Fatty acid supplementation

by David Garnett, Pathway Intermediates Ltd, Unit C17 Rosehill Industrial Estate, Market Drayton, Shropshire, TF9 2JU, UK.

Milk is a healthy product. It is rich in vitamins and minerals and contains polyunsaturates such as conjugated linoleic acid (CLA) known to be important to health. But it could be better still if it contained less saturated fat.

About 70% of the fat in milk is saturated and there is an understood link in humans between dietary saturated fat intake, high cholesterol and coronary heart disease.

In the USA and Western Europe dairy products account for about 30% of total dietary saturated fat. Studies indicate that exchanging saturated fat for unsaturated fat in the diet is more effective in preventing coronary heart disease than is the reduction of overall fat intake.

Milk lower in saturated fat should be an objective of the dairy industry. The Wisconsin MMB defined the 'ideal' milk fat profile as one where saturates were reduced to just 8% with the remainder comprising monounsaturates and to a lesser extent (10%) polyunsaturates.

There is now a compelling case for examining the way the dairy industry can manipulate milk output in terms of fat profile.

Designer milk is nothing new: omega-3 enriched milk is already on the shelves of the retail multiples but accounts for less than 1% of sales.

Price, unfamiliarity and even suspicion of artificially modified milks could all be reasons why sales are currently low, but sales are growing year on year with increasing consumer acceptance.

Moreover, it is possible that a mass market full fat product is now within reach, one that is naturally lower in saturated fat and has elevated levels of the healthy mono and polyunsaturates such as CLA.

How can this be achieved with current feed technology? The saturated fat in milk has two sources.

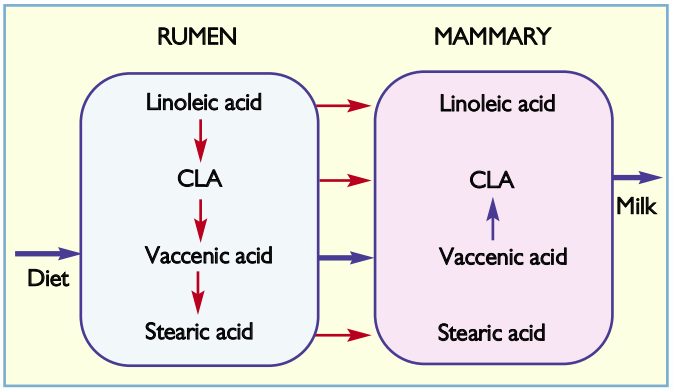

Fig. 1. Rumen bacteria hydrogenate oleic acid found in fodder into stearic acid.

The first is the dietary saturated fat intake that flows into the blood following the processing of unsaturates in the rumen into saturates.

For example, rumen bacteria hydrogenate oleic acid found in fodder into stearic acid (see Fig. 1).

Fat	Control	Treated	Change (%)
Saturated	740.5	624.4	-15.6
Polyunsaturated	53.1	53.3	+0.37
CLA	**6.5**	**8.9**	**+36.9**

Table 1. Yield of fatty acids in milk from cows fed 400g/d vaccenic acid salt. (Abridged from Piperova et al 2004).

Rumen protected fat is one solution, provided that the fat is unsaturated in the first place. Many existing fat supplements (protected or otherwise) are mainly saturated C16 or C18 acids. These are excellent products if yield and animal condition are the primary focus but these are absorbed intact and are expressed in the milk. CLA is available as a fat supplement causing a limited reduction in saturates and expression of CLA in the milk.

Consumers will doubtless find this attractive but there is a downside. Leaving aside the price of the CLA product, milk yield drops by some 6.8% and total milk fat drops by 25% at 100g/d and it is milk producers that will pick up the bill for this reduction.

Even if it were possible to completely control fat intakes, only 50% of milk saturates come from the animals' diet with the other half being produced in the udder as part of normal metabolism. These endogenously synthesised saturates are produced by enzymes in the mammary tissue that control the balance of saturates to unsaturates.

The truth is that all cells need to control this ratio in order that their cell membranes can function properly. Negative feedback systems quickly restore the balance when it is artificially disturbed.

This sounds like an intractable problem and nature is very good at maintaining the status quo.

However, nature has also provided one possible solution, there is a fat already found in low concentrations in milk called vaccenic acid and it has some remarkable properties.

Due to its shape it is able to stabilise the cell membrane even in the presence of an excess of unsaturates and this means that the cow is able to express a high proportion of unsaturates whilst maintaining the integrity of its tissue membranes.

Vaccenic acid is also an intermediate step in the rumen hydrogenation pathway but not a rate limiting one and so could be included in the diet without loss of functionality.

Experimental work has shown that if dairy diets are supplemented with small amounts of vaccenic acid salt there are several positive effects on milk quality and a drop in yield of only 4.94% and a drop in total milk fat of just 2.65% at a dose of 100g per day.

Results

This milk is still some way from the Wisconsin 'ideal' milk but it is significantly improved. So it appears that low dose supplementation of the diets of lactating cows with vaccenic acid or vaccenic acid salt is a step towards healthier milk, without significantly compromising yields.

Milk produced in this way could attract a premium in the supermarket but there may be additional improvements in the processing characteristics of the milk.

High levels of poly and monounsaturates could give softer butters that could spread straight from the fridge for example.

However, there is often a disconnection between the diet formulators (the premix companies and the fed compounders) and the end consumer who will benefit. It is difficult for the feed producers to commit to this kind of supplementation when the real benefits are further down the supply chain.

Yet the dairy industry as a whole has a genuine opportunity to exploit this technology and reap the marketing benefits associated with these new milks. ■

Table 2. Yield and type of CLA lipids in milk from cows fed with either vaccenic acid salt or CLA salt both at 100g/d: results in g lipid/d. (Abridged from Piperova et al 2004).

CLA isomer	Control	Vaccenic acid	CLA
t-7, c-9	0.82	1.07	0.66
c-9, t-11	4.99	5.95	5.50
t-10, c-12	0.09	0.09	0.28
c-11, t-13	0.03	0.05	0.19
Total	**5.93**	**7.16**	**6.63**