RESEARCHABSTRACT

ANIMAL SCIENCE — Nutritional Efficiency Consortium

**Title:** The influence of increasing dietary intake of omega-3 fatty acid concentration on postpartum hypophagia and energy output in the milk via alterations in lipolytic activity and insulin sensitivity of the adipose tissue. **– NPB #09-148** **revised**

**Investigator:** Dr. Denise Beaulieu

**Institution:** Prairie Swine Centre, Inc., Saskatoon, SK. S7H 5N9

**Co-investigator:** Laura Eastwood, MSc.

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**Scientific Abstract:**

Modern sows are hyper-prolific, and due to a continual increase in litter sizes, the productivity of the pork industry is continually improving. This increase in piglet numbers, however, has several consequences on the survival and performance of piglets as well as on sow longevity. An experiment was conducted to determine the metabolic adaptations of the sow throughout lactation, in response to altering the dietary omega-6 (n-6) to omega-3 (n-3) fatty acid ratios, and to determine the effects on overall sow and piglet performance. Sows (n=150) were assigned to one of five test diets on d 80 of gestation and remained on these diets for three reproductive cycles. Diets (5% crude fat), divided into gestation and lactation rations, consisted of a control (tallow based) and 4 diets with n-6:n-3 ratios of 10:1, 5:1, 1:1 or 5:1 fish based. In order to determine the effects of dietary polyunsaturated fatty acids on high producing sows, any sow farrowing less than 11 piglets during cycle 3 was removed from trial, as were any sows that dropped below 10 nursing piglets throughout lactation. A set of 8 sows for the 10:1 and 1:1 diets had jugular catheters inserted on d 5 of lactation and underwent an epinephrine challenge in order to determine the effect of diet on body fat mobilization, and a glucose challenge to determine the effects on insulin sensitivity. Milk samples were collected on d 4 and d 16 of lactation and blood was collected for leptin analysis on d 5 and d 15.

Piglets raised by sows consuming the 5:1 plant diet had higher birth and weaning weights, while those nursing from sows on the fish based diet had lower weights ($P < 0.05$). During cycle 2 and 3 a significant affect of dietary treatment on feed intake was observed. In cycle 2 there was no difference between the control pigs,

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and the three plant based treatment groups; however sows consuming the fish diet ate half a kg less than the others ($P = 0.04$). In cycle 3 the control and 5:1 plant diet sows ate the most feed, while the 1:1 and fish diet sows consumed the smallest amount ($P = 0.05$). Altering the n-6:n-3 fatty acid ratio of sow diets did not affect the overall milk composition or output, and with the exception of the fish based diet, there were no major effects on piglet growth rates, indicating that sows will compensate for changes in feed intake through body fat mobilization, ensuring that their offspring are provided with an adequate supply of energy and nutrients for growth. Prior to any form of challenge, sows consuming the 1:1 ratio diet appeared to be in a state of body fat mobilization when compared to those consuming the 10:1 ratio, as they tended to have higher circulating levels of NEFA, glycerol and leptin. When sows underwent a metabolic challenge with exogenous epinephrine we found that the sows consuming a ratio of 10:1 had a greater response, indicated by a lower net incremental area under the curve( niAUC) for glucose ($P < 0.05$) and tendencies for higher niAUC NEFA and glycerol concentrations. It appears that since the 1:1 ratio sows were mobilizing more body fat prior to the challenge, they were less sensitive to a dose of exogenous epinephrine than the 10:1 ratio sows. There were no dietary effects during the glucose challenge, indicating that dietary fat did not alter the insulin sensitivity of sow tissues.

Overall, it appears that if the dietary n-6:n-3 ratio becomes too low, negative effects on sow performance are seen, and a ratio of 5:1 appears optimal in terms of sow and piglet performance. Regardless of diet the sow is able to undergo metabolic adaptations to ensure that the energy and nutrients required by her offspring are met. This means that if she is consuming less feed, she will draw on her own body reserves to meet the energy output demands, which will in turn negatively affect her long term performance and increase producer costs.