EFFECT OF MANAGEMENT PRACTICES ON TIME SPENT BY COWS IN WAITING AREA BEFORE MILKING

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Abstract. The objective of this study was to investigate the time spent by cows in the waiting area depending on the cow herd size and some management practices. Time and space constitute two basic elements in the assessment of the waiting area and activities undertaken in the waiting area before cow milking. The presented example of investigations showed premises to find differences in the time spent by cows in the waiting area including variability not only between morning and evening milkings but also within each of the milkings. Changes in the size of cow groups taken to the waiting area were associated with the space per one animal in the waiting area. The space per cow found in the experiment, depending on the cow group size was: 2.14 m^2 per animal (for group of 12 cows), 1.66 m^2 per animal (for group of 24 cows) and 1.11 m^2 per cow (for group of 36 cows). Waiting area is the place, where cow comfort can be improved. The management practices should provide the possibly shortest time spent by cows in the waiting area. Possible shortest time of standing with proper comfort can meet the general needs of dairy cow welfare as the area for further investigations.

Keywords: cow, dairy production, herd size, milking, waiting area.

Introduction

The dairy production system is the area of many dynamic changes to reach higher and higher effectiveness, and possible producer satisfaction [1] concerning milk production in the farm. The dairy production effectiveness as well as farmer satisfaction depend on many factors, where access to more and more modern technical and technological solutions play one of the most important roles [2]. Technical equipment, one of the most important elements in assessing the efficiency of a farm's dairy production, has provided the basis for many research analyses [3].

Technical equipment in a barn is investigated to find the most effective conditions for developing a farm's dairy production. It is possible to very well confirm in the area of milking. Milking parlour performance has been evaluated using primarily time and motion studies [4]. Some procedures have also been used to evaluate the effect of different factors on the milking parlour performance, i.e. pre-milking hygiene, level of milk production, type of parlour, level of mechanization as well as construction [5]. Relationships among the operator, machine and animal were analysed as they pertain to milking parlour efficiencies including field survey as well as simulation study [6]. To better recognize some details concerning the parlour performance there were simulation models of parallel, rotary, and side-opening milking parlours built that could predict the milking parlour performance according to the herd size, number of milking stalls, labour quality, and cow characteristics [7].

Milking parlours are situated in the farm milking system, so the parlour performance should include some effects resulting from such connected (with parlour) elements like the waiting area (waiting yard, holding area) for cows. Significance of cow group management in the waiting area is confirmed by some investigations, where, for example, cow crowding in the waiting yard using mechanical drivers and its influence on productivity of rotary type milking equipment were considered [8]. Another research problem concerning the waiting area is influences of various factors on cows' entrance order into the milking parlour [9]. Developing problem of the waiting area assessment, cows' time spent in the possibly stressful waiting area of the milking parlor and their behavioral patterns were also investigated [10].

The objective of this study was to investigate the time spent by cows in the waiting area depending on the cow herd size and some management practices.

The expected effect of the carried out investigations were suggestions concerning the efficient size of the cow group taken to the waiting area before milking. The efficient size of the cow group can be understood as the group, which spent in the waiting area possibly shortest time including proper comfort of standing. The standing comfort in the waiting area is created by cow crowding [8] and should include general rules of animal welfare improvement [11].

Materials and methods

One farm was included to collect data concerning cows taken to the waiting area and at the next step entered to the milking parlour. It was an experimental farm UBC Dairy Education and Research Centre located in the west coast of Canada, where cows are kept in many groups differed in number of animals in one technological group. This way in practice it was possible to include the following cow herd size: 12 cows, 24 cows and 36 cows. The module of 12 cows resulted from organization of milking, i.e. the milking parlour type side-by-side with 12 stalls in one row and the opposite side of 12 stalls in the second row located at the milker corridor. The milking parlour constituted part of the barn. The naturally ventilated (with curtained sidewalls) wooden frame barn consisted of 288 free stalls divided into smaller units, i.e. pens with 12 stalls each covered with sand as a bedding material. The lying stalls in each individual pen were configured in 3 rows, 2 rows facing one another and the back row facing a cement wall. Some pens with 12 stalls were connected to each other, so the complex pens with 24 and 36 stalls (and the same number of cows) were created in the barn. Moreover, the cows from the second barn with 120 lying stalls were also taken to the milking parlour. Not all stalls in the barns were used for milking cows. Part of the lying stalls was occupied by dry cows and heifers. Only about 250 cows were milked each morning and evening, i.e. two times per day.

Including the system of alleys in the barn the particular groups of cow were taken to the waiting areas. Each part of the milking parlour with 12 milking stalls was connected with one independent waiting area. Each of the two waiting areas had the same construction details, i.e. a mechanical cow driver, fences at both sides and a narrow corridor connecting the waiting area with the entrance gate to the row with 12 milking stalls. The mechanical cow driver was a gate with two options of work. One of the options was open and closed position of the gate, while the second option included possible move of the gate along the waiting area to push the cows into the milking stalls. The move of the gate closing the waiting area was managed by the milker or the person responsible for taking cows from the barn to the waiting area.

The corridor between the two independent waiting areas and near the milking parlour was the place where we spent the time to collect data concerning management of cows taken from the waiting areas to the milking parlour. The data were collected by means of a paper sheet, where exact time of all activities observed in the waiting areas was taken down, including accuracy of the measurements of 1 second. The activities included such elements like: time, when the cows representing one group were collected in the waiting area; time, when the entrance gate to the milking stalls was opened and closed; time, when the entrance gate to the waiting area was closed; time necessary to take the cows from the waiting area to the milking stalls. Moreover, the position of moving the gate in the waiting area was also noted in the sheet with the collected data. Including the position of the moving gate closing the waiting area it was possible to calculate the area (in m^2), where the group of cows was kept before milking. The determined area was taken to find some indices concerning the space per animal in the waiting yard.

To compare different groups of cows the following criterion was taken to register and analyze the time spent by cows in the waiting area: it was the time, when the entrance gate to the milking stalls and the entrance gate to the waiting area were closed.

Two morning and two evening milkings were timed. The morning milking started at 5 am, while the evening milking started at 3 pm. Generally, the morning milking lasted longer than the evening one, as a result of longer break between the evening and morning milking as well as a bigger amount of milk gathered during morning milking. For each milking only one milker was responsible. One person was also responsible for management of cows taken to the waiting area and at the stage (after milking) between the milking parlour and the pens, where the cows were kept in free stall system. The investigated milkings were selected such way in order to include work of two different milkers and different persons responsible for cow herd management. In the experiment each milker conducted morning and evening milking.

The collected data were used to calculate milking performance and other indices presenting effect of management practices on the time spent by cows in the waiting area, average space per cow and the others. The space per cow was calculated on the base of the following data: the number of cows and area, where the group of cows was kept in the waiting yard, including the changed position of

themoving gate. Accuracy of the measurement of the gate position was 0.5 m. The space per cow, i.e. relationship between the area of the waiting yard and the size of the cow group was calculated for three groups: 12, 24 and 36 cows. When there was a group of 36 cows it means that the space per cow was found for 36 cows, 24 cows (when 12 cows were taken to the milking parlour) and 12 cows (when the next 12 cows were taken to the milking parlour). The same approach was included in the case of the group having 24 cows.

Statistical analysis of the collected data was performed using the Statistica v.12.5 software. Analysis of variance (ANOVA) for the main factors was conducted. The statistical model for cow management activities included the fixed effects of the cow group (12 / 24 / 36), waiting yard (left / right), milker (two persons), and person responsible for cow herd management (four persons). Significance level was α=0.05. A multiple range test for comparing means in the analysis of variance, i.e. Duncan test was used. Homogeneous groups were identified by Duncan test.

Results and discussion

In total, four milkings (two morning and two evening milkings) under investigations included 22 groups with 12 cows, 15 groups with 24 cows and 9 groups with 36 cows.

Including as the criterion morning milkings the registered time (i.e. the time spent by cows in the waiting area, when the entrance gate to the milking stalls and the entrance gate to the waiting area were closed) for two independent waiting areas was between 117.25 min and 183.74 min (mean ± SD: 143.77 ± 29.81), while the evening milkings included the registered time between 72.57 min and 148.75 min (mean ± SD: 105.29 ± 32.07). Such big differences in the range of the registered time could be a result of management practices undertaken by persons responsible for delivering the cow groups to the waiting areas. There were four different persons operating cows at the way between the barn (pens with lying stalls) and the waiting areas. Moreover, two different milkers were included in the experiment. Each of them was responsible for one morning and one evening milking.

The above-mentioned differences in management practices undertaken by the persons responsible for delivering the cow groups to the waiting areas can be confirmed by the data concerning the registered time spent by some group of cows in the waiting area. The data for the smallest groups, i.e. groups with 12 cows were taken into account and presented in Table 1.

Table 1

Time spent by the groups with 12 cows in the waiting area, before milking

Milking	Number of groups	Minimum time, min	Maximum time, min	Mean, min	SD, min
Morning (I)	6	3.00	24.50	16.89	± 8.00
Morning (II)	4	20.66	29.00	25.06	± 3.49
Evening (I)	6	1.00	30.33	16.75	± 10.69
Evening (II)	6	1.33	17.50	6.99	± 6.75

Including the extreme values given in the column “mean” (Table 1) it is possible to indicate more than 3.5-times longer time spent by cows in the waiting yard during morning milking (II) in comparison with evening milking (II). Generally, morning milking lasts longer than evening milking but the mentioned big difference suggests that some other factors can decide about the time spent by a particular group of cows in the waiting area. The individual skills and the approach of the person responsible for taking cows to the waiting yard seem to be important. It is possible to take the cows in advance, so as a result the animals need to wait longer to be milked. On the other hand, the particular group of cows can be managed such way in order to take them to the waiting area, when milking of the former group is at the final stage. Of course, such approach and activities are involving a certain amount of risk as a result of unforeseen events in the way between the barn (lying stalls) and the waiting yards.

The persons responsible for taking cows to waiting area decided also (in cooperation with the milker) about the changes of the position of the moving gate. As a result, where the cows waited for milking, it was possible to calculate the area and include it for some comparisons. The space per cow found in the experiment, depending on the cow group size was: 2.14 m^2 per animal (for group of 12

cows), 1.66 m^2 per animal (for group of 24 cows) and 1.11 m^2 per cow (for group of 36 cows). The results of analysis of variance showed significant difference of mean values ($p < 0.05$) for the considered factor, i.e. the space for a cow included in the group of the compared cow herd sizes. The mean values were denoted as a homogeneous group of values. The mean value for the group of 36 cows was comparable with some results indicated in other investigations. Using the rotary type equipment and the hard type cow mechanical mover the cow concentration in the waiting yard reached 1.1-1.2 m^2 per animal [12].

It seems to be important that space and time constitute two basic elements in the assessment of the waiting area and activities undertaken in the waiting area. Both the space and time result from management practices and directly concern cows. To find the effect of management practices on time spent by cows in the waiting area we included groups with 12 cows. There were groups having 12 cows taken to the waiting area from the barn and subgroups with last 12 cows waiting to enter the milking parlour, belonging to bigger groups (24 and 36 cows) taken to the waiting area. It was possible to expect that subgroups with last 12 cows waiting to enter the milking parlour, which belonged to the group of 36 cows waited for the longest time to be taken to the milking parlour. Such expectations were confirmed by the result of analysis of variance, which showed significant difference of mean values ($p < 0.05$) for the considered factor, i.e. the time spent by cows in the waiting area included in the group of three compared cow herd sizes (12, 24 and 36 cows). Mean time spent in the waiting area by the distinguished groups with 12 cows was presented in graphical form (Fig. 1).

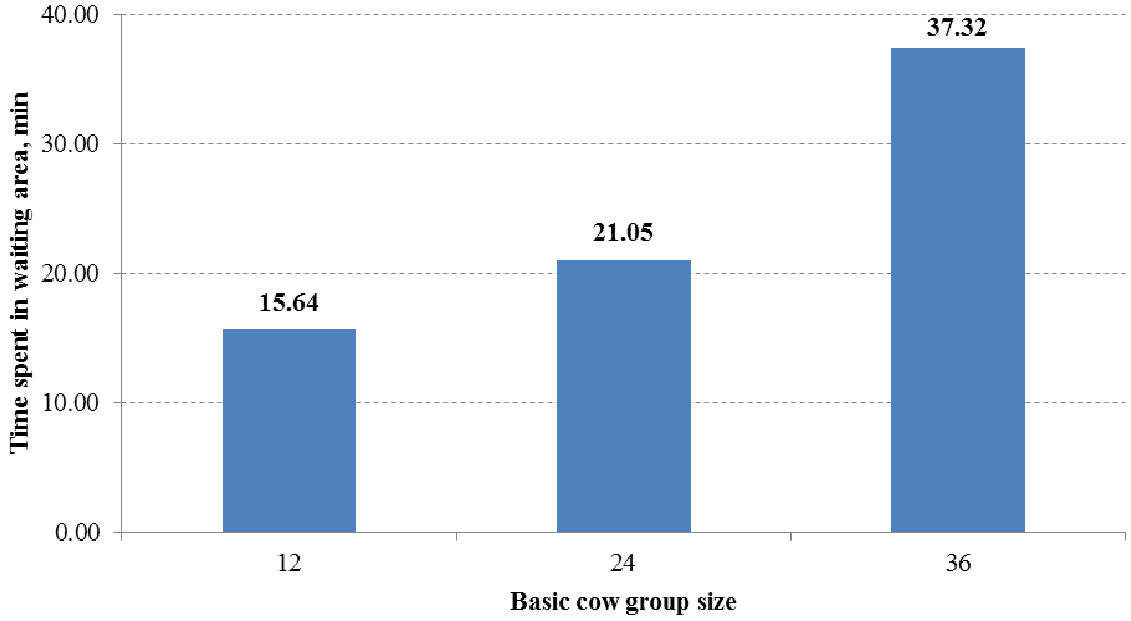

Fig. 1. **Mean time spent by 12 cows in waiting area including basic groups having 12 cows and subgroups with last 12 cows waiting to enter to milking parlour, belonging to bigger basic groups (24 and 36 cows) taken to waiting area**

It is possible to indicate (Fig. 1) that as a result of the increased number of cows per one group (group of 24 cows) taken to the waiting area there was longer time spent by the last subgroup of 12 cows in the waiting area, i.e. (mean ± SD) 21.05 ± 5.62 min in comparison with the time spent by the group with only 12 cows taken to the waiting area: (mean ± SD) 15.64 ± 9.48 min. However, the mean time spent by the last subgroup of 12 cows taken to the waiting area in the group of 36 cows amounted to (mean ± SD) 37.32 ± 5.00 min.

The problem of the waiting area, time and management constitute premises for many investigations to improve effective operation of cow herds. As an example, if side by side type milking equipment is used with groups of cows entering and the mechanical mover is not used, the consumption of time necessary for filling the milking places with new cows increases for about 5 to 9 s calculating per one animal, besides, the load for the people involved in cow driving considerably increases [12].

Cows spending more time in the waiting area have limited opportunities to behave normally; therefore, the welfare of these cows in particular is poor [10].

Conclusions

1. Time and space constitute two basic elements in the assessment of the waiting area and activities undertaken in the waiting area before cow milking. The presented example of investigations showed premises to find differences in time spent by cows in the waiting area including variability not only between morning and evening milkings but also within each of the milkings.
2. Changes in the size of the cow groups taken to the waiting area were associated with the space per one animal in the waiting area. The space per cow found in the experiment, depending on the cow group size was: 2.14 m^2 per animal (for group of 12 cows), 1.66 m^2 per animal (for group of 24 cows) and 1.11 m^2 per cow (for the group of 36 cows).
3. Waiting area is the place, where cow comfort can be improved. Possible shortest time of standing with proper comfort can meet the general needs of dairy cow welfare as the area for further investigations.

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