

## 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](http://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](http://creativecommons.org/licenses/by-nc-nd/4.0/).



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/>

## BRIEF COMMUNICATION: Comparison of the performance of dairy cows offered energy supplements prior to drying off and kale at high and low allowance during the dry period in winter

S.L. GREENWOOD<sup>1\*</sup>, D.E. DALLEY<sup>2</sup>, N.G. PURDIE<sup>2</sup>, I. RUGOHO<sup>1</sup>, R.H. BRYANT<sup>1</sup> and G.R. EDWARDS<sup>1</sup>

<sup>1</sup>Faculty of Agriculture and Life Sciences, P.O. Box 84, Lincoln University, Lincoln 7647, New Zealand

<sup>2</sup>DairyNZ, P.O. Box 160, Lincoln University, Lincoln 7647, New Zealand

\*Corresponding author: [sabrina.greenwood@lincoln.ac.nz](mailto:sabrina.greenwood@lincoln.ac.nz)

**Keywords:** body condition score; milksolids; winter feeding; dietary supplement

### INTRODUCTION

Forage availability and body condition score (BCS) of the dairy cow are important aspects of dairy livestock management during the dry and peripartum period. New Zealand guidelines recommend a target BCS of 5.0 at calving (1-10 scale where 1 = Emaciated and 10 = Obese, Roche *et al.*, 2009). Providing adequate forage to meet this BCS target will impact reproduction, production and health parameters during the next season (Dewhurst *et al.*, 2000; Cavestany *et al.*, 2009; Roche *et al.*, 2009; Judson *et al.*, 2010). The relative importance of dietary metabolisable energy allowance during the late lactation versus dry period to body condition is somewhat contentious (Judson *et al.*, 2010). However, there is potential that feeding strategies and BCS gain during each of these periods could have unique effects on subsequent lactation performance, regardless as to whether both strategies allow the animal to meet the current BCS guidelines at calving.

In southern New Zealand, kale (*Brassica oleracea*) is a common feed grazed by dairy cows during the winter dry cow period. However, the utilisation of kale by the animal and effectiveness of kale to achieve BCS gain over the winter feeding period is still poorly understood, particularly where kale is a high proportion of the winter diet (Judson & Edwards, 2008; Keogh *et al.*, 2009). The objective of the current study was to investigate the potential use of a dietary supplement during late lactation in combination with different kale allowances throughout the dry cow period in winter as a method to reach the recommended BCS at calving. The effect of these feeding strategies on milksolids production post-partum was also measured.

### MATERIALS AND METHODS

All procedures were approved by the Lincoln University Animal Ethics Committee. Forty-four

Friesian-Jersey crossbred cows were blocked by BCS ( $4.2 \pm 0.5$ ) (Mean  $\pm$  Standard deviation), live weight ( $448 \pm 49$  kg) and milksolids ( $1.3 \pm 0.2$  kg/cow/day), and allocated to one of four treatment groups in a 2 x 2 factorial design as part of a larger study examining winter feeding strategies to minimise nitrogen losses from dairy cows during winter and improve body condition gain. Cows were offered 17 kg dry matter (DM)/cow/day of perennial ryegrass-white clover pasture with ( $n = 22$ ) or without ( $n = 22$ ) a commercially available energy supplement (3 kg DM/cow/day (Dairy Elite, Westons, Christchurch. Metabolisable energy (ME) = 12.5 MJ ME/kg DM; Crude protein (CP) = 12.5% on DM basis)) for the last 56 days of the previous lactation beginning on 26 March 2010, on the Lincoln University Research Dairy Farm. Both groups of cows were grazed together. On 21 May, cows were transported to Lincoln University Ashley Dene Farm and randomly allocated within their treatment groups to receive either 10 or 14 kg DM kale/cow/day plus 3 kg DM barley straw/cow/day during the 60-day winter feeding dry cow period ( $n = 11$  per treatment). In the dry cow feeding period on kale, cows grazed a dryland kale crop (cultivar Regal) on shallow, stony soil, at Ashley Dene, Lincoln University's dryland research farm near Burnham. The kale crop was sown at 4 kg/ha on 15 December 2009 with yields of 8,000-9,000 kg DM/ha during the winter feeding period. Over the first week of grazing on kale, dairy cows were adapted to the crop to minimise animal health disorders such as nitrate poisoning. In this period, cows were offered a diet of perennial ryegrass pasture, kale and straw with the kale component increased progressively until given at the full allowance after seven days. All cows were returned to a perennial ryegrass-white clover pasture on the Lincoln University Research Dairy Farm on 20 July immediately before calving and maintained on this pasture over the first 60 days of lactation. The mean calving date was 13 August  $\pm$  6 days.

During the winter dry period on kale from 21 May to 20 July, all cows were offered straw at 09:00 h each morning and access to new kale allocations at 10:00 h each morning. All crop measurements were performed as previously described (Rugoho *et al.*, 2010). Briefly, pre-grazing kale dry matter (DM) was determined weekly every Monday, by cutting to ground level six randomly positioned 1 m x 1 m quadrats within the area estimated to be grazed over the following week. Total fresh weight was recorded and a sub-sample of three plants from each quadrat was returned to the laboratory. These were separated into leaf and stem, and oven-dried at 65°C until a constant weight. Dried sub-samples were ground and analysed for forage composition using near infrared spectroscopy. On Tuesday of each week from the second week onwards, post grazing DM was measured in areas grazed the previous week on Thursday and Sunday. All remaining kale was removed from three 1 m x 1 m quadrats on the allotted days. The soil surface of each quadrat was dug, raked and searched to a depth of 10 cm to extract all remaining kale. Samples were washed to remove any soil or excrement, and oven-dried at 65°C to a constant weight in order to determine the DM content.

After the previous lactation, BCS was determined weekly during the dry period, and at Day 60 of the subsequent lactation, using the New Zealand scoring system (Roche *et al.*, 2009). Live weight was recorded concurrently. Milk yield was recorded daily for the first 60 days of the subsequent lactation. Milk samples were collected on

consecutive evening and morning milkings every second week from the beginning of the subsequent lactation for the first 60 days of lactation. Milk fat, protein and lactose percentage were determined (LIC Ltd., Christchurch). Milksolids was considered to be the milk fat plus protein (kg/d) determined by the component percentage and total milk yield at each individual milking session for each animal.

Results were analysed using two-way ANOVA GenStat (Version 12) with supplement and kale allowance as factors. Significance was declared at  $P < 0.05$  and tendencies were discussed as  $P$  being between 0.05 and 0.10.

## RESULTS AND DISCUSSION

As shown in Table 1, BCS at the end of the supplement period on 21 May, was greater ( $P = 0.001$ ) in supplemented (BCS 4.9) than non-supplemented groups (BCS 4.4), but there was no significant difference in live weight (No supplement 441 kg, Supplemented 455 kg). Though liveweight gain could not be recorded on the last full day of kale on 19 July, prior to transport of cows to a ryegrass-clover pasture, due to mechanical breakdown of the scales, BCS was determined. During the winter dry cow period on kale from 21 May to 20 July, both late lactation supplement feeding ( $P = 0.036$ ) and winter dry cow kale allowance ( $P < 0.001$ ) affected BCS change. However, when the dry cow period also includes the first seven days of ryegrass-clover pasture intake upon return to the Lincoln University Research

**TABLE 1:** Body condition score (BCS), live weight (LW) and postpartum milksolids (kg/cow/day) of dairy cows (average of first 60 days in milk) receiving either pasture only (No supplement) or pasture plus supplement (Supplement) for 56 days during the late lactation period of the previous lactation, and either 10 or 14 kg kale DM/cow/day allowance through the kale period (21 May to 19 July), and dry cow period (21 May to 27 July) in winter including the first seven days transition onto a ryegrass-clover pasture from the winter kale crop (21 May to 27 July). SED = Standard error of difference; S x K= Supplement by kale interaction.

Measurement	No supplement		Supplement		SED	P value		
	10 kg kale/d	14 kg kale/d	10 kg kale/d	14 kg kale/d		Supplement	Kale	S x K
Body condition score								
End of supplement period (21 May)		4.4		4.9	0.14	0.001		
After 60 days in milk (13 August to 22 October)	3.7	3.9	3.8	4.0	0.16	0.458	0.064	0.722
Change over kale period (21 May to 19 July)	0.23	1.00	-0.09	0.64	0.11	0.036	<0.001	0.885
Change over winter period (21 May to 27 July)	0.00	0.50	-0.18	0.27	0.19	0.143	0.001	0.868
Live weight (kg)								
End of supplement period (21 May)		441		455	12.9	0.286		
After 60 days in milk (13 August to 22 October)	440	439	449	454	16.7	0.317	0.868	0.832
Change over winter period (21 May to 27 July)	59.8	80.6	66.4	82.1	8.11	0.486	0.003	0.666
Milksolids production (kg/cow/day)								
After 60 days in milk (13 August to 22 October)	2.0	2.0	2.1	2.1	0.10	0.074	0.895	0.859

Dairy Farm between 21 May and 27 July, BCS gain of cows offered a high (14 kg DM/cow/day) kale allowance was greater ( $P = 0.001$ ) than those offered the low (10 kg DM/cow/day) kale allowance, while no effect of late lactation feeding was observed (Table 1).

The pre-grazing crop yield of kale averaged  $8,375 \pm 209$  kg DM/ha over the winter dry cow feeding period, with  $54.6 \pm 0.6\%$  of DM made up of leaf and  $44.4 \pm 0.6\%$  stem. Chemical composition of the whole kale plant as determined by near infrared spectroscopy was: Nitrogen content = 3.14% of DM; Dry matter digestibility = 86.1%; Neutral detergent fibre = 18.8% of DM; Water-soluble carbohydrates = 29.2% of DM). Analysis of a subset of samples via wet chemistry (McLeod & Minson, 1978) gave a dry matter digestibility of the whole kale plant of 88.8%. Utilisation of kale was  $97.3 \pm 1.4\%$  at 10 kg DM/cow/day kale allowance and  $94.1 \pm 2.1\%$  at 14 kg DM/cow/day kale allowance. Utilisation values are at the upper end of the range of values found in a survey of crop utilisation of dairy cows in Canterbury (Judson & Edwards, 2008). In the survey, the mean utilisation of DM was 80%, with greater than 90% utilisation in 40% of the herds sampled.

A feature of the results was the low BCS gain of cows fed at the low kale allowance, less than 0.25 BCS units, over the winter feeding period relative to estimated ME intake. Based on the equation for roughages ( $\text{ME (MJ/kg DM)} = \text{Digestible organic matter content} \times 0.016 \text{ (g/kg DM)}$ ; McDonald *et al.* 2002) ME of the kale would be calculated at the high value of 13.8 MJ ME/kg DM. However, due to the low fibre and lipid content of kale, the coefficient in the above equation derived using more fibrous feeds may be inadequate for determination of energy in brassica crops. Using a conservative estimate of 11.5 MJ ME/kg DM for kale and 7.3 MJ ME/kg DM for straw and kale utilisation values from above would give calculated ME intakes of 133.7 MJ/cow/day and 173 MJ/cow/day for the 10 and 14 kg kale allowance, respectively. These are high relative to the approximately 115 MJ ME/cow/day estimated to be required for cows to gain 0.5 BCS over a six week winter feeding period (Nicol & Brookes, 2007). The reason for the disparity is unclear at this stage, but may reflect an inability to sustain ME intake during the transition to pasture from kale. Table 1 shows the changes in BCS including and excluding a seven day pasture transition period at the end of the kale feeding period. This may arise as a possible effect of poor rumen function and anti-nutritional factors such as nitrates and S-methyl cysteine sulphoxide that are known to limit performance on kale, even when fed at a high allowance (Judson *et al.*, 2010; Rugoho *et al.*, 2010). An examination of rumen dynamics was

not included in the current study. The results indicate that the higher allowance of approximately 14 kg kale/cow/day may be needed to reliably achieve 0.5 BCS gain over the winter feeding period.

Average milksolids/cow/day over the first 60 days of the subsequent lactation tended to be greater for those cows that had been fed supplement prior to drying off ( $P = 0.074$ ) but was unaffected by kale allowance (Table 1) which may reflect the marked drop off in BCS on the transition back to pasture on the milking platform prior to calving. This result provides tentative evidence that providing additional dietary metabolisable energy during late lactation could be more beneficial in terms of milksolids production in the following lactation than increasing the availability of kale through the dry period. It is also interesting to note that providing supplement during the late lactation period had a positive effect on average milksolids/cow/day even though the supplemented group that later received 10 kg DM kale/cow/day, actually lost condition, albeit only a fraction of a score, during the dry period.

Ultimately, the current research examining the efficacy of late lactation and dry period feeding regimens on BCS, live weight, and milksolids production clearly demonstrate that further research is needed to understand the metabolism of kale, as well as nutritional factors governing changes in BCS and live weight during the transition from kale back onto a ryegrass-clover pasture at the milking platform.

## ACKNOWLEDGEMENTS

The authors would like to thank V. Walpot, A. Paule, L. Rossi and D. Paramschivam for their help during sample collection. Financial support from the Foundation for Research, Science and Technology (DRCX 0802; Dairy Systems for Environmental Protection) is also gratefully acknowledged.

## REFERENCES

- Cavestany, D.; Viñoles, C.; Crowe, M.A.; La Manna, A.; Mendoza, A. 2009: Effect of prepartum diet on postpartum ovarian activity in Holstein cows in a pasture-based dairy system. *Animal Reproduction Science* **114**: 1-13.
- Dewhurst, R.J.; Moorby, J.M.; Dhanoa, M.S.; Evans, R.T.; Fisher, W.J. 2000: Effects of altering energy and protein supply to dairy cows during the dry period. 1. Intake, body condition, and milk production. *Journal of Dairy Science* **83**: 1782-1794.
- Judson, H.G.; Edwards, G.E. 2008: Survey of management practices of dairy cows grazing kale in Canterbury. *Proceedings of the New Zealand Grassland Association* **70**: 249-254.
- Judson, H.G.; Dalley, D.E.; Edwards, G.R.; Steven, D.R.; Gibbs, S.J. 2010: Improving winter feeding outcomes in South Island dairy herds. In: Meeting the challenges for pasture-based dairying. Proceedings of the 4th Australasian Dairy Science Symposium. Edwards, G.R.; Bryant, R.H. eds. Lincoln University, Christchurch, New Zealand. p. 137-143.

- Keogh, B.; French, P.; McGrath, T.; Story, T.; and Mulligan, F.J. 2009: Comparison of the performance of dairy cows offered kale, swedes and perennial ryegrass herbage *in situ* and perennial ryegrass silage fed indoors in late pregnancy during winter in Ireland. *Grass and Forage Science* **64**: 49-56.
- McDonald, P.; Edwards, R.A.; Greenhalgh, J.F.D.; Morgan, C.A. 2002: *Animal Nutrition*. Sixth Edition. Prentice-Hall, London, UK. 308 pp.
- McLeod, M.N.; Minson, D.J. 1978: The accuracy of the pepsin-cellulase technique for estimating the dry matter digestibility *in vivo* of grasses and legumes. *Animal Feed Science and Technology* **3**: 277-287.
- Nicol, A.M.; Brookes, I.M. 2007: The metabolisable energy requirements of grazing livestock. *In: Pastures and supplements for grazing animals*. Rattray, P.V.; Brookes, I.M.; Nicol, A.M. eds. New Zealand Society of Animal Production. Occasional Publication Number 14. p. 151-172.
- Roche, J.R.; Friggens, N.C.; Kay, J.K.; Fisher, M.W.; Stafford, K.J.; Berry, D.P. 2009: Invited review: Body condition score and its association with dairy cow productivity, health, and welfare. *Journal of Dairy Science* **92**: 5769-5601.
- Rugoho, I.; Gibbs, S.J.; Bryant, R.H.; Edwards, G.R. 2010: Intake and feeding behaviour of dairy cows grazing kale and grass at low and high allowance during winter. *In: Meeting the challenges for pasture-based dairying*. Proceedings of the 4th Australasian Dairy Science Symposium. Edwards, G.R.; Bryant, R.H. eds. Lincoln University, Christchurch, New Zealand. p. 317-320.