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Automatic Feeding Stations for Experimental Farms and Animal Performance Recording

Reliable and accurate information about the feed intake and feeding behaviour of individual animals is necessary for scientific feeding experiments. Experimental results should be gathered under conditions similar to practical husbandry conditions. Gathering data manually leads to high personnel expenses and subjective errors are possible, especially when observing individual animals. For these reasons fully automated feeding stations were developed for cattle, fattening lambs and pigs respectively. These stations make it possible to record and control both the pattern of feed intake and the quantity of feed consumed by the individual animal.

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Keywords

For efficient breeding and research in animal husbandry, experiments with individual animals are indispensable. The recording of feed intake and eating behaviour is an important element of this research. For determining exact data, the weighing of the feed consumed is an essential prerequisite. If the data collected for the individual animal are also intended to comprise the basic ration or mixed rations, this means separated eating areas for each animal and great expenditures for the weighing of the individual kinds of feed. Detailed records of when and in which portions the feed is consumed require particularly complex trial planning and realisation, which is very labour- and cost-intensive, if carried out manually.

However, electronic animal identification and electronic scales in combination with process computers allow the recording of such experimental data to be fully automated. In cooperation with industry and research institutions, the Institute of Agricultural Engineering developed feeding systems suitable for practical application and equipped several test stations with them [1, 2].

Design and Working Principle of Universal Feeding Stations

Core elements of the system are animal identification with RFID transponders, feed weighing with the aid of electronic weighing cells, the control of access to the feed, and the precise measurement of the time spent by the animals in the feeding station.

In principle, the feeders consist of a feed storage container, whose weight is constantly measured by weighing cells as long as no animal has access to the feeding station. The weight data are edited in a process computer and stored together with the animal identification- and time data of the visits in a kind of log. In the systems for the various animal species, access to the feed trough is controlled differently. In order to facilitate operation, each animal can be given a stall number, which can also be displayed during eating in addition to the current trough weight.

Variants

Cattle
The system was developed for the dispensing of basic or mixed rations, because common automatic feed concentrate dispensers generally offer sufficient possibilities of recording animal-specific feed concentrate consumption. Depending on the quantity of feed stored, different systems for fattening bulls and dairy cattle are available. The design of the weighing troughs is shown in *Fig. 1*. The troughs are dimensioned to allow a maximum of two animals to be fed once per day. They can be filled either manually or with the aid of a feeder-mixer wagon. The troughs can be filled several times per day. For reasons of hygiene and for clear identification of the substances contained in the feed, they should be emptied prior to filling. Due to their pivoting bearings, the troughs can be emptied easily. If an animal with a transponder (TIRIS ISO-HDX ear tag or an injected unit) enters the identification area of the rod antenna, the process computer
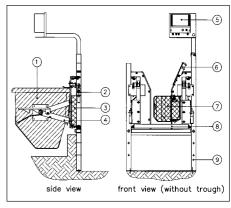

Fig. 1: Design of the feeding station for cattle; (1) Feeding trough, (2) weighing cell, (3,7) gate with interlock, (4) trough bracket, (5) process controller with display, (6) antenna, (8) weighing frame, (9) basic frame
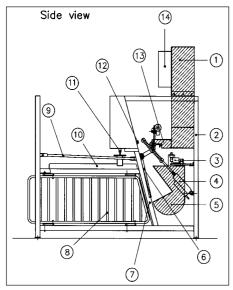
Fig. 2: Design of the feeding station for sheep; (1) feed store, (2) basic frame, (3) weighing cell, (4) drive for gate, (5) feeding trough, (6) gate, (7) front board with antenna, (8) adjustable width, (9) adjustable hight, (10) swing door, (11) raster interlock, (12) light barrier, (13) dispenser, (14) process controller with display

checks if the animal is entitled to feeding, determines the trough weight before the visit, and releases the revolving door, which controls access to the trough. Afterwards, the animal can easily depress the door with its neck and eat from the trough. If the animal removes its head from the trough, the door is closed by gravity and locks itself until the next animal is identified. At the same time, trough weight is determined again, and weight difference along with the beginning and the end of the visit as well as the corresponding transponder number are stored as a data set.

Sheep

In feeding stations for sheep, the above-described principle of feed weighing is extended in two points: feed storage containers with metering systems and electrically driven locking gates [1]. Another special feature is the width-adjustable footstep which reliably guarantees access for only one animal. The animals are identified with the aid of a frame antenna, through which the electronically marked animal must move its head, if it wants to reach the feed. The standard design of the station (*Fig. 2*) enables dry feed concentrate to be dispensed in a defined manner. A relatively small feed trough is always refilled from a storage container in order to maintain feed quality and avoid accidental overfeeding of animals. Due to the driven locking gate, the stations also allow the animals to be expelled from the feeder. In

addition to the double feeding station shown in *Figure 2*, which can serve two pens and approximately 16 animals, depending on the age of the animals and the kind of feeding (ad lib or limited feeding), a single feeding station without a swinging door is available, which can also be equipped with a hay scale instead of a feed concentrate trough as a special feature. For special trial purposes, the single feeding station was made suitable for grown ewes by increasing the height of the side walls and the trough area.

Pigs

In principle, the dry feeding system for pigs (*Fig. 3*) is identical with the sheep feeding station. Access and footstep, however, are adapted to the size and the eating habits of the animals. Adjustment possibilities allow weaning piglets and fattening pigs to be fed using the same system.

Software

In all three systems, the data are collected according to the principle described for cattle. The feeding stations are equipped with a process computer which can control feeding after one-time setting even without a connected PC and is able to store the visit data over a period of several days. For the adjustment of the system and long-term storage, the special Windows-based PC software „TIM" was developed. It communicates with the process computers connected to a BUS and offers a comfortable user interface for the entry of the setting parameters for the station by the service personnel and the recording of the animal parameters by those in charge of the trial. In addition, it serves to supervise the eating behaviour, and in some cases it allows the trial data to be pre-evaluated graphically. All data are stored in an Access data base and can be exported in different formats for further evaluation.

Supplement and Future Prospects

Due to the modular design of the systems and the BUS-capability of the process computers, modified versions for drinking water measurement and as an animal scale are possible. In the future, structuring by an intelligent BUS-controller based on a micro-PC is intended to allow the feeding systems to be connected to a standardised network (Ethernet and ISOagriNET) and thus to facilitate communication with other systems, such as feeding, weighing, and milking equipment as well as herd management programs.

Cooperation

The development of the feeding system for

cattle was supported by the DeLaval company. The development of the feeding system for sheep and comprehensive tests were carried out together with the University of Applied Sciences of Weihenstephan and the Institute of Animal Husbandry of the Bavarian State Research Center of Agriculture. Altogether, eight systems for the registration of basic and mixed rations for cattle with a total of 171 troughs, five feed recording systems for sheep with a total of 43 feeding stations, and one feed recording system for fattening pigs with 24 automatic dispensers are currently run in Germany according to this principle.

Literature

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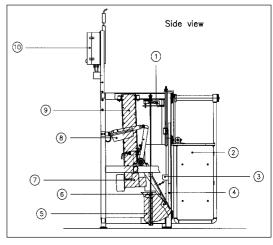
Fig. 3: Construction of the feeding station for pigs; (1) Weighing cell, (2) adjustable width, (3) antenna, (4) adjustable hole for feeding, (5) trough, (6) flap, (7) dispenser, (8) drive for flap, (9) feed store, (10) process controller with display