

Milk from hay-fed cows is suitable for high-quality cheese

Hay-cheese needs neither addition of nitrate nor mechanical pretreatment of the milk due to high microbial standard. Yet, hay does not affect the fatty acid composition of the milk, and herbs in the hay do not influence the content of plant derived aroma compounds.

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This study of hay-cheese has been completed as a part of the EcoServe project. Hard cheeses were produced of milk from cows fed with hay that contained variable amounts of Danish herbs. In conclusion we found no differences in the content of plant derived aroma compounds in the cheeses. There were, however, some indirect differences in the microbial composition of the cheeses. Thus, in contrast to cheese made out of milk from silage-fed cows, high quality cheese can be made of hay-milk with no addition of nitrate to inhibit unwanted bacteria growth in the ripened cheese.

The aim of EcoServe

The overall aim of the EcoServe project was to increase the biodiversity in the grasslands and hence improve the living conditions of pollinating insects. Three different multispecies grass-clover fields with different Danish herbs were established in the southern part of Jutland and were used for hay production (table 1).

The different aspects of the EcoServe project have been covered in earlier ICROFS publications (1, 2). The cheeses were produced at Naturmælk, an organic dairy in Tinglev, and the analysis of the cheese was done at the Department of Food Science, Faculty of Science, University of Copenhagen.

Feed and cheese quality

Cheese quality depends on a number of factors of which the cow feed is of utmost importance. Studies from the southern part of Europe have shown that cheese made of milk from cows grazing on highland pastures can be distinguished from cheese made of milk from cows grazing on lowland pastures. The most likely explanation to this is that herbs from the mountain pastures contain a variety of different aroma active compounds, which can be absorbed directly in the milk and potentially affect the smell and taste of the cheese. The content of herbs in the feed can also affect the fatty acid composition of the milk and e.g. lead to higher content of n-3 and n-6 fatty acids (3).

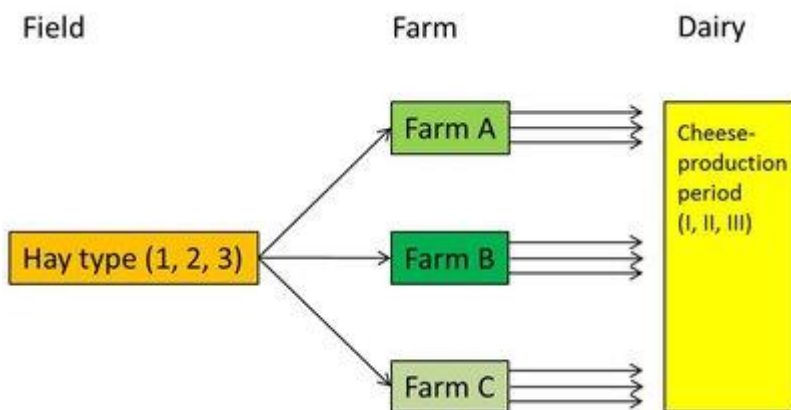


Figure 1:

Schematic overview of the cheese production done in the project. Three types (feed 1,2, 3) were feed to three dairy farms (A, B, C). Cheeses were made during three production periods (I, II, III) in duplicate from all combinations of dairy farm and feed type)

The cheese production

In the present study, cows on three dairy farms (A, B and C) were feed with three different types of hay (1, 2, and 3) produced on multispecies grass-clover fields. Farm A and B had Holstein Frisian and farm C had Jersey cows. Hard cheese was made in duplicate with milk from all combinations of dairy farms and hay types, resulting in 18 experimental cheese vats (figure 1). Control cheeses were made from bulk-milk from cows primarily feed with silage. The cheeses were made in 800 liters cheese-vats (figure 2), using a traditional cheese starter and the cheese was ripened for one year before analyzing the content of aroma compounds.

The microbial composition of the cheeses was investigated along with the water content and pH and composition of fatty acids was determined in the milk samples. The milk used for the control cheeses were mechanically treated in order to remove detrimental *Clostridium* spores, which potentially can spoil the cheeses. Milk from hay-feed cows contains a very low number of these spores, and no pre-treatment was necessary.

Hay-milk has high quality

Fatty acid composition of the milk differed from farm to farm, whereas the feed type did not affect the composition of fatty acid. The dairy farm with Jersey cows (dairy farm C) had higher content of palmitic acid and long chain fatty acid (LCFA, C14:0-24:0)), and contained less C18:1 and monounsaturated fatty acids (figure 3).

The content of aroma compounds was dominated by compounds from microbial activities on the main constituents in milk; fat, protein, lactose and citrate. Only a few aroma compounds deriving from the feed were found, and there was no difference between the cheeses. The control cheeses contained significantly higher content of a specific "house-flora" bacteria species, and the aroma compounds coming from these bacteria made it possible to distinguish between control cheeses and experimental cheeses. A loss of leaf-

material was observed during the drying of the hay, and this could help to explain why the higher amounts of herbs did not lead to higher amounts of plant aroma compounds in the cheeses.

In conclusion, high quality cheese can be produced out of milk from hay-feed dairy cows with no addition of nitrate and no mechanical treatment of the milk to inhibit/remove bacterial spores from the milk. Further studies with alternative feed-types, such as silage with herbs where there is less loss of leaf material could potentially result in a higher transfer of plant aroma compounds to the cheese.

Main conclusions from the cheese making project

- High quality cheese can be made from hay-milk
- Hay-cheese can be made without addition of nitrate and mechanical pretreatment of the milk
- The different hay-types did not lead to any differences in the content of plant derived aroma compounds
- No effect of the feed types on the fatty acid composition
- The control cheese had a different microbial profile compared to the hay-cheeses

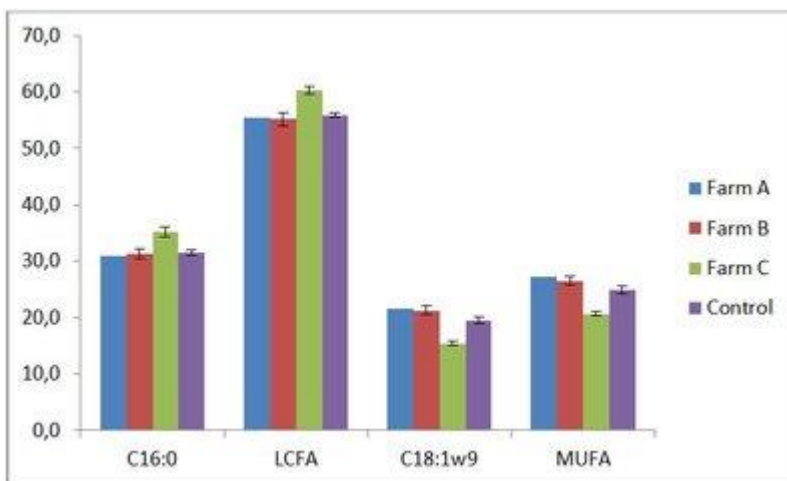


Figure 2:

Content of selected fatty acids/groups in milk coming from the three dairy farms involved in the project. The values are mean of three milk samples analysis from the dairy farms where the cows have been fed three different hay types. LCFA (long chain fatty acids, C14:0-24:0) and MUFA (sum of mono unsaturated fatty acids). Control milk was only analysed once.

Table 1. Composition of plants in the three hay-types used, all the mixtures contained ryegrass and white clover.

Hay type	Plant species composition
1	Ryegrass and white clover.
2	Red clover, chicory and ribwort plantain
3	Lucern, birdsfoot trefoil, melilot, caraway, yarrow and salad burnet

