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RESEARCH ARTICLE

Evaluation of Effects of Milking Hygiene and Management Factor on Clinical Mastitis Incidence in Dairy Cows

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Summary

The aim of this study was to determine the prevalence of clinical mastitis and somatic cell count (SCC) in six dairy herds which had different milking management and hygiene conditions. Four - hundred thirty one Holstein - Friesian cows were used in the study. The herds were classified to be good (Group 1, n=2), medium (Group 2, n=1) or bad (Group 3, n=3) according to milking management and hygiene. The study was carried out on these 3 groups. Diagnosis of clinical mastitis was based on pathological symptoms in quarters and abnormal changes in milk. Rates of clinical cases were 20.2%, 28.3% and 36.5% for good, medium and bad conditions. Individual (ISCC) and bulk tank (BTSCC) somatic cell count were categorized to be low, medium and high. Of the quarters, 82% had low ISCC (<200.000 cells mL^{-1}) in herds with good milking hygiene. Average ISCC and BTSCC values were higher in bad conditions than others ($P<0.05$).

Keywords: *Clinical mastitis, Dairy cow, Milking management, Hygiene conditions, Somatic cell count*

Sütçü İneklerde Sağım Hijyeni ve Yönetiminin Klinik Mastitis İnsidensi Üzerine Etkisinin Değerlendirilmesi

Özet

Bu çalışmanın amacı farklı sağım yönetimine ve hijyen şartlarına sahip altı adet sütçü inek işletmesinde klinik mastitis insidensi ve somatik hücre sayısını belirlemekti. Çalışmada 431 Holstein-Friesian inek kullanıldı. Sütçü inek işletmeleri sağım hijyeni ve yönetimine göre iyi; (Grup I, n=2), orta (Grup II, n=1) ve kötü (Grup III, n=3) olarak sınıflandırıldı. Çalışma bu 3 grup üzerinde yürütüldü. Klinik mastitisin tanısında meme loblarındaki patolojik değişiklikler ve sütteki normal olmayan değişiklikler esas alındı. Klinik mastitis oranı iyi, orta ve kötü koşullarda sırasıyla; %20.2; %28.3 ve %36.5 olarak belirlendi. Bireysel ve tank süt somatik hücre sayısı normal, orta ve yüksek olarak kategorize edildi. İyi sağım hijyeni ve yönetimine sahip işletmelerde meme loblarının %82'sinin düşük somatik hücre sayısına (<200.000 hücre mL^{-1}) sahip olduğu tespit edildi. Bireysel ve tank sütü ortalama somatik hücre sayısı değerlerinin kötü koşullarda diğerlerinden daha yüksek olduğu belirlendi ($P<0.05$).

Anahtar sözcükler: *Klinik mastitis, Sütçü inek, Sağım yönetimi, Hijyen şartları, Somatik hücre sayısı*

INTRODUCTION

Clinical mastitis is one of the important disease that causes excessive economic losses in dairy herds [1,2]. Many factors related with cows and herds affect the prevalence of clinical mastitis [3-6]. It is reported that clinical mastitis incidence, depend on various factors is generally between 12.7% and 57% in dairy herds [7-10].

Milking management and hygiene conditions are reported to be the most important factors on clinical mastitis and somatic cell counts (SCC) [11-13]. Milking and management practices included use of post-milking teat disinfection, excellent milking hygiene, culling for chronically infected animals, antibiotic treatment for

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dried cows off and clinical events, prevention of clinical mastitis [14-16].

Individual SCC and BTSCC are the most frequently used criteria for identifying milk quality and udder health program in dairy cows for many years [14,15,17,18]. It is suggested that low BTSCC can be maintain by arrangement of milking management and hygiene protocols [12,16]. In healthy cows, ISCC is generally found less than 200.000 cells/ml and higher value than this threshold is accepted to be a mammary gland infection [19,20].

The aim of this study was to determine the prevalence of clinical mastitis and somatic cell count (SCC) in dairy herds which had different milking management and hygiene conditions.

MATERIAL and METHODS

Study Design

In every herd, milking management and hygiene conditions were evaluated and the herds were divided into 3 groups to be good (n=2), medium (n=1) or bad (n=3). Cows and quarters were examined for detection of clinical mastitis cases and milk samples were collected to detect test day ISCC and BTSCC. All these findings were used for evaluating the clinical infection rates and average SCC in herds which had different milking management and hygiene conditions.

Detection of Herds and Cows

In this study, 431 Holstein-Friesian cows in different stage of lactation were chosen from 6 dairy herds which have a size ranging from 32 to 122 cows (average 71 cows). The herds were chosen if they had free stall barns and similar conditions as bedding material, diet, and climate. There was automatic milking system in all herds and milking was performed twice in a day. Average milk production was 4995±59 kg/305 days for the herds (between 3943±76 to 7483±124 kg/305 days). All observations in the herds were performed by the same researcher.

Evaluation of Milking Management and Hygiene Conditions

This evaluation was performed according to 14 criteria which established by previous reports [12,14,16]. A few milking was observed without any intervention by same researcher and herds were scored to be bad, medium or good *(Table 1)*. If 6 criteria were performed maximal, the herd accepted to be bad. The herd which had 8 criteria, it was evaluated to be medium. If 12 criteria were administrated at least, these herds were classified to be good.

Detection of Clinical Mastitis

Clinical mastitis was diagnosed by using inspection and palpation of udder. Symptoms like swelling, hardness

Table 1. *Criteria of milking management and hygiene protocol*
Tablo 1. *Sağım yönetimi ve hijyen kriterleri*

	Milking Management and Hygiene Protocols	Herds					
		A	**B**	**C**	**D**	**E**	**F**
1	Use of milking schedule	-	-	-	+	-	+
2	Udder cleaning	+	+	+	+	+	+
3	Pre-dipping	-	-	-	-	-	-
4	Post-dipping	+	+	+	+	+	+
5	Culling chronically affected cows	-	-	-	+	-	+
6	Treatment at dry-off	-/+	-/+	+	+	-	+
7	Treatment of clinical cases	-	-	+	+	-/+	+
8	Milking order	-	-	-	+	-	+
9	Experience of workers in milking	-	-	-	-/+	-	+
10	Udders and teats remaining clean	+	+	+	+	+	+
11	Treatment protocols applied for cure	+	+	+	+	+	+
12	BTSCC less than 400.000 cells/ml	-	-	+	+	-	+
13	Monitoring and recording of mastitis	-	-	-	+	-	+
14	Proper maintenance of milking system	-/+	-/+	+	+	-/+	+
	Score	**Bad**	**Bad**	**Medium**	**Good**	**Bad**	**Good**

(+) Proper, (-/+) Irregular, (-) Failed

or nodules were accepted to be clinical mastitis. Additionally, physical changes in milk (viscosity, color and density) and systemic symptoms were used for detection of clinical mastitis according to recommended procedure [21].

Collection of Milk Samples and Detection of SCC

Milk samples were taken prior to morning milking into 10 ml plastic tubes. Sampling from bulk tank was performed according to following procedure which stated in National Mastitis Council [22]. The tubes were labeled and sent to laboratory at +4°C. Somatic cell counts were detected using flow cytometry (Bactocount IBCm, Bentley Instrument, USA). The threshold value was accepted to be 200.000 cells per mL [19,20]. Individual SCC [23] and BTSCC values were divided into three categories: low (<200.000 cells mL^{-1}), medium (200.000 - 400.000 cells mL^{-1}) and high (>400.000 cells mL^{-1}).

Statistical Analysis

The average ISCC values were compared among groups by one-way variance analysis method. Descriptive statistics were used for detection of clinical mastitis rates in the groups and P<0.05 were considered to be significant.

RESULTS

Clinical Mastitis Rates in the Groups

Clinical mastitis rates were 20.2% (17 of 84 cows), 28.3% (17 of 60 cows) and 36.5% (105 of 287 cows) for good (Group 1), medium (Group 2) and bad (Group 3) conditions, respectively (*Table 2*). Additionally, experiences of workers in milking and herd sizes were found effective to minimize clinical cases. Although herd A and B had nearly 2 times greater herd size than herd F, clinical mastitis cases were 3 times higher. As clinical mastitis rate was lower in herd F, the herd had highest milk production than the others. However clinical mastitis cases were more prevalent in herd E though average milk yield and average milk yield in lactation was other herds had bad milking hygiene and management conditions (*Table 2*).

Individual SCC and BTSCC Values in the Groups

The average value of ISCC were $194x10^3$, $272x10^3$ and $561x10^3$ cells mL^{-1} for the herds with good, medium and bad milking management and hygiene conditions, respectively *(Table 3)*. High ISCC value in the herds with bad conditions were found to be significant, statistically (P<0.05). Although, the average ISCC in the herd with medium condition was upper than $200x10^3$ cells mL^{-1}, a

Table 2. *Descriptive results of the herds used in the study*
Tablo 2. *Çalışmadaki işletmelere ait tanımlayıcı sonuçlar*

Herds	**A**	**B**	**C**	**D**	**E**	**F**
Herd size	122	105	60	32	60	52
Quarter (n)	488	420	240	128	240	208
Average daily milk yield (kg/cow)	13.13	14.90	17.68	16.75	17.67	24.47
Average milk yield in lactation ± SE (kg/305day)	3943±76	4546±131	5358±196	5161±207	5358±113	7483±124
Average ISCC±SE $x10^3$ cells mL^{-1}	572±61	476±64	272±40	258±40	68±12	155±34
BTSCC ±SE $x10^3$cells mL^{-1}	451	543	274	380	984	234
Cows with clinical mastitis % (n)	37.7 (46)	30.4 (32)	28.3 (17)	31.2 (10)	45 (27)	13.4 (7)
Score	**Bad**	**Bad**	**Medium**	**Good**	**Bad**	**Good**

Table 3. *Classification of the mammary quarters and evaluation of average SCC results in groups*
Tablo 3. *Meme loblarının sınıflandırılması ve gruplardaki ortalama SHS sonuçlarının değerlendirilmesi*

Parameters Based on SCC	**Herds**		
	Good	**Medium**	**Bad**
Average ISCC ± SE $x10^3$ cells mL^{-1} (p)	194±47	272±62	561±14 (P<0.05)
Test day BTSCC $x10^3$ cells mL^{-1}	274	307	660
Quarters with high SCC n (%)	270 (82)	173 (72.9)	742 (65.8)
Quarters with medium SCC n (%)	26 (8)	27 (11.3)	129 (11.4)
Quarters with low SCC n (%)	33 (10)	37 (15.6)	256 (22.7)

significant difference with the herds had good condition was not found (P>0.05). On the other hand, quarters were classified to be low, medium and high according to SCC. Of the quarter's 82% and 65% had low SCC in the herds with good and bad conditions, respectively *(Table 3)*. A relationship was observed between high SCC value and clinical mastitis rates. Indeed, higher clinical mastitis rates were detected in the herds had high ISCC and BTSCC.

In this study, test day BTSCC values were compared between the herds in groups. The results showed that average BTSCC values were high in every condition and it was related with clinical infections that increased the BTSCC *(Table 3)*. One of the herds in bad conditions had excessive high BTSCC and affected the average value in this group (*Table 2*). It was clear that, high BTSCC value would be permanent, unless the clinical infections were not minimized in herd.

DISCUSSION

Some researchers have reported similar incidence of clinical mastitis in dairy herds [8,9]. However, previous reports stated lower incidence that ranged between 11.05% and 23% [7,10,11,24]. It was seen that, some criteria cause the difference among groups. Culling chronically affected cows, treatment of clinical cases, establishing of milking order, monitoring and recording of mastitis cases were performed especially in good managed herds. It was clear that milking hygiene and management conditions directly affected the clinical mastitis cases in a herd. Previous results supported to these findings [12,14,25,26]. In group F, clinical cases were limited and compatible with previous studies. In group A and B herd sizes were bigger than others and experiences of workers were in adequate so clinical mastitis cases caused milk production loss were more prevalent. Interestingly, herd E had greatest rate of clinical cases but average milk yield in lactation and average daily milk yield were as higher as the herd F. This finding was related with widespread infection started newly around test day in the herd.

It was a reality that environmental conditions and milking hygiene directly affect mammary gland health and SCC used for an indicator of health status. Especially, proper milking hygiene administrations could reduce the SCC in the herd because most bacteria caused sub-clinical infections and high SCC could contaminate the mammary gland during milking. This study showed that, average ISCC reduced when the hygiene conditions got better in the herds. Although there was no statistical difference for ISCC between herds with good and medium conditions, the bad conditioned herds had significantly higher ISCC. Similarly clinical mastitis cases were lower in the herds with low ISCC and BTSCC. This result was similar with previous reports suggested that the rates of clinical mastitis were higher in quarters with high SCC [3,27,28]. Probably, the quarters with high SCC might increase the risk of clinical mastitis in this study. On the other hand, some researchers reported that the lower SCC values in quarters might lead to increase the risk of clinical cases [3,29]. Erskine et al.[27] suggested that the herds with high SCC had low clinical infection rates when the herds with low SCC had high clinical mastitis rates. On the other hand some reports stated that there was not a relationship between them [14,28]. Contrary of these findings Baudeu et al.[29] declared that if the number of cows with high SCC (250.000 cells mL $^{-1}$) were higher than 15% of whole herd, the rates of clinical mastitis would increase. However, it was reported that clinical mastitis due to specific pathogens could change the BTSCC categories [10,14,28,30]. In clinical cases, *Escherichia coli* was reported [30] to be major causative agent in herds with bad milking conditions and *Staphylococcus aureus* was the most isolated bacteria in herds which had annual BTSCC above 150.000 mL $^{-1}$. But bacteriologic tests were not administrated in the current study. It was concluded that the difference between results could be related to the type of pathogen prevalent in the herds. According to Bastan et al.[31] 65% of quarters (224 of 344 quarters) could be subclinically infected at the beginning of lactation. So that subclinical infections can lead to clinical cases in udder, occasionally. In the further studies, bacteriologic results can be used for evaluation of management and hygiene status of dairy herds not only in clinical cases but also subclinical infections.

According to results milking management and hygiene conditions were quite effective on clinical mastitis rates and ISCC. It was a key point that proper milking management and hygiene conditions would decrease the clinical mastitis cases and increase milk quality. In the current study BTSCC were high in spite of good conditions. This result showed that clinical cases could not be detected and the mastitic milk was mixed into the bulk tank milk by workers. Thus, ISCC, BTSCC and rates of clinical mastitis cases can be used for evaluation of milking management and hygiene conditions in a herd. In the further studies, effects of each management factors on BTSCC, ISCC and clinical cases can be more detailed by periodic analysis.

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