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Preliminary Observations on Intra- and Inter-Litter Differences in the Composition of l.dorsi Muscles from Pigs of Two Breeds.

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Even when such influences as species, breed, age, feeding regimen and anatomical location are constant, there is still considerable variability in the composition of the muscles of meat animals. In this general context an opportunity to ascertain the relative influence of the individual animal and of the mother was offered by the National Pig Progeny Testing Board. For both Large White and Landrace breeds, one litter (of four pigs), from each of four sows mated with the same boar, were reared under controlled conditions from the age of eight weeks until they attained bacon weight (approx. 200 lbs live weight). The carcases were measured and dissected by the staff of the National Pig Progeny Testing Board, Letchworth, in accordance with their normal procedure, when muscle samples were made available for analysis.

The entire l.dorsi from the region of the 1st-6th lumbar vertebrae, inclusive, was dissected from the pig carcases three days after death, during which time they had been stored at 0°C. Samples were freed from intermuscular fat and extraneous connective tissue, twice minced and thoroughly mixed. Aliquots were then taken for analysis.

Ultimate pH, and total sarcoplasmic, myofibrillar and stroma nitrogens were determined. The term "weight" of l.dorsi in Tables 1 - 3 refers to that section of the muscle between the levels of the 5th thoracic and 6th lumbar vertebrae: its cross sectional area was measured at the level of the 14th - 15th lumbar vertebrae. The authors are indebted to Mr. R.F. Johnson, General Manager of the National Pig Progeny Testing Board for making these measurements available and for providing data on feed conversion efficiency. The latter is represented in Tables 1 - 3 as lbs food required for 1 lb live weight gain.

Mean data on various characteristics of the l.dorsi muscles from the four litters of Large White and Landrace breeds are given in Tables 1 and 2 respectively. It is clear, first of all, that with each breed the sow has a distinct influence on these characteristics. Nevertheless, as judged by the scatter of values within each litter, the influence of the individual is strong.

With pigs of the Large White breed, there is less variation between litters in the weight, area of cross section or the percentage of total musculature of the l.dorsi, and in the quantity and distribution of nitrogen, than within litters. On the other hand the influence of the mother is greater than that of the individual pigs of the litter with respect to feed conversion and, unexpectedly, ultimate pH, which would have been supposed to reflect the immediate premortem circumstances affecting the individual pig. It may be, however, that susceptibility to withstand glycogen depletion is inherited. Statistical analysis shows that feed conversion is significantly, and negatively, correlated with the total nitrogen content of the l.dorsi when the data for the 16 Large White pigs are considered as a single group. But there is no such correlation within litters.

With pigs of the Landrace breed, the influence of the sow on the ultimate pH is again greater than that of the individual in the litter; but in contrast to the situation with pigs of the Large White breed, feed conversion is influenced more by the individual than by the dam. This may reflect the fact that sex has a markedly greater effect on feed conversion with Landrace pigs than in those of Large White breed (Table 3): gilts and hogs were not differentiated in Tables 1 and 2.

Table 3 summarizes the other effects of sex and the overall influence of breed on the parameters studied. In both breeds the weight and area of cross section of the l.dorsi is considerably greater in gilts than in hogs. Data on nitrogen content and distribution show an intereaction between sex and breed. Thus the total nitrogen content in l.dorsi is greater in gilts than in hogs in the Large White breed but the converse if found in pigs of the Landrace breed. Again, while sarcoplasmic, myofibrillar and stroma nitrogens represent similar fractions of the total nitrogen in both gilts and hogs of the Landrace breed, the two former are less in Large White gilts than in Large White hogs.

Overall, the weight and cross sectional area of l.dorsi muscles were found to be markedly greater in the Landrace pigs than with the Large White pigs: total nitrogen is much the same in both, but there is some suggestion that there is a higher fraction of myofibrillar nitrogen, and less stroma in the Landrace. It should be pointed out that all the pigs providing muscle samples in this investigation were "normal", there being no manifestations of the so-called "white" muscle disease: such would have affected nitrogen distribution considerably.

Even when other sources of variability are not involved it is evident from the above within litter differences that the individual animal still represents a most important remaining determinant of muscle characteristics. It would be instructive to ascertain how this might correlate with the position of the individual in the uterine horn: the importance of this factor on embryonic size has been stressed

recently.

SUMMARY

The weight, cross-sectional area, ultimate pH and total, sarcoplasmic, myofibrillar and stroma nitrogens in the l.dorsi muscles (1st - 6th lumbar vertebrae) of four pigs from a litter by one boar from each of four sows, and reared identically from 8 weeks to 200 lbs live weight, have been ascertained for both Large White and Landrace breeds. Apart from distinct differences in these characteristics due to breed, sex and mother, residual within litter variability, arising from the individual, was high.

Résumé

Pour les élévages Landrace et Large White, on a déterminé le poids, l'étendue de la section transversale, le pH final et le contenu d'azote total, du sarcoplasme, des myofibrilles et du stroma, parmi les muscles longissimus dorsi (1er - 6ème vertèbre lumbarique) de quatres porcs d'une portée que l'un verrat a produite de chaque de quatres truies. On a élevé ces porcs sous des circonstances identiques de temps qu'ils ont eu l'âge de huit semaines jusqu'à ce que leurs poids avaient atteint 90 Kg. Malgré des differences distinguées de ces characteres qu'on attribuer à l'élévage, au sexe et à la mère, il y avait encore beaucoup de variabilité qu'on attribuait aux porcs individuels de chaque portée.

Zusammenfassung

Schweine von zwei verschiedenen Rassen, "large white" und "Landrace", wurden für die Versuche benutzt, und zwar je 4 Tiere von je 4 Würfen welche jedesmal von einem Eber und 4 verschiedenen Säuen abstammten, und welche unter den gleichen Bedinzungen vom Alter von 8 Wochen bis zur Erreichung von 200 Pfund Lebendgewicht gehalten waren. Folgende Grössen wurden ermittelt: das Gewicht, die Querschnittsfläche, das endgültige pH und der gesamte, sarcoplasmische, myofibrilläre und Stroma-Stickstoff in den l.dorsi.

Ausser deutlichen Unterschieden in diesen Characteren welche auf Rasse, Geschlecht und Mutter Zurückzuführen sind, waren restliche Unterschiede innerhalb des gleichen Wurfes, welche durch die Individualität der einzelnen Tiere bedingt sind, sehr ausgeprägt.

Table 1. Litter means and standard errors for various characteristics of pig l.dorsi muscles:

Large White

Characteristic	Litter nos.			
	1 (4)	2 (4)	3 (4)	4 (4)
muscle wt. (gm)	3813 ± 129	3898 ± 158	3531 ± 235	4131 ± 209
cross-section area (sq.cm.)	25.30 ± 0.66	26.87 ± 0.54	28,49 ± 2.44	26.05 ± 1.60
muscle wt. (as% total muscle wt. in side)	25.16 ± 0.43	26.06 ± 0.55	25.20 ± 1.20	26.79 ± 0.84
ultimate pH	5.46 ± 0.01	5.55 ± 0.01	5.56 ± 0.05	5.81 ± 0.07
nitrogen (i) Total (TN) (% wet wt.)	3.74 ± 0.05	3.64 ± 0.09	3.49 ± 0.04	3.60 ± 0.03
(ii) Sarcoplasmic (%TN)	23.2 ± 2.2	24.5 ± 3.0	26.5 ± 3.0	27.2 ± 1.1
(iii) Myofibrillar (%TN)	40.8 ± 7.6	46.1 ± 6.5	49.8 ± 2.7	51.8 ± 1.5
(iv) Stroma (%TN)	23.8 ± 9.5	17.3 ± 9.6	10.8 ± 3.5	8.3 ± 2.3
feed conversion	3.99 ± 0.04	4.44 ± 0.13	4.48 ± 0.10	3.96 ± 0.11

Table 2 Litter means and standard errors for Various characteristics of pig l.dorsi muscles : Landrace

Characteristic	Litter Nos.			
	1 (4)	2 (4)	3 (4)	4 (4)
Muscle wt. (gm.)	4030 ± 155	3921 ± 101	3974 ± 207	4111 ± 289
Cross-section area (sq.cm.)	29.60 ± 2.20	20.30 ± 1.10	29.80 ± 2.80	25.90 ± 0.90
Muscle wt. (as % total muscle wt. in side)	27.38 ± 0.80	26.08 ± 0.40	26.15 ± 0.15	27.31 ± 0.81
Ultimate pH	5.55 ± 0.05	5.52 ± 0.03	5.62 ± 0.02	5.74 ± 0.04
Nitrogen (i) Total (TN) (% wet wt.)	3.58 ± 0.07	3.63 ± 0.04	3.61 ± 0.02	3.46 ± 0.09
(ii) Sarcoplasmic (%TN)	23.0 ± 0.61	23.1 ± 0.7	24.6 ± 1.1	25.7 ± 0.5
(iii) Myofibrillar (%TN)	52.9 ± 1.5	45.1 ± 4.2	50.9 ± 1.5	53.7 ± 0.6
(iv) Stroma (%TN)	10.9 ± 2.5	19.5 ± 5.1	12.0 ± 2.4	7.7 ± 0.9
Feed Conversion	3.91 ± 0.07	4.13 ± 0.14	4.38 ± 0.14	4.32 ± 0.19

Table 3 The effect of sex and breed on various characteristics of pig l.dorsi muscles

(means & S.E.)

Characteristic	Hogs (8)	Gilts (8)	Overall (16)
	(a) Large White		
muscle weight (gm)	3541 ± 103	4146 ± 83	3843 ± 96
cross sectional area (sq.cm.)	24.5 ± 0.8	28.4 ± 1.1	26.5 ± 0.7
muscle weight (B% total muscle wt. in side)	24.7 ± 0.4	26.9 ± 0.5	25.8 ± 0.3
ultimate pH	5.60 ± 0.06	5.60 ± 0.05	5.60 ± 0.04
nitrogen (i) Total (TN) (% wet wt.)	3.55 ± 0.04	3.69 ± 0.05	3.62 ± 0.04
(ii) Sarcoplasmic (%TN)	26.2 ± 1.0	24.5 ± 1.7	25.4 ± 1.0
(iii) Myofibrillar (%TN)	49.5 ± 2.7	44.7 ± 4.1	47.1 ± 2.4
(iv) Stroma (%TN)	11.5 ± 3.8	18.6 ± 6.0	15.1 ± 3.5
feed conversion	4.20 ± 0.12	4.16 ± 0.10	4.17 ± 0.07
	(b) Landrace		
muscle weight (gm)	3747 ± 87	4301 ± 83	4024 ± 98
cross sectional area (sq.cm.)	26.4 ± 1.1	30.9 ± 1.0	28.6 ± 0.9
muscle wt. (as% total muscle wt. in side)	26.5 ± 0.3	27.0 ± 0.6	26.7 ± 0.3
ultimate pH	5.59 ± 0.03	5.62 ± 0.05	5.6 ± 0.03
nitrogen (i) Total (TN) (wet wt.)	3.61 ± 0.03	3.54 ± 0.04	3.58 ± 0.03
(ii) Sarcoplasmic (%TN)	24.4 ± 0.6	23.9 ± 0.7	24.2 ± 0.4
(iii) Myofibrillar (%TN)	50.6 ± 2.0	50.7 ± 2.0	50.7 ± 1.2
(iv) Stroma (%TN)	12.5 ± 2.6	12.5 ± 2.6	12.5 ± 0.7
feed conversion	4.33 ± 0.12	4.04 ± 0.09	4.19 ± 0.08