New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website www.nzsap.org.nz

View All Proceedings | Next Conference | Join NZSAP

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

You are free to:

Share— copy and redistribute the material in any medium or format

Under the following terms:

Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

NonCommercial — You may not use the material for commercial purposes.

NoDerivatives — If you remix, transform, or build upon the material, you may not distribute the modified material.

http://creativecommons.org.nz/licences/licences-explained/

Effect on milk production and liveweight of feeding balanced or unbalanced supplements to cows grazing restricted summer pasture

P.G. NEIL AND N.A. THOMSON

Dairying Research Corporation, Private Bag 3123, Hamilton, New Zealand.

ABSTRACT

To test whether supplementing summer pasture with a balanced ration would improve milk production and liveweight compared to supplementing with silage, four groups of 12 cows were offered either grazed pasture (P), P plus silage (S), P plus a ration which balanced the diet for crude protein (CP) and carbohydrate (PB), or P plus a ration which balanced the diet for neutral detergent fibre (NDF), non structural carbohydrate (NSC) and CP, (CB). The S, PB, and CB treatments produced similar milk and milk protein yields, which were higher ($P<0.01$) than P. Milk fat yield for PB and CB was higher ($P<0.001$) compared to P but not compared to S. The average liveweight gain for S and PB was 16 kg higher ($P<0.01$) than P. No improvement in milk production was observed to feeding supplements which balanced either total carbohydrate and CP, or NDF, NSC and CP compared to silage supplemention.

Keywords: dairy cattle; summer pasture; diet balancing; milk production; liveweight change.

INTRODUCTION

Dry matter production of ryegrass/white clover pasture during summer in many New Zealand locations is low and when offered as the sole feed to cows on high stocked dairy farms is below that required to maintain cow liveweight and milk production at a high level (Campbell and Bryant, 1978). Pasture silage is commonly used to provide extra feed during summer, yet documented milksolids responses to silage supplementation have been small (Bryant, 1978; Clark, 1993).

Summer pasture contains 33-55% neutral detergent fibre (NDF) and 5-12% non-structural carbohydrate (NSC) (Wilson *et al.*, 1995) which according to the NRC (1989) based SPARTAN feed balancer (SPARTAN user manual, 1992) would be best supplemented with a feed high in NSC. Pasture silage by contrast is high in NDF, 50-60%, (Wrenn, unpublished), which if added to a summer pasture based diet is predicted to slow digestion rates, increase gut fill, and reduce the rate of rumen volatile fatty acid (VFA) and microbial synthesis. These factors may be contributing to poor milksolids responses observed when supplementing summer pasture with silage.

Insufficient dietary crude protein (CP) may also contribute to reported poor milksolids responses to dd.feeding silage. Pasture silage with CP ranging from 10-21% (Howse *et al.*, 1996) may cause dietary CP to drop below levels recommended by SPARTAN when supplementing a summer pasture base diet containing 16-26% CP (Wilson *et al.*, 1995).

This experiment investigated whether feeding supplements which balanced either total carbohydrate and CP or which balanced NDF, NSC and CP, would give improved milk production and liveweight responses compared to supplementation with pasture silage.

MATERIALS AND METHODS

The experiment was conducted over 3 periods during January, February and March of 1996 at Dairying Research Corporation's No. 5 Dairy. Forty eight Friesian cows were allocated to four treatment groups following a 10 day uniformity period (Period 1). Milk production, milk composition and liveweight were measured during this period when all cows were offered grazed pasture. The liveweight assessments throughout the experiment were the mean of recordings taken at 0700h on 2 consecutive days.

Treatment groups were grazed as separate herds with pasture offered at approximately 25 kg dry matter (DM)/cow/day for 38 days (Period 2). The treatments were: pasture only (P), pasture plus silage (S), pasture plus a supplement aimed to balance the diet for total carbohydrate and CP (PB), and pasture plus a supplement aimed to balance the diet for NDF, NSC and CP (CB). The S, PB, and CB supplements were offered at 30% of estimated metabolisable energy intake (MEI) calculated for each cow immediately prior to Period 2 using the equations described by (Holmes and Wilson, 1987) and values for milk production, milk composition, and liveweight obtained from Period 1. The MEI calculations were also adjusted for days pregnant and stage of lactation. The supplement was offered to individual cows in feed boxes as a 50:50 split ration at 0800 and 1600h each day. Supplement intakes were measured by weighing the amount offered and the amount remaining in feed boxes following each feeding during days 3-38. The PB and CB compositions were calculated by the SPARTAN feed balancer and minerals were introduced into a ration if a deficiency was indicated. The PB supplement consisted of pasture silage and soybean meal. The CB supplement consisted of pasture silage, soybean meal and kibbled maize grain. Soybean meal was used in the CB and PB supplements as the predicted proportion of CP which was rumen degradable protein (RDP) was 70% which was similar to the predicted RDP of pasture which ranged between 70-80% (SPARTAN user manual, 1992). The silage used in S, PB and CB was ensiled in a bunker 15 months prior to the experiment and had a metabolisable energy (ME) of 10 MJ ME/kg DM assessed from core samples obtained prior to Period 2.

SPARTAN was used rather than other feed balancing recommendations as it includes effective NDF (eNDF) and has a mineral balancing component. Providing adequate eNDF is important in maintaining ruminal pH and microbial yield (Sniffen *et al.*, 1992).

During Period 2 milk production and composition were assessed on days 7, 13, 20, 27, 30, 34 and 37. Liveweight was assessed on days 7, 12, 22, 28 and 35. Pasture intakes were estimated using pre- and post- grazing rising plate meter (RPM) estimates every 2-3 days between days 3-38. Pasture intake was also assessed using the alkane technique (Dove and Mayes, 1991) during days 31-38.

Pasture samples from paddocks that were to be grazed in Period 2, and core samples of silage were analysed for NDF, CP, rumen fermentable carbohydrate (RFC) and ME by NIR (FeedTech, AgResearch Dairy and Beef Division, Grasslands Research Centre, Palmerston North). The results of these analyses were used for SPARTAN supplement calculations with the assumption that RFC was equivalent to NSC. Values for NDF, CP, NSC, and ME for maize grain and soybean were obtained from the SPARTAN feed library. Pasture, silage, maize grain and soybean were analysed for minerals prior to feed balancing calculations.

During Period 2, representative pasture samples were obtained prior to each grazing and bulked on a weekly basis. Sub-samples of the silage offered daily were bulked over days 4-16, 11-24 and 25-38. Sub-samples of the soybean and maize offered daily were each bulked over the whole period. Pasture and silage samples were analysed for NDF, CP, RFC, and ME using NIR. Maize and soybean were analysed for CP (N% x 6.25) using a micro-Kjeldahl digest (Model 16120, Foss Electric, Denmark), and for NDF using a modified technique of Goering and van Soest (1970). The NSC values for soybean and maize were assumed to be the same as those in the SPARTAN feed library.

The carry-over period (Period 3) was conducted for 26 days immediately following Period 2. During this time milk production and composition were measured on days 3, 6, 10, 13 and 24. Liveweights were assessed on days 19 and 26.

Statistical analyses were conducted using SAS analysis of covariance (SAS, Version 6.10, SAS Institute Inc., Cary, NC USA)

RESULTS

The predicted MEI using the equations described by Holmes and Wilson (1987) was 139 MJ ME/cow/day while SPARTAN recommended that the composition of the diet should contain 17.4% CP, 41.0% NDF and 31.6% NSC.

Pasture intake estimates averaged 5.8 kg DM/cow/day higher for the RPM compared to the alkane technique. The RPM estimates indicated that cows on S, PB and CB had similar pasture intakes which were lower than for cows on P In contrast the alkane estimate indicated similar intakes for cows on P and CB which were higher ($P<0.001$) than for cows on P and PS (Table 1). Using the RPM estimate of pasture contribution to the diet, the MEI for cows on S, PB and CB averaged 29 MJ ME/cow/day higher than cows on P. The alkane estimate of MEI indicated that for cows on CB averaged 21 MJ ME/cow/day higher than cows on P, S, and PB. The alkane and RPM estimates of pasture contribution to the diet showed the NSC% in the total diet was higher and NDF% lower for cows on CB compared to cows on P, S and PB. Both estimates of pasture intake indicate CP% was similar for cows on S and PB but higher for cows on P and PB.

TABLE 1: Metabolisable energy intake (MEI) (MJ ME/cow/day) and diet composition (%DM) assessed by using rising plate meter (RPM) and alkane estimates of pasture eaten (kg DM/cow/day), for P, S, PB and CB treatments.

	P	S	PB	CB	SED
Pasture eaten					
RPM	13.5	12.3	12.4	12.5	-
alkane	8.8	5.5	5.2	8.2	0.6
MEI					
RPM	143	175	175	166	-
alkane	93	104	99	120	-
Diet composition - RPM					
NDF	51.3	53.1	50.3	45.2	-
NSC	7.3	6.3	6.1	16.6	-
CP	19.8	18.3	18.4	18.9	-
Diet composition - alkane					
NDF	51.3	54.4	53.4	41.2	-
NSC	7.3	5.6	5.7	20.4	-
CP	19.8	17.3	17.3	18.5	-

During Period 2 milk and milk protein yields were similar for cows on S, PB and CB which were higher ($P<0.001$) than for cows on P (Table 2). Milk fat yields during this period were higher ($P<0.001$) for cows on PB and CB compared to cows on P and similar between cows on S, PB and CB. Greater increases in liveweight were observed for cows on S ($P<0.001$) and PB ($P<0.01$) compared to cows on P, while cows on S also had a greater increase in liveweight gain compared to cows on CB ($P<0.05$). Milk yield, milk protein yield, milk fat yield and liveweight change were similar between cows on all treatments in Period 3. The higher liveweight gain of cows on S and PB treatments during Period 2 translated into 16 and 15 kg higher liveweights compared to cows on P at the end of Period 3.

TABLE 2: Average milk, milk protein and milk fat yield (kg/cow/day) and liveweight change (kg) during Period 2 and 3 for P, S, PB and CB treatments.

	P	S	PB	CB	SED
Period 2					
Milk yield	10.8	12.8	13.0	12.9	0.5
Milk protein yield	0.37	0.42	0.43	0.44	0.02
Milk fat yield	0.53	0.57	0.60	0.60	0.02
Liveweight change	6	23	20	14	4
Period 3					
Milk yield	11.4	12.0	11.9	12.3	0.5
Milk protein yield	0.42	0.45	0.44	0.45	0.02
Milk fat yield	0.57	0.60	0.59	0.61	0.03
Liveweight change	22	21	23	21	4

DISCUSSION

The feeding of supplements to cows grazing summer pasture increased milk and milk protein yields, compared to cows grazing summer pasture only. Compared to supplementing with silage, no improvement in milk, milk protein or milk fat was observed when the supplement fed was aimed to balance the diet for either total carbohydrate and CP or NDF, NSC and CP. The CB treatment clearly increased the level of NSC in the diet compared to silage supplementation with no observed increase in milk, milk protein or milk fat yield. SPARTAN advocates high NSC contents to increase voluntary intake, rumen microbial growth rates, rumen VFA production and therefore increased milk production. The observation in this trial that increasing NSC in the diet did not increase milk production questions the validity of these recommendations for pasture based dairy systems. The effect of balancing for total carbohydrate and crude protein were unable to be adequately tested due to the level of CP in the pasture being higher than anticipated during this experiment.

The RPM and alkane techniques demonstrated marked differences in predicted pasture intake (Table 1). The liveweight change and fat corrected milk production observed during Period 2, by back calculating energy requirements using the equations described by Holmes and Wilson (1987), is predicted to have required an average MEI of 125, 160, 157 and 150 MJ ME/cow/day for the P, S, PB and CB treatments respectively. These predicted values could vary up to 5% due to differences in animal motility or grazing activity. When comparing the alkane or RPM estimate of MEI to the back calculated values it appears that the RPM gives a more accurate estimate of pasture intake.

The methodology in the alkane technique could be responsible for the low intake prediction. The alkanes were administered as a drenched gelatin capsule 1 hour prior to supplement feeding and approximately 2 hours prior to grazing. This lag period between alkane drenching and feed ingestion may have resulted in non-uniform mixing of digesta and dosed alkane, which may have resulted in a pulse appearance of dosed alkane in the faecal collection rather than a uniform appearance. Another methodological problem could be that while the pasture samples obtained for alkane analysis were representative of what was in the paddock, due to selective grazing it may not be representative of ingested pasture. This is particularly likely on summer pasture as there is often a high proportion of weed, reproductive tiller and dead material in the sward each containing a different alkane profile (Dove and Mayes, 1991) compared to the more palatable green leafy ryegrass and white clover. Further validation of the alkane methodology is required before this technique can confidently be used for quantifying pasture intake in all situations.

ACKNOWLEDGEMENTS

The authors thank Matthew Schofield and David Phipps for the feeding of supplements to cows and to the No. 5 Dairy staff for assistance with faecal sampling. Thanks to the Nutrition laboratory staff for chemical analyses and Rhonda Hooper for statistical analyses.

REFERENCES

Bryant A. M. 1978. Dairy cattle management: Summer supplementary feeding. *Proceedings of the Ruakura Farmers Conference*.AgLink RFC: FPP163.

Campbell, A.G., Bryant, A. M. 1978. Pasture constraints on dairy production. *Proceedings of the Annual Conference of the Agronomy Society of New Zealand* **8:** 115-118.

Clark, D. A. 1993. Silage for milk production. *Proceedings of the Ruakura Farmers Conference***45:** 41-46.

Dove, H., Mayes, R. W. 1991. The use of plant wax alkanes as marker substances in studies of the nutrition of herbivores: A review. *Australian Journal of Agricultural Research***42:** 913-952.

Goering, H. K., van Soest, P. J. 1970. Forage fibre analyses (appartus, reagents, procedures, and some applications). Agricultural Handbook No. 379. ARS-USDA, Washington, DC.

Holmes, C. W., Wilson, G. F. 1987. Milk Production from Pasture. Butterworths Agricultural Books, pp107-112.

Howse, S. W., Isherwood, P., Miller, D. B., Wells , J. L., Riddick, C. M., Thomson, N. A., Clark, D. A. 1996. Pasture silage in New Zealand - targets and current practice. *Proceedings of the New Zealand Grasslands Association* **57:** 157-160

NRC. 1989. Nutrient Requirements for Dairy Cattle (6th ed.) National Academy Press, Washington.

Sniffen, C.J., O'Connor, J. D., Van Soest, P. J., Fox, D. G., Russell, J. B. 1992. A net carbohydrate and protein system for evaluating cattle diet: II. Carbohydrate and protein availability. *Journal of Animal Science* **70:** 3562-3576.

SPARTAN user manual 1992, Version 2.01, Michigan State University, MI, USA.

Wilson, G. F., Moller S., Parker, W. J., Hodgson, J. 1995. Seasonal differences in pasture composition and nutritional implications. *Dairy Farming Annual* **47:** 46-56.