

The difference of production and utilization of two automatic milking machines for one group of cows kept in free cow traffic barns

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2 台の自動搾乳機を 1 乳牛群で利用した酪農場での乳生産量および搾乳機利用性の偏り

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Summary

The objective of this study was to describe the differences of production and utilization between two milking machines installed for one cow group in a free cow traffic barn. The data of seven days from three commercial dairy farms were used for this study (Farm A, B and C). Cows were kept in a free-stall barn that had a free cow traffic system with two automatic milking machines for one cow group. The average daily milk yields of three farms were 41.2 kg/day in Farm A, 34.1 kg/day in Farm B and 35.7 kg/day in Farm C. The individual selection rate was calculated. The daily milk production was tended to differ between the milking machines ($p=0.09$). The cows classified by the individual selection rate from 50% (equal use) to 100% (completely unequal use). The unequal cows who selected only one machine in Farm A was higher than that in Farm B and Farm C. There was no relationship between the individual selection rate and milking traits. It was concluded that there were a few differences in the utilization between the two milking machines that were installed in the free cow traffic barn. We suggested that the number of cows who was rigid users should be reduced, and the cows who were flexible users should be increased.

Introduction

The automatic milking system (AMS) was introduced in Japanese dairy farms quickly. One of the aims of introducing AMS was a response to rearing high milk-yield cows and a large number of cows, as

many as 120 cows, in one group. The milking frequency for a group of about 120 cows was approximately 300 milkings per day. Normally, one automatic milking machine was able to milk about 180 times per day. So, two milking machines have to be installed for a group of 120 cows.

Tokida et al. (2005) reported that milking times and milk production differed between the milking machines in the farm that had two milking machine for one group in the guided cow traffic system. The visiting frequency and pattern were very different between the cow traffic system (guided traffic system and free traffic system) (Kageyama, 2003). The AMS in the free cow traffic barn was based on a cow's voluntary visits to the milking machine(s). Then, the inequality of the visits to milking machines in a free cow traffic system might be more than in the guided cow traffic system. However, there was no research about the difference of the milk production and milk traits between two machines in the free cow traffic barn.

The objective of this study was to describe the differences of production and utilization between two automatic milking machine installed for one cow group in free cow traffic barn.

Materials and methods

The data of seven days from three commercial dairy farms were used for this study (Farm A: 2016/07/26-08/01, Farm B: 2016/04/16-04/22, Farm C: 2015/12/06-12/12). The three farms were located in Hokkaido prefecture of Japan. Cows were kept in a free-stall barn that had a free cow traffic

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system with two automatic milking machines (Lely Astronaut, A4 type) for one cow group. Every milking machine was lined up at the opposite side of PMR feeding-trough. Milking machines were on the cow's left side in Farm A, and on right side in Farms B and C. The stalls were located in three row and the number of stalls was 120 in each farm.

The average numbers of cows in the three farms were 108 cows in Farm A, 116 cows in Farm B, and 98 cows in Farm C. The average daily milk yields of the three farms were 41.2 kg/day in Farm A, 34.1 kg/day in Farm B and 35.7 kg/day in Farm C.

The records of the automatic milking machine were made with a backup, and the individual milk yield and number of visit to the automatic milking units were calculated. The total milk yield, and number of visits per day were taken by summing up the individual data from the three farms.

The individual selection rate was calculated as individual preference of use of the milking machine. The cows classified by the individual selection rate from 50% (equal use) to 100% (completely unequal use).

The interval from the preceding milking to the next milking was the interval of milking. The individual regularity of milking intervals was evaluated by the weekly coefficient of variation (CV) of the interval of milking that Bach and Busto (2005), and Morita et al. (2017) used. The weekly CVs of intervals of milking were calculated by dividing the standard deviation by the average of intervals of the record for seven days.

Data were analyzed using the package of the R (ve3.4.1). It was used paired t-test for the comparison of the average of items of two automatic milking machines, and used one-way ANOVA and Tukey HDS test for the comparison of the average of milking traits in several selection rate in this study.

Results and Discussion

The number of cows who were milked in each machine, the daily milk production and milking times of each milking machine in the dairy farms were shown in Table 1. The daily milk production was tended to differ between the two milking machines ($p=0.09$). Also the number of milking cows was tended to differ between the milking machines ($p=0.08$). Tokida et al. (2005) reported that milking times and milk production differed between the milking machines in the farm that had two milking machines for one group in the guided cow traffic system. The present study's results showed that there was a difference of milk production and number of milking cows between the two milking machines. And the degree of these differences was varied among farms that used two automatic milking machines (milk production: 300 kg/day in Farm A, 100 kg/day in Farm B and 149 kg/day in Farm C; number of milking cows: 11.5 cows in Farm A, 5.1 cows in Farm B and 5.2 cow in Farm C).

The distribution of the number of cows of individual selection rate in three farms was shown in Figure 1. There was a difference between the farms. The number of cows with approximately equal use (50–60%) in Farms B and C (30%) was higher than that of Farm A (25%). The completely unequal cows who selected only one machine in Farm A (20%) was higher than that in Farm B (10%) and Farm C (15%).

The cows that had not milked in over 12 hours were fetched and guided to the milking machine, regardless of the position of the milking machine in Farms B and C. However, in Farm A, the cows were guided to a fixed the machine. We did not check the individual cows who were guided, but it might be one reason why the percentage of completely unequal cows was higher in the Farm A than others.

Table 1 The daily milk production of one automatic milking machine, and the number of cows that was milked in each of automatic milking machine and daily milking times.

automatic milking machine	More production	Less production	P-value
Milk production of one AM unit	2.07 ^a ± 0.31	1.90 ^b ± 0.20	0.09
Number of milking cows	92.3 ^a ± 6.4	85.0 ^b ± 6.6	0.08
Daily milking times in one AM unit	184 ± 20	170 ± 14	0.21

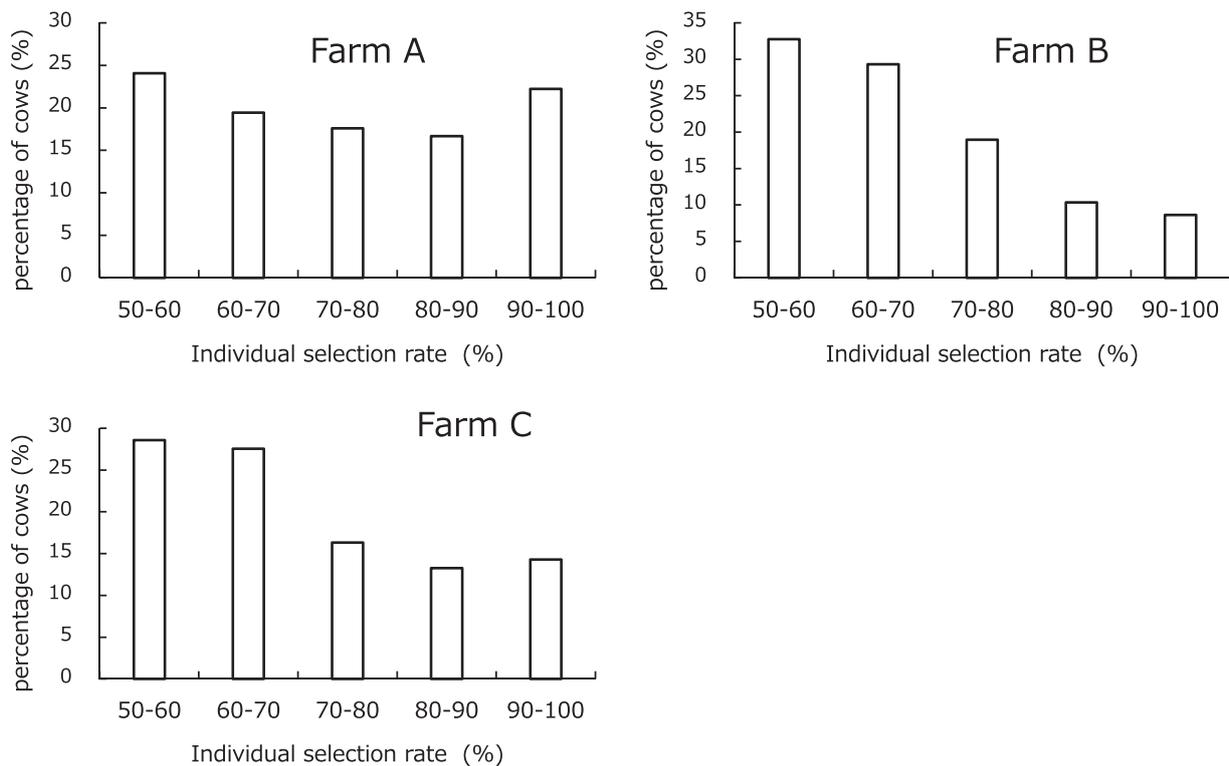


Figure 1 The distribution of the individual selection rate in three farms

Individual selection rate and milking traits (daily milk yield, milking frequency per cow, regularity of milking intervals and visiting frequency per cow) were shown in Figure 2. There were no differences in the daily milk yield, milking frequency per cow and the regularity of milking intervals. Only, the visiting frequency of the cows in the 90-100% group was significantly ($p=0.048$) smaller than that in 80-90% group.

The difference between the visiting frequencies of several class of the cows in individual selection rate was 1.0 visiting per day (maximum visiting frequency was 5.2 in 80-90% and minimum visiting frequency was 4.2 in the 90-100% group). This level of difference of frequencies might not affect the operation of the automatic milking system, because there were no differences in the milking frequency among the class of individual selection rate in this study.

It was concluded that there were a few differences of the utilization between two milking machines that were installed in a free cow traffic barn. It was suggested that the number of cows who were rigid users should be reduced, and the cows who were

flexible users (smart users) should be increased.

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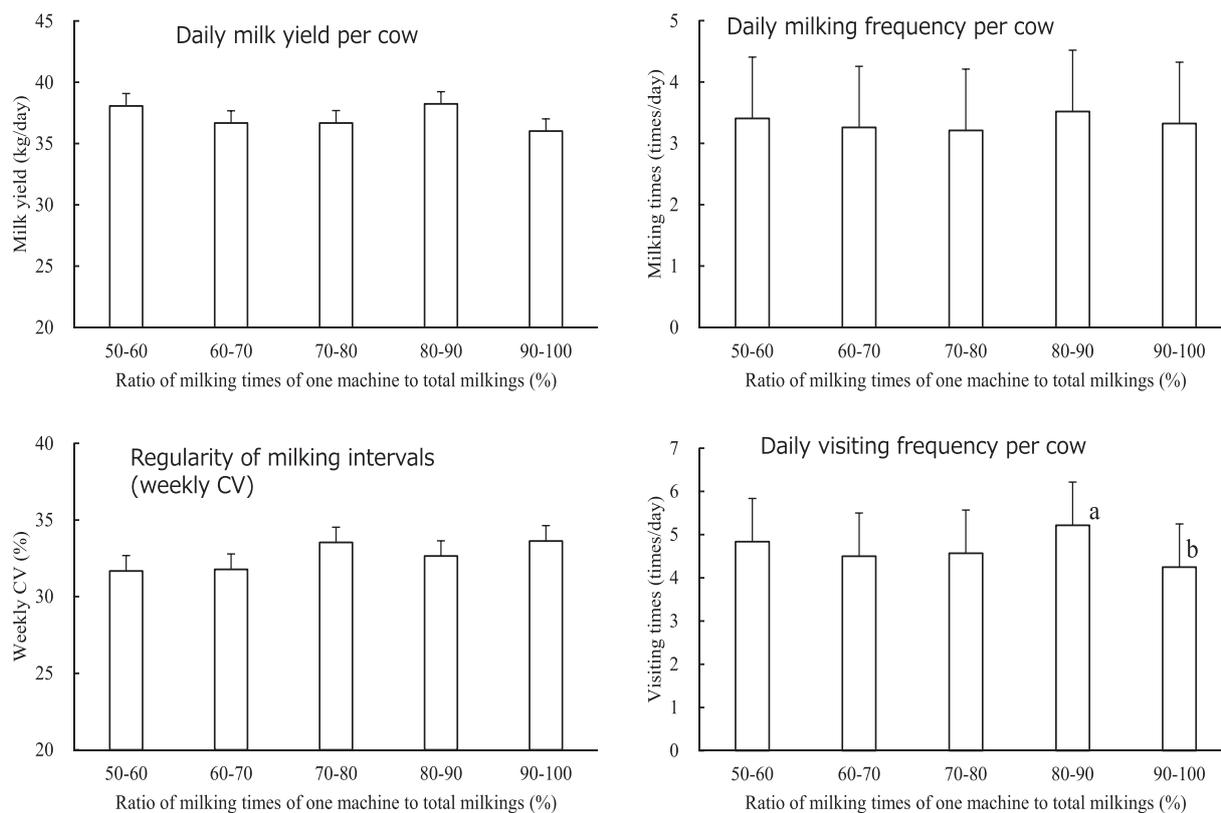


Figure 2 Individual selection rate and milking traits

要 約

本研究では、自由往来型における2台1群の利用形態での乳牛の自動搾乳機利用を調査した。調査は1牛群に2台の自動搾乳機を導入した3戸の酪農場(A, BおよびC)で実施した。各酪農場における平均搾乳量は、A農場で41.2 kg/日、B農場で34.1 kg/日およびC農場で35.7 kg/日であった。各農場を訪問し乳牛による自動搾乳機利用の状況をコンピュータ記録データ(7日間分)から把握した。コンピュータ記録データには、個体ごとの自動搾乳機への進入時刻、搾乳時刻および搾乳量が含まれていた。自動搾乳機を利用した乳牛の頭数や、搾乳機単位での搾乳量には2台の自動搾乳機間に差のある傾向があった。A農場での各自動搾乳機の搾乳量差は300 kg/日で、他の農場に比べ大きかった。搾乳回数は、それぞれの酪農場で379回/日(175回と205回)、363回/日(180回と183回)および318回/日(164回と154回)であった。A農場において、いずれか一方のみ利用した乳牛は14頭であった(B農場:3頭, C農場:8頭)。特定の自動搾乳機での搾乳頻度割合が90%を超える乳牛頭数の割合はA農場で高かった。1日当たりの搾乳量、1頭当たりの搾乳回数およびWeekly CV値に、搾乳利用の偏りの影響は認められなかった。以上の結果から、さらに自動搾乳システムでの搾乳量増加を期待するには、乳牛による搾乳機利用の偏りを無くし、均等な自動搾乳機利用を目指す必要があると考えた。