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MILK PRODUCTION AND PROTEIN CONCENTRATION ARE ENHANCED BY REPLACING MECHANICALLY EXTRACTED CANOLA MEAL WITH COMMERCIALLY TREATED CANOLA MEAL IN DAIRY DIETS

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SUMMARY

By-Pro canola meal (Australian Patent 748 131) prepared from mechanically extracted canola meal was used in an experiment near Geelong, Victoria, in which it replaced (wt/wt on a DM basis) untreated mechanically extracted canola meal in the compound feed offered to high producing dairy cows. Herd testing began after all cows had calved and continued for the next 106 days. Protein (CP), fat and milk production were measured and a dollar return for production calculated (Fat*$2.0 + Protein*$5.0 – 2.8c/L). The dollar return over the last 75 days of the experiment was significantly greater for the test cows (P=0.03) and similarly, cumulative protein production was significantly greater for the test cows (P=0.05). Fat production followed a similar pattern. The dollar return per cow for the entire experiment was $71.8 greater for the test cows and, if the same pattern had continued for the next 100 days, it would have been $190 per cow. By-Pro canola meal had a rumen undegradable protein (RUP) content of 70% compared with only 10.1% for untreated canola meal. The By-Pro process is capable of processing various protein feed materials to produce products with enhanced RUP contents.

Keywords: dairy cows, rumen undegradeable protein, milk protein, profitability

INTRODUCTION

Cost-effective realisation of the genetic potential of high-producing dairy cows is an attractive option for producers to increase their return on capital invested in their enterprises. Recently the focus of research has been on strategic supplementation to improve production responses (Wales and Doyle 2003), particularly of fat and protein. In addition, a key objective has been to provide adequate and digestible rumen undegradable protein (RUP) (Nofstger and St Pierre 2003; Monteils *et al.* 2002), and to balance the amino acid content of metabolisable protein (MP) (Evans 2003; Schwab *et al.* 2003) while improving the efficiency of nitrogen utilisation. Increased efficiency of nitrogen utilisation, thereby decreasing the impact of excreted nitrogen upon the environment, is a significant issue in the European common market.

In the work reported here, By-Pro canola meal, prepared from mechanically extracted canola meal, replaced an equal quantity of untreated mechanically extracted canola meal in the compound feed offered to dairy cows. This increased the RUP content of the canola meal from 10 to 70%, and of the compound feed from 19.3 to 38.0%.

MATERIALS AND METHODS

Animals and diets

Twenty-one high-producing Holstein dairy cows on a property near Geelong, Victoria, were allocated to 2 groups by random stratification to ensure that expected calving date, age and previous production (herd index) were as nearly equal as possible. The cows in the test and control groups were allocated at random. There were 10 cows in the test group and 11 cows in the control group. One cow in the test group was not milked for the 2 weeks following parturition due to calving problems and was excluded from the experiment, reducing the number in the test group to 9.

With both the pre-calving and post calving diets, untreated canola meal (control group) was replaced with an equal quantity (wt/wt on a DM basis) of treated canola meal (test group). Treated canola meal was prepared using a patented commercial process (Australian patent 748 131) in which the meal was subjected to heat and shear forces under defined conditions and held under prescribed conditions for a specified period. Hay was offered to both groups at 14.5 kg per head pre-calving, and at 17 kg per head post-calving. The ingredients of both the pre-calving and post-calving compound feeds are given in Table 1.

Table 1. Composition of the compound feeds offered to the cows before and after calving.

Compound feed (% DM)			
Ingredient	Pre-calving	Ingredient	Post-calving
Canola meal	14.88	Canola meal	13.81
Soy bean meal	9.92	Soy bean meal	8.66
Ground wheat	29.76	Ground wheat	42.56
Ground lupins	9.92	Ground lupins	18.16
Ground oats	14.88	Palm oil	4.84
Rice pollard	1.94	Molasses cane	1.65
Molasses cane	2.48	Sugar – sucrose	3.50
Sugar – sucrose	2.70	Urea	0.26
Ground limestone	2.95	Ground limestone	2.48
Dicalcium phosphate	1.10	Dicalcium phosphate	0.88
Calcium chloride	2.20	Potassium chloride	0.44
Magnesium sulphate	6.48	Magnesium oxide	0.44
Vit. E (50%)	0.06	Vit. E (50%)	0.01
Dairy premix	0.17	Dairy premix	0.11
Niacin	0.33	Salt	0.44
Sucram	0.17	Sodium bicarbonate	1.76
Covatone	0.06		

The CPM-Dairy model (University of Pennsylvania) was used to assist with the formulation of the compound feed. The aim was to ensure that rumen digestible protein (RDP) was not limiting production, that RUP was considerably greater for the test feed than the control fed and that neither lysine (lys) nor methionine (met) in the MP would limit production of the cows. Analyses of the compound feeds and the control and treated canola meals were carried out by the F.A.R.M.E. Institute (Homer, NY 13077, USA), and amino acid analyses were carried out by Massey University, NZ, for the lys and met contents used for canola meal in the CPM predictions. The RUP values, as determined by F.A.R.M.E. from 16 h single point analyses, were 10.1% for canola meal and 70.0% for By-Pro canola, and for the compound feeds were 19.3% and 38.0% for the control and treated feeds, respectively.

Table 2. Model formulation and laboratory analysis of the compound feeds (see the text for dteails).

	Formulation (CPM-dairy)				Analysis (F.A.R.M.E.)	
	CP (%DM)	RUP (%CP)	Lys (%MP)	Met (%MP)	CP (%DM)	RUP (%CP)
Control feed	21.5	20.3	6.9	2.1	21.4	19.3
Test feed	20.3	40.0	6.7	2.6	20.0	38.0

Cow management

Both groups of cows grazed together until 3 weeks prior to their expected parturition, at which time they were allocated to separate paddocks that had been grazed bare. They were fed 2.5 kg/hd/d of either test or control pre-calving compound feed, and consumed approximately 14.5 kg hay/hd/d.

After calving cows were run together in a single paddock and received their respective compound feed in the milking shed at the morning and afternoon milkings. The single paddock was small and had little pasture available, our intention being that the feed consumed by the cows would consist entirely of the compound feeds and hay. Initially, they were offered 3 kg/hd/d of compound feed, and this was increased over 28 days to 12.6 kg/hd/d. Between June 13th and June 18th, we attempted to increase the compound feed to 14.6 kg/hd/d, but the control cows would not consume this quantity, therefore, the amount offered to both groups was reduced to 13.0 kg/hd/d by June 20th, and was held at this level for the remainder of the experiment.

Herd testing

Milk production, fat and crude protein concentrations, and somatic cell counts were measured by the Colac Herd Improvement Co-operative. This testing commenced 28 days after the first cow calved and, after the next 15 days, was continued at weekly intervals until day 106 of herd testing.

Statistical analysis and calculations

Herd test data were used to calculate cumulative milk, fat and protein production by projecting production on any 1 day forward to the next herd test measurement, and multiplying by the number of days in the interval. The first herd test day is referred to as day zero, and subsequent values as days from day zero. The last herd test was day 106 and a 7-day projection from this sampling gives 113 days of cumulative production. Dollar returns for production were calculated as (Fat kg * $2.00) + (Protein kg * $5.00) – 2.8c/L milk.

Linear regression equations fitted from day 0 to day 38, and from day 38 to the end of the experiment, for each individual cow for all of the production measures had r^2 values of at least 0.97, with most having values of 0.99. The slope of the regression equations were used in an Analysis of Variance using Systat (version 10.2) and using the day 0 to day 38 results as a covariate for the day 38 to day 113 results. Similarly, total production and dollar returns at day 38 were used as covariates for total production and dollar returns for the remainder of the experiment.

RESULTS

The mean dollar returns and protein production for 113 days are given in Figure1. Results are almost identical to day 38, but from day 38, production of the control cows was less than that of the test cows. Results for milk and fat production followed similar patterns.

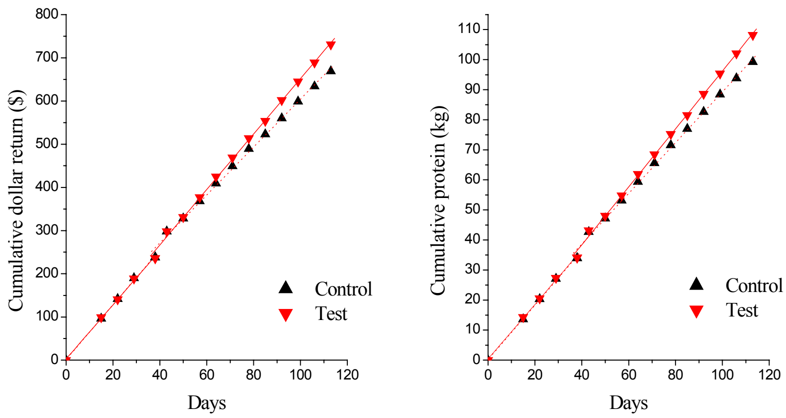

Figure 1. Mean cumulative dollar returns and protein production for control and test cows.

Least squares means for all 4 measures (cumulative milk, fat, protein production and dollar return) for each time period, day 0 to 38 and day 38 to day 113 are given in Table 3. There were no differences in the slopes in the period, day 0 to day 38, but in the period, day 38 to day 113, both the dollar return (P=0.03) and protein production (P=0.05) were significantly greater for the test cows than for the control cows (Table 3). The slopes of the regressions indicate the difference between test and control groups in the respective periods. The difference in the slopes for dollar returns represents $1.10/hd/d from day 38 to day 113. Similarly, the difference in the slopes for cumulative protein represents 0.13 kg protein/hd/d (a 16% increase compared with days 0 to 38) over the same period.

Table 3. Slopes (b) from linear regression equations (y=a+bx) for cumulative production (milk, fat and protein) and dollar return values for day 0 to day 38 and for day 38 to day 113. Least square means of slopes, from linear regressions for each individual cow, ± standard errors, are presented.

	Slopes for cumulative production					
	Day 0 – day 38			Day 38 – day 113		
	Control	Test	P	Control	Test	P[A]
Milk (L)	30.95 ± 1.12	29.30 ± 1.23	0.34	25.62 ± 1.48	28.99 ± 1.64	0.15
Fat (kg)	1.34 ± 0.044	1.27 ± 0.049	0.31	1.00 ± 0.084	1.24 ± 0.094	0.08
Protein (kg)	0.92 ± 0.028	0.91 ± 0.031	0.95	0.84 ± 0.041	0.97 ± 0.045	0.05
Dollar return ($)	6.34 ± 0.19	6.26 ± 0.21	0.79	5.36 ± 0.31	6.46 ± 0.35	0.03

[A] P values determined by ANOVA using slopes for individual cows for day 0 to day 38 as a covariate

Total production and dollar return values to day 38, and from day 38 to the end of the experiment, are given in Table 4. Analysis of results from day 38 to the end of the experiment using day 38 results as a covariate gave a P value of 0.056 for dollar returns for the test cows *v*. the control cows over this period. The P values for protein and fat production were 0.065 and 0.071, respectively. Values for protein production from day 38 to the end of the experiment were 0.87 kg/hd/d and 0.99 kg/hd/d for the control and test cows, respectively. Dollar returns for the same period were $5.72 and $6.64/hd/d for control and test cows, respectively.

Table 4. Cumulative production and dollar return values for day 0 to day 38 and for day 38 to day 113. Least square means, calculated from the results for each individual cow, ± standard errors, are presented.

	Total production (d 0 - d 38)			Total production (d 38 - d 113)		
	Control	Test	P	Control	Test	P[A]
Milk (L)	1158 ± 41	1100 ± 46	0.366	1995 ± 109	2278 ± 121	0.103
Fat (kg)	50.3 ± 1.6	47.9± 1.8	0.336	78 ± 6.1	96 ± 6.8	0.071
Protein (kg)	34.0 ± 1.0	34.1± 1.1	0.917	65 ± 2.9	74 ± 3.2	0.065
Dollar return ($)	238 ± 7.0	236 ± 7.7	0.821	429 ± 22.4	498 ± 24.7	0.056

[A] Analyses use the values to day 38 as a covariate for the day 38 to day 113 data

DISCUSSION

Dollar returns and protein production were greater for the test cows between day 38 and day 113. A similar pattern, though not significant, was apparent for total milk and fat production results. The experiment was terminated at day 106, of herd testing, when, calculating from data in table 3, the dollar return advantage to day 113 for the test cows was $0.71/hd/d and $1.07/hd/d for the entire experiment and for the last 75 days, respectively. This equates to $71.8 per cow for the entire experiment. If the same pattern continued for the next 100 days, the dollar advantage for the test cows would have been $0.89/hd/d or $190 per cow for the entire period. While lactations are usually expected to last for 300 days, extrapolation beyond about 200 days is unrealistic in view of changing physiological and nutritional requirements over the last third trimester of lactation. The dollar returns reported here are for benefits only, and do not include the cost of the By-Pro product. Further evaluation of By-Pro canola in dairy diets at both very early and late stages of the lactation is needed to determine best use of the product.

Cows did not receive the full quantity of compound feed until 28 days after parturition, and this may explain, in part, differences in production measures not occurring until day 38 of herd testing. Cows receiving the control feed were unable or unwilling to consume more than 13 kg/hd/day of the compound feed, and the test cows were restricted to this amount. Test cows did not reject larger quantities of compound feed when offered, and it is likely that production could be increased further by offering larger quantities of this feed. The CPM-Dairy model was used to assist formulation of the diet, and it predicted values of 6.7-6.9% lys and 2.1-2.6% met in the MP. Concentrations of 6.7-6.8% lys and 2.2-2.3% met in MP have been suggested by Schwab *et.al.* (2003) as practical targets for those using the CPM-Dairy model. It is unlikely, therefore, that production was limited by specific amino acid limitations.

These results suggest that beneficial economic returns can be gained by managing the RUP and amino acid balance in dairy diets in Australia. In this work, the compound feed was formulated to complement the hay offered as the roughage component of the diet. Hay was used to ensure adequate control of the variables in the experiment. For practical conditions in Australia where pasture is the principle source of roughage, By-Pro canola provides an option for producers to adjust RUP, and amino acid balance in MP, in the diet of their animals with the potential to manipulate protein and fat production, and the consequent dollar return per cow. Feeds presently available do not differ sufficiently in RUP to enable this to be achieved easily.

REFERENCES

EVANS, E. (2003). *In* 'Proc. Tri.-State Dairy Nutrition Conference.' pp. 133-140.

MONTEILS, V., JURJANZ, S., BLANCHART, G. and LAURENT, F. (2002). *Reprod. Nutrit. Dev.* **42**, 545-557.

NOFTSGER, S. and ST PIERRE, N.R. (2003). *J. Dairy Sci.* **86**, 958-969.

SCHWAB, C.G., RYAN, S.O. and WHITEHOUSE, N.L. (2003). *In* 'Proc. Four-State Applied Nutrition and Management Conference.' pp. 25-34.

WALES, W.J. and DOYLE, P.T. (2003). *Aust. J. Exp. Agric.* **43**, 467-474.

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