EFFECTS OF *YERSINIA ENTEROCOLITICA* INFECTION ON THE DEVELOPMENT OF THE SMALL INTESTINE IN NEWBORN PIGLETS

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ABSTRACT

A model of bacterial gastroenteritis has been developed in which the effects of *Yersinia enterocolitica* infection on the structural and biochemical development of the small intestine have been examined in neonatal piglets both during the infection period (3 and 5 days postinfection) and during the subsequent recovery period after antibiotic therapy (at 14 days). The potential of oral bovine lactoferrin and another bovine milk protein for preventing or reducing the effects of *Y. enterocolitica* gastroenteritis have been evaluated in these piglets.

Newborn, colostrum-deprived piglets were inoculated orogastrically with a high dose (about 3 x 10^{10} colony forming units/ml) of *Y. enterocolitica* serotype 0:3, biotype 4. Diarrhoea began between 40 hours and 4 days after inoculation in 18 of the 19 animals and microabscesses, the typical lesions of Yersiniosis, were present in the mucosa of the small intestine in all infected piglets. At 5 days postinfection, microabscesses also were present in the liver of 7 of 8 piglets, and in the mucosa of the stomach in 2 animals. The mucosal damage and resulting malabsorption were reflected in the lower plasma glucose, Na^+ and Cl^- concentrations.

Yersinia enterocolitica infection reduced the body weight but not body length, but did not significantly affect the gastrointestinal tract length or weight or the growth of non-intestinal organs except the liver. There were markedly lower lactase and sucrase, but not maltase and Na^+-K^+-ATPase, activities in the small intestine. The mucosal protein and DNA contents and the ratio of RNA to DNA in the small intestine were not significantly different in infected animals. Rapid proliferation of crypt cells resulted in crypt enlargement in the entire small intestine, but reduced vacuolation of the epithelium of the distal small intestine.

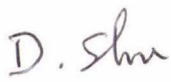
Following institution of effective antibiotic therapy, gastrointestinal lesions were absent. Compared with controls, the piglets gained body weight at the same rate, although remaining lighter in weight, and organ weights and concentrations of plasma Na^+ and Cl^-, but not glucose, were no different. Previously-infected piglets retained an altered profile of disaccharidase activity with a lower lactase activity, higher maltase and sucrase activities and early appearance of sucrase activity in the ileum. There were fewer vacuoles in the epithelium of the distal ileum.

A bovine milk fraction, but not bovine lactoferrin, appeared to reduce the severity of the infection due to *Y. enterocolitica*, there being shorter crypts, fewer proliferating crypt cells and higher lactase activity. The group means for the lesion number were also much lower although not significantly different. Oral supplementation with bovine lactoferrin in the milk formula did not have any beneficial effects in the infected piglets. In non-infected piglets, lactoferrin appeared to have trophic effects on the kidney and the small intestinal crypts, increased the lactase activity and caused an unexplained reduction in plasma glucose concentration and liver weight.

Yersinia enterocolitica enteritis in newborn, colostrum-deprived piglets accelerated the maturation of the epithelium of the small intestine, indicated by reduced enterocyte vacuolation and an altered disaccharidase profile.

STATEMENT

This is to certify that the work on which this thesis is based was carried out by the undersigned, and has not been accepted in whole or in part for any other degree or diploma. Assistance received is specifically recorded in the Acknowledgements section bound with this thesis.



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LIST OF ABBREVIATIONS

A/AG	acid/acid with gas
AB/PAS	Alcian blue/periodic acid-Schiff
ANOVA	Analysis of Variance
BMF	bovine milk fraction
BrDU	5-Bromo-2'-deoxy-uridine
BSA	bovine serum albumin
BSS	biocil surgical scrub
CFU	colony forming units
CIN	cefsulodin-irgasan-novobiocin
CRL	crown rump length
C_{RNA}	RNA concentration
DAB	3,3 diaminobenzidine tetrahydrochloride
DF	degree of freedom
E. coli	*Escherichia coli*
EDTA	ethylenediaminetetra-acetate
EGF	epidermal growth factor
FITC-D	fluorescein-isothiocyanate-labelled dextran
HE	haematoxylin and eosin
Ig	immunoglobulin(s)
K/A	alkali/acid
Lf	lactoferrin
LIA	lysine iron agar
M	molar
mM	millimolar
mmol	millimole
mOsm	milliosmole
MS	mean square
N	normal
Na^+-K^+-ATPase	sodium-potassium adenosine triphosphatase
NRL	nose rump length
NS	not significant
OD	optical density
PBS	phosphate buffered saline
P_i	inorganic phosphate
rpm	revolutions per minute
SE	standard error of the mean
TGE	transmissible gastroenteritis
TPN	total parenteral nutrition
TSB	tryptone soy broth
TSI	triple sugar iron
TW	tryptone water
U	unit
µmol	micromole
V. cholera	*Vibrio cholera*
VP	Voges-Proskauer
Y. enterocolitica	*Yersinia enterocolitica*