Rapid estimation of boar taint in pork carcases.

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B12

Introduction

Castration at an early age of male pigs intended for pork or bacon production has been customary in most European countries including Britian for many years. However, it is generally accepted that there are worthwhile economic advantages to be gained by keeping the male pigs entire; in a recent experiment[1], boars showed a 29% superiority in terms of lean meat production per unit of feed compared with equivalent castrates.

Consumer testing of bacon and pork produced from young boars[2] slaughtered at about 200 lb. (91 Kg) liveweight has shown that much of the meat is quite acceptable. However, it was apparent that meat from carcases with androstenone concentrations in excess of 1 part per million in the fat could be identified, although about half the consumers considered that the product (bacon) was "more pleasant than normal."

Interest has arisen recently amongst certain sections of the meat industry regarding the possibility of raising young boars for fresh meat. In view of the results of the consumer trials, and the variability known to exist in the taint levels in boars at any particular age or weight after puberty, the existing methods for testing for boar taint were reviewed for the purpose of developing a rapid, reliable and convenient test for use directly on carcases in the abattoir or factory.

Several techniques have been described for the detection of taint or sex odour in pork fats during recent years. Most methods have been based on olfactory examination of heated samples, using equipment such as frying pans or skillets[3] aluminium foil cups,[4] glass beakers,[2] or simply boiling water[3,5] to heat the fats. None of the methods is particularly rapid, and the extent of sample preparation necessary depends on the method selected. Considerable care must also be devoted to the preparation of the equipment in order to avoid the introduction of foreign odours and to eliminate the risk of carrying over odour from one test to another.

Chemical analysis of a fat for androstenone is at present a protracted procedure,[6] and although good results can be obtained, the method does not lend itself to the analysis of samples on a routine basis. Direct colorimetric detection and estimation of taint is not practicable because the available reagents are not necessarily specific to androstenone. The colours developed <u>in vitro</u> with the pure steroid are weak, and in view of the low concentration of androstenone normally found in young boars (10^{-8} to 2×10^{-6} g/g tissue), detection of colour development against the normal background colour of fat would be difficult, and would depend on the quality and intensity of the incident lighting, the condition of the cut surface of the fat, adequate penetration of the reagents into the fat, etc. In addition, most reagents are strongly acidic solutions of heavy metal salts (eg. uranium), which would not be readily acceptable in a meat processing factory.

In a preliminary note in 1969, A.H. Martin[7] mentioned the use of a soldering iron to test the carcases of male pigs for the presence of sex odour, and his procedure has recently been published in more detail.[8] The use of a soldering iron to heat localised areas of a fat for olfactory analysis was examined at the Meat Research Institute and it was concluded that after certain modifications and development the technique could be adopted as a routine tool, both in the laboratory and on the slaughterhouse floor, for the rapid testing of fats and other tissue for odour defects by trained observers.

Equipment

An electrically heated soldering iron powered by a 230/250 volt mains electrical supply reaches a final "bit" temperature of approximately 375°C. This temperature is considerably in excess of the temperature required (150°C) for the evaluation of the odour quality of fats and tissue, and can be conveniently reduced by inserting a variable transformer between the mains supply and the iron. While this arrangement is simple and safe to operate in a laboratory, the use of mains voltages and extension cables is undesirable in a slaughterhouse.

A self-contained, portable version of the equipment has been developed using a low voltage soldering iron and rechargeable batteries. The present prototype consists of a 12 volt, thermostatically controlled iron adjusted to give a temperature of 150°C at the tip of the probe. It is powered by either lead/acid or nickel/cadmium batteries which can be recharged overnight by connection to a suitable constant current charging unit. The apparatus, dimensions approximately 24 x 14 x 16cm high, can be conveniently carried over the shoulder, and gives a visual indication when it is switched on and ready for use.

Carcases or samples of fat are tested by applying the heated tip of the iron (area 5 x 5mm) to a clean, freshly cut surface for a period of 1 second. This is sufficient to coat the probe with melted fat and avoids leaving a noticeable mark on the carcase. The hot fat on the tip of the iron is smelled and, after a judgement has been made, is wiped off with a clean cloth or paper tissue leaving the iron ready for further use. Any residual odour volatilises quickly from the hot probe, but it is advisable to check that it is free from odour before the next sample is tested. It is desirable for the operator(s) to breathe slowly through the nose between samples particularly after judging a sample with a high concentration of odour.

Evaluation of the technique.

A series of tainted lards was prepared by dissolving known quantities of the pure steroid in commercial lard. Four concentrations were prepared 0.17, 0.51, 1.5 and 4.5 µg steroid/g.fat, covering the range of androstenone concentration normally found in the fat of young boars. Sets of standards, including a "blank", were presented on six occasions to a six-member laboratory panel who were asked to arrange the samples in increasing order of taint. All panel members were known to be sensitive to the odour of androstenone.

The following table shows the frequency with which the lards were ranked correctly:

TABLE 1

a) Ranking of lards containing known concentrations of androstenone.

Increasing order of odour intensity

Androstenone concentration factor \	0	1	2	3	4
0	25	8	2	1	
1	7	21	5	3	
3	4	5	24	3	
9		1	4	24	7
27		1	1	5	29

b) Performance of individual panel members.

Panel member	Number of mistakes in total of 30 judgements
P	1
F	1
G	3
J	5
D	7
S	8

36 judgements were made on each sample (number on panel X number of trials) and for complete consistency all 36 results should have appeared in the diagonal element of the table; the deviations shown are normal for a sensory judgement, and show no evidence of any trend with concentration. Table 1b shows the number of errors made by individual panel members; four panellists were satisfactorily accurate, but the last two were not.

Scores given for strength of taint were compared with the concentration of androstenone in fat in two trials. In the first, randomised groups of the synthetic lard solutions (3 samples per group) were presented to the panel

on 10 occasions, and in the second, boar fats were scored and then analysed chemically for androstenone.

Figure 1a shows the relationship between the panel mean scores for the lard solutions and the concentration of androstenone added. Figure 1b shows the degree of correlation obtained between the panel scores for taint in authentic boar fats and the concentration of androstenone subsequently determined by chemical analyses ($r = 0.46$, $P<0.001$).

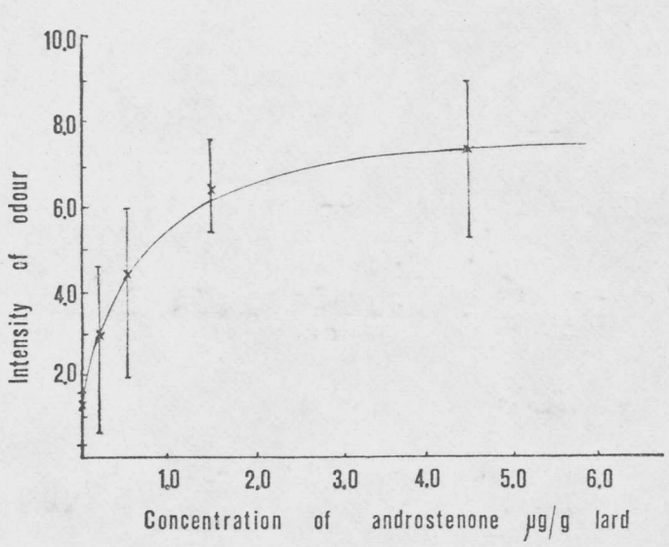

Figure 1a. Relationship between panel score for intensity of odour and concentration of androstenone added to lard. Range of individual scores shown by brackets.

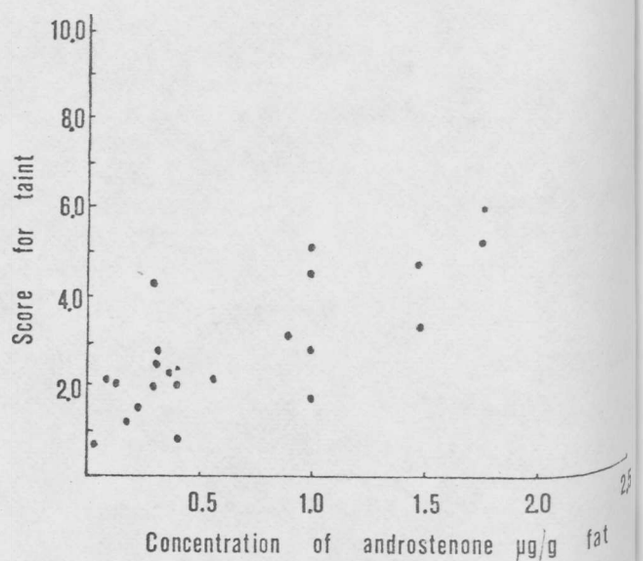

Figure 1b. Relationship between panel scores for intensity of boar taint and concentration of androstenone determined by chemical analysis.

Practical applications.

The method has been tested extensively in the abattoir on carcases on the line. Boars culled from a progeny testing programme have been examined either as a group or randomly mixed with hog and gilt carcases. In the laboratory, coded back fat samples (10 x 10cm) from boars, hogs or gilts have been tested on a routine basis for the presence of taint. All carcases or samples were from either Large White, Landrace, or Large White X Landrace pigs. None of the pigs was raised especially for the study, and although the total numbers are not large, there is no reason to believe that they are not representative of the three breed groups, which together comprise a large proportion of the national pig herd.

Results.

164 boars, comprising 60 Large White, 70 Landrace and 34 Large White X Landrace were tested for taint. Liveweights at slaughter ranged from 150 to 283 lb. (68.2 to 128.6 kg), and age from 159 to 260 days. 198 hogs and gilts were also examined, these pigs being in the normal bacon or heavy hog weight range.

The results for the groups of boars were analysed both individually and collectively. Comparing two equivalent sets of the Large White and Landrace boars (40 Large White, weight range 214 to 271 lb; 43 Landrace, weight range 212 to 283 lb.), the mean scores for taint was significantly higher ($P<0.05$) for the Landrace boars (5.1) than for the Large Whites (4.3). With the Landrace boars, there was a trend upwards for taint with increasing liveweight. The relationship between the distribution of the scores for taint for the two breeds and the percentage frequency is shown in Figure 2.

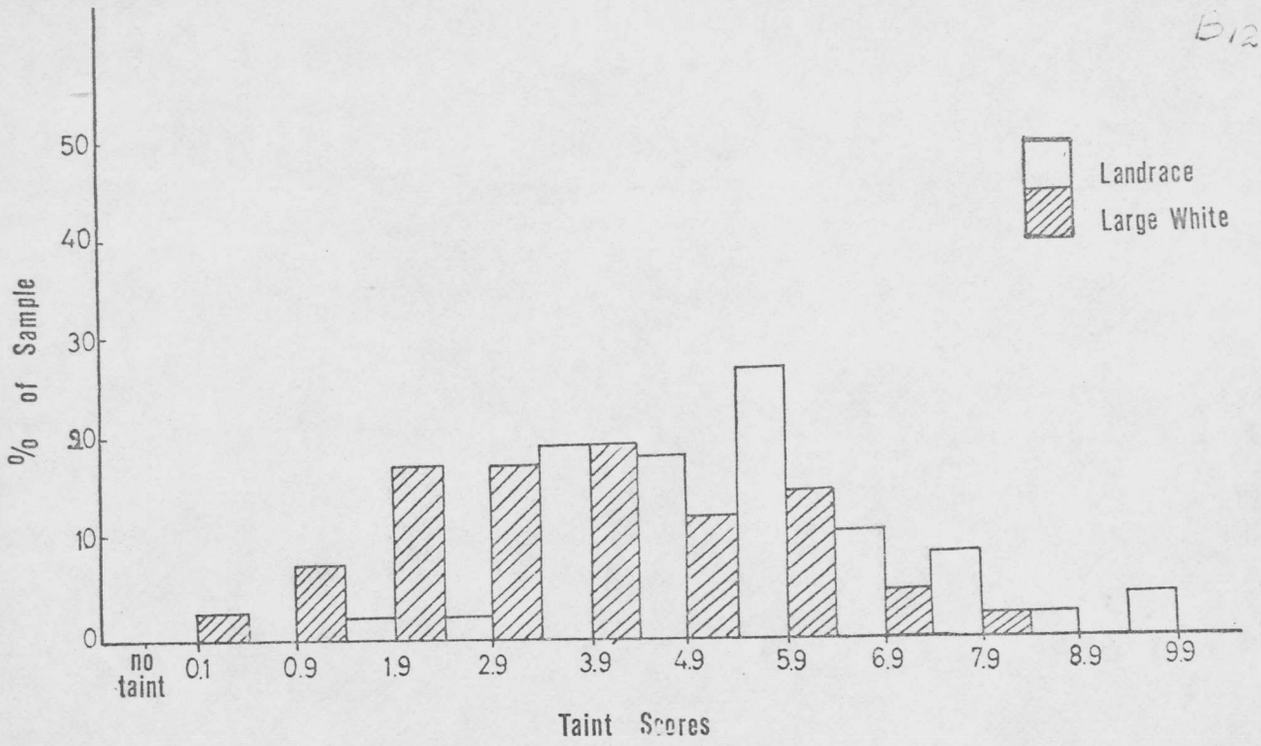

Figure 2. Relationship between percentage frequency and distribution of taint scores for comparable sets of Large White and Landrace boars.

Within each breed group separately, there was no significant correlation between age or weight and degree of taint (Figures 3 and 4). Similarly, there was no clear effect of growth rate nor, where data were available, of back fat thickness (C+K value) on the degree of taint.

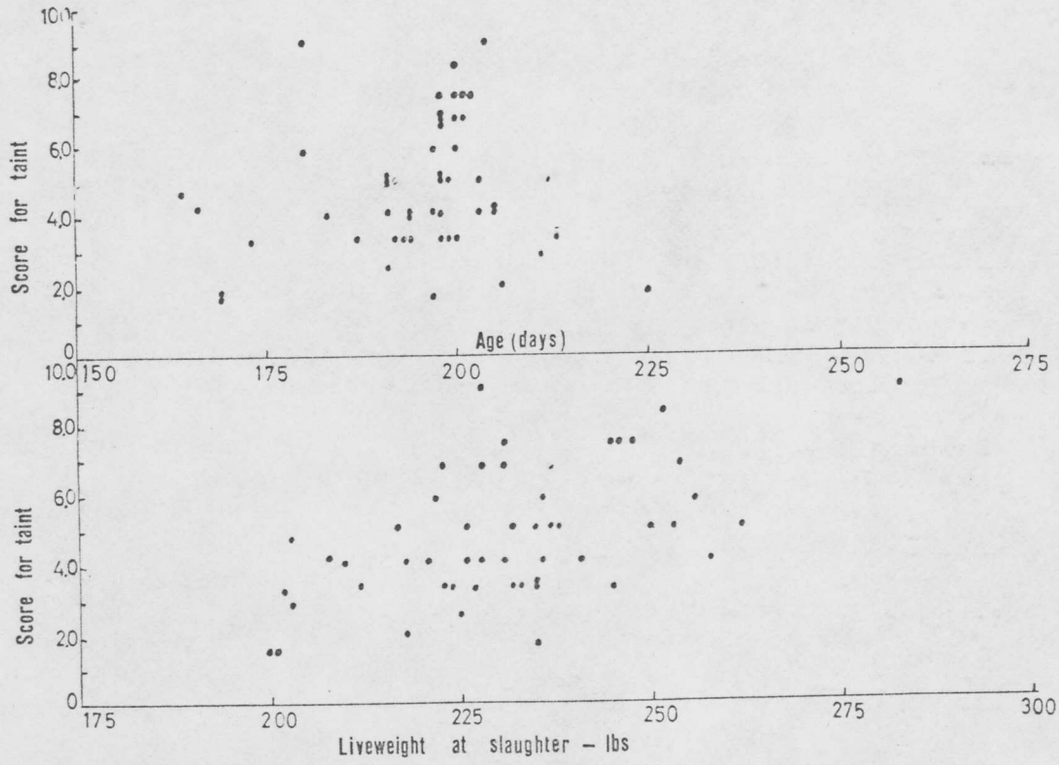

Figure 3. Relationship between score for taint and a) age, and b) weight, for Landrace boars.

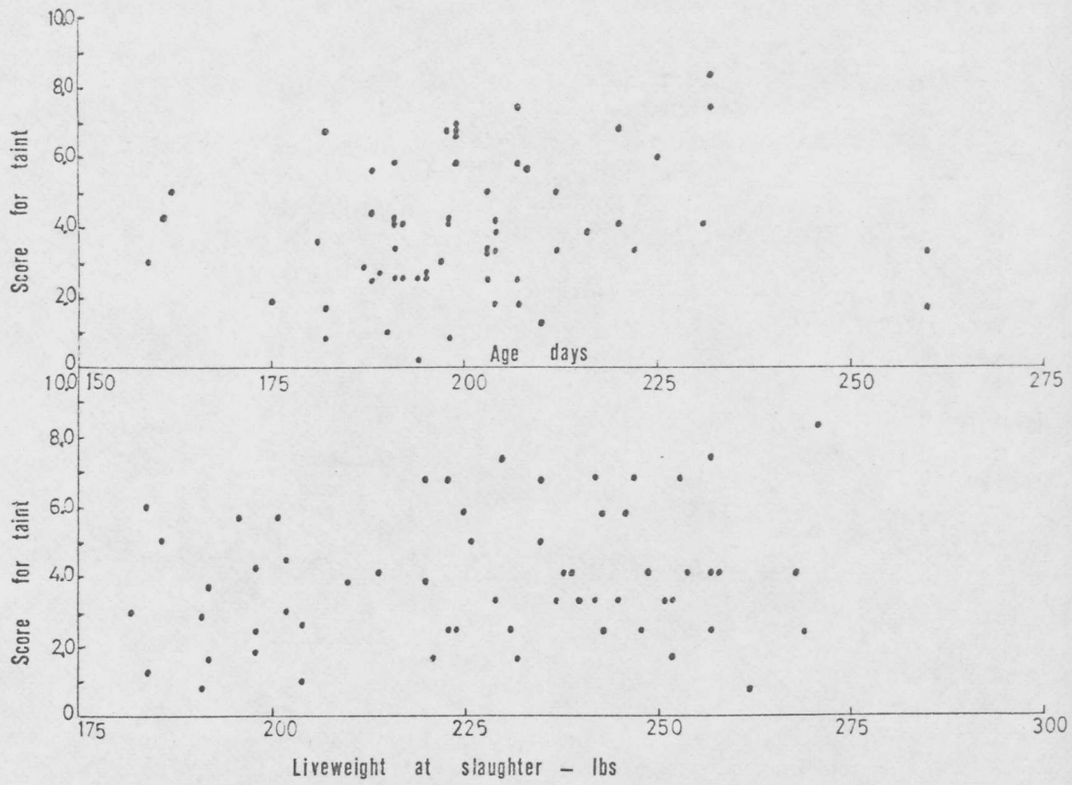

Figure 4. Relationships between scores for taint and a) age, and b) weight, for Large White boars.

The distribution of the scores for taint for all boars, hogs and gilts examined is shown in Table 2.

Table 2. Frequency distribution of taint scores for boars and hogs plus gilts expressed as a percentage of the number examined in each group.

Score for taint	Gilts + Hogs	Boars
No taint	50.5%	0.6%
0.1 to 0.9	44.2	3.7
1.0 to 1.9	4.3	8.5
2.0 to 2.9	1.0	14.6
3.0 to 3.9	0	17.7
4.0 to 4.9	0	19.5
5.0 to 5.9	0	16.5
6.0 to 6.9	0	10.4
7.0 to 7.9	0	5.5
8.0 to 8.9	0	1.8
9.0 to 9.9	0	1.2

94.7% of gilts and hogs appear in either the "no taint" or lowest taint groups, whereas only 4.3% of boars fall into these two categories. The ability of the panel to distinguish between boars and hogs and gilts, and the efficiency of the technique is demonstrated clearly by these results.

Discussion

In the consumer trials referred to previously,[2] no effect of taint on eating quality was detected until the concentration of androstenone in the fat exceeded 1.0 µg/g, corresponding to a subjective score for taint greater than 4.0. On this basis, it can be seen from Table 2 that 45% of the boars tested could have been used for bacon or pork production without the risk of consumer reaction.

In the event of future legislation encouraging the raising of boars for meat, it will be necessary to test all carcases for intensity of taint at the point of slaughter. Since neither age nor weight are correlated with taint in the average boar of potential commercial value, the test described in this paper, requiring only a few seconds for each judgement, could be effectively used to grade carcases for taint, and therefore prevent those with an unacceptably high concentration of androstenone from being passed as suitable for consumption as pork or bacon. Even in the absence of increased numbers of young boars, a rapid test for boar taint is still required in abattoirs at the present time to facilitate accurate evaluation of taint in cryptorchids (rigs), suspected late castrates, casualty boars, etc. In about half the rigs examined during the development of the technique, the scores for taint awarded by the panel contrasted markedly with the decisions of the graders regarding the degree of male character and hence the probable intensity of taint in the various carcases. The criteria upon which the "maleness" of a carcase and hence its commercial value are judged, are all secondary features and no account is taken of the actual odour of the heated fat.

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