Impact of grass-feeding at different altitudes and oilseeds on fatty acid composition of milk

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The impact on the fatty acid (FA) composition of milk fat of traditional summer grass-feeding in the Lowlands (600-650 m), Mountains (900-1210 m) and Highlands (1275-2120 m) as well as a typical winter fodder composed of 15 kg beet supplemented with 1.0-1.4 kg rape-, lin- or sunflower seed was compared. Up to 70 FA were quantified using a high-resolution gas chromatographic method.

Results and discussion: The quantities of the nutritionally most important groups of FA in milk fat from cows fed the different diets are shown in Figure 1. Details on feeding (A-I) are given in the legend. For grass-feeding at different altitudes (A-C), the sum of the amount of saturated FA C12, C14 and C16 decreased from Lowlands to Highlands from 35.8 to 30.9 g 100 g^{-1} fat (-13.6%). The basal diet with hay, beet and protein concentrate (D) yielded milk fat with the highest amounts of the saturated FA C12, C14 and C16 which are associated with coronary disease (47.6g 100 g^{-1} fat). Supplementation with 1.4 kg of sunflower seed (I) decreased the amount of this type of FA by 30.6%. In comparison with the typical winter feeding (D) grass-feeding had as expected a positive effect on mono-unsaturated fatty acids (MUFA) content. However, between Lowlands (A) and Highlands (C) a significant increase by 15.9% was also observed. In the winter, supplementation of the basal diet (D) with oilseeds (E-I) was even more effective on MUFA. A supplement of 1.4 kg of sunflower seed (I) increased the amount of MUFA by 60.0% to 28.7 g 100 g^{-1} fat. Higher MUFA contents in milk fat contribute to a more balanced uptake of FA. Due to bio-hydrogenation of PUFA in the rumen by specific bacteria the content of poly-unsaturated fatty acids (PUFA) in milk fat is rather low. Surprisingly grass-feeding in the Mountains (B) and the Highlands (C) increased the amount of PUFA by 28.6% and 64.3%, respectively. The observed effects correlated with the botanical composition of the grass. Supplementation with 1.4 kg sunflower- (H) or linseed (I), be rich in PUFA, had a similar effect and compared to the basal winter diet (D), increased the amount of PUFA by 50.0% and 60.0%, respectively. The ratio of ω-6 and ω-3 FA in milk fat from cows fed grass in the Highlands (C) or a basal winter diet supplemented with 1.4 kg of linseed (H) rich in α-linolenic acid (C18:3, ω-3) was optimal (1.1:1 and 1.2:1, respectively). In contrast to linseed, an equivalent supplement with sunflower seed (I), rich in linoleic acid (C18:2, ω-6), increased the ratio to 4.1:1. In spite of the distinct influence of the oilseeds the ratio of ω-6 and ω-3 FA remained very

favourable for all types of diet. In recent years much attention has been directed to conjugated linoleic acids (CLA), a mixture of positional and geometrical isomers of linoleic acid, which are associated with several beneficial health properties. In milk in the Highlands (C) a total CLA content up to 2.87 g 100 g^{-1} fat was detected (average: 2.4 g 100 g^{-1} fat). A supplement of 1.4 kg sunflower seed (I) had a similar effect and resulted in a total CLA content of 1.8 g 100 g^{-1} fat.

Conclusions: Summer milk fat from cows grazing in the Mountains and the Highlands had a nutritionally more favourable fatty acid composition than that from the Lowlands because of different botanical composition of the fodder. Similar improvements were obtained in the winter season by supplementation of a basal diet composed of hay and beet with sunflower- and linseed.

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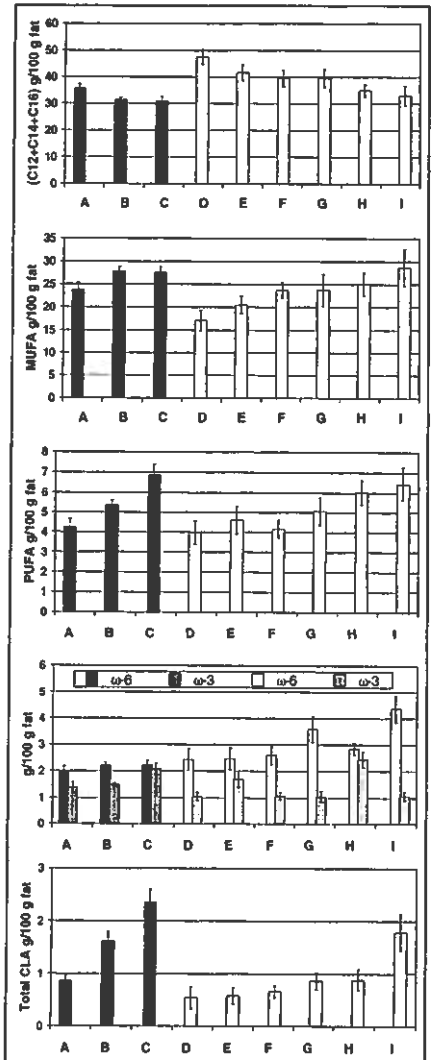

Legend:
A: Grass-feeding in Lowlands (600-650 m): cows mainly fed in the stable with grass and addition of cereals; (n=11)
B: Grass-feeding in Mountains (900-1210 m): Only pasture; (n=12)
C: Grass-feeding in Highlands (1275-2120m): Only pasture; (n=21)
D: Hay *ad libitum*, 15 kg fodder beet, cereals, protein; (n=33)
E: Diet D supplemented with 1.0 kg linseed; (n=11)
F: Diet D supplemented with 1.0 kg rape seed; (n=11)
G: Diet D supplemented with 1.0 kg sunflower seed; (n=11)
H: Diet D supplemented with 1.4 kg linseed; (n=11)
I: Diet D supplemented with 1.4 kg sunflower seed; (n=11)

Figure 1: Impact of different diets on the most important groups of FA in milk fat.