WHOLE GRAIN INCLUSION IN POULTRY DIETS: EFFECTS ON PERFORMANCE, NUTRIENT UTILISATION, GUT DEVELOPMENT, CAECAL MICROFLORA PROFILE AND COCCIDIOSIS CHALLENGE

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in

Animal Science

at Institute of Veterinary, Animal and Biomedical Sciences (IVABS)
Massey University, Palmerston North,
New Zealand

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2013

Abstract

Whole grain feeding has recently received renewed interest in the commercial poultry industry as a mean of lowering feed manufacturing cost. Wheat is the cereal grain of choice for whole grain feeding, despite the fact that globally maize is the most commonly cereal grain. Published data on the use of whole maize in poultry diets are scant. The size of maize grain may be the major reason for the lack of interest in feeding whole maize. The first three experiments of the thesis investigated alternative feeding strategies such as pre-pelleting inclusion or minor modifications such as cracking or coarser grinding to overcome the issue of maize kernel size. Experiment four evaluated whole wheat (WW) feding and examined the interaction between pellet diameter (3.0 vs 4.76 mm) and method of wheat inclusion (ground wheat (GW) or WW pre-and post-pelleting). The intention of using a larger pellet die was to retain the larger wheat particle size in pellets. Experiment five investigated the effect of whole wheat feeding in broilers experimentally challenged with a mixed infection of *Eimeria*.

Pre-pelleting inclusion of 0 to 600 g/kg whole maize replacing (w/w) ground maize in broiler starter diets showed that the weight gain of broilers was poorer despite improvements in gizzard development, nutrient utilisation and pellet quality (Chapter 4). Poor weight gain was due largely to reduced feed intake. Inclusion of 0 to 600 g/kg coarse maize, replacing (w/w) finely-ground maize, in broiler diets in mash form from day 11 to 35 post-hatch resulted in improvements in weight gain and gizzard weight without any negative effect on nutrient utilisation and carcass yield (Chapter 5). Increased caecal counts of beneficial bacteria *Lactobacilli* spp. and *Bifidobacteria* spp. and decreased counts of *Clostridium* spp., *Campylobacterium* spp. and *Bacteroides* spp. were also reported. Similarly, feeding diets containing 0 to 600 g/kg coarse maize to laying hens, from 39 to 62weeks of age, had no adverse effects on any production parameters and egg quality (Chapter 6). These results indicated that ground maize in broiler and layer diets could be completely replaced by coarsely ground maize with no adverse effects of bird performance. .

Data reported in Chapter 7 showed that the effect of pellet diameter on broiler performance varied depending on the form of wheat and method of WW inclusion. Larger pellet diameter increased the weight gain and lowered feed per gain of birds fed

diets with GW and post-pellet inclusion of WW. However, in birds fed diets with pre-pelleting inclusion of WW, the larger pellet diameter lowered weight gain and increased feed per gain, due largely to reduced feed intake which may be attributed partly to poorer pellet quality. Relative gizzard weight was increased by larger pellet diameter with pre-pelleting inclusion of WW, but was unaffected by diets containing GW or post pelleting inclusion of WW. Larger pellet diameter increased the apparent metabolisable energy and ileal starch digestibility, irrespective of method of WW inclusion. These results suggested that, irrespective of whether the wheat grain was milled or added whole post-pelleting, a larger diameter pellet was beneficial. On the other hand, when WW was added pre-pelleting, a smaller diameter pellet resulted in improved weight and feed per gain in broiler performance.

In the final experiment (Chapter 8), broilers fed WW either pre-or post-pelleting and experimentally challenged with a mixed *Eimeria* infection at 21 day of age showed that mortality in challenged birds was highest in those fed diets with WW post-pelleting, followed by pre-pelleted WW and GW (58, 35, and 17%, respectively). The pattern of mortality paralleled the changes in gizzard size, which suggested that WW feeding exacerbated the severity of coccidiosis infection, possibly via a mechanism involving enhanced gizzard development.

Dedicated

to

my late father

(SUJAN SINGH)

Acknowledgements

My heartiest gratitude goes to my Chief supervisor, Prof V. (Ravi) Ravindran who always smiles to solve the problem and remains silent to avoid the problem. I salute his patience, knowledge and supervision for the conductance of experiments and writing this thesis.

I am heartily thankful to my co-supervisors, Dr G. (Rana) Ravindran, Dr. Timothy Wester and Dr. Molan Abdul, whose encouragement and guidance was always there to hurdle all the obstacles to learn and understand the subject matter. No words can explain the support and valuable guidance provided by them.

I would like to thank Dr Patrick Morel for teaching me statistics, and for his expert advice on statistical matters. I am also thankful to Dr Allan Hardacre for his scientific technical support related to maize grain.

I must acknowledge Dr S. V. Rama Rao and Mr Raju from Hyderabad, India for providing all facilities for the smooth conductance of experiments and providing me a comfortable home environment. The facilities they provided were beyond expectation.

I am grateful to the Poultry Research Unit staff for the support they provided through my entire research. Colin Naftel, Edward James, Rick Lee Huki and especially Don Thomas for enriching my experience about life and making us comfortable.

I appreciate the staff of the IFNHH Nutrition, Food Chemistry Lab, and Human Nutrition Physiology Lab for their assistance and support.

My sincere thank goes to the governments of India and New Zealand for their joint collaboration through the Commonwealth scholarship (NZAID) to support my studies and give me an opportunity to learn and develop new skills. My special thanks go to Mrs Sylvia Hooker, and her team (Mrs Olive Pimentel, Jamie Hooper, and Leuaina Vaai-Hatier, Dianne Reilly, Natalia Benquet and Sue Flynn) at the International Student Office at Massey University for all their care and support.

I wish to thank my student colleagues Reza, Fifi, Pla, Khaldon, Rhuvini and all the others in my office for helping me throughout my studies.

I wish to convey my warmest appreciation to my parents, family members, and my wife (Manoj Kumari) and kids (Chiku and Chicky).

Finally, the one above all of us, the omnipresent God.

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List of Abbreviations

AGP	Antibiotic growth promoters
AME	Apparent metabolisable energy
ANOVA	Analysis of variance
CM	Coarse maize
DM	Dry matter
FCF	Free choice feeding
FISH	Fluorescence in situ hybridisation
g	Gram
GE	Gross energy
GMD	Geometric mean diameter
GSD	Geometric standard deviation
GW	Ground wheat
h	Hours
HCL	Hydrochloric acid
kg	Kilogram
MF	Mixed feeding
Min	Minutes
MJ	Mega joule
mm	Millimetre
µm	micrometre
N	Nitrogen
NSP	Non starch polysaccharide
PDI	Pellet durability index
PP	Post-pelleting
PRP	Pre-pelleting
SF	Sequential feeding
Ti	Titanium
WW	Whole wheat