Effects of low protein diets on fat deposition in the whole body and within the muscle and subcutaneous adipose tissue of pigs

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Introduction Protein is an expensive nutrient in pig diets and high protein diets lead to high N excretion, a source of pollution. Low protein nutritional strategies are therefore needed, but these often increase fat deposition. This study compared three nutritional strategies differing in protein and energy supply using genotypes with different propensities for fat deposition.

Materials and methods One hundred and ninety-two entire male pigs; half 0.75 Duroc (D) and half 0.75 Large White (LW) were fed *ad libitum* from 40 to 120 kg live weight on one of three nutritional strategies (Table 1). The pigs were group fed, eight animals per pen, on a breed x nutritional strategy basis, over four replicates. The dietary protein content was reduced across the strategies, with the concentration of lysine and other amino acids being reduced in relation to protein. The pigs were reared at Harper Adams then transported to the University of Bristol abattoir, where they were slaughtered and dissected as described by Brown and Wood, (1979). Data were analysed using GLM with breed and nutritional strategy as factors.

Table 1 Nutritional strategies

Wt	Baseline (B)			SOTA [d]			L P [e]		
range	DE[a]	CP[b]	L[c]	DE	CP	L	DE	CP	L
40-65	13.5	210	12	14.0	195	12	14.0	195	12
65-90	13.5	210	12	13.5	180	11	13.5	165	10
90-120	13.5	210	12	13.0	170	10	13.0	130	7

[a] MJ Digestible Energy/kg ; [b] g/kg crude protein; [c] g/kg lysine; [d] 'state of the art'; [e] Low protein

Results Table 2 shows several significant breed x nutritional strategy interactions for different measures of fat within the empty body (carcass plus red and green offal components). The values in Duroc were similar across the nutritional strategies, rising slightly in some cases from B to SOTA to LP, while a greater response to nutritional strategy was found in LW, where the amount of fat increased significantly across the strategies in the order Baseline < SOTA < Low N. The same pattern was also found for the concentrations of intramuscular fatty acids in the *longissimus* dorsi muscle (LD) and in the subcutaneous adipose tissue depot in LW.

Table 2 The effects of breed x nutritional strategy on overall fat distribution

Variable	Duroc			LW			S.E.D.	P value
	B	SOTA	L P	B	SOTA	L P		
Body measurements								
Empty body weight (kg)	105.4	104.7	105.8	107.5	106.1	107.4	1.40	>0.05
P2 fat depth (mm)	17.9^{b}	18.9^{b}	19.0^{b}	13.8^{a}	15.0^{a}	18.4^{b}	0.93	0.013
Fat % EBW	15.5^{b}	15.7^{b}	15.9^{b}	12.1^{a}	13.7^{a}	16.9^{b}	0.77	<0.001
EB fat depots (kg)								
Total fat	16.5^{bc}	16.5^{bc}	16.8^{bc}	13.0^{a}	14.5^{ab}	18.2^{c}	0.88	<0.001
Subcutaneous	11.9^{b}	11.8^{b}	11.9^{b}	9.8^{a}	10.1^{ab}	13.4^{b}	0.59	<0.001
Intermuscular	3.5^{b}	3.7^{b}	3.7^{b}	2.6^{a}	3.0^{ab}	3.8^{b}	0.28	0.018
Thoracic (g)	44.3^{a}	51.1^{ab}	51.5^{ab}	41.9^{a}	45.2^{a}	66.0^{b}	6.00	0.035
Flare (g)	809.1^{ab}	851.3^{b}	838.8^{b}	566.0^{a}	699.3^{ab}	1007.3^{b}	0.07	<0.001
Omental & mesenteric (g)	151.3	149.3	162.5	124.1	130.7	156.0	16.80	>0.05
Total fatty acid weights								
LD muscle (mg/100g)	1785	1946	2078	914	957	1185	161	>0.05
Subcut adipose (g/100g)	73.9^{ab}	74.1^{ab}	73.9^{ab}	70.8^{a}	71.7^{a}	75.5^{b}	1.30	0.018

SED standard error of difference, maximum quoted. Means in a row with the same superscript do not differ significantly. Tukey-Kramer test at the 0.05 level, *post-hoc*.

Conclusions These results show that different pig breeds respond differently in terms of fat deposition to the levels of nutrients supplied, particularly protein and energy. Therefore it is necessary to balance diets to genotypes, especially for leaner genotypes such as LW, to avoid excess levels of fat deposition within the body.

Acknowledgements The authors thank DEFRA for funding this work.

References

Brown, A.J. and Wood, J.D. (1979) Pig carcass evaluation – measurement of composition of using a standardised butchery method. Agricultural Research Council, Meat Research Institute – Bristol, Memorandum No. 42.