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THE EFFECT OF GENETIC SELECTION FOR FLEECE WEIGHT ON

UREA METABOLISM AND DIGESTIVE FUNCTION IN ROMNEY SHEEP

A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Agricultural Science
in Animal Science
at Massey University

BEVERLEY CAROL THOMSON

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ABSTRACT

The study was undertaken to investigate the effect of 30 years selection for greasy fleece weight on rumen metabolism, apparent digestibility and nitrogen metabolism in the NZ Romney sheep. Previous studies had recorded a lower plasma urea concentration in the fleece weight selected (Fwt) animals as compared to the randomly selected control (C) animals, so most emphasis was placed on determining whether the lower plasma urea concentration in the Fwt sheep was accompanied by a lower irreversible loss (IRL).

Eight C and eight Fwt yearling rams (mean liveweight 42kg) were housed inside in individual metabolism crates. The study was divided into two almost identical experiments - the first one when the animals were fed on a chaffed meadow hay diet and the second on a lucerne chaff diet. Each experiment consisted of a two week adaptation period, a ten day digestibility period and a final period of six days during which ^{14}C -urea was infused intravenously for fourteen hours. At the end of the lucerne chaff experiment the animals were slaughtered and the rumen contents weighed and subsampled.

The Fwt animals had a one mM lower plasma urea concentration when fed on both diets. However there was no difference in the plasma urea IRL, urinary urea excretion or urea recycling to the digestive tract between the Fwt and C sheep when fed on either diet.

Relative to the C sheep, the Fwt animals had a higher creatinine clearance rate (63 vs 50 ml/min; $P < 0.05$) when fed the meadow hay diet, and a higher urea clearance rate when fed both diets (meadow hay diet 42 vs 32 ml/min, $P < 0.10$; lucerne chaff diet 72 vs 60 ml/min, $P < 0.05$).

When fed the meadow hay diet there were no differences between the Fwt and C animals in voluntary feed intake (VFI) (Fwt animals 44 vs 42 gDM/kgW^{0.75}/d C animals) or apparent digestibility (DM digestibility 55% for both genotypes). However when fed on the lucerne chaff diet the Fwt animals had a higher VFI than the C animals (102 vs 94 gDM/kgW^{0.75}/d) and a lower apparent dry matter digestibility (56.1% vs 61.3%; $P < 0.05$). These changes were associated with an increase in the rumen Fractional Outflow Rate (FOR) of lignin in the Fwt sheep (3.00 vs 2.58 %/h; $P < 0.05$). There was a higher molar proportion of acetate present in the rumen fluid of the Fwt animals than in the C animals (68.6 vs 64.0%; $P < 0.10$).

These results confirm that the Fwt animals have a consistently lower plasma urea concentration over a range of nutritional levels (0.6X maintenance and 1.5X maintenance) than the C animals, but there was no difference in urea metabolism as measured by plasma urea IRL and urea excretion. The urea and creatinine clearance rates suggest that selection for fleece production may have altered kidney function, but that the expression of these differences is related to the nutritional level. The greater FOR in Fwt sheep fed at the high level of nutrition (i.e. lucerne chaff) may mean that the amino acid

flow at the duodenum (undegraded dietary plus microbial protein) is greater than in the C animals and this could be a factor contributing to the superior wool production of the Fwt sheep.

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LIST OF ABBREVIATIONS

Acet	Acetic Acid
ADR	Acid Detergent Residue
But	Butyric Acid
C	Control Animals from the randomly selected line of sheep
°C	degrees Celsius
CCR	Creatinine Clearance Rate
Cl	Clearance
Conc	Concentration, []
Creat	Creatinine
d	Day
DDMI	Digestible Dry Matter Intake
Dig	Digestibility
DM	Dry Matter
DNI	Digestible Nitrogen Intake
F DPR	Fractional Disappearance Rate
FDR	Fractional Degradation Rate
FOR	Fractional Outflow Rate
F+	Australian Merino Fleece Weight Selection Line
F-	Australian Merino Selection Against Fleece Weight Line
Fwt	NZ Romney Fleece Weight Selection Line
G	Genotype
GE	Gross Energy
GFR	Glomerular Filtration Rate
GIT	Gastro Intestinal Tract

Hemi	Hemicellulose
I	Intake
IBut	Iso Butyric Acid
IVal	Iso Valeric Acid
IRL	Irreversible Loss Rate
IU	International Units
$L^{0.75}$	Metabolic Liveweight
Luc	Lucerne Chaff Diet
MH	Chaffed Meadow Hay Diet
mM	millimoles
MRT	Mean Retention Time
N	Nitrogen
ND	Not Determined
NDR	Neutral Detergent Residue
NH_3	Ammonia
OM	Organic Matter
PCC	Plasma Creatinine Concentration
Prop	Propionate
PUC	Plasma Urea Concentration
R	Room
Ret	Retention
RG/WC	Ryegrass White Clover Pasture
SA	Specific Activity
SE	Standard Error of the Mean
μ	Mean
UER	Urinary Excretion Rate
Val	Valeric Acid

VFA Volatile Fatty Acids
VFI Voluntary Feed Intake
Wt Weight