THE EFFECTS OF DIETARY FAT SUPPLEMENTATION ON GROWER/ FINISHER PIG PERFORMANCE AND DIGESTIBILITY

Submitted by

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DECLARATION

I declare that this thesis is my own account of my research and contains, as its main content work, which has not previously been submitted for a degree at any tertiary education institution.

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GENERAL SUMMARY

Increasing the DE content of pig diets through fat addition has been shown to have a variety of effects on performance of pigs, including a decrease, no effect or an improvement. The addition of supplemental fat to diets, for growing/finishing pigs above current recommendations has been a controversial issue for many years, as it is generally viewed that any surplus energy in this form will be deposited as adipose tissue, and therefore become detrimental to carcass value. Nevertheless, there is some recent evidence demonstrating benefits in terms of production and profitability in increasing DE content of the diet by adding supplemental fat, however the definition of the most efficacious feeding strategy (type of fat, amount of dietary fat, length of feeding period) and the precise mechanism(s) of action have not been elucidated. Therefore, the objectives of the studies conducted in this thesis were to:

1. Assess the effects of dietary fat supplementation (types and amounts) on pig performance by investigating production indices and carcass attributes and where possible linking changes to blood metabolites;
2. Determine the effects of supplemental dietary fat (types and amount) on apparent ileal and total tract nutrient digestibility in pigs fed diets containing varying amounts of tallow and oil.

Two experiments were conducted using diets containing varying amounts of vegetable or animal fat, with canola oil (CO) and beef tallow (BT) used as representatives of these sources. These fats sources were fed to cannulated pigs and the effects on the coefficients of ileal apparent digestibility and total tract apparent digestibility were evaluated.

Experiment 1 (Chapter 3), indicated that dietary fat supplementation in Period 1 (grower period) increased ($P<0.05$) average daily gain but had no effect on carcass weight or P2 backfat thickness. In contrast, 4% dietary fat supplementation during Period 2 (finisher period), regardless of fat consumed in Period 1, increased average daily gain ($P<0.05$) over the entire experiment. Plasma glucose concentrations were unaffected by dietary fat, however, insulin and non-esterified fatty acid (NEFA) were increased by addition of fat ($P<0.001$) in both periods. Plasma triacylglycerols (TAG) were increased as dietary fat was increased ($P=0.02$). These data provide evidence that feeding fat to finisher pigs above the assumed DE requirement causes increased carcass weight but increased P2 backfat thickness. Economic returns on the carcass were not compromised. Indeed, adding 4% fat to the finisher diet increased returns over feed costs by as much as AU $3.95 per pig.

Experiment A (as part of Experiment 2 – Chapter 4), investigated two dietary fat sources, canola oil and beef tallow (CO and BT) and their amount in the diet (0%, 4% or 8%) in ileal T-piece-cannulated pigs for their effects on coefficients of ileal apparent digestibility (CIAD) and total tract apparent digestibility (CTTAD) of nitrogen (N), dry matter (DM), gross energy (GE) and fat. The amount of added fat had a significant increase effect on CIAD and CTTAD of fat ($P=0.01$ and $P=0.002$ respectively), as did type of fat ($P=0.013$ and $P=0.005$ for BT and CO, respectively). However, when the interaction between the amount of fat and type of fat was analysed, the response pattern differed for the CIAD of DM ($P=0.031$), N ($P=0.048$) and GE ($P=0.022$) with all values being higher at the 4% inclusion rate for CO compared to BT and higher for BT at the 8% inclusion level. The CTTAD of fat increased with inclusion level and was higher for BT than CO. The CTTAD of other nutrients was unaffected by the type of fat or level of fat included in the diet. These findings suggest at lower inclusion rates CO should support better performance than BT but that the effects will be reversed at higher inclusion rates.

Experiment B (as part of Experiment 2 – Chapter 4), evaluated the same two fat sources (CO and BT) but in different combinations with each other, to represent different ratios of dietary unsaturated fatty acids (UFA) to saturated

fatty acids (SFA), for their effects on coefficients of ileal apparent digestibility (CIAD) and total tract apparent digestibility (CTTAD) of nitrogen (N), dry matter (DM), gross energy (GE) and fat. There were no effects ($P>0.05$) on the CIAD or CTTAD of nutrients associated with the varying ratios of CO:BT (UFA:SFA) of the added fat in the diet.

From the results obtained in this thesis, it is proposed that:

1. Feeding 4% supplemental fat in the finisher period only is the ideal (most cost effective means of increasing pig performance and economic returns under commercial situations);
2. Digestibility of fat increases as fat inclusion increases, however, ileal digestibility increases when unsaturated fats are fed at a lower level (4%) and when saturated fats are fed at a higher level (8%);
3. At higher inclusion rates there appears to be no value in blending saturated and unsaturated fats in pig diets.

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Abbreviations used in this thesis

ACCX	Acetyl-coenzyme A carboxylase
AD	Apparent digestibility
ADFI	Average daily feed intake
ADG	Average daily gain
AIA	Acid insoluble ash
BT	Beef Tallow
BW	Body weight
Cal	Calories
Cfat	Crude fat
CIAD	Coefficient of ileal apparent digestibility
CO	Canola oil
CP	Crude protein
Cr_2O_3	Chromic oxide
CTTAD	Coefficient of total tract apparent digestibility
DE	Digestible Energy
DM	Dry matter
EDTA	Ethylenediaminetetracetic acid
EFA	Essential fatty acid
F	Fat
FA	Fatty acid
FCR	Feed conversion ratio
FFA	Free fatty acid
FFL	Final fat level
GE	Gross energy
GIT	Gastro-intestinal tract
HCW	Hot carcass weight
IFL	Initial fat level

Kcal	Kilocalories
KJ	Kilojoules
LW	Live weight
Mcal	Megacalories
MJ	Megajoules
MUFA	Mono-unsaturated fatty acid
N	Nitrogen
NEFA	Non-esterified fatty acids
NS	Not significant
PUFA	Poly-unsaturated fatty acid
sed	Standard error of the difference
sem	Standard error of the mean
SFA	Saturated fatty acid
TAG	Triacyglycerols
TiO_2	Titanium dioxide
UFA	Unsaturated fatty acid
VLDL	Very low density lipoproteins
W	Week

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