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Young stock rearing using automatically recorded data

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Abstract

The subject 'young stock rearing' is important for future dairy farming. So far there has been too little attention for young stock rearing. Proper care by monitoring health and growth of the young animals will lengthen life expectancy and increase milk production of the adult dairy cow. Due to the increasing farm sizes it becomes harder for the farmer to pay sufficient attention to all individual animals. Facilities like automatic milk feeders and water drinkers combined with weighing systems are used to gather information about the status of all individuals. The information consists of daily milk and water intake, body weight and other behavioural data. Models are developed to detect deviations in the normal pattern of this information. Only these anomalies are reported with instructions for standardized actions to be undertaken, the standard operating procedures. This paper provides the background for the alerts for health problems and for lagging growth in young stock till the age of 4 months.

Keywords: young stock, data collection, milk intake, body weight, detection model

1 Introduction

In 2012 started in the Netherlands the project 'Smart Dairy Farming (SDF)', in which companies in the dairy chain cooperate in the development of sensor technology and decision support models for operational on farm management and exchange of relevant information between the dairy chain partners.
Dairy farmers are supported in the care of individual animals, with the goal to provide a good health, a longer life and a longer production time of the cow. Sensors and other technological tools, decision models and advice products are developed and applied to achieve these goals. At the end this project should provide a contribution to the sustainability of the dairy chain.
The project has three focus areas, animal health, fertility and feeding. Within the focus area 'animal health' is worked on optimizing young stock-rearing as a basis for long-lived cows. In dairy farming is about 30% of the dairy herd annually replaced. Lowering the replacement rate has a significant positive impact on the financial result. Less replacement means a higher life span and thereby raise living production per cow. A proper course of development during the rearing turns out to have a positive effect on milk production (Soberon et al., 2012).

Calves weigh at birth 35-45 kg. There are several possible strategies to achieve desired development of calf to heifer. The weight of the heifer after calving should be between 510 and 550 kg. To achieve this bodyweight in a two-year-old heifer a certain growth course is desired. It is important that the animal is fed the right nutrition at the right time and that health problems can be prevented. The rearing period can be divided in a number of phases. The first three days after birth is called the colostrum period. Colostrum contains antibodies, making the first resistance against all kinds of diseases. After the colostrum period follows the suckling period, which lasts until the age of about 2 months. For a good development adequate amounts of feed (calf milk replacer, calf grain and roughage) of the right composition

should be consumed. If the calf tweighs about 80 kg she can be weaned. This weaning period runs from about 8 weeks to 16 weeks. A smooth transition from milk to concentrate and roughage is important. In the adolescent period, from 4 to 13 months of age, the young stock needs less energy for maximum development. In the fertility period, in the age from 13 to15 months, the young stock can be inseminated in order to give birth at an age of about 24 months. In the last phase, the pregnant phase, the yearling has to develop further into a robust heifer, which is giving birth at the age of 24 months and subsequently has a trouble-free start of lactation.
This project focuses on recognizing and properly addressing the problems that have arisen in the young stock rearing. In this paper we will only address the rearing during the first 4 months of life and particularly the suckling and weaning period.
Building the ICT infrastructure for collecting real time information about milk, water intake and body weight gathered in these periods and the development of decision support tools will be discussed. The main objectives for this young stock rearing project are realizing state of the art tools that support the farmer to optimize growth and development of young stock. These tools will give alerts in cases of potential health problems and lagging growth.

2 Materials and methods

In the framework of the Smart Dairy Farming project on two farms, 'Dairy Campus' and 'Bruunshoge', data are collected that are important for proper rearing of young stock. On these farms automatic milk feeders (AMF) are used for providing milk to individual calves (Figure 1).

Figure 1. Automatic milk feeder with weighing floor.


Figure 2. Station equipped with water drinker and weighing floor.

These feeders are equipped with a weighing floor. In addition, the animals can drink water in stations also equipped with a weighing floor (Figure 2). Each visit to AMF or water drinking station produces the following information: animal ID, date and time, milk or water intake, duration of visit and bodyweight. This information is automatically stored in an external database and made available via an info broker (Figure 3).

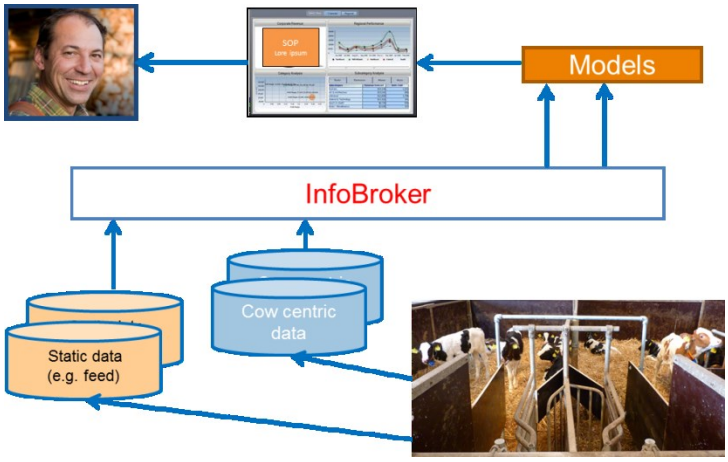

Figure 3. Schematic information architecture.

Firstly, the information in the database is used to develop software to generate alerts when anomalies in the data streams of an individual animal are present. In a later stage, this software will run at scheduled times each day. In an internet application the farmer has access to the output of the models through a dashboard. In the dashboard the output is translated into practical management advices.

3 Results and discussion

3.1 Collected data

Examples of daily collected data will be given to provide an overview of the information that is available from each individual calf. Figure 4 gives the average daily bodyweight of a calf from birth till the age of about 100 days.

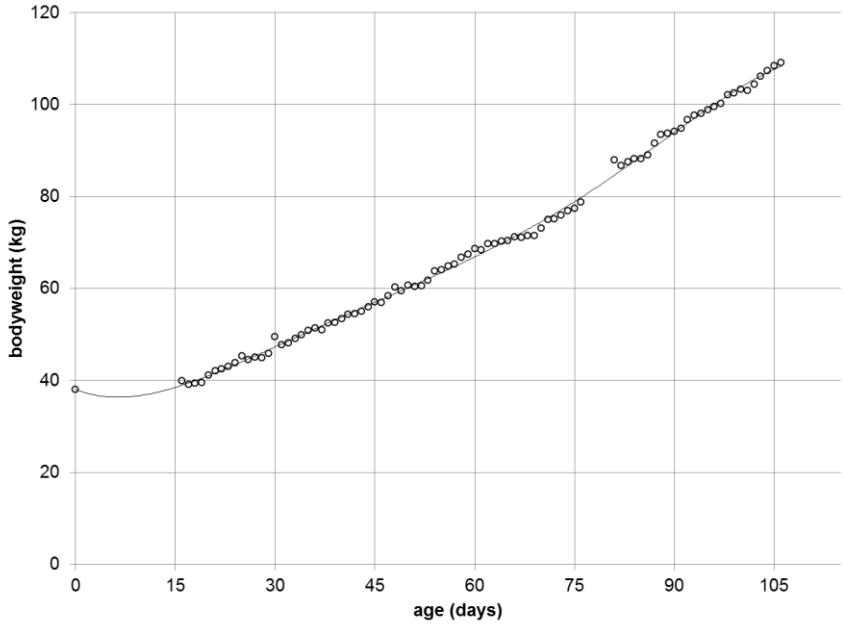

Figure 4. Bodyweights of calf 4284 during first 100 days.

The birth weight of the calf in figure 4 was 38 kg. In the first weeks, when the calves are housed individually, there is hardly any growth. After two weeks the calves are housed in groups and receive milk at the AMF. At 60 days of age the weight of this calf was 68 kg. Some deviation of the bodyweight from the trend line is clearly visible. The rough data measured with the weighing platform in the AMF or water drinker need some filtering to exclude values which deviate to much from the expected weight. Deviating values occurred when a calf was only with the front legs on the weighing platform (values too low) or when a second calf stepped with her front legs on the weighing platform (values too high). When the filtered bodyweight as shown in Figure 4 is on two consecutive days lower than the day before an alert is given for a possible health problem. For calf 4284 such a case was not found.

In Figures 5 and 6 the daily intake of milk and water respectively the daily number of visits to the AMF and water drinker are given.

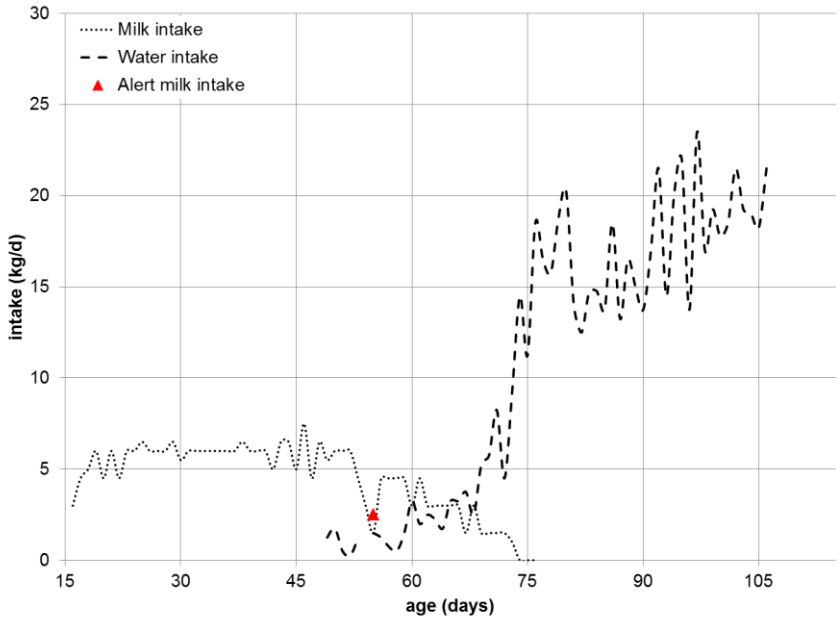

Figure 5. Daily milk and water intake of calf 4284 during first 100 days.

At the age of 16 days calf 4284 has got access to the AMF. Until the age of 75 days a fixed amount of milk according a pre-set scheme is available for the calf in the AMF. The daily amount starts with 5 litres on the first day, increases to 6 litres in 10 days, stays at 6 litres during 25 days, then decreases to 2 litres in 10 days and finally decrease to 0 litres in 5 days. The dotted line in Figure 5 shows the quantities of milk the calf has drunk daily. The profile of the drunk quantities follows reasonably well the profile of the quantities that were potentially available. Only at the age of 55 days the consumed amount was much lower than available. The detection model will then generate an alert (red triangle). At the age of 49 days we see the calf drink water for the first time. During the period the available amount of milk decreases the water intake starts increasing till the level of about 15-20 litres daily in the period the calf is weaned completely and has switched to nutrients intake from concentrates and forage.

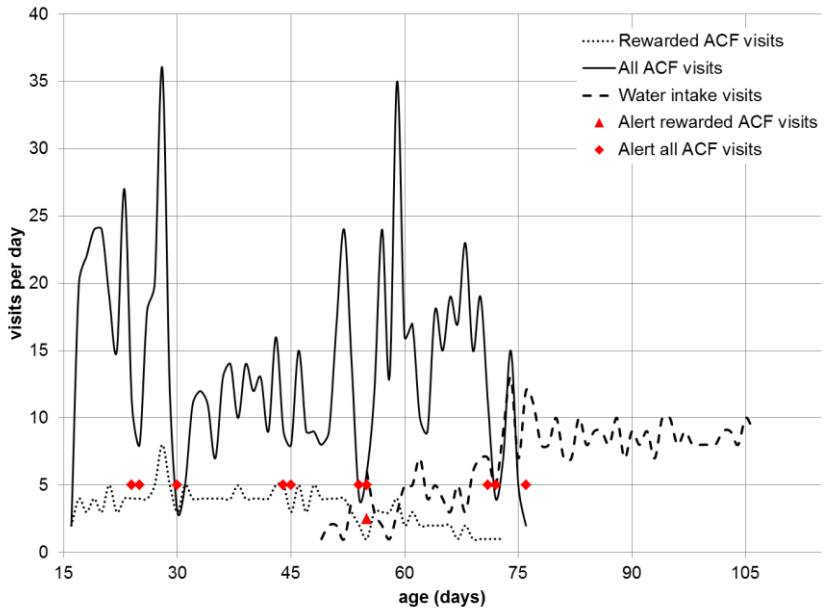

Figure 6. Daily AMF and water drinker visits of calf 4284 during first 100 days.

The milk ration is offered to the calf in meals of 1.5 kg. As shown with the dotted line in Figure 6, this means that the number of rewarded visits to the AMF will usually be at the level of 4. When the number of rewarded visits is much lower than expected an alerts is given. In this

calf an alert (red triangle in graph) based on the rewarded AMF visits was produced on day 55. In the period of decreased availability of milk, after the age of 50 days, the number of rewarded visits is also decreasing.
The total number of visits to the ACF is much higher; the calf is more times daily interested whether there is already a new meal of milk available. The total number of visits is in that respect a sign for the eagerness of the calf. Svensson & Jensen (2007) found that the total number of visits might therefore be of interest as a parameter that shows the activity of the calf. A decreasing number of visits to the ACF is detected and alerted by the model (red diamond). A remarkable phenomenon is the lower number and lower variation of daily visits to the water trough after the calf have been weaned. Obviously the AMF creates some unrest.

3.2 Alerting deviations and standard operation procedures

As explained in paragraph 3.1 possible health problems are alerted if the consumed amounts of milk are considerably less than the available amounts (one case in Figure 5), the visiting behaviour to the AMF shows a reduced activity (more cases in Figure 6) and/or the bodyweight on two consecutive days is lower than the day before (no cases detected in Figure 4). If one or more of these parameters produce an attention than the farmer is advised to check and possibly to treat the animal. In severe cases, the veterinarian should be consulted. The message the farmer gets on the dashboard is 'Health problem calf 4284'. The underlying instruction is 'Check health status of calf, make diagnosis and possibly carry out an action'. On request the farmer can be informed about the reason(s) the message is generated.

An important parameter for the development of young stock is the growth rate in the different phases of the rearing period. Soberon et al. (2012) concluded that nutrition and management of the pre-weaned calf are the major environmental factors influencing the expression of the genetic capacity of the animal for milk yield; increased growth rate before weaning had positive effects on future lactation milk yield. We compared the growth rate of the calves from birth till 60 days of age on the two test farms (Table 1).

Table 1. Growth rate of calves from birth till 60 days of age on two test farms.

Test farm	Number of calves	Weight at birth (kg)	Weight at 60 days of age (kg)	Growth rate ($g.d^{-1}$)
Dairy Campus	51	41.2	77.8	610
Bruunshoge	40	38.3	67.8	492
Desired		44.6	79.3	579

Table 1 shows that there is a rather large difference in the growth of the calves between the two test farms. The results of the calves on farm 'Dairy Campus' correspond rather well with the desired normative values; on farm 'Bruunshoge' the figures were lower. The differences were probably caused by a lower amount of milk that was fed to the calves on farm 'Bruunshoge'. For this reason we developed an alert that warns the farmer when the development of a certain calf is lagging behind in comparison with the normative (desired) growth. When at an age of 42 days the weight and growth of a calf is more than 15% lower than desired the message 'Adapt scheme milk ration' is given on the dashboard. The underlying instruction is 'Switch to a milk scheme in which more milk comes available for the calf'. Also for this message the farmer can ask for background information why it was generated.

4 Conclusions

The project has shown that it is feasible:
- to collect automatically various relevant data at individual animals on a farm,
- to make this data available in real time for detection models using the internet,
- to report the abnormalities also via an internet application (dashboard) to the farmer and

- to include management advices in the reports in order to solve the identified problems.

5 Acknowledgements

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