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**FEED PARTICLE SIZE, WHOLE WHEAT INCLUSION AND
XYLANASE SUPPLEMENTATION IN BROILER DIETS:
INFLUENCE ON THE PERFORMANCE, DIGESTA
CHARACTERISTICS AND DIGESTIVE TRACT
DEVELOPMENT**

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ABSTRACT

The first three experiments of this thesis examined the effects of particle size reduction of grains in relation to feed form (mash vs. pellet), grain type (wheat vs. maize) and xylanase supplementation on broiler performance, energy utilisation, digestive tract development and digesta parameters. The fourth experiment examined the interaction between wheat hardness and xylanase supplementation. The effects of insoluble fibre source and whole wheat inclusion were studied in the fifth experiment.

In the first experiment (Chapter 4), pelleting reduced nitrogen-corrected apparent metabolisable energy (AMEn), but broiler performance was superior in birds fed pelleted wheat-based diets compared to those fed mash diets. Feed form had a greater effect on various measured parameters than did particle size. Pelleting evened out differences in particle size distribution between treatments and, as a result, wheat particle size had no effect on the performance of broilers fed pelleted diets. In contrast, the second experiment (Chapter 5) showed that differences in particle size distribution persisted between diets after pelleting and, as a result, coarse grinding of wheat or maize improved broiler performance compared to those fed diets based on fine particles. These results may be related, in part, to changes in size distribution following pelleting.

In mash diets, inconsistency in performance responses were found. In the first experiment (Chapter 4), coarse grinding of wheat improved weight gain and feed per gain compared to medium grinding. In the third experiment (Chapter 6), however, grinding particle size had no influence on broiler performance. The observed discrepancy suggests involvement of other factors such as wheat cultivar and grain hardness.

Data reported in Chapter 6 showed that xylanase supplementation improved feed per gain of birds fed the coarse particle size diet, but had no effect on those fed the medium particle size diet. In Chapter 7, there was a significant interaction between wheat hardness and xylanase supplementation due to the improved feed per gain and AMEn of birds maintained on hard wheat-based diet, while there was no effect of xylanase on soft wheat-based diet. These findings suggest that the efficiency of exogenous enzymes is influenced by both particle size and wheat hardness.

Data reported in Chapter 7 showed that inclusion of soft or hard whole wheat pre-pelleting produced different particle size distributions in the pelleted diets. This

suggested that hardness of the grain must be considered when choosing whole wheat for inclusion in broiler diets.

Data on the effect of feed particle size on its subsequent distribution in poultry digesta are scanty. Results reported in Chapters 4 and 5 showed that there was no effect of feed particle size within feed form on duodenal digesta particle size. On the other hand, particle size of duodenal digesta was influenced by feed form (mash vs. pellet). Wheat hardness was also found to influence the particle size of proximal (duodenum and jejunum) intestinal digesta (Chapter 7). These results indicated that the gizzard does not uniformly reduce the size of all particles. However, the gizzard appears highly efficient in grinding large particles, although some large particles escape the grinding.

The final experiment demonstrated that the effects of insoluble fibre on digestive tract development and broiler performance differed depending on the fibre source. Wood shavings, a source of coarse insoluble fibre, increased relative gizzard size and improved corrected feed per gain and ileal starch digestibility. In contrast, cellulose, a source of fine insoluble fibre, had no influence on these parameters.

In conclusion, dietary manipulations, which stimulated gizzard development, positively influenced broiler performance and starch digestibility. The findings of this thesis suggest that energy savings during feed processing could be achieved by coarse grinding of grains with no adverse effect on broiler performance and that cereals used in broiler diets can be ground more coarsely than the current practice. Wheat hardness appears to be an important criterion to consider when choosing a cultivar for whole wheat inclusion in broiler diets. Another major finding was that the effectiveness of exogenous xylanase in wheat-based diets could be improved by considering factors such as particle size and wheat hardness.

Didicated to Nrmeen (my wife)

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Publications

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Table of contents

Abstract	i
Acknowledgements.....	iv
Publications	v
Table of contents	vii
List of tables	ix
List of figures	xi
List of abbreviations	xii
Chapter 1	xii
1. General introduction	1
Chapter 2	4
2. Review of Literature	4
2.1. Feed particle size: Implications on the digestion and performance of poultry ..	4
2.2. Exogenous enzymes and the nutritive value of wheat	21
2.3. Endosperm hardness and the nutritive value of wheat.....	29
Chapter 3	34
3. General Materials and Methods	34
3.1. Birds and housing.....	34
3.2. Determination of the geometric mean diameter (GMD) and the geometric standard deviation (GSD) of feed particles.....	34
3.3. Apparent metabolisable energy determination.....	35
3.4. Digestive tract measurements	36
3.5. Intestinal morphology measurements	36
3.6. Determination of particle size distribution in the diets, duodenal and colonic digesta by wet sieving	37
3.7. Determination of digesta transit time.....	37
3.8. Pellet durability	38
3.9. Statistical analysis	38
Chapter 4	39
4. Influence of feed particle size and feed form on the performance, energy utilisation, digestive tract development and digesta parameters of broiler fed wheat- based diets	39
4.1. Abstract	39
4.2. Introduction	40
4.3. Materials and methods	41
4.4. Results	43
4.5. Discussion	50
4.6. Conclusions	53
Chapter 5	54
5. Influence of feed particle size and grain type on the performance, energy utilisation, digestive tract development and digesta parameters of broilers fed either wheat- or maize-based diets	54
5.1. Abstract	54
5.2. Introduction	55
5.3. Materials and methods	55
5.4. Data analysis	57
5.5. Results	57
5.6. Discussion	64
5.7. Conclusions	67

Chapter 6	69
6. Influence of particle size and xylanase supplementation on the performance, energy utilisation and, gross morphology and histology of the digestive tract of broilers fed wheat-based diets.....	69
6.1. Abstract	69
6.2. Introduction	70
6.3. Materials and methods	70
6.4. Results	73
6.5. Discussion	78
6.6. Conclusions	80
Chapter 7	81
7. Influence of wheat hardness and xylanase supplementation on the performance, energy utilisation, digestive tract development and digesta parameters of broilers fed wheat-based diets.....	81
7.1. Abstract	81
7.2. Introduction	82
7.3. Materials and methods	83
7.4. Results	85
7.5. Discussion	91
7.6. Conclusions	93
Chapter 8	94
8. Influence of insoluble fibre source and whole wheat inclusion on the performance, digestive tract development and ileal microbiota profile of broiler chickens.....	94
8.1. Abstract	94
8.2. Introduction	95
8.3. Materials and methods	96
8.4. Results	100
8.5. Discussion	106
8.6. Conclusions	109
Chapter 9	110
9. General discussion	110
9.1. Introduction	110
9.2. Effect of physical form of feed - mash versus pellets.....	110
9.3. Effect of wheat particle size on broiler performance in mash diets.....	111
9.4. Effect of wheat particle size on broiler performance in pelleted diets.....	111
9.5. Effect of whole wheat inclusion in broiler diets	112
9.6. Wheat particle size, wheat hardness and xylanase supplementation in broiler diets	112
9.7. Factors influencing the development and function of the digestive tract of broilers	114
9.8. Factors effecting digesta particle size	115
9.9. Effect of particle size on pellet durability index	116
9.10. Summary and main conclusions.....	117
References	119

List of Tables

Chapter 2

Table 2.1. The effect of grain type on particle size analysis.....	7
Table 2.2. Effect of particle size on the performance of broiler fed mash diets	9
Table 2.3. Suggested GMD of cereal grains for broiler chickens	11
Table 2.4. Effect of particle size on the performance of broiler fed pelleted diets.....	12
Table 2.5. Effect of particle size on pellet durability	19
Table 2.6. The types and level of NSP present in wheat (g/kg dry matter)	22
Table 2.7. Classification of wheat types according to kernel texture	32

Chapter 4

Table 4.1. Composition and calculated analysis (g/ kg as fed) of the basal diet.....	42
Table 4.2. Influence of particle size and feed form on the weight gain (g/bird), feed intake (g/bird), feed per gain (g/g), AMEn (MJ/kg dry matter) and digesta passage rate (min.) of broilers(1-21 days posthatching).....	45
Table 4.3. Influence of particle size and feed form on gross morphology of the digestive tract of broilers maintained on wheat based pelleted and mash diets.....	46
Table 4.4. Influence of particle size and feed form on total extent of the mucosal layer (μm), villous height (μm) and crypt depth (μm) of the duodenum and jejunum of broilers	48
Table 4.5. Influence of particle size and feed form on the proportion of particle size classes in the duodenal and colonic digesta (on a dry weight basis) of broilers.....	49
Table 4.6. Influence of feed form on the proportion of particle size classes (mean) in the duodenal and colonic digesta (on a dry weight basis) of broilers.....	50

Chapter 5

Table 5.1. Composition and calculated analysis (g/kg as fed) of the basal diet	56
Table 5.2. Influence of particle size and grain type on weight gain (g/bird), feed intake (g/bird), feed per gain (g/g) of broilers (1-21 days posthatch).....	59
Table 5.3. Influence of particle size and grain type on the AMEn (MJ/kg dry matter), passage rate (min.) of broilers and pellet durability index (%).....	60
Table 5.4. Influence of particle size and grain type on villous height-crypt base, villous height (μm), crypt depth (μm), and epithelial thickness (μm) of the duodenum for broilers	63
Table 5.5. Influence of particle size and grain type on the proportion of particle size classes in the duodenal and colonic digesta (on a dry weight basis) of broilers.....	64

Chapter 6

Table 6.1. Composition and calculated analysis (g/kg as fed) of the basal diet	71
Table 6.2. Influence of particle size and enzyme supplementation on the weight gain (g/bird), feed intake (g/bird), feed per gain (g/g) and AMEn (MJ/kg dry matter) of broilers (1-21 days posthatching).....	74
Table 6.3. Influence of particle size and enzyme supplementation on gross morphology of the digestive tract of broilers maintained on wheat based pelleted and mash diets.....	75
Table 6.4. Influence particle size (PS) and enzyme supplementation on total extent of	

the mucosal layer (μm), villous height (μm) and crypt depth (μm) of the duodenum and jejunum of broilers	77
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Chapter 7

Table 7.1. The composition and calculated analysis (g/kg as fed) of the basal diet ...	84
Table 7.2. Influence of wheat hardness and xylanase supplementation on weight gain (g/bird), feed intake (g/bird) and feed per gain (g/g) for broilers	87
Table 7.3. Influence of wheat hardness and enzyme supplementation on gross morphology of the digestive tract of broilers.....	88
Table 7.4. Influence of wheat hardness and enzyme supplementation on the proportion of particle size classes in the proximal small intestine digesta (on a dry weight basis) of broilers	89
Table 7.5. Influence of wheat hardness and enzyme supplementation on the proportion of particle size classes in the proximal small intestine digestal (on a dry weight basis) of broilers.....	90
Table 7.6. Relative differences ¹ in of particle size classes between diet and proximal small intestine digesta of broilers fed soft and hard wheat-based diets.....	91

Chapter 8

Table 8.1. Composition and calculated analysis (g/kg as fed) of the basal diet ¹	97
Table 8.2. Weight gain (g/bird), feed intake (g/bird), feed per gain (g/g), AMEn (MJ/kg dry matter) and excreta score of broilers as influenced by whole wheat and insoluble fibres (1-21 days posthatching)	102
Table 8.3. Ileal starch digestibility of broilers as influenced by whole wheat and insoluble fibres	102
Table 8.4. Influence of dietary treatments on gross morphology of the digestive tract of broilers (21 d posthatching)	103

List of Figures

Chapter 2

Figure 2.1. Arabinoxylans consist of β (1 \rightarrow 4)-linked D-xylopyranose backbone and α -L-arabinofuranose residues attached as branch-points.	21
Figure 2.2. Wheat endosperm cells	22
Figure 2.3. Cell wall structure of wheat endosperm cell	23
Figure 2.4. Proposed modes of action of wheat NSP.....	24
Figure 2.5. Scanning electron microscope analysis of purified starch granules taken at 1000 \times magnification.	30

Chapter 4

Figure 4.1. Particle size distribution of mash (A) and pelleted (B) diets.....	44
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Chapter 5

Figure 5.1. Particle size distribution of wheat and maize pre-pelleting.....	58
Figure 5.2. Particle size distribution of pelleted diets.....	58

Chapter 6

Figure 6.1. Particle size distributions of the two grinds of wheat (A) and diets (B) used in this experiment	73
Figure 6.2. Flow curves of digesta of broilers fed coarse ground wheat, coarse ground wheat supplemented with xylanase, medium ground wheat and medium ground wheat supplemented with xylanase.....	76

Chapter 7

Figure 7.1. Particle size distribution of ground soft and hard wheats	86
Figure 7.2. Particle size distribution of pelleted diets.....	86

Chapter 8

Figure 8.1. Particle size distribution of experimental diets	101
Figure 8.2. Denaturant gradient gel electrophoresis profile (gel 1) from ileal digesta of broilers as influenced by the inclusion of whole wheat and insoluble fibres. Relative similarity of band patterns of two denaturing gradient gel electrophoresis gels is indicated by their grouping on the dendrogram and the percentage coefficient (bar).....	104
Figure 8.3. Denaturant gradient gel electrophoresis profile (gel 1) from ileal digesta of broilers as influenced by the inclusion of whole wheat and insoluble fibres. Relative similarity of band patterns of two denaturing gradient gel electrophoresis gels is indicated by their grouping on the dendrogram and the percentage coefficient (bar).....	105

List of abbreviations

AME	Apparent metabolisable energy
AMEn	Nitrogen-corrected apparent metabolisable energy
ANOVA	Analysis of variance
DGGE	Denaturing gradient gel electrophoresis
DM	Dry matter
DNA	Deoxyribonucleic acid
GE	Gross energy
GLM	General linear model
GMD	Geometric mean diameter
GSD	Geometric standard deviation
h	Hours
HI	Hardness index
MJ	Mega joule
mm	millimetre
µm	Microns
N	Nitrogen
NIR	Near-infrared reflectance
NSP	Non-starch polysaccharide
PCR	Polymerase chain reaction
PDI	Pellet durability index
PSI	Particle size index
SEM	Standard error of mean
SKCS	Single-kernel characterisation system
Ti	Titanium
UV	Ultra violet
XU	Xylanase unit