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Online motography for movement analysis of dairy cattle feeding behaviour

New types of feeding systems such as, for instance, the Weelink-Moveable Feeding Barrier can, through offering feed continually, reduce the animal/feeding space ratio and thus reduce space requirement and investment costs. There exist, however, doubts regarding the animal welfare properties of the system: the floor-level positioning of the feeding passage and possible disadvantages for smaller animals through the predetermined distance to the silage block have been criticised. With the help of motography, feeding behaviour under such conditions was recorded

As part of a comprehensive investigation into the construction-technological functionality of a moveable feeding barrier (Weelink system), the feeding behaviour of cows was studied. Unlike the case with fixed feeding barriers, cows using a moveable barrier system are fed silage direct from the block (about 1 m high) which is placed on the ground-level feeding passage. The distance cows have to reach to the silage is regulated by the barrier pushing the block towards the cows (manufacturer's figure: 90 cm). The silage falling on the floor collects between the block and the forward edge of the moveable feeding system as in a trough.

To be questioned was whether the manufacturer's suggested spacing between silage and cow stance represented an anatomically-caused disadvantage for the feed intake of smaller animals. It also had to be clarified whether, and to what extent, animals are forced to eat silage lying on floor level, that is, without the possibility of compensating for natural grazing behaviour. Investigations so far into trough design [1, 3, 4] have determined the reach of individual cows in a feeding barrier system by offering concentrate feed laid on surfaces placed at different levels.

A three-dimensional availability of feed as offered with a silage block was, however, not preconsidered in these investigations. With the moveable silage barrier, feed intake is possible within a reach of 0 to 0.9 m and

from 0 to 1 m high with (at least theoretically) the choice left to the cow. From this situation, not only the known process of maximum reach of animals of differing sizes in the respective heights (feeding profile) is to be determined a new, but also the preferred feeding area and length of time for feed intake at the silage block (feeding behaviour).

Material and methods

The activities of individual animals at the feeding barrier were determined by online-motography [2]. With this technology, signals from an infrared diode (IR-diode) attached to each cow's halter were digitally recorded with a CCD camera (charge-coupled devices semiconductor picture sensors) with a maximum frequency of 50 Hz. For the extrapolation of the distance from the halter position to the end of the cow's nose, the distance between the nose and the IR-diode was determined from photogrammetry exposures. The space co-ordinates delivered by the CCD camera were reduced to a single level for evaluation.

Figure 1 (left) shows the design of the trial within the cow housing. A plate with measuring points fitted in the feeding barrier behind the cows made possible the determination of the absolute co-ordinates. Motography and photogrammetry cameras were positioned with 3 m distance to the plate. The

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Keywords

Online-motography, moving feeding barrier, cows, reach, trough design

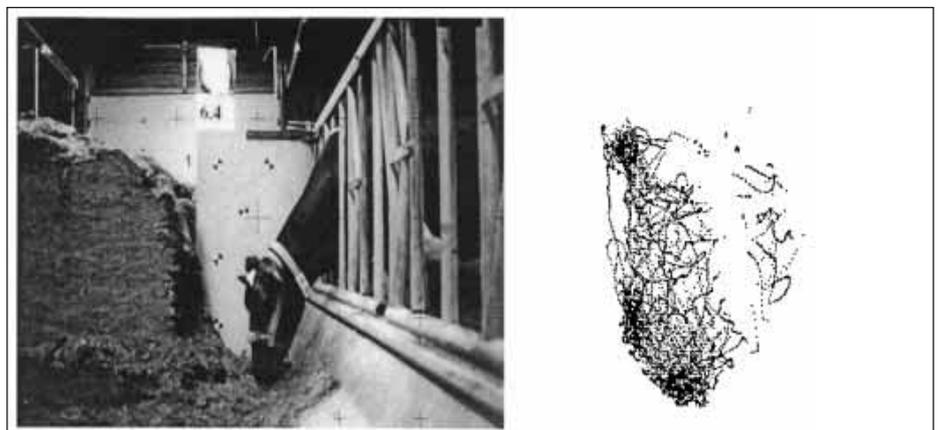


Fig. 1: Experimental design and scatter diagram of raw data of moving positions recorded

Table 1: Body measurements of examined cows

Cow nr.	Measurement value [cm] (Median from 20 measurements)		
	Wither-height	Shoulder height	Sloping body length
0	145,0	95,0	173,0
1	145,5	97,0	152,3
2	139,8	92,0	152,3
3	144,8	96,0	158,5
4	143,0	96,0	153,8
5	146,3	96,5	150,0
6	141,5	96,0	149,3
7	141,0	94,0	156,5
8	144,0	95,5	161,8
9	134,5	86,8	<145*
Variation width	11,8	10,2	>28

data from a feeding process recorded by the IR diode is represented by the cloud of points in figure 1 (right).

Selected for the investigations were 10 research station milk cows (Holstein-Friesian) which had already fed at a movable feeding barrier over an extended period. The choice of cows included the largest and the smallest animal in the FAL herd. The heights of withers, shoulder and sloping body length were measured several times with each animal.

In a first trial procedure, the reach of the animals at the feeding barrier on differing levels in an upwards direction was determined by offering concentrate on a flat surface. The second trial procedure followed under real conditions at the silage block. In order to calculate the relative periods of time the animals spent feeding at different heights and distances from the silage block, finally the complete feeding procedure over 45 to 60 minutes was recorded and analysed.

Results

The anatomical details of the cows are given in table 1. Cow number 0 is the biggest, one of the oldest, and alpha animal at the station. With a length of 173 cm and 145 cm wither height, she was more than 10 cm taller, and 20 cm longer, than the smallest and youngest animal in the herd, cow 9.

The movement data collected by the online-motography allowed multiple observations of the feeding area at the movable feeding barrier: the maximum reach of an animal was presented as an envelope-curve from the position data of the nose (fig. 2). In total, reach distances of from 100 to 120 cm were determined (minimum and maximum values from cow 9 and cow 4). No correlation with the sloping body length was able to be determined. Primarily, the reach of each cow was determined by the respective total neck-head length.

The preferred feeding area was determined from the percentage value of the length of time feeding/position co-ordinates. These differing periods of feeding are displayed in figure 3 through different colour stages. A characteristic feeding profile (middle) for feeding at a silage block was determined. In this, the entire silage block was used by the animals. Preferred, however, was a height of between 30 and 60 cm and within a reach of 65 to 95 cm.

The smallest and the largest animals in the herd (cow 9 – cow 0) recorded with ± 110 cm the same reach. The behaviour of the smallest, cow 9, equalled the characteristic profile (right).

This cow fed preferably at 40 cm height and hardly ever above 1 m. The dominant cow 0 showed, however, only limited activity and fed mostly at 80 to 100 cm height (left).

At the 20 cm level, the animals fed on average for only about 1% of feeding period, i.e., less than one minute in every hour. No cows took silage from the block under the 10 cm level.

Conclusion

In total, the results were positive, but also showed that in this system a high measure of self-responsibility is required by the user. Where the advised 90 cm reach distance as

advised by the moveable feeding barrier manufacturer is followed, the possibility of a disadvantage to smaller animals can be disregarded.

Where enough forage is at hand, in other words, where the barrier is moved forward in good time and new silage is made available as blocks lose their structure, the cows do not eat less than the normal intake from conventional trough systems.

Literatur

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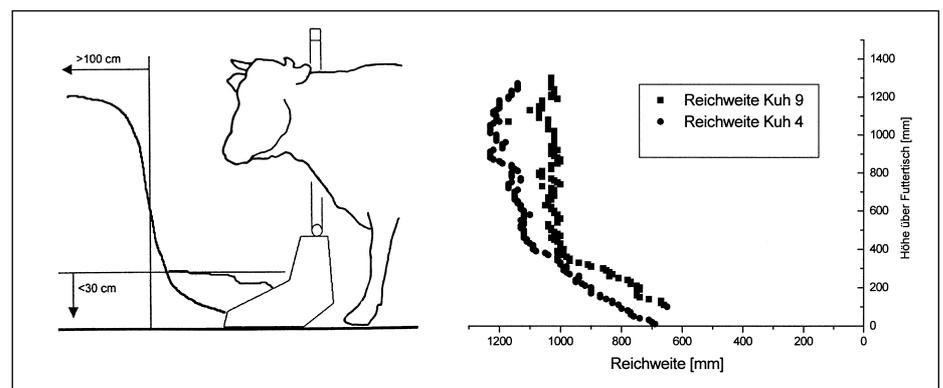


Fig. 2: Schematic presentation of a cow within the Weelink system (left) and maximum reach within the feeding barrier (cows 9 and 4, right)

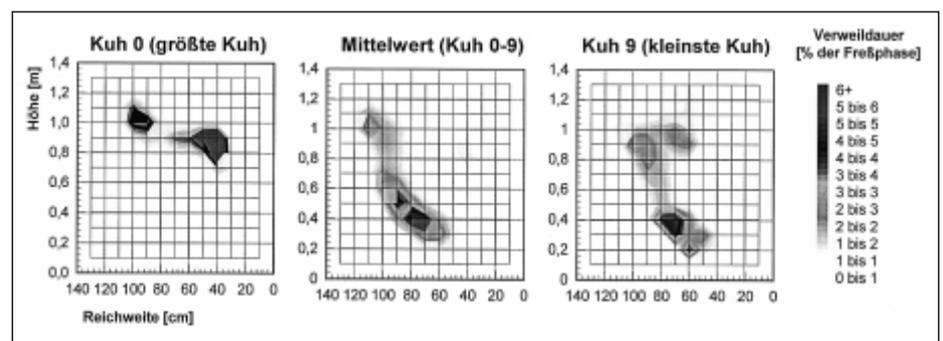


Fig. 3: Relative time spent in different areas in front of the feeding barrier within a feeding interval