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**EFFECT OF CONCENTRATE SUPPLEMENTATION ON DAIRY  
COW PERFORMANCE, WITH EMPHASIS ON TROPICAL FORAGES**

A thesis presented in partial fulfilment of the  
requirements for the degree of Doctor of Philosophy  
in Animal Science at Massey University  
Palmerston North, New Zealand

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JUNE 1993

## ABSTRACT

The objectives of the present study were to measure the effects of supplementation with concentrates which differed in their protein concentrations and protein degradabilities on the performance of dairy cows, with emphasis on tropical feeds. The degradability of protein in a range of feedstuffs was also measured and rumen metabolism was studied in sheep fed on diets which differed in protein degradability, at two different temperatures.

The first experiment (Chapter 4) was conducted in Thailand to determine the effects of concentrates which differed in their protein concentration (17%CP vs 30%CP) and protein degradability (0.65 and 0.53) on the performance of dairy cows fed on fresh pasture. The control treatment of feeding pasture only was also included. The yields of milk and liveweights gain were increased when concentrates were supplemented to pasture fed dairy cows both indoor and under grazing conditions. The response in milk yield to concentrate supplementation ranged from 1.2 to 2.0 kg milk/kgDM concentrate DM eaten. Increases in level of concentrate from 0 to 2.7 and 5.4 kgDM/cow daily resulted in decreases in response to supplementation (from 2.0 to 1.2 kg milk/kg concentrate DM eaten, compared with the unsupplemented group). The high protein (low degradable) concentrate tended to give higher responses in milk yield and liveweight gain per kg concentrate DM eaten.

The second experiment (Chapter 5) was also carried out in Thailand to investigate the effects of concentrates containing about 20% crude protein of different degradabilities (altered by inclusion of 0, 1 and 2% urea) on performance of dairy cows fed low quality tropical grass silage (5.2%CP and 48%DMD). The yields of milk and milk protein, and liveweight gain were significantly increased by Concentrate 2 (21%CP with 1% urea; 0.63 protein degradability) when compared with Concentrate 1 (19%CP with no urea; 0.57 protein degradability), Concentrate 3 (21.5%CP with 2% urea; 0.68 protein degradability) and Concentrate 4 (19.5%CP with no urea; 0.62 protein degradability). Silage intake was also increased in cows given Concentrate 2.

The degradability of DM and protein of 10 feedstuffs which are widely used in concentrates in Thailand were determined by the nylon bag technique at Khon Kaen University, Thailand (Chapter 6). The measurements used nylon bags inserted into fistulated cows given a diet of 4 kgDM urea-treated rice straw with an additional 2 kg of balanced concentrates. Between 45 and 55% of the crude protein content in cotton seed meal, maize and rice bran was effectively degraded in the rumen, compared with 63 to 69% for groundnut meal, palm meal, corn meal and sesame meal. Cotton seed meal could therefore be considered the most useful bypass protein source for use in feed supplements given to dairy cows in Thailand.

To determine the effects of environmental temperature conditions and the inclusion of urea in the concentrates on rumen metabolism, an experiment was conducted in New Zealand using sheep kept in controlled temperature room. Concentrates which differed in protein degradability (by inclusion of urea) were supplemented to sheep fed on low quality hay under 'mild' and 'hot' conditions. Hot temperature conditions had negative effects on DM intake, concentration of total VFA and degradability of protein but positive effects on respiration rate and water intake. The inclusion of urea in the concentrate supplements had fewer effects than the temperature conditions. Intakes of low quality roughage DM were reduced by hot temperature. High temperatures and low quality roughages are the two major factors contributing to the low production of animal in the tropics.

The final experiment was conducted in New Zealand to investigate the effects of a high protein-low degradable protein concentrate on the performance of grazing dairy cows fed generously on high quality autumn/winter temperate pasture. The high protein (low degradable) concentrate supplement significantly increased milk production. The milk yield response to the concentrate however, was lower than in the measured in the experiments in Thailand, probably because of the very high allowance of high quality pasture used in the New Zealand experiment.

It can be concluded that, in the present experiments, the major factor which contributed to differences in animal performance was ME intake, particularly for cows fed on concentrates. The effects of increased crude protein concentration or increased crude protein degradability in the concentrates on forage DM intake and on milk yield were variable. However, when a moderate level of low degradable protein concentrate was supplemented to cows on poor quality tropical grass silage, the effect of low degradable protein in the concentrate on increased milk production was evident.

## ACKNOWLEDGEMENTS

I wish to thank **Associate Professor C.W. Holmes** and **Dr. G.F. Wilson**, my supervisors, for their providing a remarkably unconstrained atmosphere in which the experiments could be conducted, and contributing ideas and constructive criticism throughout.

I also wish to thank **Professor B.R. Watkin** for strongly encouraging me to study in New Zealand.

Technical assistance was provided by:

**Professor M. Wanapat** and his staffs in protein degradability trial.

**M.F. Scott, D.A. Hamilton, J. Anderson, and R.A. Watson** in chemical analyses.

The staffs of Dairy Farming Promotion Organisation of Thailand (DPO.); **P. Sakpitaksakul, S. Srimuang, P. Klaimee, and C. Klaoplod** in Thailand's trials.

The staffs of Dairy Cattle Research Unit; **M.L. and B.S. Chesterfield**, a staff of Animal Physiology Unit; **W.B. Parlane**, the staffs of No.1 Dairy Farm (Commercial Winter Milk Unit); **M.I. Power** and **J.P. Waltz** and a staff of Sheep Farm; **T.J.R. Harcombe** in all New Zealand's trials.

The assistance of all these who contributed to this study is acknowledged.

Financial support was provided by **The New Zealand Government**.

*Mrs A. Eustace*

Finally, I wish to thank my mother, **Waleepan**; my wife, **Piyarat**; my sons, **Sukrit** and **Niwit**; for their patience, comprehension, support and encouragement throughout all the period of my study.

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