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COMPARISON OF THE PASSIVE PROPHYLACTIC EFFECT OF BOVINE MILK
IMMUNOGLOBULIN FED EITHER AS A BOLUS OR CONTINUOUSLY
AGAINST DIARRHOEA CAUSED BY *ESCHERICHIA COLI* K88 USING
PIGLETS AS MODELS

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ABSTRACT

The overall aim of the study was to determine the passive prophylactic effect of bovine milk immunoglobulin administered orally either as a bolus (once a day) or as continuously (three times a day) against diarrhoea caused by *Escherichia coli* K 88.

As the piglets have gastrointestinal structural and physiological similarities to humans they were assumed to be an appropriate model for the study. The first part of the study was done to evaluate the quantity of undigested immunoglobulin G in the gastrointestinal tract of the piglet. This was conducted in two experiments. One was a pilot study and the other was to estimate the quantity of undigested immunoglobulin G in the gut.

A pilot study was conducted to evaluate the rate of movement and the quantities of digesta that can be collected in the gastrointestinal tract regions at varying time intervals. Ten piglets were randomly divided into five groups of two in each. One from each group was selected, fed with an experimental diet which contained blue colour glass beads and dye and slaughtered at either 1, 5, 9, 16 and 24 hrs after feeding. Digesta was collected from various regions of the gastrointestinal tract. Faeces were collected using ostomy bags from those slaughtered at 9, 16 and 24 hrs only. The dye movement and the glass beads recovered were monitored. The movement of the dye was observed up to the small intestine at 1 hr, the caecum at 5 hrs, the beginning of the colon at 9 hrs, the two third of the colon at 16 hrs, and in the faeces at 24 hrs. Most of the beads were found in the stomach between 1 and 5 hrs, spread throughout the small intestine at 9 hrs, in the caecum at 16 hrs and in the colon at 24 hrs. The results confirmed that a sufficient amount of digesta could be collected from the various regions over a 24 hr period. The data facilitated the planning of the immunoglobulin digestibility trial which is the second part of the experiment.

To measure the IgG digestibility, the piglets were fed on a large dose of an experimental diet (10% of their metabolic body weight $\text{kg}^{0.75}$ contain 30% immunoglobulin) and the digesta, faeces and blood were collected. On the slaughter day, a group of five animals were fed on an experimental diet and digesta and blood were collected 1, 5, 9, 16, and 24 hours after feeding. Faeces were collected from those killed at 16 and 24 hours. Blood was analysed for immunoglobulin G for all piglets. Digesta and faeces were

analysed for chromium and immunoglobulin G. There was no evidence of the presence of immunoglobulin G in the blood and faeces. A larger quantity of immunoglobulin G was found in the stomach ($p < 0.001$) with a less in the first and second third of the small intestine ($p < 0.05$) 24 hours post-prandially. This demonstrated that immunoglobulin G could resist digestion in the gut.

The second part of the study was conducted to compare the effect of feeding bovine immunoglobulin as a bolus versus continuous against *Escherichia coli* K88 diarrhoea. Twenty-four piglets, four-week-old, were randomly allocated to three treatment groups, namely continuous (fed a diet containing 10% immunoglobulins three times a day), control (fed an immunoglobulins free diet), and bolus (fed a 30% immunoglobulins diet in the morning and control diet the other two feeds). On Day 9, 30 minutes before the morning feed, the piglets were inoculated with 1×10^9 cfu *Escherichia coli* by a syringe into their throat, and observed for nine days. On day 17, all piglets were fed on control diet (no Ig) to evaluate if *Escherichia coli* K88 would have any effect on recolonisation and diarrhoea and observed for further three days. Finally they were all treated with antibiotics, Biosol M and Tylan 200. The observations include faecal culture, faecal consistency, the percent of free water content in the faeces, weight and feed intake. Faecal culture was done twice before inoculation, three times during treatment, and once after all were fed on control diet and once after the antibiotics treatment. The free liquid content in the faeces was highest in the control group (37.5%) and lower in the continuous immunoglobulin group (25.0%) and least in the bolus immunoglobulin group (17.5%). Bolus immunoglobulin feeding (11.25%) lessened the severity of diarrhoea (classified by consistency) compared with the control group (26.2%) and continuous group (25.0%). Hence bolus immunoglobulin feeding had a better effect in controlling water loss and the severity of diarrhoea. A higher dosage of immunoglobulin in bolus feeding may also have prevented bacterial shedding. From this study, it can be concluded that feeding immunoglobulin as a bolus could be used as a prophylactic treatment for diarrhoea.

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TABLE OF CONTENTS

	Page
Abstract	ii
Acknowledgements	iv
Table of Contents	v
List of Tables	ix
List of Figures	xi
List of Appendices	xiii
Abbreviations	xvi
INTRODUCTION TO EXPERIMENTS	1
<u>Chapter 1</u> REVIEW OF LITERATURE	2
1.1 Immunity	3
1.2 Immunoglobulin: Classes, Structure and functions	5
1.2.1 Immunoglobulin G	5
1.2.2 Immunoglobulin M	7
1.2.3 Immunoglobulin A	8
1.2.4 Immunoglobulin D	11
1.2.5 Immunoglobulin E	11
1.2.6. Immunoglobulin Y	12
1.3 Occurrence of immunoglobulins in milk and other secretions	12
1.3.1 Human	13
1.3.2 Bovine	14
1.3.3 Composition of human milk versus bovine milk immunoglobulins	15
1.4 Immune response to infection	15
1.5 Control of infection	17
1.6 Immunization	17
1.7 Routes of administering immunoglobulins for passive immunization	20
1.7.1 Subcutaneous administration	20

1.7.2 Intramuscular administration	20
1.7.3 Intravenous administration	21
1.7.4 Oral administration	21
1.8 Use of immunoglobulins from different species to provide passive immunization	23
1.8.1 Use of human immunoglobulins	23
1.8.2 Use of non-human origin immunoglobulins	24
1.9 Digestion of immunoglobulins in the gastrointestinal tract	25
1.10 Oral administration of immunoglobulin derived from bovine colostrum and milk used as passive immunity therapy or prophylaxis	28
1.11 The need for a suitable animal model	30
1.12 The inferences of the literature review	31
1.13 References	42
<u>Chapter 2</u> TRANSIT OF DIGESTA THROUGH THE DIFFERENT PARTS OF THE GASTROINTESTINAL TRACT OF PIGLETS OVER 24 HOURS PERIOD	62
2.1 Abstract	63
2.2 Introduction	64
2.3 Materials and methods	64
2.3.1 Animals	64
2.3.2 Housing	65
2.3.3 Diets and feeding regime	65
2.3.4 Experimental procedure	67
2.3.5 Collection of digesta and faeces	67
2.3.6 Analysis of digesta and faeces	68
2.3.6.1 Dye marker	68
2.3.6.1.1 Visual observation	68
2.3.6.1.2 Colour measurement by colourimeter	68
2.3.6.2 Beads	69
2.3.7 Data analysis	69
2.4 Results	69

2.5	Discussion	78
2.6	References	81
2.7	Appendix 2	84
<u>Chapter 3</u>	DIGESTION OF IMMUNOGLOBULIN G DERIVED FROM BOVINE MILK FED AS A SINGLE BOLUS TO WEANER PIGLETS	91
3.1	Abstract	92
3.2	Introduction	93
3.3	Materials and methods	94
	3.3.1 Animals	94
	3.3.2 Housing	94
	3.3.3 Diet and feeding regime	95
	3.3.4 Experimental procedure	95
	3.3.5 Collection of digesta, faeces and blood	95
	3.3.6 Sample analysis	97
	3.3.6.1 Measurement of bovine immunoglobulins	97
	3.3.6.2 Measurement of Chromium	100
	3.3.7 Data analysis	
3.4	Results	101
3.5	Discussion	110
3.6	References	113
3.7	Appendix 3	116
<u>Chapter 4</u>	THE EFFECT OF BOVINE IMMUNOGLOBULINS FED EITHER AS A BOLUS VERUS AS CONTINUOUS ON THE DEVELOPMENT AND SEVERITY OF DIARRHOEA CAUSED BY <i>ESCHERICHIA COLI</i> K88 AS THE ENTEROPATHOGENIC CHALLENGE MICROORGANISMS USING A PIGLET MODEL	145
4.1	Abstract	146
4.2	Introduction	148
4.3	Materials and methods	150

4.3.1 Animals	150
4.3.2 Housing	150
4.3.3. Diet and feeding regime	150
4.3.4 Experimental procedure	154
4.3.5 Measurement of diarrhoea	155
4.4.6 Obtaining evidence of <i>Escherichia coli</i> K88 infection	156
4.3.7 Obtaining evidence of Rotavirus infection	156
4.3.8 Obtaining evidence of other diarrhoea causing micro-organisms	157
4.3.9 Data analysis	157
4.4 Results	157
4.5 Discussion	159
4.6 References	170
4.7 Appendix 4	174
Chapter 5 GENERAL SUMMARY, DISCUSSIONS AND RECOMMENDATIONS	186

LIST OF TABLES

Table		Page
1.1	Components of the immune system	3
1.2	Concentration of immunoglobulins in the milk from different species	13
1.3	Research into the use of bovine immunoglobulins for passive immunity against <i>Escherichia coli</i> administered orally as therapy or prophylaxis	33
1.4	Research into the use of bovine immunoglobulins for passive immunity against rotavirus administered orally as therapy or prophylaxis	35
1.5	Research into the use of bovine immunoglobulins for passive immunity against other miscellaneous organisms administered orally as therapy or prophylaxis	38
2.1	The ingredient composition (%) of the weaner diet fed to six-week-old piglets in a gut transit time trial	66
2.2	The calculated nutrient content of a weaner diet fed to six-week-old piglets in a gut transit time trial	66
2.3	Visual colour observation in digesta and faeces collected from piglets at different times and at different locations in the gastrointestinal tract after a single meal of experimental diet containing 0.12% carmine red dye marker per 100g of diet fed	71
3.1	The ingredient composition (%) of an experimental meal fed to four to five-week-old piglets as a single bolus in an IgG digestibility trial	96
3.2	The calculated nutrient content of the experimental meal fed to four to five-week-old piglets as a single bolus in an IgG digestibility trial	96
3.3	Statistical significance of effect of hours after feeding, location, and the location by hours interaction on the amount of IgG in the freeze-dried digesta sample, the amount of chromium (Cr) in the freeze dried digesta sample, the IgG:Cr ratio and percentage of undigested IgG	103
4.1	The ingredients composition (%) of the control diet, the "continuous Ig diet", and the "bolus Ig diet" fed to weaner piglets in the challenge trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia- coli</i> K88 challenge	152
4.2	The calculated nutrient content of the control diet, the "continuous Ig diet", and the "bolus Ig diet" fed to weaner piglets in the challenge trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after	153

Escherichia- coli K88 challenge

- | | | |
|-----|--|-----|
| 4.3 | The presence of <i>Escherichia coli</i> in the fresh faeces of piglets in the trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia- coli</i> K88 challenge | 163 |
| 5.1 | The percent of undigested bovine IgG (range and $\bar{X} \pm SD$) found in different parts of a piglets gastrointestinal tract is given as relative to the amount consumed as a single bolus experimental diet containing 2% IgG at different times after feeding | 190 |

LIST OF FIGURES

Figure		Page
1.1	The basic structure of human IgG	9
1.2	Pentameric polypeptide chain structure of human IgM	9
1.3	Pentameric polypeptide chain structure of human IgA	10
1.4	Polypeptide chain structure of human IgD	10
1.5	Polypeptide chain structure of human IgE	10
2.1	The number of beads recovered in different sections of a piglet's gastrointestinal tract expressed as a percentage of the total amount of beads recovered from entire gastrointestinal tract 1 hr after feeding experimental diet	72
2.2	The number of beads recovered in different sections of a piglet's gastrointestinal tract expressed as a percentage of the total amount of beads recovered from entire gastrointestinal tract 5 hrs after feeding experimental diet	73
2.3	The number of beads recovered in different sections of a piglet's gastrointestinal tract expressed as a percentage of the total amount of beads recovered from entire gastrointestinal tract 9 hrs after feeding experimental diet	74
2.4	The number of beads recovered in different sections of a piglet's gastrointestinal tract expressed as a percentage of the total amount of beads recovered from entire gastrointestinal tract 16 hrs after feeding experimental diet	75
2.5	The number of beads recovered in different sections of a piglet's gastrointestinal tract expressed as a percentage of the total amount of beads recovered from entire gastrointestinal tract 24 hrs after feeding experimental diet	76
2.6	The average number of beads recovered in the different sections of the piglet's gastrointestinal tract expressed as a percentage of the total amount of beads recovered from entire gastrointestinal tract at different times after feeding experimental diet	77
3.1	The percent of undigested bovine IgG found in different sections of the piglets' gastrointestinal tract expressed relative to the amount consumed as a single bolus experimental diet containing 2% IgG, 1hrs after feeding	104
3.2	The percent of undigested bovine IgG found in different sections of the piglets' gastrointestinal tract expressed relative to the amount consumed as a single bolus experimental diet containing 2% IgG, 5hrs after feeding	105
3.3	The percent of undigested bovine IgG found in different sections of the piglets' gastrointestinal tract expressed relative to the amount consumed	106

	as a single bolus experimental diet containing 2% IgG, 9hrs after feeding	
3.4	The percent of undigested bovine IgG found in different sections of the piglets' gastrointestinal tract expressed relative to the amount consumed as a single bolus experimental diet containing 2% IgG, 16 hrs after feeding	107
3.5	The percent of undigested bovine IgG found in different sections of the piglets' gastrointestinal tract expressed relative to the amount consumed as a single bolus experimental diet containing 2% IgG, 24 hrs after feeding	108
3.6	The average percent \pm SD of undigested bovine IgG found in different sections of the piglets' gastrointestinal tract expressed relative to the amount consumed as a single bolus experimental diet containing 2% IgG, at different times after feeding from the entire gastrointestinal tract at different times after feeding	109
4.1	Average weight of weaner piglets fed three different diets in a trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	160
4.2	Distribution of faecal consistency versus percentage of free liquid in the faeces of all piglets in a trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	161
4.3	The percentage of piglets that had abnormal faeces, as defined by more than 10% of water in the faeces, in the different treatment groups before challenge, during challenge and after challenge with <i>Escherichia coli</i> K88 to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea	162
4.4	The percentage of piglets that were shedding <i>Escherichia coli</i> K88 for less than or more than five days in a trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	164
5.1	Number of piglets that had diarrhoea each day throughout the trial in the continuous Ig group, bolus Ig group and control, no Ig group after challenge with <i>Escherichia coli</i> K88 on Day 9 to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea	191

LIST OF APPENDICES

Appendix		Page
2.1	Nutrient content of vitamin and mineral mix added to a standard weaner diet for piglets in all trials	84
2.2	Nutrient content of DICP (Di calcium phosphate) added to a standard weaner diet for piglets in all trials	85
2.3	Total daily feed intakes (g/day) by six week-old piglets fed over seven days during gut transit time trial	85
2.4	visual colour observation of digesta collected throughout the gastrointestinal tracts of piglets at different times after feeding a experimental diet containing 0.12g carmine red marker per 100g of diet fed	86
2.5	Colour measurements, <i>L</i> , <i>a</i> , <i>b</i> and 530nm wave length by colourimeter, recovered percent of beads from different parts of the gastrointestinal tract of piglets 1, 5, 9, 16 and 24 hrs after feeding a experimental diet	88
3.1	Equations used to calculate immunoglobulin concentration in the whey globulin concentrate, the diets used in chapter III and IV, and in the faeces and digesta collected, after detection using a radial immunodiffusion assay ("The binding site", Birmingham, UK)	116
3.2	Calculation of sample concentrations used to measure bovine IgG concentrations in whey globulin concentrate by the radial immunodiffusion assay	117
3.3	IgG calibrator readings for the radial immunodiffusion assay used to measure bovine IgG levels in whey globulin concentrate	118
3.4	IgG calibrator curve for the radial immunodiffusion assay used to measure bovine IgG concentration in whey globulin concentrate	118
3.5	Calculation of bovine IgG concentration in whey globulin concentrate (WGC) as measured by the radial immunodiffusion	119
3.6	IgA calibrator readings for the radial immunodiffusion assay used to measure bovine IgA concentration in whey globulin concentrate	120
3.7	IgA calibrator curve for the radial immunodiffusion assay used to measure bovine IgA concentration in a whey globulin concentrate	120
3.8	Calculation of bovine IgA concentration in whey globulin concentrate (WGC) as measured by the radial immunodiffusion	121

3.9	IgM calibrator readings for the radial immunodiffusion assay used to measure bovine IgM concentration in whey globulin concentrate	122
3.10	IgM calibrator curve for the radial immunodiffusion assay used to measure bovine IgM concentration in a whey globulin concentrate	122
3.11	Calculation of bovine IgM concentration in whey globulin concentrate (WGC) as measured by the radial immunodiffusion	123
3.12	Concentration of diet samples assayed for bovine IgG concentration by the radial immunodiffusion assay	124
3.13	IgG calibrator readings for the radial immunodiffusion assay used to measure bovine IgG concentration in weaner diet and an experimental diet fed to four to five-week-old piglets in IgG digestibility trial as measured by the radial immunodiffusion assay	124
3.14	IgG calibrator curve for the radial immunodiffusion assay used to measure bovine IgG concentrations in weaner diet and experimental diet fed to four to five-week-old piglets in the IgG digestibility trial	125
3.15	Calculation of bovine IgG concentration in the weaner diet and experimental diet fed to four to five-week-old piglets in the IgG digestibility trial as measured by the radial immunodiffusion assay	126
3.16	IgG calibrator readings in the radial immunodiffusion assay used to measure bovine IgG concentrations in digesta from weaner piglets in the IgG digestibility trial	127
3.17	Standard curve for IgG calibrators in the radio immunodiffusion assay used to measure bovine IgG concentration in digesta from piglets in the IgG digestibility trial	128
3.18	Radial immunodiffusion plates readings for digesta, faeces, and blood from weaner piglets in the IgG digestibility trial	129
3.19	Calculation of percent of undigested IgG (k18) in the digesta from weaner piglets in the IgG digestibility trial	134
3.20	General linear model	143
3.21	Total daily feed intake (g/day) by four to five-week-old piglets in the IgG digestibility trial	144

4.1	Calculation of sample concentrations for measurement of bovine IgG in the diets used to feed piglets in a trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	174
4.2	IgG calibrator readings from the radial immunodiffusion assay measuring IgG concentration in diets to feed piglets in a trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	175
4.3	IgG calibrator curve from the radial immunodiffusion assay measuring IgG in diets to feed piglets in a trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	176
4.4	Calculation of bovine IgG in diets fed to piglets in a trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	177
4.5	General linear model	178
4.6	Total daily feed intake (g/day) by weaner piglets during the trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	179
4.7	Weight of piglets throughout a trial to determine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	181
4.8	Daily observation of the faeces consistency from piglets during the trial to examine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	182
4.9	The percentage of free liquid content in the faeces of piglets during the trial to examine the effect of continuous immunoglobulin feeding versus bolus immunoglobulin feeding on the development of diarrhoea after <i>Escherichia coli</i> K88 challenge	184

ABBREVIATIONS

AIDS	Acquired immunodeficiency syndrome
CCM	Caecum
COL	Colon
Cr	chromium
Cr FD	chromium in freeze dried sample
DICP	Di calcium phosphate
E.coli	Escherichia coli
FD	Freeze dried
Fab	Fragment antigen binding
Fc	Fragment crystalline
Ig	Immunoglobulin
Igs	Immunoglobulins
IgA	Immunoglobulin A
IgD	Immunoglobulin D
IgE	Immunoglobulin E
IgG	Immunoglobulin G
IgG FD	IgG in freeze dried sample
IgM	Immunoglobulin M
IgY	Immunoglobulin Y
IM	Intramuscular
IV	Intravenous
N	Negative
NF	Not fed
NS	No samples
P	Positive
PBS	Phosphate buffer solution
RID	Radial immuno diffusion
SI1	Small intestine 1
SI2	Small intestine 2
SI3	Small intestine 3
SIgA	Secretory immunoglobulin A
SIgGCr	Sample IgG/chromium
SMP	skim milk powder
STM	Stomach
TNBS	Trinitrobenzenesulfonic acid
WGC	Whey globulin concentrate