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# **FACTORS INFLUENCING FAT DIGESTION IN POULTRY**

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

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## Abstract

The first experiment in this thesis was conducted to understand the digestion of fat along the gastrointestinal tract and ileal endogenous fat losses. The second, third and fourth experiments investigated the factors influencing fat digestion in broilers, including age of birds, cereal type, fat source and dietary calcium concentrations. In the fifth experiment, influence of unsaturated to saturated fatty acid ratio (U:S ratio) on fat digestion was examined.

The first experiment reported in Chapter 4 showed that jejunum is the major intestinal site where majority of fat and fatty acids is digested and absorbed. Long chain fatty acids showed lower digestibility than short chain fatty acids, and unsaturated fatty acids were better digested than saturated fatty acids. The fatty acid profile of ileal endogenous fat was remarkably similar to that of the bile, suggesting that the reabsorption of fat and fatty acids in bile was incomplete.

Data reported in Chapter 5 showed that the apparent metabolisable energy (AME) and total tract digestibility of fats was influenced by the age of broilers. The AME of fat was markedly lower during the first week, increased rapidly during second week and then remained constant thereafter. Total tract fat digestibility was poor during the first week and then increased until the third week of age. No further improvement was observed after the third week. The AME and fat digestibility of soybean oil, poultry fat and palm oil were determined to be higher than those of tallow. Blending of tallow and soybean oil resulted in AME and fat digestibility estimates higher than the arithmetic averages of tallow and soybean oil.

The study reported in Chapter 6 showed that the supplementation of tallow in wheat- and maize-based diets resulted in lower weight gain than that of soybean oil, but fat source had no effect on the weight gain of broilers fed sorghum-based diets. Broilers fed soybean oil supplemented diets had lower feed per gain, higher total tract retention and ileal digestibility of fat compared to those fed tallow supplemented diets. In addition, supplementation of xylanase in wheat-based diets resulted in improved weight gain and feed efficiency of broiler starters irrespective of the fat source. Xylanase supplementation increased the AME of tallow supplemented diets, but had no effect on soybean oil supplemented diets.

Data reported in Chapter 7 indicated that high dietary calcium concentrations had negative impact on broiler performance, irrespective of tallow inclusion levels. High calcium concentrations resulted in higher excreta soap and, lowered the total tract retention of fat, calcium and phosphorus. Lower calcium concentrations resulted in higher ileal digestibility of fat, nitrogen and phosphorus.

Data from the final experiment (Chapter 8) showed that the U:S ratio influenced the performance of broilers during the starter period (1 to 21 day), but had no effect on the performance over the whole trial period (1 to 35 day). Increasing the U:S ratio decreased the AME of diet and increased the total tract retention of fat. A positive linear correlation between U:S ratio and the AME of fat blends was observed, with increasing U:S ratios improving the AME of fat blends.

In conclusion, the research reported in this thesis identified several factors that influence the digestion of fat in poultry. Age of broilers influenced the digestion and absorption of fat, particularly during the first week of age. The findings consistently demonstrated that tallow was more poorly digested than soybean oil. The utilisation of these two fat sources was influenced by the cereal base used in the diets, with the effect of fat source on weight gain differing between cereal types. High dietary calcium concentrations were detrimental to the digestibility of nutrients, especially of fat. A finding of practical interest was that digestion and absorption of animal fats, containing high concentrations of saturated fatty acids, can be improved by blending with soybean oil to increase the U:S ratio.

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## Publications

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## List of Abbreviations

AME	Apparent metabolisable energy
AMEn	Nitrogen-corrected apparent metabolisable energy
ANOVA	Analysis of variance
°C	Degree Celsius
Ca	Calcium
DM	Dry matter
FFA	Free fatty acid
g	Gram
GE	Gross energy
h	Hours
K	Potassium
Kg	Kilogram
meq	Milliequivalent
mg	Milligram
MJ	Mega joule
ml	Millilitre
mm	Millimetre
N	Nitrogen
Na	Sodium
ng	Nanogram
NRC	National research council
NSP	Non-starch polysaccharide
P	Phosphorus
S	Saturated
Ti	Titanium
TME	True metabolisable energy
U	Unsaturated
µl	Microlitre