FACTORS WHICH INFLUENCE THE REQUIREMENTS FOR PROTEIN AND ENERGY IN RUMINANTS

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by

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PREFACE

The studies presented in this thesis were completed by the author whilst a postgraduate student in the Department of Biochemistry, Microbiology and Nutrition, Faculty of Rural Science, The University of New England, Armidale, N.S.W., Australia. Assistance given by other persons is indicated in the list of acknowledgments. All references cited are included in the bibliography. The work is otherwise original.

I certify that this thesis has not already been submitted for any degree and is not being currently submitted for any other degree.

I certify that any help received in preparing this thesis and all sources used have been acknowledged in this thesis.

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I dedicate this work to my daughter and hope that she too will be given the opportunity to do what she wants.

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GLOSSARY OF TERMS AND ABBREVIATION

† P<0.10
* P<0.05
** P<0.01
*** P<0.001
Acet acetate;
AL *ad libitum*
ATP adenosine triphosphate
But butyrate;
CSH cottonseed hulls
DEI digestible energy intake
DM dry matter
FCR feed conversion ratio
FC formaldehyde treated casein
FCU formaldehyde treated casein and urea
GER glucose entry rate
GP glucose pool size
Ibut isobutyrate
Ival isovalerate
Lwt live weight
LCFA long chain fatty acids
ME metabolisable energy
NH_3-N ammonia nitrogen
NADP nicotinamide dinucleotide phosphate
$NADPH_2$ reduced NADPH
ns non-significant
Prop propionate
SEM standard error of the mean
TCA cycle tricarboxylic acid cycle
$t^{1/2}$ half time
TDMI total dry matter intake
UDR urea degradation rate
UER urea entry rate
Val valerate
VFA volatile fatty acids

SUMMARY

The studies reported in this thesis were part of a continuing study on the effects of supplementation of low protein diets with proteins that escape ruminal fermentation.

A basal diet of oaten chaff fed to lambs, was supplemented with casein, formaldehyde treated casein (FC) or FC plus urea. Voluntary feed intake and liveweight change of lambs was measured over a 105 d period. Feed intake, liveweight gain, wool growth and feed conversion efficiency was increased by the addition of treated casein. Urea plus treated casein did not improve responses above that obtained by treated casein. Provision of a soluble protein source (untreated casein) did not increase feed intake, liveweight gain or feed conversion efficiency.

A second feeding trial using lambs fed a basal diet of oaten chaff, showed that supplementation with 100 g lupins, either untreated or treated with formaldehyde, did not produce greater growth responses or feed conversion efficiencies than did supplementation with 10 g urea.

Lambs fed a basal diet of cottonseed hulls increased their liveweight gain, feed conversion efficiency and wool growth when supplemented with formaldehyde treated casein. Lambs fed cottonseed hulls as the basal diet had nil or very low protozoa populations in their rumen. Supplementation with sodium propionate or sodium acetate had no effect on liveweight gain, feed conversion efficiency or wool growth. No differences in glucose entry rates or acetate clearance was found in lambs fed cottonseed hulls as the basal diet and supplemented with formaldehyde treated casein, sodium propionate or sodium acetate.

When lambs were kept at different environmental temperatures and fed a basal diet of cottonseed hulls, their feed intake decreased at 37 ^{o}C. Supplementation of the basal diet with formaldehyde treated casein resulted in increased liveweight gain, wool growth and feed conversion efficiencies by lambs.

Lambs fed a basal diet of ammoniated barley straw and kept at 25 or 37 ^{o}C decreased their feed intake at 37 ^{o}C. When supplemented with formaldehyde treated casein at either temperature, lambs responded by increasing their liveweight gain, feed conversion efficiency and wool growth. When supplemented with sodium propionate at 37 ^{o}C lambs lost weight and decreased feed intake. Water intake of lambs supplemented with treated casein remained relatively constant over the two temperatures whilst water intake by unsupplemented lambs or those supplemented with propionate increased considerably at 37 ^{o}C.

Metabolic studies of lambs at 25 or 37 ^{o}C and fed a basal diet of ammoniated barley straw supplemented with formaldehyde treated casein and/or sodium propionate showed that the effect of temperature in decreasing glucose entry rates and urea entry rates was through its effect on feed intake. Less urea was recycled to the rumen of lambs housed at 37 ^{o}C.

Supplementation with bypass protein increased growth responses by lambs in all experiments. Future studies are required to examine the effects of bypass proteins in different temperature environments to determine whether there is a temperature by supplement interaction.