Effect of Diet on the Expression of Swine Dysentery in Experimentally Infected Pigs

by

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......Dedicated to my beloved Wife, Yalum; Daughter, Quintilla; and Sons, Valentine, Ruben and Jonathon......

"Your love, understanding and presence has been my strength"
DECLARATION

I hereby declare that the work presented in this thesis has been performed by me, except where otherwise clearly stated in the text, and that it has not been previously submitted for application for a degree at any University.

Signed .............................................

PETER MAX SIBA
ABSTRACT

Swine dysentery (SD) is a severe mucohaemorrhagic colitis resulting from infection with the anaerobic spirochaetal bacterium, *Serpulina hyodysenteriae*. The disease affects weaner and grower pigs throughout the world, and causes significant financial losses due to mortality, decreased rate of growth, poor feed conversion, and expense of chemotherapy. Previous studies have shown that despite the presence of *S. hyodysenteriae* in pigs on many farms, clinical signs of SD do not always occur. This study was aimed at investigating the effect of diet on the clinical expression of SD. The ultimate aim was to identify diets that could be used to prevent or control the disease.

One hundred and seventy-eight weaner pigs were purchased from specific-pathogen free farms and fed one of 16 diets based on: cooked rice-animal protein, cooked rice-dehulled lupin, wheat-lupin, wheat-animal protein, parboiled rice-dehulled lupin, parboiled rice-animal protein, and processed (hammer-milled or steam-flaked) cereal grains (barley, groats, maize, sorghum and wheat) supplemented with animal protein. Eighty four pigs on these diets were slaughtered after one month to measure the influence of the diets on parameters in the large intestine, including organ sizes, and pH, VFA concentrations and dry matter content of the digesta in the caecum, and proximal and distal colon. The cooked rice-animal protein diet caused low levels of microbial fermentation in the large intestine of pigs as indicated by higher pH values, lower VFAs, smaller intestinal organ sizes, and drier contents in the colon and rectum, compared to pigs on the other diets. A limited amount of fermentative substrates from the cooked rice-animal protein diet entered the large intestine, and this led to a low microbial fermentation activity. Pigs fed diets containing cereal grains, parboiled rice and or dehulled lupins had greater fermentative activity in the large intestine. Parboiled rice unexpectedly was not easily digestible. Of the processed cereal grain diets, steam-flaked grains resulted in significantly higher (P<0.05) intestinal pH values than hammer-milled grains. This suggested that steam-flaking process made the nutrients (most likely starch) more available for digestion in the small intestine than did the hammer-milling process.
Another 94 pigs fed on the various diets were orally challenged with broth cultures of *S. hyodysenteriae* and were monitored for faecal excretion of spirochaetes, and for the development of SD. Diseased pigs were slaughtered immediately, and healthy pigs were slaughtered after 4-6 weeks, and changes in the large intestine were recorded. None of 16 challenged pigs fed cooked rice-animal protein developed SD and it was assumed that the reduced fermentation with this diet inhibited colonisation by *S. hyodysenteriae*, and expression of SD. Disease occurred in varying numbers of pigs fed all the other diets, for example cooked rice-dehulled lupin (83.3%), wheat-dehulled lupin (62.5%) and wheat-animal protein (60%). The diseased pigs developed diarrhoea with blood and mucus, were depressed, lacked appetite and showed gross and microscopic evidence of severe mucohaemorrhagic colitis. When two pigs fed the protective cooked rice-animal protein diet were transferred to the wheat-dehulled lupin diet, one died of acute clostridial enterotoxaemia, whilst the other developed SD. This provided further evidence for the protective effect of the cooked rice-animal protein diet.

Of the processed cereal grain types, steam-flaked maize and steam-flaked sorghum diets containing animal protein protected all pigs against SD, although small numbers of animals were used. All cereal-based diets resulted in greater fermentation than the cooked rice-animal protein diets, but fermentation was relatively reduced with steam-flaked maize.

The protective rice-animal protein diet was fed to pigs on a commercial piggery with SD. It resulted in good growth rate and carcass composition, but unfortunately no disease occurred amongst the control pigs during the experiment, so its efficacy against SD in the field could not be assessed.

In conclusion, all protective diets were based on cooked cereal grains which had low levels of non-starch polysaccharides and resistant starch (cooked rice, steam-flaked maize and steam-flaked sorghum) and animal protein. It appears that reducing the availability of such fermentable substrate in the large intestine prevents colonisation by *S. hyodysenteriae*, and protects
pigs from developing SD. This is a major new paradigm for the control of this important disease.
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