CHANGES IN PIGLET SMALL INTESTINE AT WEANING

D.J. HAMPSON, D.E. KIDDER*& E.M. HAMPSON
DEPARTMENT OF VETERINARY MEDICINE,
UNIVERSITY OF BRISTOL, BRISTOL, ENGLAND.

There is a critical period shortly after piglets are weaned when diarrhoea may occur, causing considerable economic loss. This enteric disorder is frequently associated with the presence of certain serotypes of haemolytic Escherichia coli in the upper small intestine (Sojka,1965). Even when diarrhoea does not occur in this period there is often a marked temporary setback in growth.

Gay et al.(1976) and Kenworthy (1976) reported changes in piglet intestinal villous structure and enzyme activity associated with weaning, and we have studied these changes in relation to alterations in numbers and distribution of serotypes of E. coli along the small intestine after weaning.

Methods

Piglets on the sow had access to antibiotic-free commercial creep feed from 10 days of age and a number of litters were weaned on to this food when 3 weeks old. Other litters were left on the sow and used as controls. Piglets from both groups were killed either at 3 weeks of age or at approximately one day intervals thereafter. Immediately before killing, anaesthesia was induced using halothane, nitrous oxide and oxygen, and the intestines were carefully exposed. Several sections of small intestine, about 5 cm. in length, were selected, ligated and the lumen perfused with a buffered formaldehyde/glutaraldehyde fixative. Subsequently five of these sites, at fixed percentages of the total small intestine length, were taken for stereomicroscopy and for optical and electron microscopic study. Immediately after perfusion the animals were killed, the intestines rapidly removed and samples of their contents and the mucosal wall of the various sections of the gut were taken for coliform counts and subsequent serotyping. Other contents were removed and stored at -70 C before clarifying and examining for virus particles under the transmission electron microscope. Samples of small intestine wall at set percentages of the small intestine length were also frozen in liquid nitrogen and stored at -20 C for determination of sucrase and lactase levels.

Results

In our experimental piglets, weaning was followed by dramatic alterations in small intestinal structure and enzyme activity with a temporary increase in coliform numbers.

Structure

The long finger-like villi of the unweaned piglets had shortened over the first 4 days after weaning to approximately half their initial length and then, after a further 3 to 4 days, showed a slight recovery. The depths of the crypts began to increase around the second to third day after weaning and by about the eighth day after weaning the ratio of villous height to crypt depth approached the near-adult value of 2:1, compared with approximately 7:1 in our unweaned piglets.

Villous morphology began to alter around the third to fourth day after weaning, when villous length was at its shortest and crypt depth was increasing. Tongue, leaf and eventually some ridge-like villi began to supplant the finger-like villi, as the small intestine gradually adopted a morphology more typical of the adult pig.

Enzymes

Lactase activity decreased from the first day after weaning and continued to fall before levelling off at around 25% of its pre-weaning value by the fourth day, with a moderate recovery after a further 3 to 4 days. Sucrase activity showed a similar pattern, except that the initial fall did not occur until 2 days after weaning, and the subsequent recovery was more marked.

Bacteria

In some piglets an increase in numbers of E. coli in the upper small intestine was observed around the third and fourth day after weaning. These organisms were usually haemolytic, in which case they were almost always of the O-149 serotype which had swamped other more varied O-types at all levels of the intestinal tract. Despite the presence of these potential pathogens in some piglets and the remarkable reductions in intestinal absorptive area and digestive enzyme activities which occurred in all our weaned piglets, no diarrhoea occurred and none of our animals showed signs of ill-health. Preliminary results indicate that similar changes occur when piglets are weaned abruptly at this age without prior access to creep feed.

Discussion

The changes seen may well be a normal accompaniment of weaning, but may temporarily increase the susceptibility of the animal to diarrhoea. Haemolytic E. coli appear to be favoured in the gut of the newly-weaned, so that their presence in the intestine of a scouring piglet could be merely coincidental, or making a contribution varying according to numbers, position, and extent of enterotoxin production.

We are continuing our studies to determine the basis of the changes seen and to attempt to manipulate them in the prevention or prophylaxis of post-weaning diarrhoea.

References

Gay,C.C., Barker, I.K. & Moore, P. (1976) Proc. 4th IPVS Congress, v11.
Kenworthy, R. (1976) Res. vet. Sci., 21,69.
Sojka,W.J. (1965) Escherichia coli in domestic animals and poultry, Farnham Royal, C.A.B.