ISSN 0370-2731/2002 Proceedings of the New Zealand Society of Animal Production 62: 240-241

BRIEF COMMUNICATION

Concentrations of conjugated linoleic acid in milk from cows grazing pasture or fed a total mixed ration for an entire lactation.

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Conjugated linoleic acid (CLA) is a collective term for the range of conjugated isomers of linoleic acid ($C_{18:2}$). These fatty acids occur naturally in milkfat and have proven anticarcinogenic properties in laboratory rodents (Ip *et al*., 1999). Additionally, the various isomers have other reputed benefits for human health such as enhanced bone mineralisation, antidiabetic effects, reduced atherosclerosis and immune system modulation (Whigham *et al*., 2000). Such potential benefits for human health have focussed international research on enhancing concentrations of CLA in milk and dairy products.

Overseas data show that one way to increase the concentrations of CLA in milk is to change the diet of cows from a typical total mixed ration (TMR) to pasture (Kelly *et al*., 1998; White *et al*., 2001). This points to a potential competitive advantage for the New Zealand dairy industry, in which pasture is already almost the sole source of feed. Despite this there are no data confirming the beneficial effects of pasture for enhancing CLA under New Zealand grazing conditions.

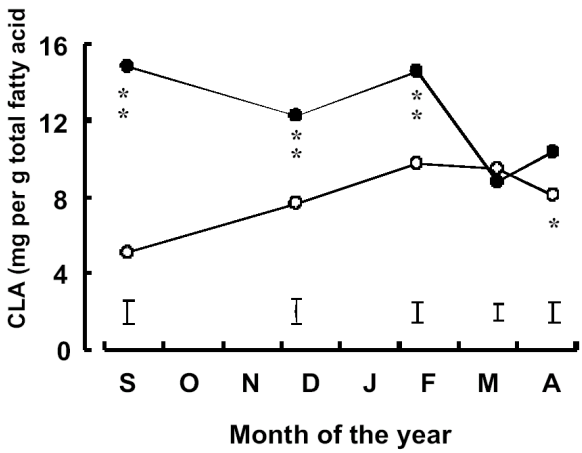
The experiment described here used an existing experiment to compare the concentrations of CLA in milk from cows fed TMR or grazing pasture for an entire lactation under New Zealand conditions.

A group of Holstein-Friesian cows, all in their second lactation, was divided randomly into two groups of 20. One group grazed a generous pasture allowance. The other group was fed a TMR formulated from silage and concentrates, and was contained within an outdoor feed pad. The TMR was formulated according to the nutritional requirements of the cows, and nutritional treatments were imposed for an entire lactation. At the time of the experiment the same nutritional regimens had been in place for the preceding lactation as well. Further details of experimental conditions are provided by Kolver (2001).

Milk was sampled from each cow at six consecutive milkings on five occasions during the year (September, December, February, March and April). On each sampling occasion, the milk samples from the six milkings (i.e. three days) were bulked to form one sample per cow, and the fatty acid profiles of milk, including CLA, were analysed using gas chromatography techniques (MacGibbon, 1988).

Concentrations of CLA (mg/g fatty acids) in the milkfat of grazing and TMR-fed cows are presented in Figure 1. CLA concentrations of milk from grazing cows were nearly always higher than for cows fed TMR. The exception was in March (late summer) when there was no difference between the CLA concentrations in milk from cows on the two treatment groups. Differences in CLA between TMR-fed and grazing cows were greatest during the early part of the dairying season (September – February). Concentrations of CLA in milk from grazing cows declined as lactation progressed, but increased slightly for TMR-fed cows. Overall, the mean concentrations of total CLA for pasture-fed and TMR-fed cows in the current study (12.2 c.f. 8.0 mg/g fatty acids respectively) appeared slightly greater than values reported in the U.S.A. of 10.9 and 4.6 mg/g of milkfat (Kelly *et al*., 1998).

FIGURE 1. Concentrations of conjugated linoleic acid (CLA) throughout lactation in milk from cows grazing pasture (●) and cows fed a typical total mixed ration (❍) for an entire lactation. Vertical brackets indicate standard errors of the differences. Asterisks indicate the significance of differences at each sampling point.



This pattern of change in CLA concentrations across lactation may be due to changes in the quality and availability of pasture. These factors may have altered the intake of total pasture lipid and, in particular, linolenic acid. This explanation is consistent with research (N.A. Thomson, unpublished data) showing that in the year the current experiment was conducted, concentrations of total lipid and proportions of linolenic acid in Waikato pasture were low in autumn (March) and high in spring (September). Although it was initially thought that most CLA was derived directly from the ruminal biohydrogenation of linoleic acid, it is now recognised that the majority arises from the desaturation in the mammary gland of *trans*-vaccenic acid (*trans*-11 $C_{18:1}$), another intermediate in the biohydrogenation pathway of polyunsaturated fatty acids (Griinari *et al*., 2000). Recently a study in New Zealand confirmed the importance of such endogenous synthesis of CLA in grazing cows (J.K. Kay, unpublished data). Thus this could explain the higher concentrations of CLA in cows grazing pasture, since the high levels of linolenic acid in pasture compared to TMR would provide an increased source of *trans*-11 $C_{18:1}$ for desaturation.

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These data provide the first controlled confirmation under New Zealand conditions that pasture provides a more effective supply of substrate for the production of CLA in milkfat than a forage/concentrate TMR. Future research will determine whether CLA concentrations of grazing cows can be increased even higher, perhaps by providing an even greater supply of *trans*-11 $C_{18:1}$, so as to maximise the benefits in terms of both consumer perception and human health.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of B. Sugar and No. 1 Dairy staff for animal care and husbandry, B. Dow for statistical analyses of data, and A. Chand for chemical analyses of milk fatty acid profiles.

REFERENCES

Griinari, J.M.; Corl, B.A.; Lacy, S.H.; Chouinard, P.Y.; Nurmela, K.V.; Bauman, D.E. 2000: Conjugated linoleic acid is synthesised endogenously in lactating dairy cows by delta(9)-desaturase. *Journal of nutrition 130*: 2285-2291.

Ip, C.; Banni, S.; Angioni, E.; Carta, G.; McGinley, J.; Thompson, H.J.; Barbano, D.; Bauman, D. 1999: Conjugated linoleic acid-enriched butter fat alters mammary gland morphogenesis and reduces cancer risk in rats. *Journal of nutrition 129*:2135-2142.

Kelly, M.L.; Kolver, E.S.; Bauman, D.E.; Vanamburgh, M.E.; Muller, L.D. 1998: Effect of intake of pasture on concentrations of conjugated linoleic acid in milk of lactating dairy cows. *Journal of dairy science 81*: 1630-1636.

Kolver, E.S. 2001: A comparison of Holstein Friesian strains for South Island dairying. *Proceedings South Island dairy event*, Lincoln University, Canterbury, New Zealand.

MacGibbon, A.K.H. 1988: Modified method of fat extraction for solid fat content determination. *New Zealand journal of dairy science and technology 23*: 399-403.

Whigham, L.D.; Cook, M.E.; Atkinson, R.L. 2000: Conjugated linoleic acid: implications for human health. *Pharmacological research 42*: 503-510.

White, S.L.; Bertrand, J.A.; Wade, M.R.; Washburn, S.P.; Green, J.T.; Jenkins, T.C. 2001. Comparison of fatty acid content of milk from Jersey and Holstein cows consuming pasture or a total mixed ration. *Journal of dairy science 84*: 2295-2301.