Optimising palmitic acid dosage for dairy cows in early and mid-lactation

Fat supplements for ruminants have been investigated widely, but in recent years many trials have focused their attention on mid-lactation cows, and it was assumed that fat has little benefit in early lactation (Grummer 1992). The majority of trials were done under controlled feeding with corn-based total mixed rations.

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From earlier trials at Michigan State University with Adam Lock, Berg+Schmidt elaborated recommendations for the optimum dosage of BergaFat for high yielding dairy cows in mid-lactation. Knowledge about early lactation, however, is still scarce. In order to evaluate the optimum dosage under different production systems and to initiate a new series of early lactation trials, AddVise and Berg+Schmidt, together with their partner Dairy Link, conducted a trial on a Chilean dairy farm.

The Chilean milk production system is based on grazing with high concentrate input. As cows usually graze the whole day, concentrate is fed twice daily during milking.

To ensure sufficient energy uptake, the amount of concentrate is relatively high. The use of rumen bypass fat high in palmitic acid (C16) like BergaFat F 100 is a common strategy for increasing the energy density of the diet without compromising ruminal fermentation.

Furthermore, the heat increment of fat digestion is lower than the heat increment of carbohydrate digestion, relieving animals under heat stress situations during the summer. Thus, rumen bypass fat has a double benefit for Chilean milk producers, as it delivers rumen-protected energy and also reduces heat production in the digestive tract.

The challenges with fresh (<day 24 in milk) and early lactation (>day 24 in milk) cows are high metabolic demands and low feed intake, resulting in a negative energy balance (NRC, 2001).

One approach is to increase energy density of the diet by adding fat supplements. However, in fresh cows high lipid loads can reduce feed intake and increase the risk of metabolic disorders. Therefore, both the timing and the dosage of fat supplements are critical.

Therefore, the focus of the present study was to evaluate the optimum dosage of C16 rich fat supplements for early and mid-lactation cows.

Materials and methods

The trial was carried out at a commercial farm in the Los Lagos region during autumn, from April 15th 2017 to June 5th 2017. In total 72 multiparous cows, 36 in early lactation (14-32 days in milk) and 36 in mid-lactation (148 to 184 days in milk), were randomly assigned to four treatment groups.

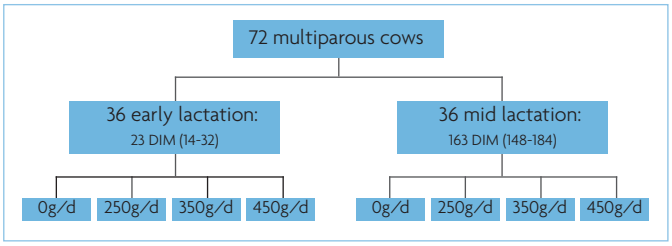

Fig. 1. Dosage scheme of BergaFat F-100.

The treatment groups were 0, 250, 350 and 450g of BergaFat F-100 per cow per day (Fig. 1). The trial lasted seven weeks, with the first week as an adaptation period. Concentrate was fed individually at the milking parlour twice daily during milking.

To ensure intake of the supplement for each individual cow, the fat supplement was top dressed on the concentrate. Milk yield was monitored continuously and milk samples were analysed every two weeks for fat and protein.

The typical composition of BergaFat F-100 is given in Table 1.

Fatty acid	(%)
Palmitic acid (C16)	85.5
Stearic acid (C18)	3.7
Oleic acid (C18:1)	6.9
Linoleic acid (C18:2)	1.2
Total saturated	91.9
Total unsaturated	8.1

Table 1. Fatty acids profile of BergaFat F-100.

Results and discussion

The results show that early and mid-lactation cows react differently to supplemental fat.

In early lactation cows, milk yield and milk fat increased with the addition of fat to the diet. The best results were obtained at the lowest dosage (250g/animal/day). Cows in mid-lactation, by contrast, had the highest milk and fat yield with the highest dosage of BergaFat (450g/animal/day) (Table 2, Fig. 2).

For milk protein the results were similar, although the increase was lower than for fat. This is due to the fact that fat yield was driven by

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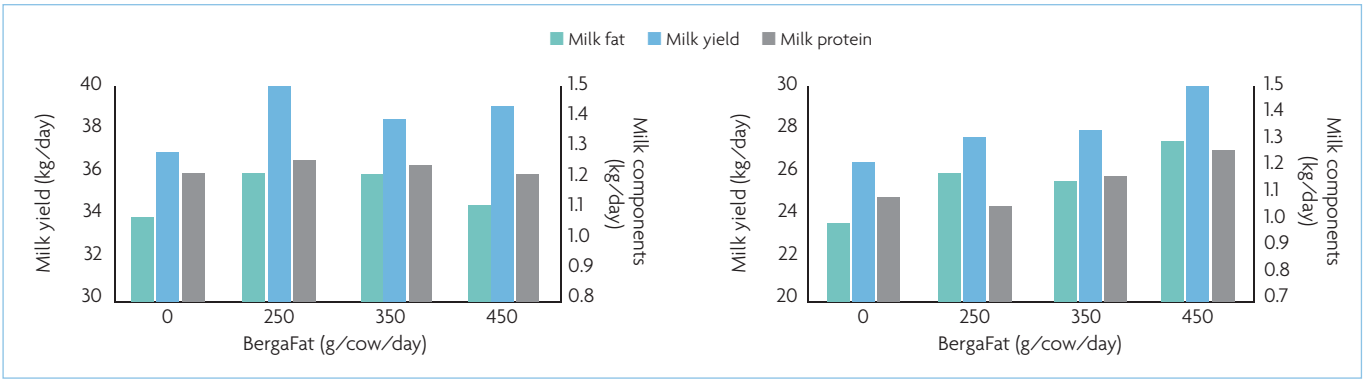
Fig. 2. Effects of BergaFat F-100 on milk yield, fat and protein yield.



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increased fat percentage and increased milk yield, whilst protein yield was only driven by increased milk yield (Table 2).

The results of the present study are well in line with results shown in literature (deSouza and Lock 2018, 2019). For early lactation cows deSouza and Lock (2019) found an increase of milk yield of about 3.6kg per animal per day with a dosage of 460g fat per animal per day. The higher dosage of this trial reflects the higher milk yield and the more intensive production (corn silage TMR vs. pasture) compared to the present trial. For mid-lactation cows, deSouza and Lock (2018) found similar increases of milk and fat yield at a dosage of 450g per animal per day.

Although it seems to be beyond dispute that supplementing fat makes sense for mid-lactation cows, there is still a lot of discussion about the timing of palmitic acid supplementation in early lactation.

One challenge of feeding fat is that it can affect feed intake (Kuhla et al. 2016), as feed intake (especially in early lactation) is controlled by mechanisms related to 'fuel oxidation' in the liver (Allen and Piantoni 2013). These conclusions are in line with earlier literature (Grummer 1992).

However, deSouza and Lock (2019) showed that the critical period is not the entire early lactation period, but rather the fresh period (<24 days in milk). They showed that the effects of supplemental fat on milk yield were only marginal in this period, but body weight losses were increased.

Indeed, from their results it can be concluded that energy status as well as milk yield and fat yield were improved when C16 was supplemented from 25 days in milk onwards. Therefore, it makes sense to start feeding rumen bypass fat as early as 3-4 weeks after calving, as shown in the present study.

	Early lactation				Mid lactation			
Dosage (g/cow/day)	0	250	350	450	0	250	350	450
Milk yield (kg/day)	36.8	39.4 **(+2.6kg)**	38.3	38.6	26.6	27.8	28.2	30.6 **(+4.0kg)**
FCM 4% (kg/day)	30.7	34.1 **(+3.4kg)**	33.7	32.5	24.0	26.6	26.3	28.4 **(+4.4kg)**
Fat (%)	2.90	3.10	3.20	2.95	3.36	3.71	3.55	3.51
Protein (%)	3.28	3.16	3.24	3.19	3.54	3.51	3.48	3.55
Fat (kg/day)	1.07	1.22 **(+150g)**	1.23	1.14	0.89	1.03	1.00	1.07 **(+180g)**
Protein (kg/day)	1.21	1.25 **(+40g)**	1.24	1.23	0.94	0.98	0.98	1.09 **(+150g)**

Table 2. Effect of BergaFat on dairy cow performance in early and mid lactations (improvement shown in bold).

Conclusion

The results clearly show that C16-rich fractionated fat is a valuable feed additive in pasture-based milk production systems for early as well as mid-lactation cows. It can also be concluded that the optimum dosage of fractionated fats depends on the stage of lactation.

In early lactation, when energy is scarce due to increasing energy output with milk and limited feed intake capacity, a low dosage is the optimum to improve the performance of dairy cows and to avoid compromising feed intake regulation.

In later lactation, when milk yield starts to decline and body energy reserves are fully replenished, the dosage can be increased. ■

References are available from the authors on request

Benefits of BergaFat F-100

- Low to moderate dosage (250g per animal per day) in early lactation (starting in week four) to increase the energy density of the diet and to provide energy and fat for efficient milk production.
- Moderate to high dosage (up to 450g per animal per day) in mid-lactation to provide energy and fat for efficient milk production, and for shifting energy towards milk production.

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