Endotoxins in weaning piglets – Establishment of models to evaluate alternatives to zinc oxide and antibiotics

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Background and objectives

In weaning pigs, it is essential to find alternatives to zinc oxide as well as antibiotics to prevent endotoxin-associated effects. Due to the complexity of the mechanism of endotoxin translocation into blood, models to test alternative strategies are quite limited. However, an intact gut barrier is crucial to prevent endotoxin-associated effects. Once endotoxins enter the blood flow due to an impaired gut barrier, behavioral changes like reduced feed intake as well as induction of the acute phase response (1), and even sepsis can be the consequence. To evaluate alternatives to zinc oxide and antibiotics, it is necessary to understand which events can affect endotoxin translocation in weaning pigs. Therefore, the objective of the study was to investigate two different models: heat stress, and oil/endotoxin challenge, on their effect on gut permeability and inflammation response.

Material and methods

Heat stress trial: Eight weaning-pigs were kept at thermoneutral conditions (24 hours 28 °C) followed by three days of diurnal heat stress (6 hours 35 °C, 18 hours 32 °C). Gut permeability was assessed at day 0 and day 2 using a non-invasive dual sugar assay. Blood samples were collected at day 0, 1 and 3 to measure pig-major acute phase protein (pig-MAP) as well as lipopolysaccharide-binding protein (LBP).
Oral oil/endotoxin challenge: Eighteen weaning piglets were assigned to three different groups: oral administration of 0.9% saline (control), coconut oil or coconut oil combined with endotoxins. Blood was sampled four hours after administration. Endotoxin activity was measured with the LAL assay as well as the endotoxin concentration (based on 3-OH C14) was measured with the HPLC-MS/MS. Acute phase proteins, haptoglobin, pig-MAP, and serum amyloid A (SAA), were assessed with commercially available ELISA kits.

Results

Heat stress trial: The dual sugar assay revealed a significantly increased lactulose/rhamnose ratio during heat stress. Furthermore, the pig-MAP concentration as well as the LBP concentration was significantly increased at the last day of heat stress.
Oral oil/endotoxin challenge: Blood endotoxin activity was significantly increased 4-fold in the oil + LPS group compared to the control group. In addition, the blood endotoxin concentration was significantly increased 2-fold in the oil group. The oil + LPS group showed a trend to increase the endotoxin concentration 2-fold. Haptoglobin concentration was not affected by any treatment. However, the oil alone administration significantly increased the pig-MAP concentration and showed a trend to increase the SAA concentration 3-fold. The oil + LPS administration significantly increased the SAA concentration 2.5 fold.

Conclusion and discussion

Taken together, both models seem to affect gut permeability in weaning pigs, thereby increasing the translocation of endotoxins into the blood stream. As a consequence, this translocation led to an induction of the acute phase response. In conclusion, it is important to find alternative strategies to avoid increasing endotoxin concentrations in the gastrointestinal tract as well as endotoxin translocation. Beside management, feed additives might provide the potential to be used as alternatives to zinc oxide or antibiotics. Therefore, established models might be used to further investigate the potential of feed additives to prevent endotoxin-associated effects.

References

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