Using mobile milking robots for special quality dairy products based on site-specific grazing

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Abstract

An option for combining grazing and automatic milking is Infield Automatic Milking, with more or less mobile infield automatic milking systems (IAMS), which have been practiced since 2008 in several European countries. This emerging technology can be used to harvest milk from specific areas, giving specialized dairies the possibility to market concept milk, cheese or butter. Terroir dairy can be a new way to increase marginal product value and thereby farm income. Three different options are described: i) the IAMS placed on a stationary platform in the field, ii) movable together with facilities necessary for the functionality from field to field, and iii) as a self-propelled moving unit that changes positions in the field every day, requiring transportation of the milk to the field border. All systems could guarantee dairy products that are based on maximum grazing for the period that the pasture can provide sufficient feeding. Batch size depends on the dairies minimum process volume for the specific products. Local conditions will be decisive for the number of days needed for pooling before production.

Keywords: automatic milking, mobile, infield, sward, milk quality, grazing systems

Introduction

'Site specific' can be used in the wine production industry to describe a product which has its own qualities associated with soil, altitude, angle of sun incline and other factors that can influence the quality of the grape and the corresponding wine. Parallel to this, in dairy production based on grazing, it is often claimed that milk, cheese or butter are different in consistency, taste, smell and colour, depending on the pasture (Monnet *et al*., 2000).
Dairy industries are already seeking new market share by introducing special product types; like, for example, raw-milk cheese, a cheese made of milk not homogenized and not pasteurized and no older than one day. It is claimed that the gentle handling and avoidance of heating gives a better taste. In addition, the organic milk sector is growing, and here the summer grazing is the key benchmarking factor. The dairy industry has lately been especially focused on increasing the milk quality, e.g. lower free fatty acids (FFA) and higher conjugated linoleic acid (CLA). FFA and CLA concentrations in milk are positively influenced by grass diets, especially grazed grass (Oudshoorn *et al*., 2012).
When a dairy industry wants to collect milk, based on pasture, the pasture ratio of the total feed diet has to be dominating. This can often be a problem for farmers lacking sufficient grazing fields adjacent to the barn, where they have to gather the herd for milking once or twice daily. In some countries (Denmark, the Netherlands) the expanding sizes of the herds have forced many farmers to increase the barn-feeding ration to ensure the milk yield, which in practice sometimes even means the outside time for the cows is mostly dedicated as exercise for avoiding hoof and leg problems. In other countries only remote grazing areas exist (mountains, valleys, marshes). Increasing experience and resilience of automatic milking technology has inspired initiatives in several countries to experiment with infield automatic

milking systems (IAMS). In Denmark (DK), the Netherlands (NL), and Belgium (B), different mobile automatic milking systems have been designed and tested (Figure 1).

Figure 1. Mobile Automatic Milking Systems in the field in Denmark, The Netherlands and Belgium.

The experiments were conducted in 2008-10 in Denmark, in 2008-11 in the Netherlands, and they started in 2010 and continue in Belgium. All three prototypes have in common that the automatic milking system is made mobile and therefore can be moved in the field, where the grazing is taking place.

Design and functionality

Denmark: The IAMS was designed as a semi-mobile unit which could be moved to another site. Due to the gates, fences, vacuum slurry tank, diesel generator, water hose connection, and preparation of the waiting area with wood chips, the process of moving took about 4-5 hours. Afterwards the urine and manure-soaked wood chips were removed and stored as manure, to be spread in the spring on arable land. Soil samples underneath the waiting area revealed no increased nitrate, phosphate or potassium concentrations. The IAMS, consisting of two milking units, was tested with a herd of 70 Red Danish milking cows (RDM). The total amount of concentrates in the robot amounted to between 2 and 3 kg; the amount was automatically regulated according to the milk yield average of the last 5 days. Milk yields were around 22 kg per cow in the spring, decreasing to 19 kg in autumn. Major problems were increasing somatic cell counts in the milk, mud around the smart gates and access paths, and declining milk yields in the autumn due to worsening grass quality (Oudshoorn, 2008).
The Netherlands: The IAMS was designed as a fully mobile unit, self-propelled with its own power and traction source, driving on caterpillar tracks. Later in the design process a shuttle was constructed to fetch the milk and drive supplies of diesel and fresh water to the site every 2 days. Due to the daily location shift (or sometimes more frequently), no notable soil pollution or disturbance was induced. The IAMS was tested on an experimental location (Zegveld) with 55-60 Holstein Friesian (HF) and 'Blaarkoppen' cows. Using permanent grazing with free cow traffic, forced strip grazing, and free cow traffic with strip grazing, 20.3, 19.4 and 24.9 kg of milk per cow was obtained, respectively. No extra roughage was supplied, with an average of 5.9 kg concentrates in the robot (De Haan *et al*., 2010).
Belgium: The IAMS in Belgium was designed as a satellite milking station, where the waiting area around the IAMS was hardened with perforated concrete, and drained into a flexible slurry tank. Electricity and water were connected from source, and a small concentrate silo was placed aside the unit. The unit was tested with a herd of 45 HF cows and in the robot an average of 2.15 kg of concentrate was provided. In dry periods some supplementary maize was fed in the pasture. Water was provided in the fields. The cows yielded an average of 19.6 kg milk (Dufrasne *et al*., 2012).

Results of grazing

The systems as described all had the main objective to guarantee a high ratio of pasture grass in the diet. In Denmark, both permanent grazing and high intensive rotational grazing combined with strip grazing was tested. Free cow traffic, with as little manual fetching as possible, was the goal. The rotational grazing system increased the milking frequency to slightly more than two, but also induced some stress in the herd, which can increase somatic cell count. Cows were guided along fenced paths to the IAMS, only allowing them to go back to the pasture after milking. In the Netherlands, permanent grazing was practiced, avoiding manual labour. However, the milking frequency and milk yield seemed to decrease with increasing freedom, in some cases to below two daily the first year. Introducing controlled strip grazing by moving the fence up to three times a day, with free cow traffic, increased milking frequency and milk yield. In Belgium, rotational grazing on 11 paddocks was used, and here the cows were fetched twice a day but, in between, free visits were possible.

Conclusion

Stand-alone units in separate grazing areas automatically milking the cows are possible with milk yields per cow up to 24 kg a day, and will be able to collect milk primarily based on the pasture they are situated in. However, the unit will have to be serviced with concentrates (3-5 kg per cow per day) in order to secure sufficient milking events, water for flushing the system, and electricity for driving the milking system and the cooling of the milk. Depending on the system design, 45-80 cows can be milked, collecting 900-1600 kg of milk daily. The milk yield and composition will be very much dependent on the quality of the pasture, as the concentrates only contribute a small part of the diet. The system could potentially be used by dairies that want to produce special products, associated with exactly the specific pasture composition or location. Benchmarking of the product as 'site specific' and tagging the product with information on location and habitat could justify a higher price, as compensation for the extra costs of infield automatic mobile milking systems.

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