QUELQUES EFFETS DE CASTRATION SUR CARCASSES DE PORC MAIGRES ET DE PORCS GRAS

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Abrégé

Le quantité de gras, d'eau, de protéines, de cendre, de couenne et d'os a été évaluée:

1) Dans chaque moitié - côté gauché - de sept verrats "Large White
(3 d'entre eux abattus pour la viande à 120 livres, poids vif.
(4 abattus pour le bacon à 200 livres, poids vif.

2) Dans chaque moitié - côté gauche - de sept cochons "Large White castrés, le poids total du 1) étant pratiquement égal à celui de 2).

On a aussi évalué par le procédé organoleptique le degré de mauvais goût dans ces moitiés de viande.

Résultats:

- Les sept côtés provenant des bêtes castrées étaient plus gras que ceux des verrats mais contenaient moins d'eau et d'os.

- Les quatre côtés provenant des verrats et mentionnés ci-dessus possédaient davantage de couenne que ceux des cochons castrés de la même portée.

Partant sur une base excluant le gras, il n'y avait aucune différence entre les verrats et les cochons castrés à part:

a) Une couenne plus épaisse dans la moitié gauche des 4 verrats abattus pour le bacon.
b) La quantité de nitrogene allant en augmentant du poids de la viande de porc a celui du bacon.
c) La quantité de "muscle" (coupe ou côté excluant le gras, les os et la couenne) dans les pattes représentant un pourcentage du "muscle total" dans les côtés respectifs, était d'1% plus élevée dans celles provenant des cochons castrés (côté gauche) que dans celles des verrats (côté gauche).
d) La quantité d'os (en tant que pourcentage du total en os des côtés respectifs) dans les épaules des verrats (côté gauche) était d'environ 1% plus e'levée que dans les épaules des bêtes castrées.

L'évaluation organoleptique des côtelettes de filet - côté droit - n'a revélé aucun mauvais goût indésirable dans les carcasses de verrat.

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SOME EFFECTS OF CASTRATION ON PIG CARCASES OF PORK AND BACON WEIGHTS

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ABSTRACT

Left sides from seven Large White boars (three of which were slaughtered at pork weight, 120 lb. liveweight and four at bacon weight, 200 lb. liveweight) and seven Large White castrated pigs of comparable weights were quantitatively evaluated for fat, moisture, protein, ash, skin and bone, and organoleptically evaluated for taint. The sides from the castrated animals were fatter than those from the boars, but contained less moisture and less bone. The sides from the bacon weight boars contained more skin than those from the castrated litter mates. On a fat-free basis there was no difference between boars and castrates except that there was more skin in the boar sides at bacon weight. Nitrogen on a fat-free basis was found to increase from pork to bacon weight. The amount of "muscle" (cut or side on a fat, bone and skin-free basis) in the legs expressed as a percentage of the total "muscle" in the respective sides was greater by about one per cent in those from the castrated sides than in those from the boar sides. The amount of bone (as a percentage of the total bone in the respective sides) in the shoulders of the boar sides was greater by about one per cent than that in the shoulders of the castrates. Organoleptic evaluation of loin chops from the right sides did not reveal any undesirable taint in boar carcases.

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EINIGE KASTRATIONSEFFEKTE IN SCHWEINEKÖRPERN VON KLEINEREN UND GRÖSSEREN GEWICHTEN

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ZUSAMMENFASSUNG

Linke Seiten von sieben Large White Ebern (wovon drei zu 120 lb. Lebendgewicht und vier zu 200 lb. Lebendgewicht geschlachtet wurden) und sieben Large White Kastraten vergleichbaren Gewichts, wurden für Fett, Feuchtigkeit, Eiweiss, Asche, Schwarte und Knochen quantitativ und für Verdorbenheit organoleptisch ausgewertet. Die Seiten von den Kastraten enthielten mehr Fett als jene von den Ebern, hatten aber weniger Feuchtigkeit und weniger Knochen. Die Seiten von den zum grösseren Gewichte geschlachteten Ebern enthielten mehr Schwarte als jene von Kastraten aus derselben Tracht. Auf einer fettfreien Basis war kein Unterschied zwischen Ebern und Kastraten, mit der Ausnahme, dass es an den Seiten von den zum grösseren Gewichte geschlachteten Ebern mehr Schwarte gab. Stickstoff auf einer fettfreien Basis nahm vom kleineren bis zum grösseren Gewicht zu. Der "Muskelanteil" (Fleischstück oder Seite auf einer fett-, knochen- und schwartenfreien Basis) in den Beinen, als Prozent des gesamten "Muskels" in den betreffen Seiten ausgedrückt, war um ca. 1% grösser in jenen von den Kastraten als in jenen von den Ebern. Der Knochenanteil (als Prozent des gesamten Knochens in den betreffenden Seiten ausgedrückt) in den Schultern der Eber war um ca. 1% grösser als in den Schultern der Kastraten. Organoleptische Auswertung der Lendenstücke von den rechten Seiten hat keine unerwünschte Verdorbenheit in den Eberkörpern entdeckt.

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SOME EFFECTS OF CASTRATION ON PIG CARCASES OF PORK AND BACON WEIGHTS

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Left sides from seven Large White boars (three of which were slaughtered at pork weight, 120 lb. liveweight and four at bacon weight, 200 lb. liveweight) and seven Large White castrated pigs of comparable weights were quantitatively evaluated for fat, moisture, protein, ash, skin and bone, and organoleptically evaluated for taint. The sides from the castrated animals were fatter than those from the boars but contained less moisture and less bone. The sides from the bacon weight boars contained more skin than those from the castrated litter mates. On a fat-free basis there was no difference between boars and castrates except that there was more skin in the boar sides at bacon weight. Nitrogen on a fat-free basis was found to increase from pork to bacon weight. The legs of the castrates had about one per cent more of total "muscle" (cut or side on a fat, bone and skin free basis) than the legs of the boars. About one per cent more of total bone occurred in the shoulders of the boars than in the castrates. Organoleptic evaluation of loin chops from the right sides did not reveal any undesirable taint in boar carcases.

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INTRODUCTION

The object of the work discussed in this paper was to compare the quantitative carcase composition of castrated and uncastrated male pigs and to determine if any difference in taste or odour could be detected between the meat from the two types of carcase.

Four male pigs (Large White) were selected from each of four litters. Two of each litter were castrated at seven weeks of age and the other two left entire. From ten weeks of age to pork weight (120 lb.) all the pigs were fed a proprietary sow and weaner ration. Those carried to bacon weight (200 lb.) were fed a proprietary fattening ration from pork weight to slaughter. Feeding was according to a scale based on liveweight (weekly weighings). The pigs were individually fed twice a day and housed as a group.

Post-mortem inspection revealed that one of the pork pigs was suffering from tuberculosis. The carcase from this pig and the carcase of its litter mate (pork weight) were not evaluated. In the statistical analysis missing plot values were calculated for these carcases.

Taint in boar meat

The American worker Self (1) in 1957 reported that consumer complaints regarding "off flavour" or "off odour" in pork had caused some concern within the meat trade in the United States. He stated that most pork processing establishments avoid slaughtering boars, or processing boar carcases because of the "sex odour" alleged to be associated with them and the resultant contamination of the finished product. Lerche (2) working in Germany in 1936 stated "as soon as the male pig is sexually mature and the testes become capable of functioning, there appears a specific odour in the meat and the

fat of the animal, and the odour which is onion-like or unpleasantly perspirative, occurs in all boars with normally developed testes. It is also always present in cryptorchids unless the testes lying in the abdominal cavity are atrophied. The odour-bearing substances from the testes are regularly transmitted to the body." Lerche assumed that sex odour would disappear after castration. Self (1) cites an American survey which refutes the assumption that "sex odour" occurs only in boars and crytorchids. The survey showed that out of 162 males and 181 females slaughtered, approximately 17% of each sex were offenders as regards "sex odour." From his work he concludes that sex and breed have little influence on the overall incidence of "sex odour" or "boar odour" in pork. He considers that there is insufficient data available at present regarding certain stages of reproduction, weight, stress, endocrine balances and season of the year, to give a good indication of their importance in relation to "sex odour."

Craig, Pearson and Webb (3) in 1962 carried out studies on the chemical nature of the substances responsible for "boar odour". They found that the causative agents were located in the unsaponifiable matter of the fat, but that cholesterol and squalene were not responsible. They reported that the odour could be detected at body temperature, but was much more pronounced at 100° - 108°C. They found that heating excised preputial glands of boars failed to produce a more intense sexual odour than heating boar fat alone. Butt, Simpson, Christian and Barnhart (4) in 1959 had suggested that the odour was produced in these glands. Graig et al (3) cite a personal communication of Christian and Turk (1958) which states that boar

odour was less prevalent in tissues frozen for 5 months than in fresh unfrozen samples from the same animal. Ohio workers (5) recently stated that the objectional sex odour and flavour of the meat from boars could be almost eliminated by treating boars with diethylstilbestrol during the latter stage of the feeding period.

EXPERIMENTAL METHODS

Dissection procedure, sampling of muscular and fatty tissues and analysis of the tissues.

After chilling and reweighing, the left side of each carcase was dissected into leg, back, belly and shoulder. The dissection procedure, sampling of the muscular and fatty tissues and methods of analysis of the tissues were carried out as described by Hill and O'Carroll (6)*, except that the subcutaneous fatty tissue in the pork weight pigs was not separated from the cuts.

Definitions of terms used.

Meat: Cut or side which has skin and bone removed.

Lean: Cut or side which has skin, bone and subcutaneous fatty tissue removed.

Muscle: Cut or side on a fat, bone and skin free basis, or the components protein, moisture and ash in meat, including those contributed by subcutaneous, inter and intramuscular fatty tissue.

Fat: Petroleum ether, 40 - 60 extract.

Protein: Nitrogen x 6.25.

* See Appendix V and Figures I and II.

Organoleptic evaluation

Triangular flavour evaluation tests were carried out on fried loin chops from the right sides of the seven boars and similar chops from the seven castrated animals, to investigate whether any undesirable taint or any difference in flavour could be detected. Comparisons were made between litter mates which had been slaughtered at similar weights. In the case of the pork weight pigs the carcases were chilled for periods of from four to five days and the loin chops were then evaluated. All the loins from the right sides of the bacon weight pigs with the exception of one, were frozen in polythene bags for periods ranging from eleven to twenty eight days. This procedure was necessary in order to make comparisons on a within litter basis. One loin from a bacon weight carcase was evaluated after the carcase was chilled for five days. During each of the seven tasting sessions which were carried out on different days, one pair of loins (one boar and one castrate from the same litter) was used. From each pair, three cuts were prepared, two cuts being from one loin of the pair and one from the second. At each session a panel of from fourteen to seventeen judges out of a total of 25 research and field personnel, were presented with three samples (one from each cut), for appraisal. The judges were asked to indicate (a) which two of the three samples were alike, (b) whether the flavour difference between the odd and like samples was "none," "slight," "moderate," or "much." (c) if either "moderate" or "much" was indicated under (b), whether either the odd sample or the like pair was considered to have an undesirable flavour, (d) flavour ratings for the odd and the like samples, the rating in each case to be indicated by a check mark on a scale marked with the levels, "very poor," "poor," "fair," "good" and "excellent." The ratings were assigned numerical equivalents of 1, 3, 5, 7 and 9 respectively, intermediate ratings being given the intervening even values.

RESULTS

The data obtained at slaughter are shown in Table I. There was no significant difference between boars and castrates in age at slaughter, hot carcase weight, or hot carcase weight as percentage of farm liveweight. Both the fore and the hind feet of the bacon weight boars constituted a higher percentage of the hot carcase weight than did those of the castrates. There was no appreciable difference between the feet of the boars and castrates at pork weight.

(Table I near here)

Average composition of the left sides

Table IIA shows the average composition of the left sides for each treatment. The percentage of fat in the boars was lower than that in the castrates, but the percentage of moisture, protein and bone was higher. In the case of ash and skin there was a significant interaction between treatment and slaughter weight. There was no difference in percentage skin between boars and castrates at pork weight, but there were significantly higher percentages of ash and skin in the boars than in the castrates at bacon weight. The percentage of fat in the bacon weight pigs was significantly higher than that in the pork weight pigs and the percentages of moisture, ash, skin and bone significantly lower.

(Tables IIA & IIB near here)

Average composition of the left sides on a fat-free basis

Table IIB shows the average composition of the left sides on a fat-free basis. The only significant difference between the castrates and boars was the higher percentage of skin in the boars. Here again there was a significant interaction between treatment and slaughter weight as there was only a slight difference

between skin contents of boars and castrates at pork weight. There was a marked difference between pork and bacon sides. The bacon sides had 0.78 per cent more moisture, 1.28 per cent more protein, 0.58 per cent less skin and 1.48 per cent less bone than the pork sides. These differences were statistically significant.

(Table IIC near here)

Average composition of "muscle" in the left sides

Table IIC shows the average composition of the left sides on a fat, bone and skin free basis, or of "muscle" in the left sides. There was no significant difference between boars and castrates. Protein percentage in bacon sides was higher by 1.08 per cent than that in pork sides and the difference was highly significant. Moisture percentage in bacon sides was lower than in pork sides by 1.03 per cent. The difference was significant at the 1% level.

Percentage of cuts in the sides

Table IIIA shows that there was no significant difference between boars and castrates in the percentage of leg, back and belly in the respective sides. There was a statistically significant higher percentage of shoulder in the boar sides. There was a statistically significant higher percentage of leg and a statistically significant lower percentage of back in the pork than in the bacon pigs.

(Table IIIA near here)

Percentage of fat in each cut as a percentage of total fat in the side

Table IIIB shows that the backs of the castrates had a significantly higher percentage of fat than the backs of the boars. The bacon sides showed a statistically higher percentage of fat in the back and a lower percentage in the

shoulder when compared to the pork sides.

(Table IIIB near here)

Percentage of "muscle" in each cut as a percentage of the total "muscle" in the side

A significantly higher percentage of the "muscle" in the side occurred in the legs of the castrated sides than in the legs of the boars (Table IIIC). Differences were not statistically significant for the other three cuts. The bacon sides had a significantly higher percentage of muscle in the back than had the pork sides and a significantly lower percentage in the leg. There was no significant difference between shoulders or between bellies.

(Tables IIIC and IIID near here)

Percentage of bone in each cut as a percentage of total bone in the side

Table IIID shows the results for bone. A statistically significantly higher percentage of the total bone occurred in the shoulders of the boars than in the castrates. The pork sides had a significantly higher percentage of bone in the legs and a significantly lower percentage in the backs than had the bacon sides.

Composition of the cuts

(a) Sides from boars compared with sides from castrates

The composition of the cuts is given in Appendices I - IV. As in the case of the sides, the cuts from the castrates have a higher percentage of fat. In both the shoulder and back there was a statistically significant higher percentage of skin in the bacon weight boars when the values were calculated on a fat-free basis. There was no significant difference between

boars and castrates in the composition of "muscle."

(b) Pork weight sides compared with bacon weight sides

In each of the four bacon weight cuts there was a significantly higher percentage of fat than in the pork weight cuts and a significantly lower percentage of bone. There was no significant difference in percentage protein between the two types of carcase. On a fat-free basis, the bacon weight sides had a significantly higher percentage of protein in all cuts, and a significantly lower percentage of bone. The "muscle" of the bacon weight sides had a higher percentage of protein in all cuts and a lower percentage of moisture than the pork weight sides.

Organoleptic evaluation

Of the 104 subjective assessments made, only 45 were correct as regards the choice of the odd sample. At the 5% level this figure is just significantly different from the value of 104/3 = 34.7 expected on the null hypothesis that judges were completely incapable of distinguishing between samples from different carcases and provides evidence that some flavour discrimination was possible. Of the 104 assessments made, 56 were from bacon weight carcases and of these, 25 were correct as regards the choice of odd sample. At the 5% level this figure is slightly short of significance (26 correct choices would have been significant). In the evaluation of the loins from the pork weight carcases, 48 assessments were made and of these 20 were correct as regards choice of the odd sample. This figure at the 5% level is not significantly different from the value of 48/3 = 16, expected if the previously mentioned null hypothesis holds.

Under item (b) on the taste panel form, the tasters were asked whether the

flavour difference between the odd and like samples was "none," "slight," "moderate," or "much." The values 0, 1, 2, 3, respectively were assigned to these ratings and regarded as positive if the castrates were preferred and negative if the boars were preferred. In the 20 pork weight evaluations (out of a total of 48) where the correct choice of odd sample was made the average flavour difference as defined in this way was -0.05 and was not significant ($t = -0.14$ with 19 degrees of freedom). In the case of the eight bacon weight loins, 25 judgements out of a total of 56 were correct as regards the choice of odd sample. In these 25 evaluations the average flavour difference was +0.88 and was significant at the 1% level ($t = 3.02$ with 24 degrees of freedom).

In the case of the six pork weight loins, the presence of an undesirable flavour was recorded in 15 out of 48 assessments. Five of these were in boar loins, three in castrated loins and seven were in pairs of samples (one boar and one castrate incorrectly judged to be from the same carcase).

In the case of the eight bacon weight pigs, the presence of an undesirable flavour was recorded in 18 out of 56 assessments. Eight of these were in boar loins, five in castrate loins and five were in pairs of samples (one boar, one castrate) which had been incorrectly judged to be from the same carcase. These results, both in the case of the pork weight and bacon weight pigs, are consistent with the hypothesis that an undesirable flavour is equally likely to be recorded in samples from either boar or castrate loins.

(Table IV near here)

Flavour ratings

Taking into account only the 19* judgements where a correct choice of

* There were actually 20 correct choices of odd sample in the pork weight loins and 25 correct choices in the bacon weight loins, but in each set one flavour rating was inadvertently not recorded.

odd sample was made in the pork weight loins, the average flavour rating (on a scale 1 = very poor, 9 = excellent) was 6.47 for boar and 6.37 for castrate samples. (Table IV). The difference is not significant (t = 0.16 with 18 degrees of freedom). In the loins from the bacon weight pigs, taking into account only the 24* judgements where a correct choice of odd sample was made the average flavour rating was 6.08 for boar and 7.08 for castrate samples. The difference is significant (t = 2.22 with 23 degrees of freedom) at the 5% level.

To sum up, the tests provided no evidence of an undesirable taint in loin chops from boar carcases. At the bacon weight stage there was a slight preference in flavour ratings for the chops from the castrates.

DISCUSSION

The results show that castration increases the amount of fat in the side, particularly in the bacon weight pigs. This increase in fat is reflected in a reduction of the amounts of other constituents in the side. Bacon weight boar sides had 1.38 per cent more skin than those of their castrated litter mates (Table IIA) and 1.23 per cent more on a fat-free basis (Table IIB). Similar results on a whole carcase basis have been reported by Wallace (7). There was no significant difference in the composition of the "muscle" of the two types of sides (Table IIC). It would appear that castration has some effect on the shape of the carcase, as about one per cent more of the

* There were actually 20 correct choices of odd sample in the pork weight loins and 25 correct choices in the bacon weight loins, but in each set one flavour rating was inadvertently not recorded.

total muscle occurred in the legs of the castrates than in the legs of the boars (Table IIIC) and about one per cent more of the total bone occurred in the shoulders of the boars (Table IIID). The coefficients of variation in Tables III (A to D) indicate that a consistently much higher error is associated with the statistical analysis of the belly than the other three cuts. This is most probably due to inaccuracies in cutting the belly.

Comparison of pork and bacon weight sides

Pork and bacon weight sides showed no significant difference in percentage protein (Table IIA), but when the sides were compared on a fat-free basis (Table IIB), the bacon sides were seen to have had 1.28 per cent more protein than the pork and 1.48 per cent less bone. Hill and O'Carroll (6) reported a higher percentage of protein and lower percentage of bone in bacon pigs than in pork pigs when compared on a fat-free basis. John (8), reported a similar upward trend in nitrogen on a fat and bone free basis as liveweight increases.

CONCLUSIONS

The work suggests that the quantitative composition of the boar carcases is more desirable from a commercial point of view than the carcases from castrates, because the castrates contained less protein and and more fat than the boars, although at bacon weight boars contained appreciably more skin than the castrates. No definite conclusions regarding boar odour can be drawn from the work on account of the limited number of animals studied.

The results presented suggest that production from boars may have commercial advantages. However, further investigations using a much larger number of animals is desirable. Future work should include toughness studies and other qualitative evaluations.

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TABLE I

Slaughter data — Average difference or Average

	Pork weight		Bacon weight		Percentage difference		Standard error[1]	Coefficient of variation[2]	Significance of interaction, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Average age at slaughter (days)	152.3	152.3	219.8	226.8	-3.5 NS	-71.0***	2.44	2.60	NS
Average hot carcase weight (Kg)	37.8	38.0	67.3	67.1	0.1 NS	-29.3***	0.70	2.65	NS
Hot carcase weight as a percentage of farm liveweight (Kg)	67.7	67.5	73.1	73.5	-0.01 NS	- 5.7***	0.79	2.25	NS
Average head weight as a percentage of hot carcase weight	8.98	9.13	7.66	7.62	-0.05 NS	1.42***	0.21	5.04	NS
Average forefoot weight as a percentage of hot carcase weight	0.69	0.68	0.64	0.54	0.05*	0.10***	0.02	6.10	*
Average hindfoot weight as a percentage of hot carcase weight	0.98	0.97	0.86	0.76	0.05*	0.17***	0.02	4.14	*

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

TABLE II A

Average composition of the left sides

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coeff-icient[2] of variation	Significance of inter-action, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Percentage fat	15.94	18.56	20.17	27.18	-4.82**	-6.42***	0.93	9.08	NS
" moisture	51.90	50.35	49.68	45.80	2.72*	3.38**	0.83	3.35	NS
" protein	13.48	13.00	13.61	12.77	0.66**	0.05 NS	0.18	2.77	NS
" ash	0.78	0.78	0.74	0.68	0.03*	0.07***	0.01	2.82	*
" skin	5.70	5.56	5.46	4.08	0.76**	0.86**	0.17	6.66	**
" bone	12.20	11.76	10.34	9.49	0.64*	2.06***	0.23	4.16	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

TABLE II B

Average composition of the left sides on a fat-free basis

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coefficient[2] of variation	Significance of interaction treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Percentage moisture	61.75	61.81	62.24	62.89	-0.36 NS	-0.78 NS	0.40	1.30	NS
" protein	16.04	15.96	17.04	17.53	-0.20 NS	-1.28***	0.17	2.08	NS
" ash	0.93	0.96	0.92	0.94	-0.02*	0.02 NS	0.01	1.92	NS
" skin	6.77	6.82	6.83	5.60	0.59*	0.58*	0.17	5.18	**
" bone	14.51	14.45	12.96	13.05	-0.02 NS	1.48**	0.39	5.73	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

TABLE II C

Average composition of "muscle" in the left sides on a fat-free basis

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coefficient of variation[2]	Significance of interaction, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Percentage moisture	78.45	78.51	77.60	77.31	0.11 NS	1.03**	0.20	0.52	NS
" protein	20.37	20.27	21.25	21.54	-0.09 NS	-1.08***	0.20	1.90	NS
" ash	1.18	1.22	1.15	1.15	-0.02 NS	0.05**	0.01	2.12	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

TABLE III A

Average percentage of each cut in a side

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coeff-icient of variation[2]	Significance of interaction, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Leg as percentage of side	31.68	32.02	29.93	30.90	-0.65 NS	1.43**	0.40	2.55	NS
Shoulder as percentage of side	34.04	33.40	33.83	32.44	1.01*	0.58 NS	0.37	2.19	NS
Back as percentage of side	21.24	22. 19	23.45	24.37	-0.93 NS	-2.19**	0.48	4.21	NS
Belly as percentage of side	13.04	12.40	12.79	12.30	0.56 NS	0.17 NS	0.66	10.40	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

TABLE III B

Average percentage of fat in each cut as a percentage of total fat in a side

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coefficient of variation[2]	Significance of interaction, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Fat in leg as percentage of total fat in side	23.05	22.98	22.22	24.02	-0.86 NS	-0.10 NS	0.90	7.78	NS
Fat in shoulder as percentage of total fat in side	31.88	31.92	30.29	28.40	0.92 NS	2.56**	0.48	3.14	NS
Fat in back as percentage of total fat in side	28.59	30.30	30.90	32.28	-1.54*	-2.14**	0.60	3.92	NS
Fat in belly as percentage of total fat in side	16.48	14.79	16.59	15.31	1.48 NS	-0.33 NS	1.09	13.74	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

TABLE III C

Average percentage of "muscle" in each cut as a percentage of total "muscle"

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coefficient of variation[2]	Significance of interaction, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Muscle in leg as percentage total muscle	33.84	34.75	32.52	33.95	-1.17*	1.06*	0.35	2.07	NS
Muscle in shoulder as percentage total muscle	34.00	33.48	34.43	33.60	0.67 NS	-0.27 NS	0.34	1.98	NS
Muscle in back as percentage total muscle	19.26	19.58	20.75	20.83	-0.20 NS	-1.37*	0.46	4.54	NS
Muscle in belly as percentage total muscle	12.90	12.18	12.30	11.62	0.70 NS	0.58 NS	0.60	9.88	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

TABLE III D

Average percentage of bone in each cut as a percentage of total bone in a side

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coefficient of variation[2]	Significance of interaction, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Bone in leg as percentage of total bone	33.80	33.95	31.28	32.83	-0.85 NS	1.82*	0.60	3.62	NS
Bone in shoulder as percentage of total bone	39.68	38.33	40.25	39.44	1.08*	-0.84 NS	0.37	1.86	NS
Bone in back as percentage of total bone	21.80	22.86	24.08	23.42	-0.20 NS	-1.42**	0.36	3.16	*
Bone in belly as percentage of total bone	4.72	4.86	4.39	4.31	-0.03 NS	0.44 NS	0.32	13.81	NS

Significance levels: * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

TABLE IV

Flavour ratings on the 43 judgements where a correct choice of odd sample was made. (1 = very poor, 9 = excellent).

	Day	Boar loins			Castrate loins			Average castrate ratings, minus average boar ratings
		Total flavour rating	No. of correct choices	Average flavour rating	Total flavour rating	No. of correct choices	Average flavour rating	
Pork weight carcases	1	57	8	7.1	48	8	6.0	-1.1
	2	32	6	5.3	42	6	7.0	1.7
	3	34	5	6.8	31	5	6.2	0.4
Combined		123	19	6.47	121	19	6.37	
Bacon weight carcases	4	44	7	6.3	50	7	7.1	0.8
	5	25	4	6.2	26	4	6.5	0.3
	6	48	7	6.9	51	7	7.3	0.4
	7	29	6	4.8	43	6	7.2	2.4
Combined		146	24	6.08	170	24	7.08	

APPENDIX I

Average composition of the leg

Composition of leg	Pork weight: Boar	Pork weight: Castrate	Bacon weight: Boar	Bacon weight: Castrate	Average percentage difference: Boar versus castrate	Average percentage difference: Pork versus bacon	Standard error[1]	Coefficient of variation[2]	Significance of interaction, treatment x slaughter weight
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Percentage fat	11.50	13.23	15.13	21.19	-3.89**	-5.79***	1.05	13.74	NS
" moisture	55.42	54.46	53.86	50.12	2.35*	2.94*	0.96	3.59	NS
" protein	14.46	14.29	14.92	14.23	0.43 NS	-0.19NS	0.24	3.25	NS
" ash	0.85	0.88	0.82	0.74	0.01 NS	0.09***	0.01	3.40	**
" skin	4.78	4.69	4.48	3.64	0.47 NS	0.67*	0.22	9.80	NS
" bone	12.99	12.45	10.80	10.07	0.63*	2.29***	0.22	3.88	NS
Composition of fat-free leg									
Percentage moisture	62.60	62.74	63.46	63.60	-0.14 NS	-0.86 NS	0.42	1.31	NS
" protein	16.34	16.46	17.57	18.04	-0.29 NS	-1.41***	0.21	2.41	NS
" ash	0.96	1.02	0.96	0.94	-0.02 NS	0.04 NS	0.02	4.11	NS
" skin	5.40	5.40	5.27	4.63	0.32 NS	0.45 NS	0.24	9.08	NS
" bone	14.70	14.38	12.73	12.79	0.13 NS	1.78**	0.39	5.73	NS
Composition of leg "muscle"									
Percentage moisture	78.35	78.21	77.40	77.01	0.26 NS	1.08**	0.24	0.63	NS
" protein	20.44	20.52	21.43	21.85	-0.25 NS	-1.16**	0.23	2.16	NS
" ash	1.21	1.28	1.17	1.14	-0.02 NS	0.09*	0.03	4.42	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.

2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance was made for the fact that there were two missing plots

Average APPENDIX 11

Average composition of the shoulder

	Pork weight		Bacon weight		Average Percentage difference		Standard[1] error	Coefficient[2] of variation	Significance of interaction treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Composition of shoulder									
Percentage fat	14.99	17.79	18.04	23.81	-4.28**	-4.54**	0.91	9.73	NS
" moisture	52.11	50.83	50.84	47.83	2.14*	2.14*	0.83	3.28	NS
" protein	13.29	12.74	13.57	12.84	0.64*	-0.19 NS	0.19	2.88	NS
" ash	0.75	0.76	0.74	0.70	0.02 NS	0.04 NS	0.02	4.21	NS
" skin	4.64	4.39	4.51	3.30	0.73**	0.61*	0.19	9.03	*
" bone	14.23	13.49	12.30	11.54	0.75*	1.94***	0.27	4.16	NS
Composition of fat-free shoulder									
Percentage moisture	61.30	61.82	62.03	62.77	-0.63 NS	-0.84 NS	0.45	1.44	NS
" protein	15.64	15.50	16.55	16.83	-0.07 NS	-1.12***	0.18	2.22	NS
" ash	0.87	0.92	0.90	0.91	-0.03 NS	-0.01 NS	0.01	3.10	NS
" skin	5.45	5.34	5.50	4.32	0.64*	0.48*	0.19	7.30	*
" bone	16.73	16.43	15.02	15.16	0.08 NS	1.49*	0.45	5.69	NS
Composition of shoulder "muscle"									
Percentage moisture	78.78	79.03	78.04	77.96	-0.08 NS	0.90**	0.22	0.56	NS
" protein	20.09	19.80	20.82	20.90	0.10 NS	-0.92**	0.22	2.18	NS
" ash	1.14	1.18	1.14	1.13	-0.02 NS	0.02 NS	0.02	3.41	NS

*Significance levels: *5 per cent, ** 1 per cent, ***0.1 per cent, NS non-significant. 1. Standard error of the figures in colums 1 – 4*
2. Standard error expressed as a percentage of the mean of the figures in colums 1 – 4. In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

APPENDIX III

Average composition of the back

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coefficient of variation[2]	Significance of interaction, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
Composition of back	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Percentage fat	21.46	25.41	26.48	35.93	-6.70***	-7.77***	0.98	7.17	*
" moisture	46.71	44.06	43.61	38.77	3.74**	4.20***	0.73	3.39	NS
" protein	12.43	11.82	12.36	11.29	0.86**	0.32 NS	0.18	2.96	NS
" ash	0.74	0.70	0.68	0.61	0.06*	0.08**	0.02	5.87	NS
" skin	5.99	5.80	6.26	4.27	1.09***	0.63**	0.18	6.29	**
" bone	12.63	12.20	10.62	9.14	0.96*	2.54***	0.34	6.16	NS
Composition of fat-free back									
Percentage moisture	59.52	59.08	59.31	60.49	-0.37 NS	-0.60 NS	0.40	1.35	NS
" protein	15.91	15.87	16.80	17.60	-0.38 NS	-1.31***	0.22	2.61	NS
" ash	0.94	0.95	0.92	0.95	-0.02 NS	0.01 NS	0.02	3.83	NS
" skin	7.62	7.77	8.50	6.65	0.85**	0.12 NS	0.18	4.68	***
" bone	16.61	16.33	14.47	14.30	-0.08 NS	1.78**	0.49	6.41	NS
Composition of back "muscle"									
Percentage moisture	77.96	77.86	77.00	76.54	0.28 NS	1.14***	0.19	0.49	NS
" protein	20.82	20.90	21.81	22.26	-0.27 NS	-1.17***	0.19	1.80	NS
" ash	1.23	1.24	1.19	1.21	-0.02 NS	0.04 NS	0.02	2.87	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.
2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4.

In calculating the standard error no allowance has been made for the fact that there were two missing plots which would have made some slight difference to the value of the standard error.

APPENDIX IV

Average composition of the belly

	Pork weight		Bacon weight		Average percentage difference		Standard error[1]	Coefficient of variation[2]	Significance of interaction, treatment x slaughter weight
	Boar	Castrate	Boar	Castrate	Boar versus castrate	Pork versus bacon			
Composition of belly	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Percentage fat	20.02	21.90	26.06	33.89	-4.85***	-9.01***	0.82	6.42	**
" moisture	51.44	49.75	47.98	43.50	3.08**	4.86***	0.75	3.13	NS
" protein	13.26	12.51	12.95	11.89	0.90**	0.46 NS	0.21	3.31	NS
" ash	0.76	0.74	0.66	0.64	0.02 NS	0.10**	0.02	6.71	NS
" skin	10.12	10.51	8.80	6.78	0.82*	2.52**	0.28	6.26	**
" bone	4.40	4.60	3.55	3.30	0.02 NS	1.08***	0.13	6.71	NS
Composition of fat-free belly									
Percentage moisture	64.34	63.68	64.90	65.80	-0.12 NS	-1.34 NS	0.57	1.76	NS
" protein	16.58	16.02	17.52	17.98	0.05 NS	-1.45***	0.24	2.88	NS
" ash	0.95	0.94	0.90	0.97	-0.03 NS	0.01 NS	0.03	6.91	NS
" skin	12.62	13.45	11.89	10.27	0.40 NS	1.96**	0.41	6.77	*
" bone	5.50	5.91	4.80	4.98	-0.30 NS	0.82**	0.18	6.61	NS
Composition of belly "muscle"									
Percentage moisture	78.59	78.97	77.90	77.65	-0.06 NS	1.01*	0.32	0.81	NS
" protein	20.25	19.86	21.02	21.21	0.11 NS	-1.07*	0.31	2.99	NS
" ash	1.16	1.17	1.08	1.14	-0.04 NS	0.05 NS	0.04	7.73	NS

Significance levels : * 5 per cent, ** 1 per cent, *** 0.1 per cent, NS non-significant.

1 Standard error of the figures in columns 1 - 4.

2 Standard error expressed as a percentage of the mean of the figures in columns 1 - 4. In calculating the standard error no allowance has been made for the fact that there

APPENDIX V

Dissection procedure

The right side of each carcase was dissected into the following cuts, shoulder, back, belly and leg, as illustrated in Figure 1. The cheek was removed from each side by a cut made immediately anterior to the atlas bone and at right angles to the line of the neck vertebrae. The fore foot was removed by cutting at the distal end of the radius ulna. The hind foot was removed by cutting at the distal end of the tibia. The tuber calcis was left on the hind foot. The tail was removed by cutting between the third and fourth coccygeal vertebrae. The shoulder was separated by cutting anterior to the fifth rib, working as close to the rib as possible and extending the cut at both ends. The belly was separated from the back by cutting along the straight line joining the mid point of the first rib to the anterior edge of the pubis. Figure 2 illustrates the dissection of the hind leg. A cut was made through the subcutaneous fatty tissue to the muscles underneath, from the anterior edge of the pubis to the ventral region of the side, at right angles to the length of the side. The abdominal muscles (obliquus abdominis internus and rectus abdominis) and fasciae were then freed from the pubis by cutting the pre-pubic tendon and the medial femoral fasciae. The fatty tissue anterior to the incision on the tensor fasciae latae was freed from the anterior edge of the muscle. A cut was then made through the subcutaneous fatty tissue of the lateral side of the leg using the anterior edge of the tensor fasciae latae as the cutting line. The leg was then removed from the side by cutting between the last and second last lumbar vertebrae and extending this cut to the anterior edge of the tuber coxae. In the case of the bacon weight pigs, subcutaneous fatty tissue was removed from the four cuts. The skin was also removed from both types of carcase. All cuts, fatty tissues and skins were weighed. During dissection moisture loss was

minimised by covering exposed parts of the carcases with damp cloths. All cuts were boned out and the cleaned bones weighed.

Sampling of muscular tissue (lean)

Each cut was minced through a 10 mm. plate, then thoroughly mixed by hand and minced through a 5 mm. plate. All the mince was again hand mixed and minced through the 5 mm. plate. As the mince emerged a constant fraction, weighing about 600 g. was taken and stored in a screw top waxed carton at -23°C. When it was convenient to perform the proximate analysis the carton was split down the side. The frozen meat cylinder was crushed in a bone crusher (the meat being forced against a rotating serrated cylinder) and in this way a fine state of division was obtained. Any ice which had been on the inside of the carton was added to the meat which was then mixed in a food mixer and finally minced through a 2 mm. plate and analysed.

Sampling of fatty tissue

Using a chilled mincer head and worm, the chilled fatty tissue cuts were minced through a 10 mm. plate, hand mixed and minced again through the 10 mm. plate. A constant fraction (about 600 g.) was taken as the tissue emerged. This was minced through a 2 mm. plate.

Analysis of muscular tissue (lean)

Moisture: 15 g. samples were heated in flat bottomed dishes in a mechanical convection air oven at 100°C for 16 hours.

Fat: 15 g. samples were placed in flat bottomed dishes and the moisture removed by desiccating over silica gel or aluminium oxide in an evacuated desiccator (pressure about 6 mm. of mercury) overnight in a chill room (1-2°C). The dried samples were then extracted by petroleum ether 40-60°C in soxhlet extractors for 6 hours.

Protein: The Kjeldahl Gunning procedure was carried out using 5 g. samples weighed on bleached glassine paper. The ammonia was trapped in 2 percent boric acid and titrated with seminormal sulphuric acid. Nitrogen was converted into protein by using the factor 6.25.

Ash: 5 g. samples were incinerated in a fume cupboard and then heated for 16 hours in a muffle furnace at 550°C.

Analysis of fatty tissue

Moisture: 5 g. samples were heated for 5 hours at 100°C.

Fat: 5 g. samples were treated as in the case of muscular tissue.

Protein: 3 g. samples were subjected to the Kjeldahl Gunning procedure. The trapped ammonia was titrated with decinormal sulphuric acid.

Ash: 3 g. samples were treated as in the case of muscular tissue.

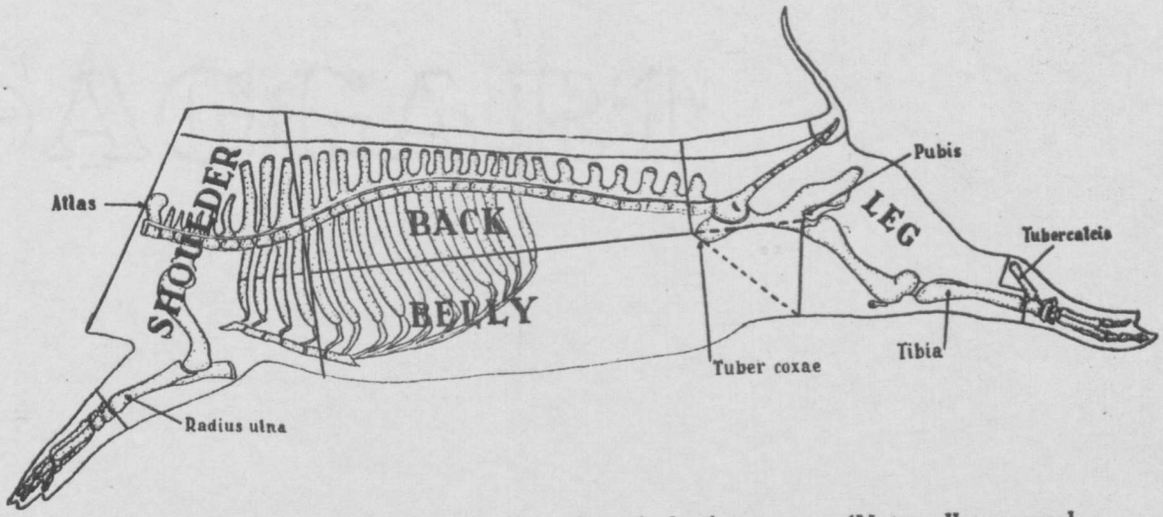

Fig. 1.—Illustrations showing the dissection of the four cuts. (Note: all coccygeal vertebrae not shown.)

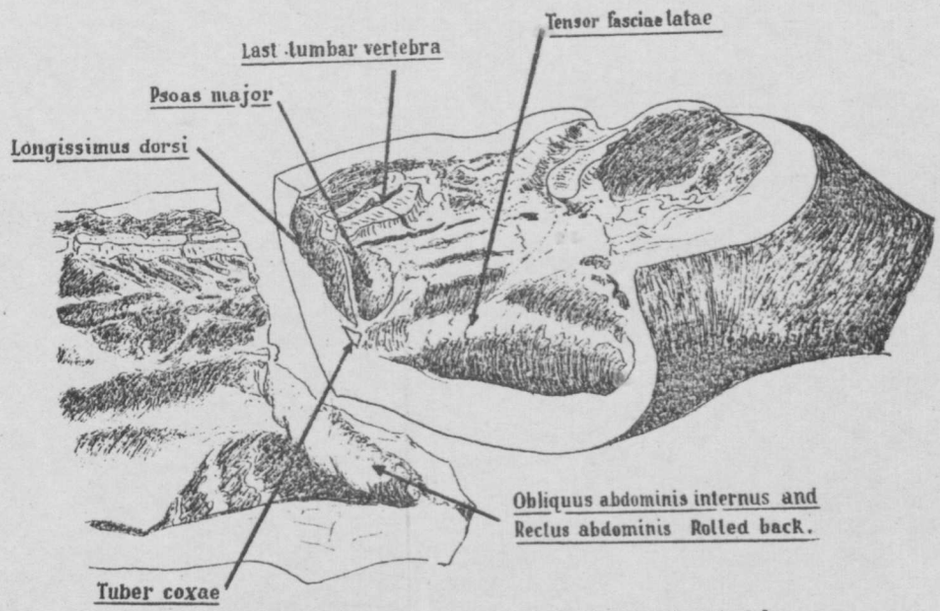

Fig. 2.—Illustration showing the dissection of the hind leg.