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Early Illness Detection in a Networked Calf Rearing System

The technical feasibility of an integrated networking of a computer-controlled feeding and monitoring system for calf rearing was tested. Using one calf as an example, the results of feed and water intake, activity and drinking behaviour are presented in relation to age and health status. Thereby, relationships between different parameters for detecting illness at an early stage were confirmed statistically. The aim of the investigation was to evaluate and optimize existing technological potential in terms of improved feeding and health management.

The requirements for the operating management are growing with increasing stock size. Therefore, the farm manager ought to rely on process control technology within the production process. Especially during the sensible part of calf rearing there are unfortunately losses of up to 11% annually. The reasons are lack of time for care by inadequately qualified labour and missing information about the real demands of calves concerning housing and feeding, as well as about the calves' rearing management. If rearing more than 60 calves per year, therefore – and also because of labour management – the use of computer-controlled feeding technologies is recommended. Until now, many proprietary solutions are available. Undoubtedly, there is important information within the acquired data in terms of animal behaviour and animal health, whereof decision making aids can be generated. The aim is to investigate to what extent important management information can be gathered by the use of the intelligent networking of different subsystems and in which way it can be used to improve the output and to promote further automation. Thereby, the possibility of early illness detection is of particular interest.

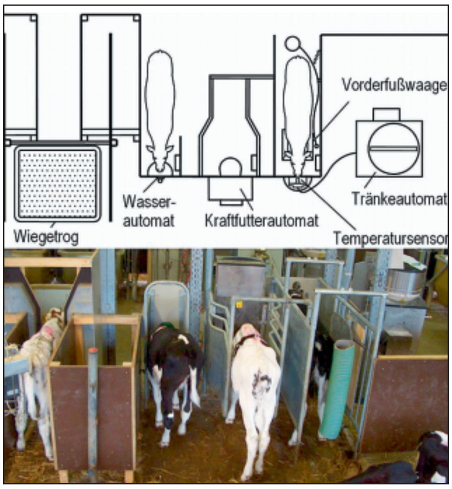

Fig. 1: Feeding technologies (from left to right): weighing trough, drinking water robot, concentrate feeding robot, milk feeding station with temperature measuring system and animal weighing system, milk feeding robot

Material and method

To test the technical feasibility of an integrated networking of all available computer-controlled systems for calf rearing, a calf shed at the experimental station Hirschau of the TU Munich was equipped each with two milk drinking and concentrate feeding robots, drinking water robots, animal weighing systems, tongue temperature measuring systems and a total of twelve roughage weighing troughs (*Fig. 1*). All systems are linked with the personal computer by different communication lines. The individual data of these systems are stored in one data base [1]. During a 33-week trial, a total of 66 animals were housed between March and November 2006 so that the automated and individual acquisition of all process parameters was realised [2].

On the basis of detailed diagnostic routines, all animals were regularly examined and their health status was documented. In collaboration with the Clinic for Ruminants of the LMU Munich, an evaluation spreadsheet was developed. For every status differing from 'no abnormality detected' like increased temperature or breathing rate, discharge or modified excremental consistency, a certain amount of points was allocated due to the kind and intensity. The higher the total illness intensity, the more conspicuously ill the animal was on that day. The daily sums result in an age specific health status diagram for each calf, whereas a calf with an illness intensity of 2 is considered still as healthy, above 7 as very ill.

The calves were fed age-dependent with milk replacer drinking (MRD), pelletized concentrate (PC), hay and drinking water

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Keywords

Calf rearing, data networking, animal health, feed intake

Tab. 1: Correlations between different parameters and age and illness severity (IS) of calf 822 (P < 0,0001)

Parameter	Body weight	DM-intake	Energy-intake	DW-intake	Number of visits	Sucking speed	Age
Age	0,98	0,94	0,91	0,86	0,89	0,82	1,00
IS	-0,81	-0,70	-0,73	-0,43	-0,59	-0,67	-0,79

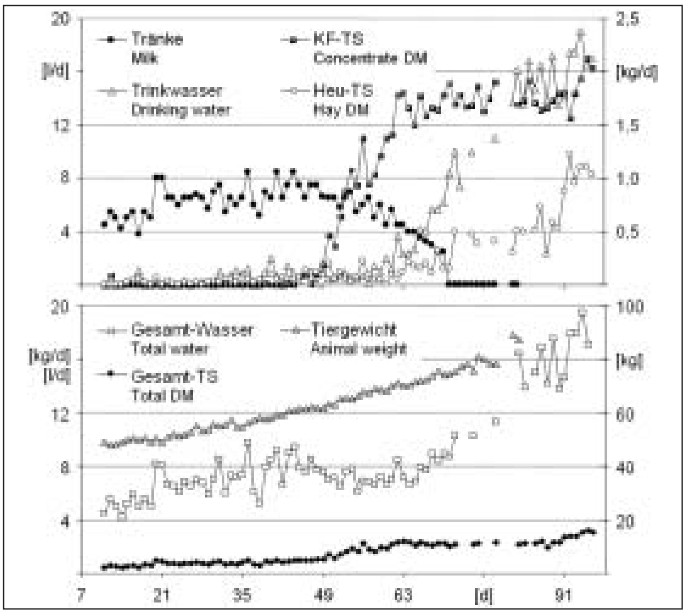

Fig. 2: Intake amounts and body weight depending on age of calf 822

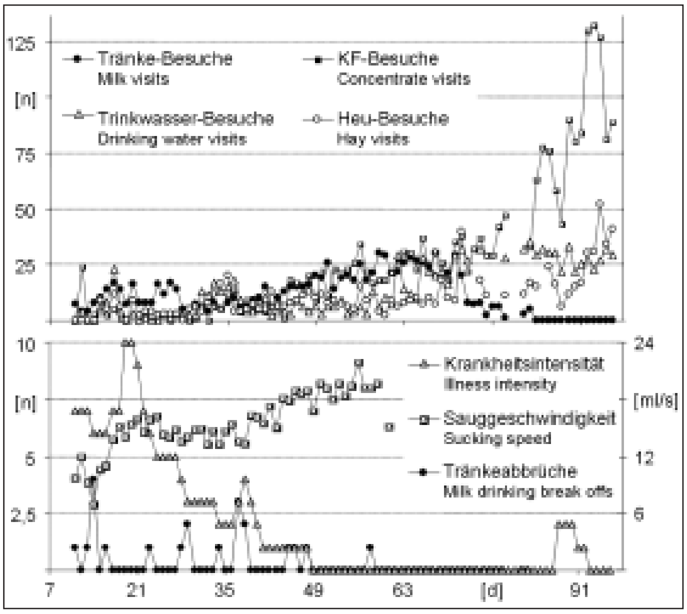

Fig. 3: Number of visits at each station, illness severity, sucking speed and number of milk drinking break offs of calf 822, depending on age

(DW). The amounts of MR-drinking and concentrate were offered according to a planned milk- and concentrate-feeding programme. Water and hay was offered ad libitum. The intakes of MR, PC and hay intakes were summed up to the dry matter (DM) intake. The retrieved amount of MRD and DW were aggregated together with the water contents of MR powder, PC and hay to the total water intake.

Results of one animal and discussion

Exemplarily, the data of calf 822 were analysed from the 11th to 96th day of life. Only 2.7 % of the 329 daily values for DM and water intake as well as the corresponding number of visits at the station could not be used for the evaluation. If the system had malfunctions, the data of these days were not used for analysis (missing data points in *Fig. 2* and *Fig. 3*). On average, the female calf of German Holstein breed was healthy and appeared physically very vital. The curves presented in *Figure 2* and *Figure 3* assume correlations, which were confirmed statistically in terms of possible early illness detection. ($P < 0.0001$) (*Table 1*). The strongest is the age-dependent development of the animal weight with a correlation of $r = +0.98$. With rising age, the animal ate more DM and thereby more energy as well as more DW. A strong positive correlation of +0.92 between age and PC intake clarifies that the amount of PC intake depends stronger on age than that of DW ($r = +0.86$) and hay ($r = +0.79$). However, the extent of correlation is also dependent on the feeding regime, whereas, the animal ate the complete offered amount of PC the first time at the 62nd day of life. Like [3] detected, the number of visits at the stations rose with rising age. Referring to age, the highest correlation was registered with visits at the PC station ($r = +0.82$). The highest correlation between number of visits at the station and each intake amount was for hay ($r = +0.87$). The curve progressions in Fig. 3 further show that with raising age the animal was less ill. With raising illness intensity the calf ate less PC ($r = -0.67$), DW ($r = -0.43$) and hay ($r = -0.40$) but the milk intake marginally rose ($r = +0.35$, $P = 0.0031$, $n = 71$). But it must be considered that mainly young animals get ill and that these do not consume much feed and drinking water. The more ill the animal was the less active it was regarding the number of visits at the stations. It reduced mainly the visits at the drinking water robot. The statement of [4] that with raising illness intensity the suckling speed decreases can be confirmed. The supposition that with raising illness intensity the number of milk drinking break-offs rises [5] can also be confirmed ($r = +0.24$, $P = 0.0457$, $n = 71$), whereas no statistical significance was found between illness intensity and the automatically gathered temperature measurements ($r = -0.026$, $P = 0.8643$, $n = 47$). Furthermore, by analysing the data it was detected that always at the second day before days with high illness intensity, the calf 822 drank more water (0.80 l and 0.35 l or 267% and 44% in reference to the previous day) and was very active (28 and 15 or 97% and 38% more visits at the stations than the day before).

Conclusion and outlook

Including of more parameters for control than hitherto allows a more efficient and largely automated health monitoring and hence an earlier veterinary treatment. Based on the results of the analysis of all 66 housed animals, recommendations for an optimized management and decision making rules for process control in networked systems for calf rearing ought to be developed. Potentials have to be assessed for the optimization of labour and production processes by the interaction of different subsystems so that preventive procedures can be substituted by demand-oriented treatments.

Literature

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