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**INFLUENCE OF FEED PROCESSING ON THE
PERFORMANCE, NUTRIENT UTILISATION AND
GUT DEVELOPMENT OF POULTRY AND FEED
QUALITY**

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

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New Zealand

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Abstract

The first two experiments of this thesis investigated the effects of conditioning temperature in relation to grain type (maize, wheat and sorghum) on the performance, nutrient utilisation and digestive tract development of broiler starters. The third experiment examined the influence of feed form (mash vs. pellet) and conditioning temperature in broiler starters fed wheat-based diets. The effects of improved pellet quality from the addition of a pellet binder or/and moisture to a wheat-based diet, and the effects of pellet diameter and pellet length on the quality of pellets and, performance, nutrient utilisation and digestive tract development of broilers were studied in fourth and fifth experiments, respectively.

In the first experiment discussed in Chapter 4, increasing conditioning temperatures decreased the weight gain and feed intake of broilers fed wheat-based diets, whereas birds fed maize-based diets conditioned at 60 and 90 °C had higher weight gain and feed intake than those fed the diet conditioned at 75 °C. Increasing conditioning temperatures increased the feed per gain in both grain-type diets. Pellet durability index (PDI) improved with increasing conditioning temperatures in wheat-based diets, but was unaffected in maize-based diets. In wheat-based diets, increasing conditioning temperatures decreased the ileal digestibility of nitrogen (N) and starch. Ileal N digestibility of maize-based diets conditioned at 60 and 90 °C was higher than at 75 °C. Starch digestibility was unaffected by conditioning temperature in maize-based diets. No effect of conditioning temperature was found for the apparent metabolisable energy (AME).

Data reported in Chapter 5 showed that birds fed maize- and sorghum-based diets conditioned at 60 °C had a similar weight gain to those fed diets conditioned at 90 °C and higher than those fed diets conditioned at 75 °C. In both grain-type diets, birds fed diets conditioned at 60 and 90 °C tended to have higher feed intake than those fed diets conditioned at 75 °C. Conditioning temperature had no effect on the feed per gain. Increasing conditioning temperatures caused gradual improvements in the PDI of maize-based diets, while the improvement was marked in the sorghum-based diet conditioned at 90 °C. In both grain-type diets, pellet hardness increased with increasing conditioning temperatures, particularly at 90 °C. In maize-based diets, ileal N digestibility was poorer at 75 °C compared with 60 and 90 °C whereas ileal starch digestibility was unaffected by conditioning temperature and AME was higher at 75 °C

compared with 60 and 90 °C. For sorghum-based diets, increasing conditioning temperatures resulted in linear reductions in the ileal N and starch digestibility and AME.

Data reported in Chapter 6 showed that in mash diets, increasing conditioning temperatures above 60 °C had negative effects on weight gain, feed per gain and nutrient utilisation of broiler starters. But the deterioration in performance parameters caused by conditioning at higher temperatures was restored when steam-conditioned mash diets were pelleted. Pellet durability and hardness increased with increasing conditioning temperatures.

Data reported in Chapter 7 showed that the negative effect of higher conditioning temperature on weight gain, and to some extent feed intake, of broilers is not limited to the starter period (d 1 to 21), but can also be carried over the whole growth period (d 1 to 35). This study also illustrated possibilities for high quality pellets to be manufactured by the addition of pellet binder or/and moisture to a mash diet without the need for high conditioning temperatures.

The final experiment (Chapter 8) demonstrated that increasing the pellet length from 3- to 6-mm during the grower period (d 10 to 21) positively influenced the weight gain and feed per gain of broilers. While the weight gain response disappeared as the birds grew older, improvements in feed per gain was maintained over the finisher (d 22 to 42) and whole grow-out (d 10 to 42) periods in 4.76-mm diameter pellets. This study also showed that using a small diameter die hole and longer pellet length may have an additive effect on pellet quality, and provide opportunities to produce high quality pellets under low conditioning temperatures.

The major finding of this thesis research was that the balance between the negative effect of high conditioning temperatures on nutrient availability and the positive effect on pellet quality is relevant in determining the broiler performance. The probability and magnitude of these two counteracting effects determine the performance of broilers. Another important finding was that the pre-conditioning addition of moisture and the use of small diameter die hole and longer pellet length can effectively address pellet quality concerns at low conditioning temperatures.

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- Abdollahi, M.R., Thomas, D.V., Wester, T.J., Ravindran, G. and Ravindran, V. (2011) Effects of a commercial pellet binder and moisture addition on pellet quality and, the performance and nutrient utilisation of broilers. *Proceedings of the Australian Poultry Science Symposium 22*: 61-64. Sydney, Australia.
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List of Abbreviations

ADE	Apparent digestible energy
AME	Apparent metabolisable energy
AMEn	Nitrogen-corrected apparent metabolisable energy
ANOVA	Analysis of variance
BTU	British thermal units
cPs	Centipoise
d	Days
DDGS	Distiller's dried grains with solubles
DM	Dry matter
DSC	Differential scanning calorimetry
g	Gram
GE	Gross energy
GIT	Gastrointestinal tract
GLM	General linear model
GS	Gelatinised starch
h	Hours
HT/ST	High-temperature/Short-time
IU	International unit
KJ	Kilo joule
kPa	Kilo Pascal
mg	Milligram
MJ	Mega joule
mm	Millimetre
N	Nitrogen
NE	Net energy
NRC	National research council
NSP	Non-starch polysaccharide
PD	Pellet diameter
PDI	Pellet durability index
PL	Pellet length
psig	Pound-force per square inch gauge
RDS	Rapidly digestible starch
RS	Resistant starch
SDS	Slowly digestible starch
SEM	Standard error of mean
Ti	Titanium
TMEn	Nitrogen-corrected true metabolisable energy
U	Unit
UV	Ultra violet