

## The role of palm oil in a sustainable dairy industry

This is the second of four articles looking at issues relating to the sustainability and use of palm oil in the dairy industry. The articles are covering the following topics :

1. Palm oil in a sustainable world
2. **Efficient milk production and role of fat**
3. Saturated fats in milk
4. UK's first fat supplement manufactured using only certified sustainable palm oil

### 2. Efficient milk production and role of fat

As highlighted in the previous bulletin, global population is set to increase by over 2 billion by 2050 (reaching 9 billion), placing increased demands on limited resources to meet the world's food requirements. Global demand for milk products is also forecast to rise and this bulletin considers the need for an efficient dairy industry and specifically the use of fat supplements in achieving this.

#### Production level vs. efficiency and resource requirement

Producing more from less is an essential component of increasing efficiency on dairy farms and on reducing the environmental impact of food production. Data presented in Table 1 provide a graphic demonstration of how the dairy industry in the US has evolved in recent decades, achieving a 61% increase in milk production from a 64% lower dairy cow population. This increased level of production has resulted in a dramatic increase in efficiency of energy use, with only 33% of energy consumed used to maintain cows at present-day levels of production, compared to 69% for cows at 1944 levels of production.

**Table 1 Comparison of production figures for the US dairy industry :  
1944 vs. 2007**

	<b>1944</b>	<b>2007</b>
Number of cows (millions)	25.6	9.3
Milk yield (billion kg)	53.2	86.4
Average milk yield (kg/d)	6.8	29.5
Proportion of energy intake used for maintenance (%)	69	33

(Capper *et al.*, 2009)

UK milk production – looking ahead

A recent report by UK consultancy group Kite highlights the major changes predicted to occur within the UK dairy industry in the period to 2020 (Table 2). Milk production is forecast to reach 15 billion litres by 2020 from the current level of 13.3 billion litres. However, with cow numbers forecast to remain stable at 1.85 million head, this increase in milk production can only be achieved by increasing yield per cow through improvements in genetics, nutrition and management.

**Table 2 Future milk production – forecast for the UK**

	<b>2010</b>	<b>2020</b>
Milk yield (kg/cow/year)	7217	8218
UK production (billion litres)	13.3	15.0
Number of cows in the UK (million)	1.85	1.85

(Kite Consulting : Vision for 2020)

How can dietary fat improve efficiency of milk production ?

Like other nutrients such as protein and carbohydrates, fat is an essential component of an animal's diet; inadequate fat in a ration can lead to deficiency diseases and poor production, and research work has provided guidelines as to how much fat is needed for optimal production of lactating cows. Fat is a unique ingredient which offers many benefits when formulating rations which cannot be supplied by other nutrients. These can be summarised as follows :

*Energy supply*

Supplementary fats are commonly added to diets primarily due to their very high energy density relative to other ingredients; research-proven fat sources contain over 2.5 times the metabolisable energy (ME) concentration of typical cereals. This ME is converted to energy in milk (net energy) much more efficiently (82%) than that from other energy sources (around 65% for typical dairy feeds), highlighting the higher production levels achievable from fat as a source of ME compared to other nutrients. The high ME concentration enables dietary energy density to be increased – more energy per bite – particularly useful in the early lactation period when the cow cannot physically consume sufficient dry matter to meet her requirements for maintenance and production.

## *Reduced acidosis and balanced rations*

Fat is a unique ingredient in that it is not fermented in the rumen and so facilitates formulation of energy-dense rations without increasing the risk of excess rumen acid production which can lead to acidosis - it is therefore a much 'safer' method of increasing energy density than feeding additional starchy ingredients such as cereals. Similarly, inclusion of fat can help with formulation of more-balanced rations, enabling forage : concentrate ratio to be increased while maintaining or increasing ME concentration.

## *Milk fat %*

Fat supplements can be very effective at increasing milk fat % though this will depend on the fatty acid profile of the particular product. The most beneficial fats in this respect are those containing a high proportion of C16 (palmitic) fatty acids ('high-C16' fats) and these can typically increase milk fat by 0.2% to 0.3%.

## *Feed efficiency*

Supplementing diets with fat invariably improves feed conversion efficiency, with more milk produced from a similar volume of DM intake. This is a key factor in promoting efficient dairying in the scenario of 'producing more from less', minimising waste (undigested feed) and reducing the volume of DM required to produce a specific quantity of milk.

## *Fertility*

Research-proven fats have a significant impact on cow fertility, improving conception rates and reducing days open. While a major part of this effect reflects the improvement of energy supply to the animal which can help reduce body condition score loss, fat can influence fertility in ways independent of energy supply. Progesterone, 'the hormone of pregnancy', is an essential component in ensuring successful pregnancy; low concentrations of circulating plasma progesterone will result in a failure of the cow to maintain a pregnancy. Dietary fat supplies the building blocks for progesterone and insufficient fat in the ration will result in low progesterone and failure of pregnancy.

Additionally, some fats have been proven by research to improve quality of ovulated eggs, increasing the chances of successful fertilisation and pregnancy. Fats differ in fatty acid profile and this will influence the effect a particular supplement may have on egg quality. Megalac has a specific fatty acid profile and studies at the University of Florida

and the University of Nottingham have demonstrated highly beneficial effects of this fat source on improving quality of ovulated eggs.

Fat supplements containing omega-3 fatty acids are also commonly added to dairy diets and are targeted specifically to improve fertility. These fatty acids act by reducing particular prostaglandin compounds by the ovary but will not be effective in all scenarios; in addition, they must be supplied in rumen-protected form.

### Rumen-protected fats

To be effective, fat sources added to diets should be in rumen-protected form. Adding 'free' (unprotected) fat to a ration will increase the energy density of a ration on paper, but can reduce digestibility of fibre and milk fat %. Ingredients such as brewers grains and distillers grains typically contain 8 to 12% fat as 'free' oils and many fat supplements also contain only 'free', rumen-active oil. As well as directly reducing fibre digestion, many 'free' fats are toxic to strains of rumen bacteria, reducing the population of rumen microbes and risking production of '*trans*' fatty acids which can greatly reduce milk fat %.

Similarly, omega-3 fatty acids can only have a beneficial effect on fertility if fed in a rumen-protected form to allow their delivery to the ovary; omega-3 oils fed in 'unprotected' form will be broken down in the rumen and changed to a non-effective form of fatty acid which will not have the beneficial effects on fertility that omega-3 fatty acids can have.

### Methane production – effect on production efficiency and role of fats

In the UK, ruminant animals are estimated to produce 20-25% of methane released to the environment. Achieving a reduction in methane output from ruminant livestock is a key target for improving the environmental sustainability of dairy production and increasing the efficiency of energy use by dairy cows. In addition to the environmental concerns, methane production represents a significant loss of energy to the animal, typically accounting for 6-8% of the animal's energy intake.

Adding research-proven fat supplements to dairy rations can effectively reduce the production of methane, reflecting an increased level of milk production and a reduction in the proportion of fermentable feed in the rumen. This is clearly demonstrated in Table 3 where substituting fermentable maize with higher energy, non-fermentable fat

(Megalac) resulted in an increased milk yield and a reduction in methane production of 13.3% per litre of milk.

**Table 3 Effect of Megalac supplementation on milk and methane production**

	<b>Control</b>	<b>Megalac-supplemented</b>
Milk yield (litre/d)	32.2	34.3
Methane (litres/d)	539	498
Methane (litre) / milk (litre)	16.74	14.52
Reduction in methane per litre milk (%)		-13.3

(Andrew et al., 1991)

On a herd basis, data from the University of Nottingham indicate that the total methane (t/year) associated with the production of one million litres of milk from cows producing 9000 litres/cow/year would be just over 50% of the methane which would be associated with cows producing 6000 litres/year. In addition, replacement animals contribute up to 27% of the methane attributed to dairy cows in the UK, such that improvements in cow fertility which lead to decreased numbers of replacements required could greatly reduce methane production.

### Conclusions

Milk production in the UK is forecast to undergo substantial expansion to 2020 and beyond but with a similar-sized dairy cow population. This will require major improvements in efficiency of production with emphasis on genetics, management and nutrition. Nutritionists have a limited number of feed ingredients and energy sources available to help them meet the challenge of increasing individual cow productivity level. Research-proven fat supplements will play a vital role in facilitating formulation of higher energy density rations to increase milk production and fertility while minimising health problems.

Volac offer a complete range of protected fat supplements, all manufactured in our Liverpool factory, and based on technology which has been highly-proven over the last 30 years. There are many types of fat available, making it a very flexible ingredient for dairy diets in improving efficiency on individual farms, and in matching the type of fat offered to a particular requirement or target e.g. to improve milk yield and milk composition, increase milk fat % or increase fertility.