

**THE EFFECTS OF BREED AND MUSCLE ON MEAT QUALITY AND MUSCLE FIBRE TYPES IN PIGS**Wood, J.<sup>1</sup>, Richardson, R.I.<sup>1</sup>, Enser, M.<sup>1</sup>, Nute, G.R.<sup>1</sup>, Hallett, K.<sup>1</sup>, Southwood, O.<sup>2</sup>, Plastow, G.<sup>2</sup>, Mansbridge, R.<sup>3</sup> and Chang, K.C.<sup>4</sup><sup>1</sup>Division of Food Animal Science, School of Veterinary Science, University of Bristol, Langford, Bristol, BS40 5DU, UK <sup>2</sup>Sygen International, Fyfield Wick, Abingdon, Oxon, OX13 5NA, UK <sup>3</sup>Rare Breeds Survival Trust, Stoneleigh, Warwickshire, CV8 2LG, UK<sup>4</sup>Veterinary Molecular Medicine Laboratory, Department of Veterinary Pathology, University of Glasgow, G61 1QH, UK**Background**

Farm animal breeds differ in carcass and meat quality characteristics making them suitable for particular markets. There is speculation in pig circles about the role for 'traditional' breeds especially in meat quality. Any variation could be due to the type of muscle fibre since some early work showed a higher abundance of slow oxidative fibres in 'unimproved' pig breeds (Rahelic and Puac, 1980). It is known that 'red' and 'white' muscles differ in muscle fibre types with an impact on meat quality. In this study, therefore, we examined muscle fibre and meat quality characteristics in 2 traditional and 2 modern pig breeds and 2 muscles, the white *longissimus* and the red *psaos*. Muscle fibres were analysed according to the isoform of myosin heavy chain (MyHC).

**Objectives**

To examine meat quality and muscle fibre characteristics in two 'traditional' breeds, Berkshire and Tamworth and two 'modern' breeds, Large White and Duroc.

**Methods**

The pigs were reared for 12 weeks from 9 weeks of age on a 'conventional' or a 'low density' diet, 48 entire males of the 4 breeds being used. They were then transported to the University of Bristol where samples of *longissimus* and *psaos* were taken within 30 minutes of slaughter and frozen in isopentane. In situ hybridisation to detect mRNA expression of MyHC slow, 2a, 2x and 2b was performed according to Chang *et al* (1995). Histochemical staining was also performed. Image analysis on serial muscle sections was used to quantitate the area contribution of each fibre type. Meat quality traits were measured using standard procedures (Wood *et al*, 1996). Loin joints were conditioned at 1°C for 10 days then frozen at -20°C prior to sensory analysis by the trained taste panel at Langford

**Results and discussion**

The breed least squares mean values for meat quality and muscle fibre traits are given in Table 1. For almost all parameters, there were highly significant effects of muscle, with *psaos* having lower initial pH, higher ultimate pH, lower drip, lower grain (fibre bundle size) and darker redder colour with greater saturation than *longissimus*. *Psaos* also had higher proportions of oxidative-glycolytic MyHC 2a and 2x fibres and a lower proportion of MyHC 2b. In contrast there were fewer breed effects. Berkshire had higher initial pH values in both muscles but this was not reflected in lower drip loss. The 2 traditional breeds had redder *psaos* muscles with greater colour saturation than the 2 modern breeds but toughness (yield force) was similar in all breeds. There were few consistent breed differences in muscle fibre type proportions except that both traditional breeds had higher MyHC 2x proportions in *psaos*, perhaps explaining the redder colour since this also distinguished *psaos* and *longissimus* muscles.

Results for eating quality are in Table 2. There were highly significant muscle effects for many parameters, with *psaos* having higher tenderness, juiciness, pork flavour intensity and overall liking than *longissimus*. In contrast, the breed effects were small. Duroc had the most tender *psaos* muscles but most sensory scores were similar in the 4 breeds.

**Conclusions**

A study of meat quality and muscle fibre characteristics in 2 muscles and 4 pig breeds showed much bigger effects of muscle *psaos* being generally superior to *longissimus*, associated with higher proportions of MyHC 2a and 2x fibre types. There were no consistent effects of breed on the parameters measured except that the 2 traditional breeds Berkshire and Tamworth had redder *psaos* muscles.

**References**

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**Conclusion**

The duck muscles from two conservative Polish breeds were distinguished by similar chemical composition. The high moisture content, the low level of lipids, high content of unsaturated fatty acids, especially oleic acid and higher level of essential amino acids (except lysine and valine) testified that the investigated muscles are favourable from the human nutrition point of view.

**Relevant literature**

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Table 1. Least squares means for fibre type traits between breeds within muscle

Trait	Muscle	Breed				S.E.M. <sup>~</sup>	Significance of breed <sup>#</sup>
		Berkshire	Duroc	LW	Tamworth		
ph45	LD	6.50 <sup>a</sup>	6.23 <sup>b</sup>	6.29 <sup>ab</sup>	6.32 <sup>ab</sup>	0.081	**
	Psoas	5.86 <sup>a</sup>	5.66 <sup>b</sup>	5.76 <sup>ab</sup>	5.75 <sup>ab</sup>	0.057	**
pH24	LD	5.49 <sup>a</sup>	5.49 <sup>a</sup>	5.49 <sup>a</sup>	5.49 <sup>a</sup>	0.019	n.s.
	Psoas	5.55 <sup>b</sup>	5.64 <sup>a</sup>	5.61 <sup>ab</sup>	5.62 <sup>ab</sup>	0.028	*
Drip %	LD	4.80 <sup>ab</sup>	5.27 <sup>a</sup>	3.72 <sup>b</sup>	3.72 <sup>b</sup>	0.511	+
	Psoas	2.98 <sup>a</sup>	2.64 <sup>a</sup>	3.26 <sup>a</sup>	2.80 <sup>a</sup>	0.268	n.s.
Grain	LD	2.34 <sup>a</sup>	2.60 <sup>a</sup>	2.47 <sup>a</sup>	2.47 <sup>a</sup>	0.204	n.s.
	Psoas	1.42 <sup>ab</sup>	1.62 <sup>a</sup>	1.44 <sup>ab</sup>	1.18 <sup>b</sup>	0.145	n.s.
L	LD	57.38 <sup>a</sup>	55.72 <sup>ab</sup>	54.30 <sup>b</sup>	56.20 <sup>ab</sup>	0.799	*
	Psoas	50.58 <sup>a</sup>	51.00 <sup>a</sup>	49.69 <sup>a</sup>	49.42 <sup>a</sup>	0.703	n.s.
a	LD	6.97 <sup>a</sup>	7.46 <sup>a</sup>	7.53 <sup>a</sup>	7.21 <sup>a</sup>	0.320	n.s.
	Psoas	18.19 <sup>a</sup>	15.61 <sup>b</sup>	16.67 <sup>b</sup>	18.18 <sup>a</sup>	0.509	***
b	LD	5.83 <sup>a</sup>	5.37 <sup>a</sup>	5.49 <sup>a</sup>	5.79 <sup>a</sup>	0.308	n.s.
	Psoas	10.46 <sup>a</sup>	8.80 <sup>b</sup>	8.76 <sup>b</sup>	10.31 <sup>a</sup>	0.361	***
Hue	LD	39.71 <sup>a</sup>	35.56 <sup>b</sup>	35.81 <sup>bc</sup>	38.80 <sup>ac</sup>	1.107	**
	Psoas	29.76 <sup>a</sup>	29.33 <sup>a</sup>	27.78 <sup>a</sup>	29.52 <sup>a</sup>	0.777	n.s.
Sat	LD	9.11 <sup>a</sup>	9.23 <sup>a</sup>	9.35 <sup>a</sup>	9.27 <sup>a</sup>	0.408	n.s.
	Psoas	21.00 <sup>a</sup>	17.94 <sup>b</sup>	18.86 <sup>b</sup>	20.95 <sup>a</sup>	0.565	***
Yield Force	LD	5.32 <sup>b</sup>	6.27 <sup>a</sup>	5.57 <sup>ab</sup>	5.98 <sup>ab</sup>	0.335	*
	Psoas	5.70 <sup>a</sup>	5.45 <sup>a</sup>	5.60 <sup>a</sup>	5.92 <sup>a</sup>	0.247	n.s.
Work done	LD	14.45 <sup>b</sup>	19.01 <sup>a</sup>	16.26 <sup>ab</sup>	16.38 <sup>ab</sup>	1.014	***
	Psoas	10.83 <sup>a</sup>	10.32 <sup>a</sup>	10.60 <sup>a</sup>	11.13 <sup>a</sup>	0.501	n.s.
MyHC1	LD	10.63 <sup>b</sup>	15.39 <sup>a</sup>	13.16 <sup>ab</sup>	12.97 <sup>ab</sup>	1.102	*
	Psoas	11.75 <sup>ab</sup>	14.48 <sup>a</sup>	9.05 <sup>b</sup>	11.85 <sup>ab</sup>	1.039	**
MyHC2a	LD	4.32 <sup>ab</sup>	3.51 <sup>b</sup>	4.28 <sup>ab</sup>	6.24 <sup>a</sup>	0.821	+
	Psoas	10.18 <sup>b</sup>	14.77 <sup>a</sup>	7.85 <sup>c</sup>	7.21 <sup>c</sup>	0.799	***
MyHC2b	LD	54.38 <sup>a</sup>	52.55 <sup>ab</sup>	50.53 <sup>ab</sup>	48.64 <sup>b</sup>	1.771	+
	Psoas	43.04 <sup>b</sup>	42.39 <sup>b</sup>	50.93 <sup>a</sup>	39.52 <sup>b</sup>	1.946	***
MyHC2x	LD	29.54 <sup>b</sup>	28.75 <sup>b</sup>	35.50 <sup>a</sup>	32.20 <sup>ab</sup>	1.620	**
	Psoas	40.24 <sup>a</sup>	37.41 <sup>ab</sup>	32.58 <sup>b</sup>	40.73 <sup>a</sup>	1.831	**

Number of observations per muscle type are: Berkshire (n=43); Duroc (n=46); LW (n=48); Tamworth (n=43)

<sup>~</sup>S.E.M. = Standard error of the means

<sup>#</sup>Significance test for breed effect: n.s., not significant, P>0.1; +, P<0.10; \*, P<0.05; \*\*, P<0.01; \*\*\*, P<0.001

Means in the same row with different superscripts differ, P<0.05

Table 2. Least squares means for sensory traits between breeds within muscle (1-8 scales)

Trait	Muscle	Breed				S.E.M.	Significance of breed <sup>#</sup>
		Berkshire	Duroc	LW	Tamworth		
Fat	LD	3.46 <sup>a</sup>	3.15 <sup>a</sup>	3.13 <sup>a</sup>	3.40 <sup>a</sup>	0.164	+
	Psoas	-	-	-	-	-	-
Pork odour	LD	2.67 <sup>a</sup>	2.96 <sup>a</sup>	2.87 <sup>a</sup>	2.67 <sup>a</sup>	0.155	+
	Psoas	-	-	-	-	-	-
Abnormal odour	LD	4.17 <sup>a</sup>	3.95 <sup>a</sup>	4.34 <sup>a</sup>	3.94 <sup>a</sup>	0.179	**
	Psoas	5.48 <sup>b</sup>	5.84 <sup>a</sup>	5.65 <sup>ab</sup>	5.23 <sup>b</sup>	0.109	***
Lean	LD	4.27 <sup>a</sup>	4.20 <sup>a</sup>	4.21 <sup>a</sup>	4.02 <sup>a</sup>	0.145	n.s.
	Psoas	4.27 <sup>a</sup>	4.57 <sup>a</sup>	4.42 <sup>a</sup>	4.44 <sup>a</sup>	0.130	*
Texture	LD	3.57 <sup>a</sup>	3.41 <sup>a</sup>	3.39 <sup>a</sup>	3.49 <sup>a</sup>	0.129	n.s.
	Psoas	3.73 <sup>a</sup>	3.66 <sup>a</sup>	3.64 <sup>a</sup>	3.69 <sup>a</sup>	0.144	n.s.
Pork flavour	LD	2.91 <sup>a</sup>	2.97 <sup>a</sup>	3.02 <sup>a</sup>	2.75 <sup>a</sup>	0.134	+
	Psoas	2.99 <sup>a</sup>	3.05 <sup>a</sup>	3.17 <sup>a</sup>	3.12 <sup>a</sup>	0.147	n.s.
Abnormal flavour	LD	4.18 <sup>a</sup>	3.90 <sup>a</sup>	3.92 <sup>a</sup>	4.14 <sup>a</sup>	0.149	+
	Psoas	4.25 <sup>a</sup>	4.15 <sup>a</sup>	3.98 <sup>a</sup>	4.08 <sup>a</sup>	0.145	+
Flavour liking	LD	3.71 <sup>a</sup>	3.47 <sup>a</sup>	3.60 <sup>a</sup>	3.60 <sup>a</sup>	0.154	n.s.
	Psoas	4.15 <sup>a</sup>	4.13 <sup>a</sup>	3.98 <sup>a</sup>	4.03 <sup>a</sup>	0.143	n.s.

Number of observations per muscle type are: Berkshire (n=43); Duroc (n=45); LW (n=46); Tamworth (n=43)

<sup>~</sup>S.E.M. = Standard error of the means

<sup>#</sup>Significance test for breed effect: n.s., not significant, P>0.1; +, P<0.10; \*, P<0.05; \*\*, P<0.01; \*\*\*, P<0.001

Means in the same row with different superscripts differ, P<0.05

