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Less brain sparing occurs in severe intrauterine growth-restricted piglets born to sows fed palm fatty acid distillate

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In intrauterine growth-restricted piglets (IUGR), relatively more nutrients are redirected towards the brain (brain sparing) compared to a normal piglet, as part of a foetal adaptive reaction to placental insufficiency, which is intended to maintain as much oxygen supply to the brain as possible (Roza *et al.*, 2008). The piglet brain is still growing between d 100 and d 110 of gestation (Nielsen, 1973), and it is hypothesised that the sows' diet might influence this final brain development. The objective of this study was to investigate the relative brain and liver weight and also brain to liver ratios of piglets suffering from IUGR, when sows were fed three different fat and fibre sources in a transition diet.

This study was conducted as part of a larger project investigating transition feeding on sow performance and piglet survival. Thirty-six second parity sows (Landrace x Yorkshire) mated with Duroc semen were transferred to a farrowing house at d 105 of gestation. Sows were fed one of nine diets in accordance with a 3 x 3 factorial design (three fibre diets x three fat sources). The three dietary fibre (DF) sources were a control (already in diet, from the wheat, barley and soy content), added sugar beet pulp and added alfalfa, and the three dietary fat sources were soy oil (S), palm fatty acid distillate (P) and trioctanoate (T). A total of 2.9, 3.0 and 3.1% dietary fat was included in the control, sugar beet pulp and alfalfa diets, respectively. Piglets were classified at birth based on head morphology and given a visual IUGR score from normal, mildly IUGR and severe IUGR, recognising 1) the IUGR piglet displaying the phenotype of a steep dolphin-like forehead, 2) bulging eyes, and 3) wrinkles perpendicular to the mouth (modified after Hales *et al.*, 2013). Twenty-four h after birth of the first piglet in a litter, the median piglet within birth order in each litter was sacrificed, as were piglets born less than 900 g. In total, 80 piglets were sacrificed and weights of the liver, brain and total body weight were recorded. Data were analysed using the MIXED procedure in (SAS®; USA).

Brain sparing was related to severity of IUGR (Table 1), but was not affected by DF source (not shown). However, severe IUGR piglets had a smaller relative brain weight percentage of total body weight when the sow had been fed P oil compared to severe IUGR piglets that were born to sows fed S and T (Table 1). There was an influence of DF source on relative liver weight percentage of total body weight, with values being 2.5%, 2.5% and 2.3% for low fibre (control), sugar beet pulp and alfalfa, respectively ($P<0.026$, SEM 0.06). The alfalfa diet produced the lowest relative liver weights ($P<0.05$).

Table 1. *The interaction between fat in the sow' diet (S, P and T) on brain (B), liver (L) and organ ratios (B/L) of normal, mildly-IUGR and severe-IUGR piglets.*

	IUGR score										Significance		
	Normal			Mildly IUGR			Severe IUGR						
	S	P	T	S	P	T	S	P	T	SEM	IUGR	FAT	IUGR × FAT
Number	9	8	8	10	8	12	10	6	9				
B (%)	2.4^{a}	2.8^{a}	2.3^{a}	4.0^{b}	4.0^{b}	4.2^{b}	5.6^{c}	4.1^{b}	5.4^{c}	0.38	0.001	0.288	0.042
L (%*)	2.7^{c}	2.5^{bc}	2.8^{c}	2.5^{bc}	2.5^{bc}	2.0^{a}	2.2^{ab}	2.6^{c}	2.0^{a}	0.13	0.001	0.006	0.002
B/L	0.9^{a}	1.1^{ab}	0.9^{a}	1.7^{c}	1.6^{bc}	2.1^{c}	2.7^{d}	1.5^{bc}	2.8^{d}	0.23	0.001	0.015	0.004

^{a,b,c,d}Means in a row not having the same superscript are significantly different ($P<0.05$); No fibre×IUGR interactions were observed; *There was a main effect of DF on relative liver weight percentage of total body weight.

The present study suggests that nutrition of the sow in the last week of gestation affects both development of the foetal liver and brain development. Indeed, DF originating from sugar beet pulp increased the relative liver weight compared to dietary inclusion of alfalfa. Moreover, dietary inclusion of palm fatty acid distillate increased the relative weight of liver and brain in severe-IUGR piglets compared to severe-IUGR piglets born to sows fed soy oil or trioctanoate.

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