Immunity and Gastrointestinal Function at Weaning

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Weaning is a critical period in the pig's life; the pig must cope with separation from the sow, the transition from highly digestible milk to a less digestible and more complex solid feed, a new environment, movement and separation from littermates, and exposure to unfamiliar pigs. During the first week of weaning, pigs have a reduced growth rate which is related in part to low and variable water and feed intake. Additionally, the newly-weaned pigs' immune and digestive systems are still maturing, making the piglet more susceptible to enteric antigenic challenges (nutritional or microbial), which can also cause a reduction in feed intake.

What are some changes in the pigs' gastrointestinal tract at weaning and why are they important?

1. The gut microflora must adapt to the change in diet and environment which can lead to high mortality associated with diarrhea[1]. The weaning process significantly increases the number of potentially pathogenic coliforms such as, hemolytic *E. coli* and rotaviruses[2], and reduces favorable lactobacilli[3] in the small intestine of pigs.

2. Adverse morphological and histological changes occur in the gastrointestinal tract due to the weaning process, such as, reduced villous height, increased villous width and crypt depth, alterations in intestinal goblet cell function and population, and reduced absorptive capacity and brush border activity. All of these adverse changes in villus/crypt architecture can affect nutrient absorption.

   Possible causes of these adverse changes in the GI tract at weaning are centered on two major hypotheses. The first hypothesis is that local immunological responses to soy protein antigens in starter diets, leads to the compromised intestinal morphology and diarrhea seen in the newly weaned pig. Pigs weaned at 3 weeks of age onto a diet containing soy protein display transient increases in serum anti-soy IgG antibodies followed by systemic tolerance[4], however, no mechanistic links between serum anti-soy antibodies and compromised intestinal structure or function have been found. A second hypothesis is that the primary factor for the compromised villus/crypt structure at weaning is due to inadequate feed intake during the postweaning period and responses to dietary antigens are secondary [2]. A compromised mucosal barrier caused by acute fasting may allow the passage of nutritional or bacterial antigens into the lamina propria where activation of immune responses can occur. Dietary restriction leads to adverse morphological changes and atrophy of mucosa[6], indicating the importance of feed intake on intestinal structure and function. A recent study reported that inflammatory responses and villus atrophy correlated with depressed feed intake occurs after weaning, and that when feed intake patterns return to normal, intestinal inflammation subsided and epithelial morphology improved in the young pig[5].

3. Digestive enzymes are inadequately developed impacting nutrient absorption.

   Activity of the digestive enzyme lactase, which splits the milk carbohydrate lactose into glucose and galactose is relatively high at birth. Lactase increases for the first 2 to 3 weeks of life and then declines precipitously. Conversely, the activity of the digestive enzymes for the carbohydrates characteristic of grains (amylase and maltase) are relatively low at birth and do not increase to any appreciable amount until four to six weeks of age.

What are some changes in piglet immunity at weaning and why are they important?

Pigs are weaned from the sow at a time when passive immunity is declining and active immunity is not fully developed.

- Lymphocytes from pigs weaned at 2 to 3 weeks of age had a decreased ability to proliferate in response to a mitogen (foreign molecule), indicating that early weaning can be detrimental to cellular immune reactivity[7].
- Cytokines (mediators of normal gut immune responses and the inflammatory response) are altered due to weaning:
  - Increased plasma concentrations of pro-inflammatory cytokines (interleukin-1 and interleukin-6)
  - Increased interleukin-1 mRNA expression in the spleen, thymus, tonsil, and mesenteric lymph node and interleukin- 6 expression in the tonsil.
    These changes could reflect an inflammatory reaction occurring in the lymphatic organs and tonsils in response to a pathogenic challenge. Furthermore, weanling pigs undergoing immunological challenges such as stress, inflammation and/or infectious diseases can have a reduction in feed intake, lean muscle accretion and growth due to redistribution of nutrients and energy from growth towards increased cytokine production and immune cells[8].

Conclusion

The weaning process and development of the gastrointestinal tract of the pig have a profound affect on nutrient absorption and protection from pathogenic challenges, thus impacting growth. Diets constructed for young pigs should take into account these changes that are occurring at weaning and utilize ingredients that the young pig can better absorb and support intestinal health.

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