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Influence of a fat supplemented maternal diet on liver fatty acid profile and metabolism in the pig

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Previous research has established a clear link between fat supplemented (FS) maternal diets and hepatic dysfunction, and suggested long term associated health issues in the offspring [(1)]. Down regulation of fatty acid binding protein 1 has been observed in the liver of new-born pigs exposed to a FS diet during gestation [(2)], however, little is known about the implications for fatty acid (FA) metabolism and composition.

Pregnant sows were assigned to one of two isocaloric diets: high starch (control n = 8, fat content 0·93MJ/Kg) or fat supplemented (FS n = 8, fat content 3·29MJ/kg fat (supplemented with palm oil)). Feed intake was increased from 70 days of pregnancy to accommodate the increased nutritional demands and all sows received a standard diet from day 110 and throughout lactation. One median weight piglet was selected from each litter for humane euthanasia at 7 days. Hepatic FA profiles were measured using gas chromatography; hepatic gene expression was investigated using real-time PCR and the Mann Whitney test was used to assess statistical differences between the control and FS group.

Eicosapentaenoic acid (EPA) was found in lower concentrations in the FS group (control, 0·32 ± 0·08 %; FS, 0·2 ± 0·03 % ($p = 0·03$)). No other differences in fatty acids were observed. No differences in expression of genes related to EPA metabolism (fatty acid desaturase (FADS) 1 and 2 and elongase (ELOVL) 2 and 5 were observed. However, correlational analysis revealed dysregulation of several expected relationships in the FS group (see Figure 1). A significant increase in fatty acid synthase (control, 1·0 ± 0·01; HF, 1·04 ± 0·01 % fold change ($p < 0·01$)) and stearoyl-CoA desaturase 1 (control, 1·0 ± 0·01 %; HF, 1·05 ± 0·01 % fold change ($p = 0·01$)) expression was observed in the FS group.

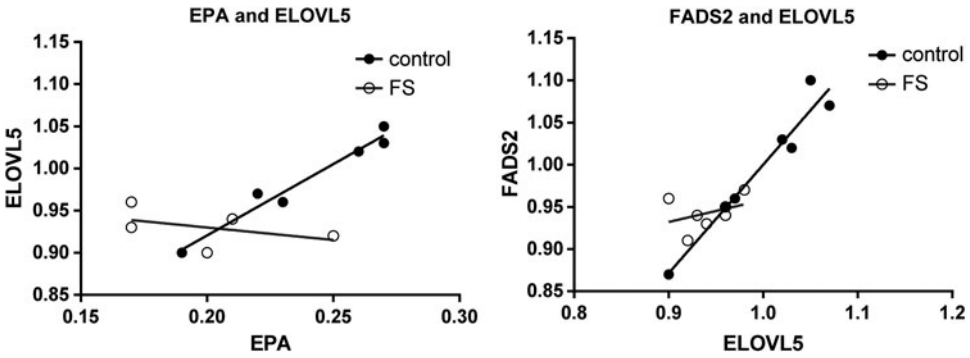

Figure 1: Scatter graphs showing the absence of correlation between EPA and ELOVL5, and FADS2 and ELOVL5 in offspring of sows fed fat supplemented (FS) diets in gestation.

This study suggests a link between a palm oil supplemented gestational diet and disturbances in FA metabolism in the porcine neonatal liver. These changes in EPA may be due to the FA profile of palm oil which is high in saturated FA and monounsaturated FA. EPA has important roles in inflammation and polyunsaturated fatty acid homeostasis; reduced levels of EPA and apparent dysregulation of genes involved in the EPA synthesis pathway may have an impact on these functions in the offspring. More research is needed to clarify the long term impact of this maternal diet on offspring health.

1. Benatti RO, Melo AM, Borges FO *et al.* (2014) *Br J Nutr* **111**, 2112–22.
2. Almond KL, Fainberg HP Lomax MA *et al.* (2014) *Reprod Fertil Dev* (In Press).