Cows fed vitamin-rich feed produce vitamin-rich milk

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On five organic dairy farms there was a positive effect of a high vitamin content in the home-grown roughage on the vitamin content of the milk produced.

Vitamins and minerals are of crucial importance for the health and performance of the animals, and they also affect the nutritional value of the products. The highest concentrations of pro-vitamin A (in the form of beta-carotene) and vitamin E (alfa-tocopherol) are found in grass, legumes and other green plants, while seeds and whole-crop silage only contain small amounts of vitamins. While the requirements for for fat-soluble vitamins of grazing cattle are normally met via their intake from pasture, the supply of fat-soluble vitamins may decrease to very low amounts when conserved herbage is used instead of pasture.

The DARCOF III project EcoVit involved five private organic dairy farms. On these farms the two most important types of roughage were monitored from harvest in 2007 and until the roughage was fed to cattle. Seven times during this period (every six weeks) a sample was collected from each of the two types of roughage and from the milk tank, and analysed for the concentrations of pro-vitamin A (in the form of beta-carotene) and vitamin E (alfa-tocopherol). At the same time the feed intake per cow per day was registered at herd level, including the supplement from a vitamin mixture, if any. This registration enabled cow total daily intake of vitamins from feed and supplements to be calculated. The two most important types of roughage in which the vitamin content was analysed constituted 90-100% of the roughage fed to cattle. For the remaining part of the roughage and the concentrated feed, table values were used for the vitamin content. The vitamin content in the vitamin mixture was assumed to be the guaranteed amount.

We found a positive effect of a high vitamin content in the home-grown roughage, and thus ration, on the vitamin content in the produced milk. This article focuses on the vitamin E supply from roughage and its concentration in milk on two of the case study farm – the farms with respectively the highest and the lowest concentration of vitamin E in roughage and milk.

Vitamin content in silage

Table 1 shows the composition of the crops included in the different types of silage registered at field level before harvest. The vitamin E content in roughage was analysed in a sample taken from the silo just after it had been filled and 3-4 times during the period when the silage was fed to cattle, here shown as the average. In the grass-clover silage the average vitamin E content was 30 mg per kg dry matter (DM) during the feeding period, which was the same as the average content of the freshly harvested silage in the silo. The potential loss of vitamin E from the fresh crop during the drying period was not measured in this investigation. On farm 206 the vitamin E content in the grass-clover silage was 22 mg/kg DM and 34 mg/kg DM on farm 609.

The vitamin E content in grass-clover silage on these farms was lower compared with results from Jensen (2003), who found 62 mg vitamin E/kg DM in grass-clover silage with a variation from 10 to 150. This large variation in vitamin contents in roughage is related to factors such as type of crops grown, stage of plant development at harvest, quality of the silage production and duration of storage. A high vitamin content is related to factors such as a high proportion of leaves in the crops, high digestibility, good weather conditions at harvest, good and fast conservation and good storage facility. Another part of the present project deals with quantifying the effect of the silage-making process on the vitamin content in the roughage under controlled experimental conditions.

The average vitamin E content in whole-crop silage during the feeding period was 28 mg/kg DM (Table 1). This was only 55% of the vitamin E level found in the fresh silage just harvested. On farm 206 the average vitamin E content in barley whole-crop silage during the feeding period was 16 mg/kg DM compared with 39 mg/kg DM in a mixture of pea and barley whole crop on farm 609.

These results for vitamin E in whole crop silage is higher than results found by Jensen (2003), where conventional grown barley whole crop had an average content of 17 mg /kg DM with a variation ranging from 10 to 35. A higher content of grass-clover in the organic whole-crop silage may be an explanation.

Figure 1 shows the daily supply of vitamin E for a lactation cow, partitioned into home-grown roughage with vitamin analysis, other types of roughage without analysis, and vitamin supply from concentrated feed and vitamin mixture. The results are based on three registrations during the winter period and two registrations during the summer period. On farm 206 the average daily vitamin E supply from feed was 380 mg, 73% of this was from roughage. On top of that 300 mg vitamin E was supplemented from a vitamin mixture. On farm 609 similar results showed 510 mg vitamin E from feed, 86% of this from roughage, plus 365 mg from a vitamin supplement. In total, the supply was 680 mg and 875 mg vitamin E per cow per day on the two farms, respectively. During the summer period the corresponding results were 2251 and 1267 mg vitamin E per cow per day on farms 206 and 609, respectively. On farm 609 they gave no extra vitamin supplement during the summer period. On both farms the total vitamin E supply correspond to the Danish requirement, which recommends a daily intake for a cow of 400-800 mg.

The concentration of vitamins in silage affects the concentration of vitamins in the milk

Figure 2 shows the total vitamin E supply from the feed ration and the concentration of vitamin E in milk. On farm 206 the average concentration of vitamin E in milk was 0.51 μg/ml during the winter period and 0.76 μg/ml during the summer period. On farm 609 the vitamin E concentration in milk was 1.11 and 1.07 μg/ml during winter and summer, respectively. The level of vitamin E in milk on the three other farms fell between these extremes.

For both vitamin E and A there was a positive correlation between vitamin content in the feed and in the milk.

References

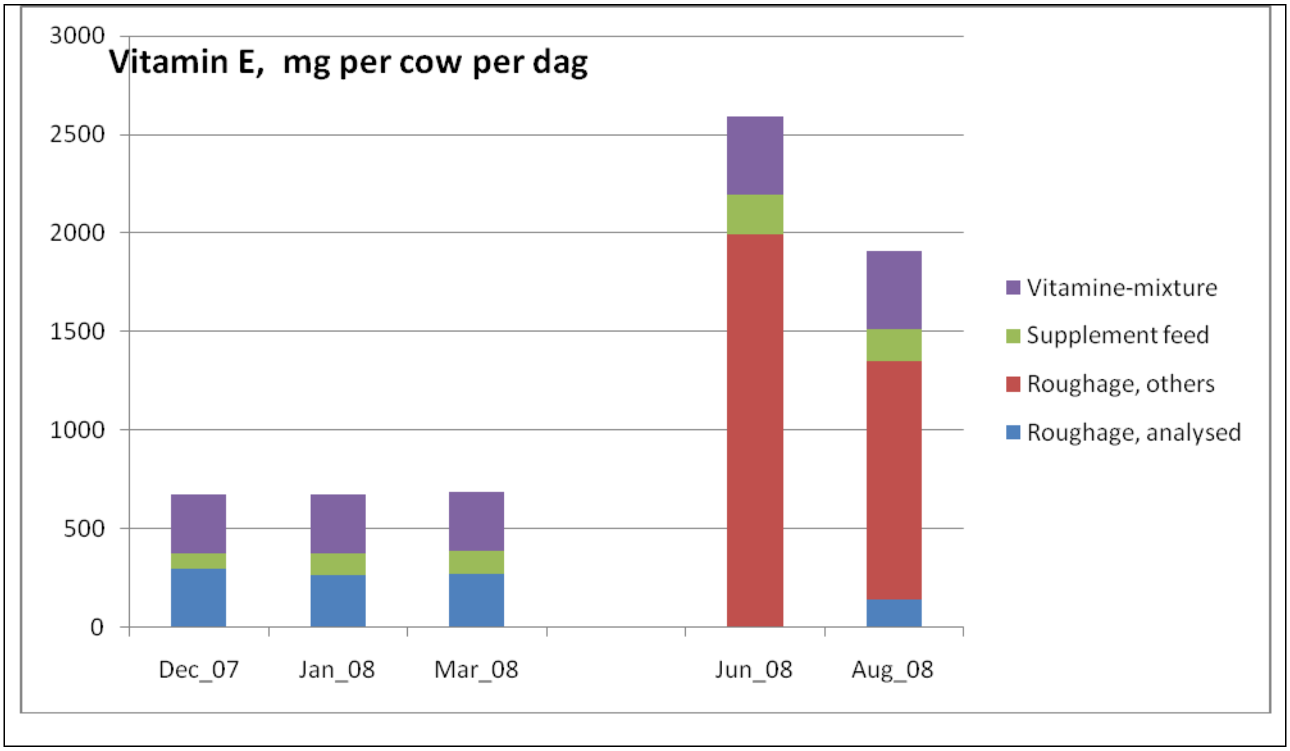
Jensen, S.K. 2003. Absorption og omsætning af vitaminer. In: Kvægets ernæring og fysiologi. Bind 1 – Næringsstofomsætning og fodervurdering. Hvelplund, T. & Nørgaard, P. (Eds.) DJF rapport, Husdyrbrug no 53. S. 375-388.

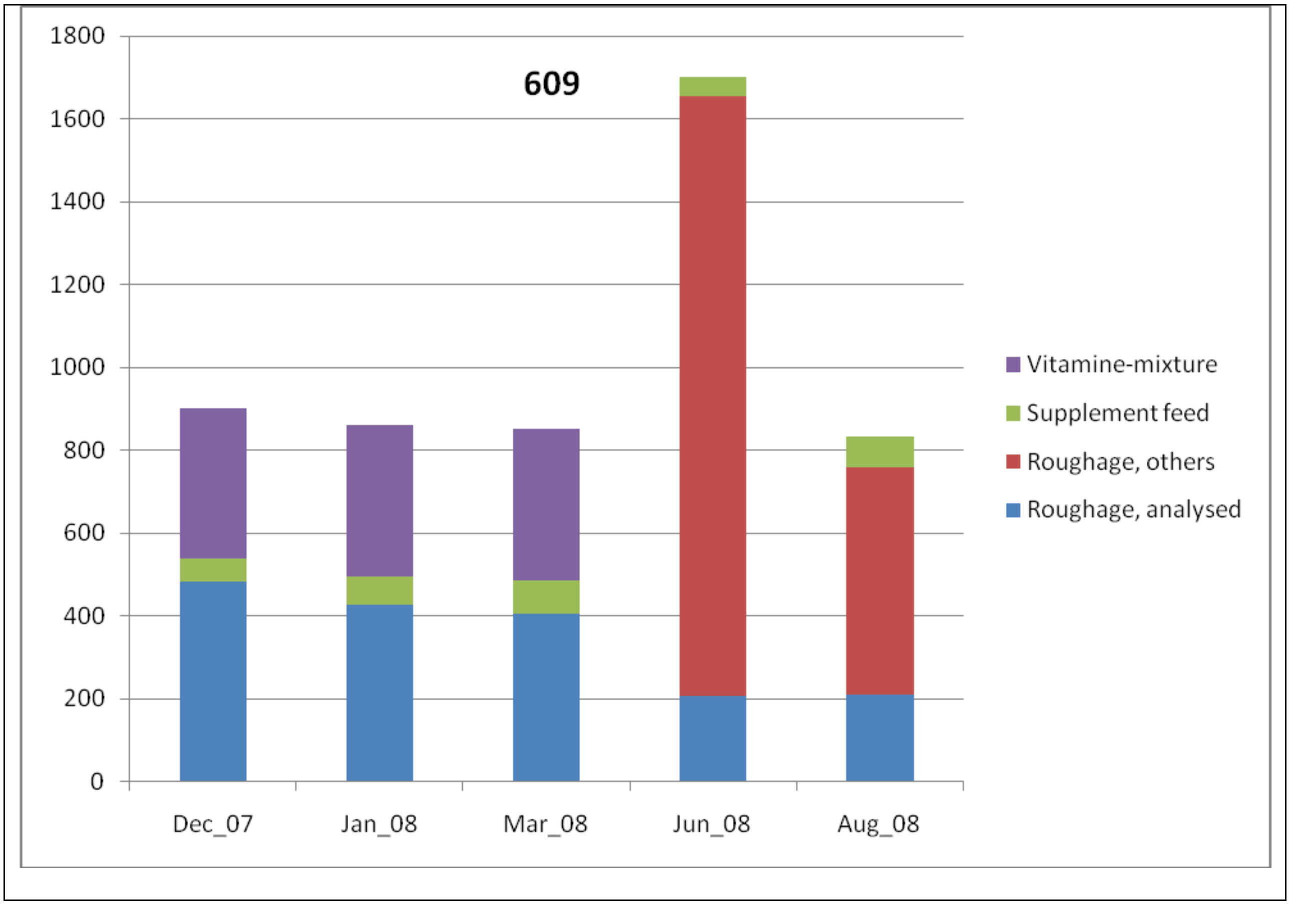
Table 1. Composition of silage and content of vitamin E, mg/kg DM

Farm no	**206**	**609**	**Average for 5 farms**
Grass-clover silage			
Composition of the silage			
- Grass, %	57	51	56
- White clover, %	25	40	28
- Red clover,%	15	6	12
- Herbs, %	2	4	3
Vitamin E, mg/kg DM silage:			
- Just after harvest	23	33	32
- Average for the feeding period	22	34	30
Average time at storage, days	288	353	281
Whole crop silage, type	**Barley**	**Barley/pea**	**Average for 3 farms**
Composition of the silage			
- Cereals, %	74	40	53
- Legumes, %	0	26	15
- Weeds, %	22	33	30
Vitamin E, mg/kg DM silage:			
- Just after harvest	28	72	51
- Average for the feeding period	16	39	28
Average time at storage, days	181	265	210

Figure 1. Daily supply of vitamin E for a lactating cow during the winter 2007/08 for farms 206 and 609

~~Figure 2. Vitamin E from feed (mg/cow/day) and vitamin E in milk (μg/ml milk) for farms 206 and 609~~


Vitamin E, mg per cow per dag
3000
2500
2000
1500
1000
500
0
Dec_07
Jan_08
Mar_08
Jun_08
Aug_08
Vitamine-mixture
Supplement feed
Roughage, others
Roughage, analysed



1800
1600
1400
1200
1000
800
600
400
200
0
609
Dec_07
Jan_08
Mar_08
Jun_08
Aug_08
Vitamine-mixture
Supplement feed
Roughage, others
Roughage, analysed