How Does the Pre-weaning Environment Affect Gut Structure and Function, and Lifetime Performance of the Pig?

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Declaration

I declare that this is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

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ABSTRACT

The reduction in feed intake and growth rate that occurs following weaning is of major economic consequence to the pig industry. Currently, a range of antimicrobial products can be used to minimise the impact of weaning on piglet health and subsequent performance. However, the use of these products in pig diets is subject to increasing restriction worldwide because of perceived risks to public health and to the environment. Thus, alternative methods are required to mitigate the growth check that almost invariably occurs after weaning in most production systems.

Piglets produced outdoors are claimed to experience less of a growth check at weaning and to be able to thrive in relatively unsophisticated weaner accommodation. However, these claims have not been substantiated under Western Australian conditions, nor a scientific basis for these claims established. Consequently, a series of experiments was designed to test the general hypothesis for this thesis – '*the gut structure and function, and lifetime performance of the weaned pig are affected by its pre- and post-weaning rearing environments'*.

Experiment 1 was conducted in two parts to quantify differences in the growth performance, health and gut structure of weaner pigs produced indoors or outdoors and reared in conventional or deep-litter pens. The weaner diet in the first part of the experiment contained 100 ppm of olaquindox and 3,000 ppm of zinc oxide (Exp1a). This experiment was repeated without using dietary antimicrobial products (Exp1b). Experiment 2 was conducted in conventional buildings to examine the effect of exposing piglets in lactation to similar substrates to those available to outdoor piglets

used in Exp1a and Exp1b in the absence of other differences in the outdoor production milieu.

Pre-weaning environments in Exp1a (indoor production (IP) and outdoor production (OP)) appeared to have little effect on gut structure and overall growth rate but significantly affected carcass composition, whereas post-weaning environments (conventional (C) or deep-litter (DL)) affected both overall growth rate and carcass composition. Although feed disappearance was similar, OP pigs grew faster than IP pigs in the first 47 d after weaning in Exp1a but not in Exp1b. Lifetime growth rate (GR), P2 backfat, feed disappearance and feed conversion ratio (FCR) were not significantly affected by the production environment in Exp1a whereas OP pigs grew slower with higher P2 backfat and FCR in Exp1b. Interestingly, OP pigs had heavier carcass weights and higher dressing percentages than IP pigs in both parts of the experiment. The effects of post-weaning environment were more consistent as DL pigs grew faster, were fatter, and had higher carcass weights and dressing percentages than C pigs.

Villus height and crypt depth of IP and OP pigs were not different at 21 (weaning) or 28 d, but villus height decreased and crypt depth increased in the week after weaning. Pigs reared in C pens had greater faecal concentrations of volatile fatty acids than pigs in DL, indicating that the latter ingested sufficient straw to alter fermentation characteristics.

In Experiment 2, there were no differences in gut structure or pre-weaning and lifetime GR of pigs offered no creep feed (NC), a commercial creep feed (CF) or an ‘outdoor’ mix (OM) comprising of 1 part straw, 5 parts sow feed and 25 parts of soil taken from paddocks in which OP pigs used in Exp1a and Exp1b were farrowed. However, NC pigs grew slower in the week after weaning than the other two treatments. Backfat and feed disappearance were similar for all treatments but pigs on the OM treatment had higher carcass weights and dressing percentages than pigs on the NC and CF treatments. Villus height and crypt depth were not different between treatments and, although the piglets were weaned at 28 d, villus height decreased and crypt depth increased in the week after weaning to an extent similar to that experienced by piglets weaned at 21 d in Experiment 1.

Although all piglets received intramuscular injections of 200 mg iron (Fe) dextran when 1 to 2 days old, piglets offered the OM during lactation had higher serum iron and blood haemoglobin (Hb) levels than those offered NC or CF. Furthermore, half the piglets offered NC or CF had Hb levels indicative of chronic Fe deficiency anaemia. The average parity of sows used in this experiment was 6.3 litters, suggesting that piglets may have been born with low Fe stores, possibly because of low Fe stores in their dams due to sub-optimal mineral nutrition over successive parities.

In summary, the findings from these experiments partly supported the general hypothesis for this thesis. Under the conditions of these experiments, access to outdoor substrates in lactation had little effect on gut structure and lifetime growth rate but increased both carcass weight and dressing percentage, whereas rearing in DL pens increased feed intake, FCR, growth rate, P2 backfat, carcass weight and dressing percentage.

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ABBREVIATIONS AND DEFINITIONS

ADG	Average daily gain (g/d)
ANOVA	Analysis of variance
AP	Any antimicrobial product including but not limited to antibiotics, zinc, copper and acidifiers in various forms
BCR	Branch chain fatty acid ratio
C	Conventional
CF	Creep Feed
DAFWA	Department of Agriculture and Food Western Australia
DL	Deep-litter
Dressing percentage	HSCW ÷ Live weight at slaughter x 100
DXA	Dual energy X-ray absorptiometry
FCR	Feed conversion ratio (kg : kg)
GIT	Gastrointestinal Tract
GR	Growth rate (g/d)
HSCW	Hot standard carcass weight
IP	Indoor production (piglets farrowed and suckled indoors)
OM	'Outdoor' mix comprising of: 1 part straw, 5 parts sow feed and 25 parts soil
OP	Outdoor production (piglets farrowed and suckled outdoors)
NF	No creep feed
P2	Site for subcutaneous backfat measurement (including skin) 65 mm from the dorsal midline and level with the posterior edge of the last rib
VFA	Volatile fatty acid