BOAR MEAT: TESTS FOR TAINT AND CONSUMER RESPONSE

Introduction

Meat animal production practices have always favored the use of castration to avoid the several management problems associated with the entire male. Research in recent years has demonstrated that in growth rate, feed convession, carcass lean content and other desirable performance attributes the entire male is clearly superior to the castrate. For this reason the livestock industry has sought to develop management practices that will permit effective utilization of entire males for meat production.

This development has been less successful with pigs than with other meat animals because of the presence in boar fat of flavor compounds which may prove objectionable during the cooking process. Although this occurs with relatively low frequency among boars slaughtered at conventional live weights (i.e., 90 - 100 kg) the incidence is considered sufficient to justify special regulations in respect of handling carcasses from boars.

For example, entire male pigs are not accepted in federally inspected slaughter houses in Canada which account for virtually 100% of marketed pigs, and carcasses of any pigs inadvertently slaughtered at such a facility and having two properly formed testicles are condemned to tankage, while ridgelings (cryptorchids) are set aside. Fat samples from ridgeling carcasses are tested later by heating the fat to evaluate the odors given off, and the results of this test determine whether the carcass is accepted for human consumption or condemned.

The odor of heated boar fat, often described as perspiration or

urine-like, has been extensively studied, and the scores assigned by laboratory panels sensitive to this odor have correlated well with the amounts of 5α-androst-16-en-3-one (androstenone) in the fat (Fuchs, 1972; Tucker, 1971). In Great Britain, where there has been some consumer experience with boar meat, Rhodes (1971) carried out a study of consumer response to bacon from 6 month old boars and gilts, and showed that less than 1% of the consumers tested discriminated against bacon from boar carcasses. Because those bacon samples judged least favorably by the consumers were from boars with the highest androstenone content, it was suggested that any carcasses containing > 1 ug of the steroid per g fat be eliminated at the factory from bacon manufacture.

The following is a comparative consumer study in Canada, where very few consumers have experienced boar meat. Three subjective tests for undesireable odors in fat, and one chemical test for the presence of androstenone were assessed in relation to each other and the consumer reactions.

Materials and Methods

The pig population consisted of purebred Lacombes raised on a high plane of nutrition, fed ad lib, and slaughtered at about 90 kg liveweight. Age at slaughter averaged approximately 140, 144 and 146 days for boars, barrows and gilts, respectively. After an overnight chill, the carcasses were processed into commercial cuts and the left ham from each of 70 boars, barrows and gilts was cut into three transverse sections to provide roasts of about 2.5 kg each. No trimming of the fat was made. The left belly cut from each of these pigs was cured, smoked and cut into three pieces to provide additional material for consumer evaluation. The fresh roasts were sharp frozen after preparation

(about 36 hrs post mortem) as were the belly samples after curing. All material was distributed and evaluated within 8 weeks of freezing.

The consumers in the survey were from 210 families of 4 or more individuals, living in Central Alberta in rural (approximately 20%) and urban (80%) locations, the latter being towns and cities with populations of 3,000 to 30,000. The economy of the area is mainly agricultural, augmented with some light industry. The families were selected by regional home economists who personally delivered the meat, explained the evaluation sheets and advised on cooking methods; the home economists were informed only that the survey concerned pork palatability. While pork samples were roasted and bacon fried or grilled, spices and other condiments could be used as desired. Each family received samples from a boar, barrow and gilt carcass designated at random from the supply available. Four evaluation sheets, coded for reference purposes and included with each piece of bacon and pork, were to provide information about consumer opinions on the following:

Appearance:	overfat, normal, underfat
Cooking aroma:	above average, average, below average
Product flavor:	above average, average, below average

Any overall impressions or comments.

Three independent subjective assessments of "cooking aroma" were made on the fat of the carcasses, using the hot iron technique described by Jarmoluk et al. (1970) and Patterson and Stinson (1971). The first test performed independently by two people was on the hot carcass as it passed along the slaughter line; all of the boar carcasses were tested at this time, but it was not possible to test all of the barrows and gilts.

Samples of fat from each of the carcasses were coded and removed to

the laboratory where each was again independently evaluated by two persons. At both times, one person (evaluator A) evaluated the carcass fat for all objectionable odors while the other (evaluators B or C) scored the fat for the presence of boar taint (5α-androst-16-en-3-one). A scoring scheme similar to that used by Patterson and Stinson (1971) was followed.

A third subjective test was carried out by a panel of six, sensitive to the odor of androstenone and trained to recognize various quantities of this odor in boar fat samples.

The quantity of 5α-androst-16-en-3-one in kidney fat (Patterson, 1969) from the boar and a selection of barrow and gilt carcasses was determined by G.L.C. using a 5 ft, 1/4 in OD glass column packed with 1% OV 17 on chromasorb G.

Standard statistical procedures were used in analyses with particular attention given to concordance or otherwise of the laboratory and consumer responses.

Results and Discussion

Correlations of the consumer opinions for cooked bacon and pork aroma and flavor with the laboratory evaluation of the odor of carcass fat, the trained panel estimation of levels of boar taint in the fat, and the androstenone content of the fat for boars are summarized in Table 1. Slaughter line data were omitted in these analyses; these data were subject to bias since sex of the carcass was known at the time of evaluation. There was a significant relationship between evaluator A's scores for carcass fat odor and the consumers opinion of pork odor and pork flavor, but this was not the case with the scores of evaluators B and C and the consumer opinions (i.e., correlations involving A were substantially greater than those involving B and C). It

appears that evaluator A, who scored the carcass fat not only for the androstenone component but also for other objectionable odors, was a better predictor of consumer opinion of cooked pork aroma and flavor than were evaluators B and C who attempted to score only for the androstenone odor component in the carcass fat. It is of interest to note that the correlation between the scores of evaluator A and those of the trained panel were not significant while there was a significant relationship between evaluator B and the trained panel. This would again emphasize the fact that the trained panel was chosen for its sensitivity to androstenone, and was trained to detect various levels of this steróid in fat and to ignore the presence of other odors in the fat. It also emphasizes that androstenone per se is only one contributor to undesirable cooking aromas in boar pork. Although cross comparison of the correlations suggest a better relationship between the evaluations of A and B than A and C, the lack of any significant correlation between evaluator C and the other parameters prompted a division of the data for A into two parts, those evaluations carried out with B and those done with C. The difference in the correlation coefficients of A when boar carcasses were evaluated with B, and when evaluated with C indicated that laboratory evaluation data for the group of boars evaluated by A and B tended to be in better agreement with consumer data than those evaluated by A and C.

Correlations of the subjective estimates of carcass fat odor with the consumer opinions of bacon aroma and flavor did not show the same relationships as those with pork aroma and flavor. Furthermore there was a complete lack of correlation between flavor of bacon versus pork and of aroma of bacon versus pork (Table 2). It would thus appear that in the case of bacon the aroma imparted by the curing process had an important influence on consumer scores for flavor

and aroma. The consumer data of Table 2 do show good correlations for all three sexes between flavor and odor scores for each product indicating concordance in estimation of aroma and flavor.

Table 3 shows the relationship between the scores given by the trained panel on boar back fat samples and the concentration of androstenone in boar kidney fat. It was not possible to extend the range of subjective scores fully from 0 to 5, as the choice of scale allowed, because upon averaging of the individual scores assigned by panel members, the means fell within the range 0 to 4. The amounts of androstenone present in the fat within these ranges shows that the trained panel was principally evaluating the fat for this component. When the androstenone content of the fat was divided into ranges and tabulated against the mean panel scores these means did not increase regularly with androstenone content. This may indicate that panel members, although attempting to evaluate the fat for androstenone content only, may have been confused by other odors present in the fat. The data may simply indicate individual variation in response to increases in androstenone content.

Consumer opinions of boar, barrow and gilt pork were developed from a comparison of each of their responses to pork from all three sexes. It was found that 64% of the total number of responses (542) did not discriminate between boar, barrow or gilt pork i.e., scored roasts from all sexes equally. The responses of 4.6% of the population indicated that they did not like pork, i.e. scored roasts from all sexes below average. Ten percent of the population scored boar pork above the other two sexes, while an equal percentage discriminated against boar pork; 4.7% of the population preferred pork from barrow and gilts while 7.3% discriminated against one of these two sexes. These results show

that a high proportion of the population would not discriminate between any of the three sexes. However, 10% of the consumers would definitely pick out boar pork and discriminate against it as compared to around 3-4% discrimination against barrows or gilts. For this reason it appears that some type of screening procedure would be necessary if boar pork is to be as consistently acceptable to the consumer as barrow or gilt pork.

To explore the feasibility of a screening technique for boar carcasses, the responses from consumers who indicated they did not like pork (i.e., consumers who also downgraded pork from gilt and barrow) were deleted and the remaining consumer data tabulated against the subjective scores assigned by A. Although this approach to data interpretation is open to criticism the results (Table 4) indicate that subjective laboratory scores from 0 - 2 for boars would represent a product which would have consumer acceptability comparable to pork from the other sexes. Laboratory scores of 3 or greater would represent a product that would tend to be downgraded by many consumers.

The possibility of a screening procedure or an evaluation procedure at the time of slaughter was also explored in the study. The abattoir set-up dictated that the most appropriate position for on-the-line testing was from the grading platform (immediately after splitting of the carcasses and prior to the final rinse and cold storage). Although distractions and extraneous odors were present a fair evaluation of back fat odors was attained by use of the hot iron technique described by Jarmoluk et al. (1971).

Trials were also carried out in the coolers after the carcasses had been refrigerated 12 - 24 hrs as an alternative to on-the-line testing. Evaluations at this time were less successful because air currents created by the cooler fans tended to interfere with adequate assessment of the odors. Further, the close proximity of carcasses in the cooler and the low temperatures

in the cooler provided less than optimum working conditions. Although practical considerations might rule out both of these locations for routine testing the separation of boar carcasses could be readily accomplished at the time of slaughter. These could be racked separately and subjected to test at a more convenient time and/or location.

Although scores on the slaughter line were not used in the general statistical analyses because of possible bias, cross tabulations of the slaughter line data and laboratory scores showed good agreement between these two tests. Knowledge of the sex of the carcass during the on-the-line test did not seem to influence judgements. It is considered therefore that this technique could be used as a quick and efficient method of selecting boar carcasses on the slaughter line. Such a test could screen out carcasses considered undesirable to that proportion of the population who find the more odoriferous boar fats objectionable. The persons responsible for the screening procedure would have to be trained to detect undesirable odors in fat samples. Results of the current study have demonstrated that a test for androstenone only will not effectively remove carcasses to which consumers would object. The present study indicates that use of this screening technique would eliminate approximately 25% of the boar carcasses (i.e., aroma scores >2) while the rest when marketed as fresh pork would be acceptable to the consumer population. A further subdivision of the carcasses could possibly be made assigning 75% as fresh pork, 20% as suitable for processing and 5% completely eliminated.

Summary

Various tests for taint in boar carcasses were evaluated as predictors of consumer response to fresh pork and bacon. Neither subjective nor

chemical determinations for androstenone were well correlated with consumer evaluations for cooking aroma or flavor. However subjective evaluation for general aroma rather than androstenone per se, using a hot iron method did correlate satisfactorily with consumer opinion. Although a proportion of the population appear to enjoy the strong odor and flavor of some cooked boar meat, it is suggested that a quick screening test carried out on the slaughter line would eliminate carcasses which could be offensive to other segments of the population.

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Table 1. Correlation coefficients of consumer opinions of cooked bacon and pork, aroma and flavor, with various estimates of boar carcass fat aroma.

Laboratory evaluations	Aroma		Flavor		Trained Panel	Androstenone by Chemical Determination
	Bacon	Pork	Bacon	Pork		
A (Total Data)[1]	.20	.41	.08	.40	.21	.30
(with B)	.29	.25	.15	.48	.40	.29
(with C)	.18	.38	.29	.36	.07	.31
B	-.01	.02	.08	.03	.51	.27
C	-.10	.11	-.05	.22	.02	.32

[1]Two independent laboratory evaluations were done at any one time. One individual (A) evaluated all samples for the presence and degree of disagreeable odor per se. Two other individuals (B and C) scored only for the presence and degree of odor from 5α-androst-16-en-3-one. Each of B and C handled about half of the carcasses and their combined evaluations covered all samples.

Table 2. Correlation coefficients of consumer estimations of the aroma and flavor of cooked bacon and pork.

		All Consumers			
		BA	BFL	PA	PFL
Barrows	BA	-	.69	.11	.09
	BFL	.69	-	-.02	.06
	PA	.11	-.02	-	.57
	PF	.09	.06	.57	-
Gilts	BA	-	.68	-.11	-.24
	BFL	.68	-	-.01	-.04
	PA	-.11	-.01	-	.61
	PF	-.24	-.04	.61	-
Boars	BA	-	.80	.15	.20
	BFL	.80	-	.11	.15
	PA	.15	.11	-	.73
	PFL	.20	.15	.73	-

BA - Bacon aroma
BFL - Bacon flavour
PA - Pork aroma
PFL - Pork flavor

Table 3. Relationship between the trained panel scores and concentration of 5α-androst-16-en-3-one in boar fat.

Range of Trained Panel Scores	Androstenone Concentration µg/g fat
0 - 1[a]	0.46
1 - 2	0.64
2 - 3	1.16
3 - 4	1.53

Range of Androstenone Concentrations (µg/g fat)	Average Trained Panel Scores
0	0.9
.01 - .50	1.3
.51 - 1.00	1.5
1.01 - 1.50	1.3
1.51 - 2.00	2.0
2.01 - 2.50	-
2.51 - +	1.9

[a] 0 - no taint
5 - very strong taint

Table 4. A comparison of consumer opinions of the aroma of cooked boar pork roasts with subjective laboratory evaluation of the odor of the boar fat.

		Consumer Opinion of Aroma (number of responses)		
		1[b]	2	3
Evaluator A	0[a]	38	43	5
	1	32	79	11
	2	10	27	3
	3	14	36	12
	4	9	18	3

[a] 0 - no unpleasant odors
4 - very strong unpleasant odors

[b] 1 = better than average, 2 = average, 3 = below average