Effect of Milking Frequency on Body Condition Score, Somatic Cell Count, and Reproductive Performance of Dairy Cows Milked by An Automatic Milking System

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Effect of Milking Frequency on Body Condition Score, Somatic Cell Count, and Reproductive Performance of Dairy Cows Milked by An Automatic Milking System

A Astuti[1], T Obitsu[2], K Taniguchi[2], and T Sugino[2]

[1]Faculty of Animal Science, Universitas Gadjah Mada. Jl. Fauna No. 3 Bulaksumur, Yogyakarta, Indonesia 55281
[2]Graduate School of Biosphere Science, Hiroshima University. 1-4-4 Kagamiyama, Higashi-Hiroshima City Hiroshima, Japan 739-8528

Corresponding author: andriyaniastuti@ugm.ac.id

Abstract. The objective of this study was to determine the effect of milking frequency using an Automatic Milking System (AMS) on body condition scores (BCS), somatic cell count (SCC), and reproductive performance of Holstein cows. The study was conducted in Hiroshima University Farm. Eight multiparous cows and four primiparous cows were divided into two treatments of groups (2 and 4 times milking frequency). Cows were fed by Partial Mixed Ration (PMR) ad libitum and concentrate diet (5-8 kg) at every milking. The PMR consisted of Italian ryegrass silage 35% dry matter (DM), oat hay (8% DM), alfalfa hay (8% DM), pellet bit pulp (8% DM), formula feed (39% DM), minerals and vitamin. The PMR nutrients contents were 13.6% crude protein (CP) and 70% total digestible nutrient (TDN), while concentrate contained 20.6% CP and 82.4% TDN. On days 20, 35, and 50 postpartum, BCS was observed, and milk samples were collected for SCC analysis. Reproductive performance data collected were S/C, calving interval, and postpartum mating. The MIXED model for repeated measures (SAS 2004) was used for testing the difference in BCS and SCC. Significance was declared at $P < 0.05$, and tendency at $P < 0.10$. The research showed that no difference on BCS and SCC between 2 and 4 times milking by AMS, but the probability of occurrence of high SCC (> 100,000) was lower for four times milking cows than 2 times milking cows (6% vs 59%). The effect of milking frequency did not show any difference on S/C, calving interval, and postpartum mating. Increasing milking frequency may positively affect on SCC without any effects on BCS and reproductive performance in this experiment.

Keywords: Automatic milking system, BCS, milking frequency, reproductive performance, SCC

1. Introduction

Somatic cell count (SCC) in milk has been known as an indicator of udder health, especially contagious pathogenic infections resulting in mastitis [6]. The SCC in milk increases when capacity of mammary cells to produce milk is damaged due to mammary gland infection [9]. When SCC exceeds 100,000 cells/ml, the infection is identified by bacteriological testing [13]. Generally, a healthy mammary gland contained less than 10,000 cells/ml milk, but SCC may also vary depending on the lactation stage, parity of cows [4], infectious status, estrus, heat stress and day-to-day variation in milk

production [9]. Hale et al. [8] reported that milking frequency did not affect SCC as well as reproductive performance. The calving interval (CI) is defined as the time from one calving to the next calving. For ideal intensive production and beneficial economy, CI is targeted 12 months [10, 14]. The body condition score (BCS), udder health, and reproduction control are important factors for practical dairy production. However, the effect of milking frequency using AMS on BCS, SCC, and reproductive performance are unclear. In this study, BCS, SCC and some reproduction data obtained from cows milked by AMS were analyzed to detect the related problems.

2. Materials and methods

This study was conducted according to the Animal Care and Use Committee of Hiroshima University guidelines. Eight multiparous cows and four primiparous cows were divided into two treatments groups of milking frequency, namely, MF2 (twice milking per day) and MF4 (four times milking per day). The milking machine used was AMS (Astronaut A3 next, Lely, Drachten, the Netherlands). The cows were divided into two blocked groups based on parity (multiparous and primiparous) with the average of cow's parity for 2 times milking cows were 3.0 and for 4 times milking cows were 2.3. Cows were fed a partial mixed ration for 5 times (09.30, 11.00, 14.00, 15.30 and 17.00 hours) daily ad *libitum* and 5–8 kg/d of concentrate. Freshwater was offered at all times. The PMR consisted of Italian ryegrass silage 35% dry matter (DM), oat hay (8% DM), alfalfa hay (8% DM), pellet bit pulp (8% DM), formula feed (39% DM), minerals and vitamin. Chemical composition of the PMR were 47.9% dry matter, 92.2% organic matter, 13.6% crude protein, 3.6% ether extract, 38.5% aNDFom, and 70% estimated TDN. Concentrate composition were 88.0% dry matter, 94.3% organic matter, 20.6% crude protein, 3.8% ether extract, 16.4% aNDFom, and 82.4% estimated TDN [2].

The animals were observed for BCS at 20, 35, 50 days postpartum and milk samples for 24 hours were collected at each milking at days 20, 35, and 50 with the sampling device of AMS. Somatic cell counts were measured by a somatic cell counter (NucleoCounter SCC-100 ChemoMetec, Denmark). Reproduction data (days to first service, service per conception (S/C) and CI) for the cows in these experiments were obtained by the routine reproduction management in the experimental farm. Usually, oestrus was detected by the sensing system of AMS which automatically recorded behavior activity. The MIXED model for repeated measures [12] was used for testing the difference in SCC between treatments. Significance was declared at $P < 0.05$, and tendency at $P < 0.10$.

3. Results and discussion

Means of BCS, SCC, and reproductive performance data are shown in Table 1. In this study, BCS of cows between milking frequency treatments were similar and related to higher dry matter intake of MF4 cows in order to produce higher milk yields compared MF2 cows. Higher milking frequency produced higher milk yield (43.1 vs. 32.0 kg/d) [2]. Somatic Cell Count at day 20 was numerically lower in MF4 cows than for MF2 cows. At day 20, the proportion of cows showing more than 100,000 SCC were 60% for MF2 cows, while 0% for MF4 cows. Similar results were obtained at day 35, such that all of MF4 cows had numerically lower SCC (< 100,000, average 42,833) and MF2 cows had numerically higher SCC (> 100,000, average 146,000). At day 50, one cow from MF4 group had a high SCC due to mastitis infection, but the average of SCC in MF4 cows was numerically lower compared to MF2 cows (27,000 vs. 409,667). Overall, the probability for occurrence of high SCC (> 100,000) was lower for MF4 cows than that for MF2 cows (6% vs 59%), even though the difference in SCC between treatment groups was not significant. Previous results showed that increased milking frequency did not only increase milk yield but also decrease milk SCC [13, 15]. Calving intervals was 411 and 408 days for MF4 and MF2 cows, respectively. Days to first service were 106 and 95 days for MF4 and MF2 cows, respectively. Service per conception was 1.6 and 2.0 for MF4 and MF2 cows, respectively. Gisi et al. [7] found that milking frequency did not affect Calving Interval, days open or S/C. Barnes *et al.* (1990) also demonstrated that milking frequency did not affect days to first inseminations, S/C or days open. In contrast, a trend for increased days open with increasing milking

frequency was observed by Amos et al [1]. DePeters et al [5] also reported a decreased reproductive performance in cows milked 3 times compared with cows milked 2 times daily. In this study, however, no differences in reproductive performances of cows milked twice or 4 times daily were obtained.

Table 1. Reproductive performance and somatic cell counts (SCC) on early lactation cows milked by AMS

Milking frequency	BCS	High SCC *	Low SCC**	Calving to first service (day)	S/C	Calving interval (day)
2 times	2.77±0.175	59%	41%	95±16.0	2.0±0.71	408±54.2
4 times	2.77±0.167	6%	94%	106±12.3	1.6±0.63	411±44.5

High: SCC > 100,000 cell/ml; Low: SCC < 100,000 cell/ml
*High SCC: proportion of cows which showed more than 100.000 cell/ml, on average of 20, 35 and 50 days
**Low SCC: proportion of cows which showed less than 100.000 cell/ml, on average of 20, 35 and 50 days
S/C: service per conception ratio

4. Conclusion

Increasing milking frequency may lower milk SCC, and that 4 times milking frequency has higher probability for low SCC without any effects on BCS and reproductive performance. For future research, an observation with large number of cows and long time period are needed to clarify the more precise reproductive performance in cows milked by AMS.

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