Mobile milking robot offers new grazing concept

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Abstract

Grazing of high-producing large dairy herds is increasingly under pressure in Europe. Due to increasing farm size, fewer enterprises possess enough land around the farm buildings to offer sufficient grazing. This limits access to the numerous beneficial effects of grazing which include improved animal health, reproduction, product quality and crop rotations.

Automatic milking systems (AMS), when made mobile, give the possibility of milking cows in the field without additional labour. Modern technologies for surveillance and livestock control facilitates the management, even if miles away from the barn. During winter, mobile AMS can service animals in the barn.

A prototype mobile milking robot was built as part of an innovation research programme, with collaboration between Århus University, industry, an organic dairy farmer and an organic crop grower. The prototype was tested in a herd of 90 cows grazing 15 km from the farm buildings, in the summer of 2007. The promising results suggest that this new management system will allow grazing to take place away from the farm and allow crop farmers to include grazed clover-grass pastures in their rotation. Further documentation is necessary before marketing the concept. Cow traffic in the field, animal welfare, production potential, and grazing management are scheduled to be monitored and recorded in the season of 2008.

Keywords: dairy cows, grazing concept, mobile AMS

Introduction

Reduction of grazing for highly productive dairy cows and large herds is noticeable in severable countries like Denmark, the Netherlands and Germany (van der Poll, 2005). This gives concern amongst consumers who perceive a decline in welfare of housed animals (Somers et al., 2005) and in product quality (Anonymous, 2006). In addition, the impact of zero grazing on the system’s energy balance and economy are unsure. With rising energy prices the cut-and-carry system for feeding roughage in the barn is becoming more expensive. Automatic milking is gaining market share, not in the least because of reduction in physical labour needs and the farmer having increased flexibility. After having overcome technical difficulties, the main concern relating to Automatic Milking Systems (AMS) is grazing management (Oudshoorn et al., 2007). Grazing reduces milking frequency (Ketelaar-de Lauwere et al., 1999) and increases the time taken to fetch cows for milking. Decreased milking frequency can be due to the synchronized behaviour of the herd (Munksgaard and Søndergaard, 2004), and the preference of cows to be out on the grass.

In addition, the lack of adequate areas of pasture adjacent to the barns, due to increasing herd size, can be a problem (Oudshoorn and de Boer, 2005). These aspects were addressed in the concept for mobile robotic milking, developed in cooperation with S.A.Christensen A/S and practical farmers. The portability makes it possible to utilize allocated pasture away from the barn but still use the expensive equipment in the barn during winter. Verification and documenting the concept, by building and using the mobile milking robot on a farm, was initialized with help from innovation funding in Denmark.
Materials and methods

A technical design of a mobile unit which could milk dairy cows in the field was made in 2003 (www.automaticmilking.dk). Challenges for this design were its mobility because of the weight, and compactness, as a standard container was preferred for the frame (Figure 1). A prototype was constructed in the spring of 2007; it uses a two-unit milking robot and weighs around 12 tonnes. It was placed in a 30 ha pasture, besides a dirt road, to service a herd of 90 mostly RDM cows. The water supply was provided by pipe, and the electricity supply for milking and milk refrigeration by generator. The unit was placed in the pasture at the beginning of June 2007. The herd had not previously been milked automatically. An automatic gate system regulated the movement of cows from one paddock to the next. To start training the herd to automatic milking, the grazing system was made as simple as possible; a regulated permanent grazing system, with two pastures. The admittance to respective pastures by separation gate was controlled by a timer and central processor (CP), which identified cows entering the robotic unit. The CP only allowed cows out to new pasture if they were not due to be milked within one hour.

Results and discussion

The adaptation to robotic milking proceeded satisfactorily. After 1 week, 90% of the cows could be milked automatically and after 4 weeks 90% of the herd entered the milking units by themselves. However, the number of cows being milked at least twice a day, without human interference, fluctuated greatly. During the ‘learning’ process, adjustments were made to the
catching dock, due in part to soil damage at gateways as a result of the high rainfall frequency during summer and the lack of farm management experience with in-field milking. This frustrated the cows, as they are very much slaves to routine.

Initial results from two months of practice with the AMS in the field were compared to the same months the year before, and they showed similar results in hygiene and milk quality (Table 1). The cows received 2 SFU (Scandinavian Feed Units) as concentrate per day; grazing was unlimited in both years, and was estimated to exceed 11 SFU per day. An average of 1.8 milkings per cow was recorded in July/August 2007, and cows visited the milking site individually, mostly at daytime.

Table 1. Milk quality parameters as averaged for two comparable months in 2006 (conventional milking system) and 2007 (automatic milking system).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Jul/Aug 2006</th>
<th>sd</th>
<th>Jul/Aug 2007</th>
<th>Sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milking Cows</td>
<td>68</td>
<td>98</td>
<td>60</td>
<td>376</td>
</tr>
<tr>
<td>kg ECM/cow</td>
<td>5900</td>
<td>5200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCC (1000 per ml)</td>
<td>388</td>
<td>10</td>
<td>98</td>
<td>376</td>
</tr>
<tr>
<td>TBC (1000 per ml)</td>
<td>10</td>
<td>0.7</td>
<td>17</td>
<td>387</td>
</tr>
<tr>
<td>Fat %</td>
<td>3.89</td>
<td>0.06</td>
<td>3.89</td>
<td>0.09</td>
</tr>
<tr>
<td>Protein %</td>
<td>3.3</td>
<td>0.07</td>
<td>3.3</td>
<td>0.05</td>
</tr>
<tr>
<td>Urea (Mmol L⁻¹)</td>
<td>6.7</td>
<td>0.7</td>
<td>5.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Spores of anaerobes L⁻¹</td>
<td>145</td>
<td>271</td>
<td>55</td>
<td>45</td>
</tr>
</tbody>
</table>

1ECM: Energy Corrected Milk, 2Somatic Cell Count, 3Total Bacteria Count *One outlier causes high value.

Conclusions

The successful start of the mobile in-field milking system will be followed up by extensive registration of data in the grazing seasons of 2008 and 2009. Technical design and functioning of the AMS was capable of delivering good results in an outside environment. Around-AMS logistics and design of the catching dock around the milking robot have to be improved.

References


