Effects of Altering the Omega-6 to Omega-3 Fatty Acid Ratio in Sow Diets on the Immune Responses of their Offspring Post-Weaning

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SUMMARY

An experiment was conducted to determine the effects of altering the omega-6 (n-6) to omega-3 (n-3) fatty acid (FA) ratio in sow diets on the immune responses of their offspring post-weaning. Piglets were subjected to an immune challenge by injecting lipopolysaccharide (LPS), a component of gram-negative bacteria which triggers an immune response. Weanling pigs produced from sows consuming different n-6:n-3 FA ratios respond differently to an LPS induced immune challenge. This allows us to conclude that the FA profile of a sows diet may affect the response of her offspring to immune challenges which occur regularly at the time of weaning

INTRODUCTION

In the swine production industry, weaning is certainly the most stressful time in a piglet's life which is partly due to exposure to new immune challenges. It is during this time that feed intakes are reduced and an immune response will be generated. Although a certain degree of immune response is beneficial during this time, an over-production of immune cells can be detrimental, leading to reduced protein synthesis and muscle degradation.

The n-3 FA's have many different health benefits, and are anti-inflammatory. They alter the body's release of cytokines, (proteins secreted by immune cells in response to stimuli) which assist in regulating the development of an immune response. The most important pro-inflammatory cytokines are tumour necrosis factor (TNF-α), interleukin (IL)-1, IL-6 and IL-8. This project was designed to determine if feeding a diet high in n-3 FA's to sows could improve performance post-weaning when piglets are challenged with E. Coli LPS by altering their immune status.

"Feeding programs for sows can affect how offspring respond to immune challenges presented at weaning"

MATERIALS AND METHODS

The weanling pigs used in this trial were produced from sows consuming diets with varied n-6:n-3 FA ratios. The diets consisted of a control (tallow based), plant based ratios of 10:1, 5:1, 1:1, and a fish based 5:1 ratio. Sows remained on these diets for 2 reproductive cycles and piglets weaned from the 2nd cycle (d 28 of lactation) were used for the immune challenge. The fatty acid profile of the milk was similar to that of the sow diets, with ratios of

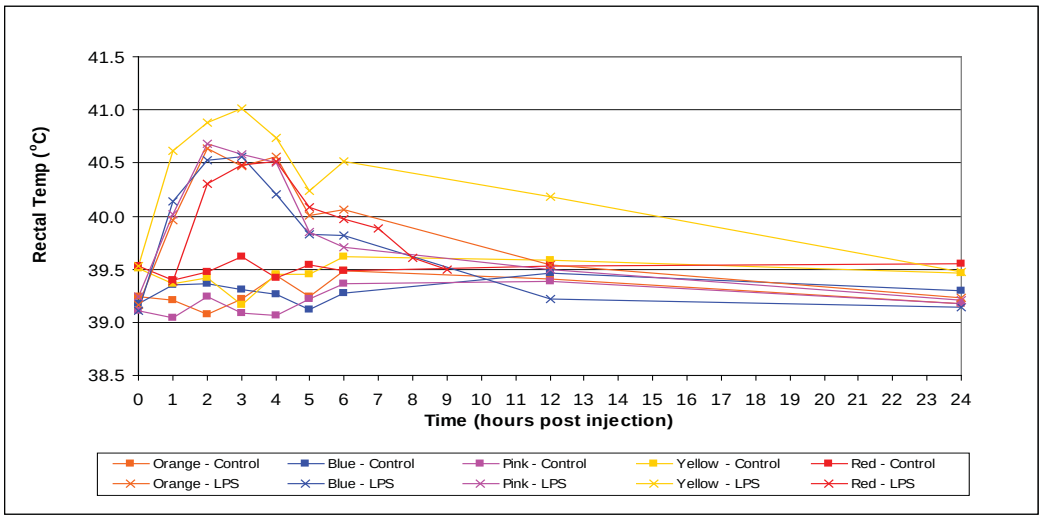

Figure 1.: Average rectal temperatures of pigs treated with LPS or saline after being raised by sows consuming varying n-6 to n-3 fatty acid ratios

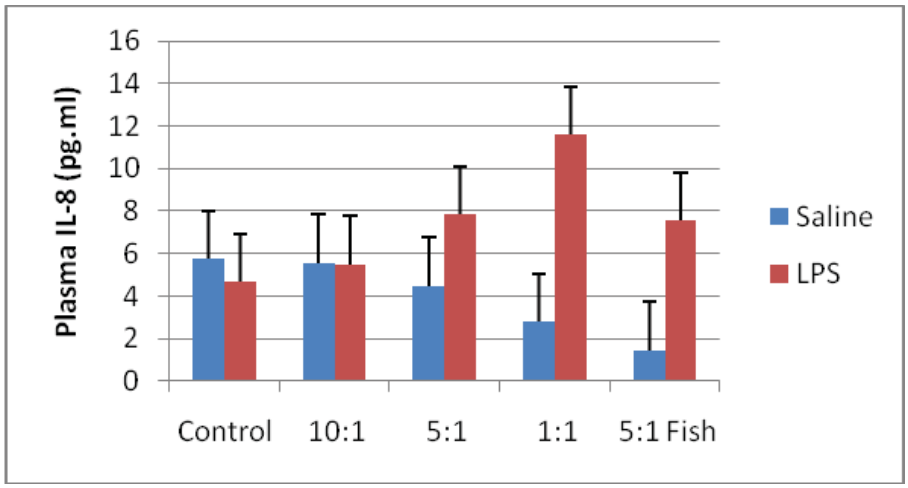

Figure 2.: Diet x Challenge interaction of plasma IL-8 concentration (average value for T0, T2, T6 and T12; bars show the mean +/- SEM)

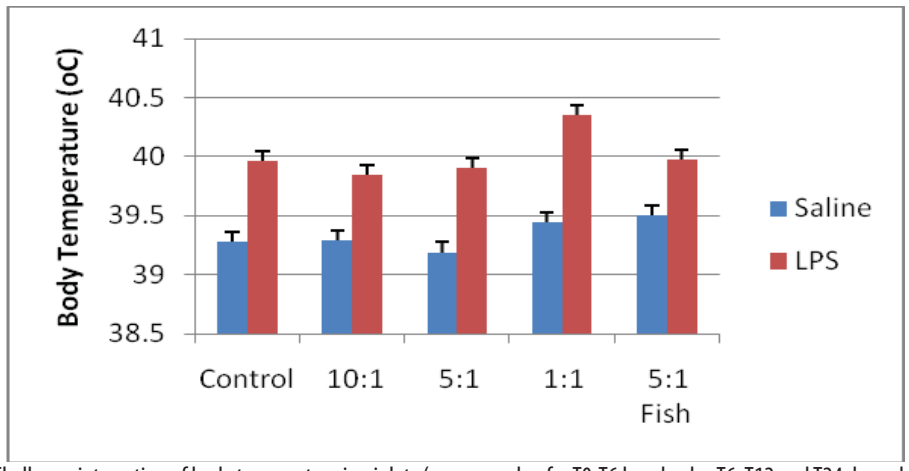

Figure 3.: Diet x Challenge interaction of body temperature in piglets (average value for T0-T6 hourly plus T6, T12 and T24; bars show the mean +/- SEM)

7.5:1, 4.5:1, 1.5:1 and 3:1 for the 10:1, 5:1, 1:1 and 5:1 fish diets respectively. Weanling pigs (n=100) were randomized to a challenge control group (saline injected) or to an LPS injected group (n=10/challenge/diet). Piglets were given 6 days to acclimate to their new environment prior to the immune challenge. Rectal temperatures were recorded at 0, 1, 2, 3, 4, 5, 6, 12 and 24 hrs post injection and blood samples were collected at 0, 2, 6 and 12 hrs post injection for cytokine analysis (IL-1β, IL-6, Il-8, TNF-α).

RESULTS AND DISCUSSION

For all parameters except IL-6, the effect of challenge, time and challenge by time were significant ($P < 0.05$), indicating that an injection of 15 ug/kg body weight LPS was effective in generating an immune reaction. Diet had a significant effect on body temperature (Figure 1), with piglets produced by sows consuming the 1:1 diet having a greater body temperature than those from the control, 10:1 and 5:1 groups. Body temperatures of piglets produced from sows consuming the 5:1 fish based diet were intermediate.

The diet by immune challenge interaction tended to be different for both body temperature (P=0.1163) and IL-8 (P=0.1819). Piglets from the 1:1 and 5:1 fish diet groups had a greater IL-8 response to the immune challenge when compared to piglets from the other diets (Figure 2). A greater febrile response to the LPS challenge also occurred in piglets originating from sows consuming the 1:1 ratio diet (Figure 3).

CONCLUSION

Feeding programs for sows can affect how their offspring respond to immune challenges presented at weaning. It appears that altering the n-3 to n-6 fatty acid ratio in sow diets can affect febrile and cytokine responses of their offspring when challenged with LPS post-weaning. Piglets produced from sows consuming a 1:1 ratio had elevated body temperatures, and a greater response to the immune challenge when compared to the other diets. Further experiments will help determine the energetic costs of these immune responses on the animals.

ACKNOWLEDGEMENTS

Strategic program funding was provided by Sask Pork, Alberta Pork, Manitoba Pork Council and Saskatchewan Agriculture and Food Development Fund. Specific funding for this project was provided by Alberta Livestock and Meat Agency (ALMA) and Vandeputte s. a., Belgium.