
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

Apple pomace as a supplement to pasture for dairy cows in late lactation

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ABSTRACT

Apple pomace, a by-product of the apple juicing industry, was assessed as a supplementary feed for lactating dairy cows during autumn. Cows were offered a base diet of 6 kg DM/cow/day from grazed pasture and one of three supplement treatments: control (7 kg DM/cow/day grass silage); apple pomace (AP) (3 kg DM/cow/day grass silage plus 4 kg DM/cow/day fresh AP); and AP+"balancer" (3 kg DM/cow/day grass silage plus 3 kg DM/cow/day fresh AP plus 1 kg DM of by-pass protein meal supplement ("balancer"). Treatment groups each comprised 10 mixed age Friesian-Jersey crossbred cows which were fed the supplement(s) in their respective groups in two equal portions following morning and evening milkings. Groups were grazed independently on similar pastures between these times.

Herd test milk yields over the 28 day supplementary feeding period were greater for the AP and AP+"balancer" groups (14.1 & 14.7 litres/cow/day, respectively) than for the control group (12.1 litres/cow/day; $P<0.001$). Milk protein yields were lower for the control than the two AP groups (0.43 vs 0.54 & 0.57 kg/cow/day for control, AP and AP+"balancer", respectively; $P<0.01$). Yields of milkfat (0.58 vs 0.70 vs 0.77 kg/cow/day) and milksolids (1.01 vs 1.24 vs 1.34 kg/cow/day) differed between all three treatment groups ($P<0.05$). Cow condition and bodyweights were similar between the three treatment groups at both the start and end of the trial. Apple pomace was therefore shown to be a useful supplement for dairy cows in late lactation.

Keywords: apple pomace; by-products; dairy nutrition; milksolids production; supplementary feeding.

INTRODUCTION

Dairy farmers and scientists are aware that milk production by New Zealand cows is constrained by the use of a pasture-only diet and appreciate that only slow progress in improving milk production will be achieved by increasing pasture production and herd genetic merit (Wilson and Moller, 1993). The focus for improving the productivity of New Zealand dairy farms is therefore shifting towards increasing milk production per cow, particularly amongst those farmers who are close to the production potential for a pasture-only system (Edwards and Parker, 1994). Improving the balance of nutrients in pasture-based diets through strategic supplementation with appropriate feedstuffs (Muller, 1993), provides a possible mechanism to increase per cow milk yields.

Significant tonnages of by-products with potential as feeds for ruminants are generated by food producing and processing industries in various regions of New Zealand (Bramwell et al., 1993). Apple pomace, a by-product of the apple juicing industry, is one such product with over 42,000 tonnes wet weight expected to be available by 1998 (Marks, 1994, pers. comm.). Numerous reports have confirmed that apple pomace can be successfully fed to sheep and cattle (Fontenot et al., 1977; Rumsey and Lindahl, 1982). These studies have, however, mainly involved lot-fed animals and/or relatively high levels of apple pomace in the diets (i.e. at least 50%). This paper describes a preliminary investigation into the feeding of apple pomace to lactating dairy cows at pasture during the autumn. A commercial by-pass protein supplement ("balancer") was also evaluated for its ability to improve production when added to a base diet of pasture and apple pomace.

MATERIALS & METHODS

Thirty mixed age (3.4 - 8.6 yrs; mean: 5.5 yrs) Friesian-Jersey crossbred cows in mid- to late-lactation (143-246 days in milk; mean: 196 days) were used in the trial. During the two weeks prior to the trial, cows were offered a diet of approximately 5 kg DM grazed pasture and up to 8 kg DM grass silage and were milked once a day. Bodyweights, cow condition scores, daily milk yields, and herd test data, collected during a 7-day pre-treatment covariate period, were used to allocate cows to one of three treatment groups.

Following the pre-treatment period the animals were returned to twice-daily milking and adapted to their respective dietary treatments over 14 days. All 30 cows were grazed in one herd during the adaptation period, but were offered their respective supplements from troughs in separate areas of a concrete feeding pad (i.e. one area per treatment). The supplements were available for one hour following morning and evening milkings. By the end of the adaptation period the three groups were being offered, in addition to an estimated 6 kg DM/cow from pasture, supplements per cow per day as follows: Control - (7 kg DM grass silage); Apple Pomace (AP) - (3 kg DM grass silage + 4 kg DM apple pomace); AP+"balancer" - (3 kg DM grass silage + 3 kg DM apple pomace + 1 kg DM protein supplement).

Apple pomace was delivered fresh from ENZA Processors (Hastings) in 4 batches and was stored in sealed 200 litre metal drums until required. Grass silage was from three 6-18 month old stacks. The by-pass protein meal supplement was from NRM New Zealand Limited (Levin). Pasture was from ryegrass/clover swards. During the 28 day treatment period (days 15 to 42) each group of cows was grazed in a

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separate paddock to allow respective pasture intakes to be estimated. Supplement refusals were measured for each group after each feeding.

Pre- and post-grazing pasture mass was measured daily for each treatment group using an Ellinbank Pasture Meter, and the groups were each given a fresh "break" of pasture after the morning supplement period. Pasture was sampled from the areas to be grazed on any particular day and combined across paddocks within days. Subsequently these were freeze dried, ground through a 1-mm screen in a Wiley mill and sent to the University of Sydney for analysis by near-infrared reflectance (NIRs). Samples were tested for ADF, NDF, DOMD, crude protein and total soluble carbohydrates. Samples of grass silage and apple pomace from each feed batch and a single sample of the protein supplement were submitted for proximate analysis of ash, crude protein, ether extractables, NDF and ADF, and for determination of in vitro digestibility.

Milk production (litres per day) was monitored daily and 24 hour milk, fat and protein yields were determined weekly on samples from consecutive evening and morning milkings. Bodyweights and condition scores were determined at the beginning, middle and end of the treatment period.

Statistical Analyses

Weekly herd test data, bodyweights and condition scores were analysed by the General Linear Model of SAS using repeated measures analysis of variance with the pre-treatment period (days -7 to -1) as a covariate (SAS, 1987).

RESULTS & DISCUSSION

Chemical Composition of Feed Components

The average chemical composition of feedstuffs used in the trial are presented in Table 1. Daily pasture samples indicated that nutrient composition changed from day to day during the trial. For example, crude protein values ranged from 14.5 to 28% of the DM, and generally increased as the trial progressed due to rain stimulating new pasture growth. The average energy content of the pasture was 10.90 MJ ME/ kg DM (Table 1). Apple pomace was a relatively high energy/ low protein feed with low dry matter and ash content. The protein supplement had a high dry matter, crude protein and energy content, and was designed to balance the potential for a low protein content in both late summer pasture and the apple pomace. Pasture quality data was not available prior to or during the trial, and this precluded adjustments being made to the meal "balancer" to ensure that cow dietary requirements were fully met.

Pasture and Supplement Intake

Estimated daily pasture intake was lower for the control group (6.6 kg pasture DM consumed/cow/day), than for the AP+"balancer" and AP groups (7.1 & 7.2 kg DM/ cow/day), respectively. Cows in the control group consumed about 4.9 kg of the 7 kg grass silage DM offered each day. In contrast, animals in the AP group consumed a total of about 6.6 kg DM of supplement each per day, comprising 2.6 kg grass silage DM and 4 kg apple pomace DM. Animals in the AP+ "balancer" group consumed about 6.9 kg DM of supplement (2.9 kg grass silage, 3 kg apple pomace and 1 kg meal supplement). Thus, the total DM intake differed for each diet. Total intake averaged 11.5, 13.9 and 14.0 kg DM/d for control, AP and AP+"balancer" cows, respectively. These data suggest that substitution of apple pomace for some of the grass silage stimulated both pasture and total supplement intake.

The DM intake estimates of the supplements are indicative of the relative intakes of the three groups, but are subject to group measurement errors in amounts offered and refused. Pasture intake levels are also approximate due to the changing nature of the pasture sward during the experiment as a consequence of rainfall and subsequent growth and decay of the sward.

TABLE 1: Chemical composition of pasture, grass silage, apple pomace and "balancer" (percent DM basis except for metabolisable energy (ME)).

Chemical fraction	Pasture (n=40)	Grass Silage (n=3)	Apple Pomace (n=8)	"Balancer" (n=1)
DM	29.13	21.60	13.90	89.00
Ash N.D.[a]	9.07	2.37	11.19	11.40
Crude protein	22.57	14.14	7.96	24.19
Ether extract	N.D.	3.34	4.37	5.36
NDF	47.06	57.71	48.28	13.87
ADF	29.74	35.53	38.79	3.72
Total soluble carbohydrates	5.07	N.D.	N.D.	N.D.
In vitro digestibility				
DMD	N.D.	57.69	74.49	82.55
DOMD	67.71	56.76	72.73	75.01
Energy (MJME/kg DM)[b]	10.90	9.08	11.64	12.00

[a] N.D. = Not determined.
[b] Calculated from M/D = 0.16 (DOMD%) - Corbett (1990).

Animal Parameters

Bodyweight and cow condition did not differ between the three treatment groups over the period of the trial ($P>0.05$). During the 28 day treatment period the average bodyweights were 492, 487 and 489 kg for control, AP and AP+"balancer" groups, respectively, whilst the average condition scores were 4.47, 4.38 and 4.39, respectively.

Milk Production

The average daily milk yields for each of the three treatment groups from the start of the covariate period until the end of the four week treatment period are shown in Figure 1. Differences between treatments varied during the trial. The overall mean yields for weeks 3 to 6 of the trial are summarised in Table 2.

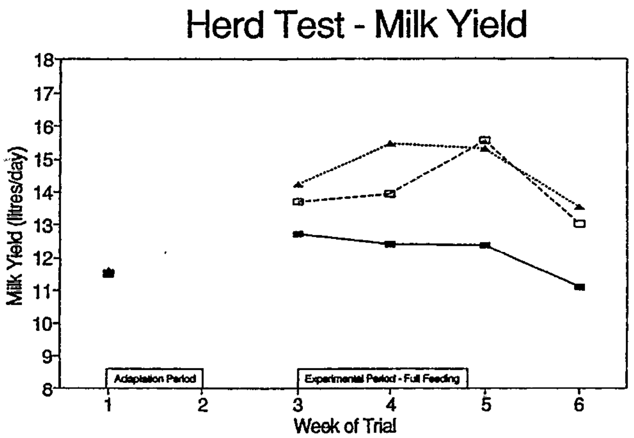
Milk yield was significantly greater ($P<0.01$) for the AP and AP+"balancer" treatments than for the control treatment, but no differences were evident between the two apple pomace treatments. Milk protein yield was greater ($P<0.05$) in groups receiving apple pomace compared with the control group. In contrast, overall milkfat and milksolids yields differed significantly ($P<0.05$) between all three treatment groups.

TABLE 2: Covariate adjusted herd test milk yields, and milkfat, protein and milksolids yields, averaged over the four week treatment period.

Parameter	Control	Yield[a] Apple Pomace	AP+"Balancer"
Milk yield (litres/cow/day)	12.11[a]	14.12[b]	14.71[b]
Milkfat (kg/cow/day)	0.582[a]	0.704[b]	0.770[c]
Protein (kg/cow/day)	0.429[a]	0.536[b]	0.569[b]
Milksolids (kg/cow/day)	1.013[a]	1.236[b]	1.340[c]

[abc] Means within a row lacking a common superscript letter differ (P<0.05).

FIGURE 1: Herd test milk yields of control (■-■) apple pomace (□ - □) and apple pomace + "balancer" (▲ - ▲) treatment groups prior to adoption and during the experimental period.



CONCLUSION

Apple pomace was found to be a useful supplement for lactating cows on pasture-based diets during the late summer-autumn months. Daily milk yield increased by 20-23% over the groups supplemented with grass silage only, and milkfat, protein and milksolids yields also increased. These responses appear to have been induced by the higher DM (energy) intake, rather than an improved balance of nutrients, in the diet of animals in the two apple pomace treatment groups, and suggests that the pasture substitution effect of supplements was small. Apple pomace resulted in greater utilisation of grass silage compared to the control group. The apparent stimulation of intake by apple pomace supplementation could perhaps be used to ensure improved utilisation of less palatable feeds.

Despite the higher levels of milk production from the apple pomace supplemented cows, they maintained their body weights and condition during the trial and did not differ from the control group for these parameters. Whilst further increases in milk yield, milk protein, lactose (not significant), milkfat and milksolids (P<0.05) were evident as a result of substituting 1 kg DM "balancer" for apple pomace (i.e. AP+"balancer" vs AP treatments), overall responses were small despite an initial 1.5 litre/day increase in milk yield over the AP group. The converging of the AP and AP+"balancer" group milk yields (Figure 1) is likely to be due to the increased crude protein levels in the new pasture following rain mid-way through the experiment and suggests that the meal supplement could have been withdrawn at this stage. This highlights the importance of knowing the chemical composition of the various diet components, so that both the quantity and type of supplement can be altered in response to changing pasture conditions.

ACKNOWLEDGEMENTS

We wish to thank Jon Marks, Technical Manager for ENZA Processors, for his support and help with the project. Thanks also to Joost Geuijen and Martin Chesterfield for their technical expertise running the trial, Gavin Wilson for his advice and help with the analysis of results, and the helpful comments of an anonymous referee.

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