DENMARK THE CAUSES OF BOAR TAINT AND SENSORY ASSESSMENT

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INTRODUCTION

The interest among Danish pig producers and slaughterhouses in the production of entire male pigs led to a commercial production in the late 1980s. In 1993 the production is expected to reach a level three million entire males. Entire male pigs in Denmark are slaughtered when they reach the normal slaughter weight which is 74kg.

It is common knowledge that the production of entire male pigs has benefits as well as disadvantages. One of the reasons for the start of production of entire male pigs has was their higher meat contents (Walstra, 1974; Barton-Gade, 1985). In 1993 the meat percentage in carcasses from entire males in Denmark has reached an average of 61%, which is 3% more than for castrates. Another reason is the better utilization in entire male pigs (Walstra and Kroeske, 1968; Kempster, 1988).

One of the disadvantages is that meat from a few of the entire male pigs has an unpleasant odour and taste when cooked -- the so-called boar taint. Based on a number of scientific investigations during the 70s and 80s it has been established that boar taint in Danish male pigs is mainly related to skatole (3-methyl-indole). An automated analysis system for sorting of entire male carcasses has been developed. The method is based on analysis of the skatole content in the backfat (Mortensen and Soerensen, 1984).

In 1990 an integrated Research and Development (R&D) project was initiated in Denmark. The main purpose of this integrated research and development project was to gain knowledge of boar taint as well as to find out what mechanism caused the boar taint in order to reduce the number of carcasses with boar taint. The results from the project should hopefully lead to a reduction in the number of entire males with boar taint (Sandersen, 1992).

The project is linked together so that the scientific results are tested in vitro, in vivo and finally in a controlled production test. The results from the production tests are then communicated to pig production consultants and to the producers.

In the following various aspects of the results of the integrated project are presented combined with the previous work carried out regarding entire male pigs and boar taint.

BOAR TAINT IN DANISH ENTIRE MALE PIGS

In Danish experiments boar taint has mainly been associated with skatole (3-methyl-indole), while androstenone seemed less important.

The results of a recent experiment (Bejerholm and Gada, 1992) confirmed that meat from entire males with high skatole values (above 0.25mg/kg) irrespective of androstenone level had on average an odour corresponding to a distinct off-odour. The results of this experiment confirmed the previous results showing that skatole is the prime factor responsible

for boar taint in Danish pigs. The correlation between skatole and odour score was 0.76, thus explaining 58% of the variation of odour scores. If androstenone was added in the calculations, about 66% of the variation in odour score was explained.

ANALYSIS AT THE SLAUGHTERHOUSE

The development of a reliable automatic analysis system for measuring skatole was a requisite before a commercial production of entire male pigs could be initiated. This system is based on a spectrophotometric method for analysis of skatole in backfat (Mortensen and Soerensen, 1984). It was further essential to establish a rejection level for skatole in fresh meat before the commercial production of entire male pigs was started. The rejection level was fixed at 0.25ppm. The distribution of skatole in the population of entire male pigs is shown in Figure 1.

A new EC fresh meat directive became effective 1st January, 1993. The directive gives provisions for inter-community trade with fresh meat from entire male pigs relating to carcass weight. Entire male pigs with a carcass weight above 80kg must be checked for boar taint (EC Council Directive 64/433). Danish entire male pigs have a carcass weight far below this weight limit, but all carcasses from entire male pigs are, however, analyzed for skatole content. Pigs with more than 0.25ppm are rejected for fresh consumption. Producers of entire males are paid less if they have too many rejected pigs. The rejection rate is on average 5% per year. The combined R&D project has as its main aim to reduce this rejection rate. Such reduction will be of benefit not only to the pig producers but also to the slaughterhouses, which then will not be forced to find alternative use for the rejected carcasses.

HPLC METHODS FOR DETERMINATION OF SKATOLE AND INDOLE

The Danish Meat Research Institute has developed two high-performance liquid chromatographic (HPLC) methods -- a gradient method (Hansen-Moeller, 1992a) and a fast semi-automatic isocratic method (Hansen-Moeller, 1992b).

The gradient HPLC method is able to separate 13 different indolic compounds and to determine seven of these.

The isocratic HPLC method for determination of indole and skatole is based on a column switching system. This system is used for on-line pre-column removal of lipid/fatty acids from the extract.

PHYSIOLOGY

An important part of the project is carried out by relevant scientist at the universities and the research centres in Denmark. The results of their work programs are published individually and are forming the basis of the practical experiments.

The most important finding has been that different skatole producing bacteria have been isolated from the hind gut and large intestine. The production of skatole takes place in the large intestine. A clear correlation has been found between the amount of skatole produced in the gut and the amount of skatole found in the backfat (Jensen and Jensen, 1992).

Results from in vivo animal models have shown that the clearance rate of skatole from the blood is more than 50% measured before and after the liver. The half-life period of skatole in blood is one hour. This indicates that skatole is removed by metabolization in the liver (Agergaard and Laue, 1992).

The concentration of skatole in backfat is 35 times the concentration in blood plasma (personal communication, Hansen-Moeller, 1993).

A close correlation has been demonstrated between a dose of 14C-skatole administered intravenously and the concentration of skatole in fat. After 24 hour up to 98% of the dose was secreted in urine and faeces (Friis, 1992).

From these results it is evident that fast is an obvious choice to bring down the skatole level in fat. Practical experiments in the future will be concentrated on the period right before slaughter, eg., the last week at the farm and the delivery strategy (transportation, the lairage period at the slaughterhouse and the length of the fast).

PRACTICAL TESTS OF HOUSING CONDITIONS AND FEEDING

Practical tests with production of entire male pigs are based on two main sources of information. One is a scientific research work and the other is a database with data from approx. 800 herds of entire male pigs in Denmark. The data comprised the data of the individual carcasses and form a complex database with information ranging from design of the pen, feeding regime, meat content and skatole measured in the backfat.

One must, however, be aware that when relating different designs, arrangements, etc. to the skatole content in backfat the result is not a completely reliable result but a valid argument that this should be investigated more carefully in comparative testings (Kjeldsen, 1992; Maribo, 1992).

The database information has indicated that wet feeding gives a lower rejection level (see Figure 2).

The practical experiments have shown that the use of wet feeding reduces the skatole level in backfat.

Fully slatted floors in wet feeding tend to reduce the skatole level (Kjeldsen, 1992).

TRANSPORTATION AND LAIRAGE TIME AT THE SLAUGHTERHOUSE

In the summer of 1990 a trial with varying transportation and stalling time was carried out. The purpose of this trial was to see whether the average skatole level or the meat quality was affected. The trial comprised about 1100 male pigs delivered from three farms, slaughtered at two different slaughterhouses. The transportation time varied from half an hour to three hours and stalling time at the slaughterhouse was either one or 24 hours. The period chosen is the maximum possible under Danish slaughter conditions.

There was no difference in the average skatole level, meat contents nor slaughter weight regardless of transportation or stalling time. The trial was repeated in autumn, this time with 750 male pigs delivered from three farms to one slaughterhouse. The results were similar to those of the first trial. The two trials show that the skatole level is not affected by transportation time nor by stalling time at the slaughterhouse under Danish conditions (Maribo 1990, unpublished).

FASTING TIME

During the summer of 1990 another trial was carried out with different levels of fasting time, about 16 or two hours before slaughter. The trial was carried out at the same three farms as above. The fasting time was at the farm before delivery to the slaughterhouse. Group 1 (16 hours) was fasting from the evening prior to the day of delivery to the slaughterhouse. Group 2 (2 hours) had access to feed until dispatch to the slaughterhouse. Group 1 had a significant lower skatole contents than Group 2. The effect of the time from last feed until slaughter was highest with pigs delivered from the farms with the highest average skatole content (Maribo, 1992).

This trial was repeated in autumn 1990 with pigs from four other farms. The results showed the same tendency. The average skatole level of Group 1 was 0.12ppm, for Group 2 0.14ppm. This difference was not significant. It may be explained by a generally lower skatole contents at the farms involved in this trial (Maribo, 1990, unpublished).

The results showed that if the average skatole level is high at the farm, a fasting time of 16 hours versus two hours will reduce the average skatole level.

CONCLUSION

Production of entire male pigs is of benefit to the producers who are paid for the higher lean meat contents.

The results of several experiments confirm that skatole is the prime factor responsible for boar taint in Danish pigs. An integrated research and development project aims at finding different ways to reduce the number of rejected male pigs. Various HPLC tests have been developed for determination of skatole and indole. It has been shown that the production of skatole takes place in the large intestine and the hind gut and is metabolised in the liver. Practical experiments have shown that fasting and wetfeeding combined with fully slatted floors has proven effective in reducing the rejection level.

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