https://doi.org/10.17221/62/2026-CJAS

Herd management practices associated with bulk tank somatic cell count on dairy farms in Western Türkiye

Tarik Ayyilmaz[1], *Can Uzmay*[2]*

[1]*Odemis Vocational School, Dairy and Beef Livestock Program, Ege University, Izmir, Türkiye*
[2]*Department of Animal Science, Faculty of Agriculture, Ege University, Izmir, Türkiye*

**Corresponding author: can.uzmay@ege.edu.tr*

Citation: Ayyilmaz T., Uzmay C. (2026): Herd management practices associated with bulk tank somatic cell count on dairy farms in Western Türkiye. Czech J. Anim. Sci., 71: 343–360.

Abstract: The objective of this study was to determine the associations between bulk tank somatic cell count (BTSCC) and herd management practices on dairy farms in Western Türkiye. The material of the study consisted of 81 registered dairy farms. The farms were visited at approximately one-month intervals. Somatic cell count was determined electronically in the milk samples. According to the average BTSCC values of the farms, two different BTSCC categories were created (low: ≤400 10^3 cells/ml with 40 farms and high: >400 10^3 cells/ml with 41 farms). A questionnaire form was created to determine the herd management practices. The association between herd management practices and BTSCC categories was evaluated using the logistic regression analysis. According to the multivariate analysis, the probability for a farm to belong to the low BTSCC category increased when maintaining the clean resting surface for cows, having a calving pen, applying pre-milking teat disinfection, and shutting off the vacuum to the claw before removing the milking cluster. In addition, the probability for a farm to belong to the low BTSCC tended to be high when not preferring a non-stanchion barn with a hard floor (concrete etc.) as resting surface in milking cow housing. According to the univariate analysis, the probability for a farm to belong to the low BTSCC category was increased significantly when maintaining the cleaner exercise area, cooling the cows, keeping records about udder health, ensuring that the teats are dry while attaching the milking cluster, applying post-milking teat disinfection, and having an automatic cluster remover. Consequently, if improvements are made in these management practices, the incidence of udder health problems and consequently BTSCC will decrease.

Keywords: bulk tank somatic cell count; dairy cattle; herd management practices

Somatic cells are body cells. The number of body cells in 1 ml of milk expresses the number of somatic cells (cells/ml) in milk. More than 95% of somatic cells are composed of white blood cells, including neutrophils, macrophages and lymphocytes (Bradley and Green 2005). Macrophages are the predominant type of white blood cells in the tissues of a healthy mammary gland and in the milk it produces (Sordillo and Streicher 2002). When an infection starts in the udder, because of the sig-

Supported financially by Coordination Unit of Ege University Scientific Research Projects (Project No. 2013-ZRF-038).

https://doi.org/10.17221/62/2026-CJAS

nal sent by the macrophages to the immune system, neutrophils are sent to the mammary gland to destroy the bacteria, and in such a case, more than 90% of the somatic cells are neutrophils (Ruegg 2001).

Somatic cell count (SCC) is a measure of udder health and milk quality (Harmon 1994). In milk from uninfected udders, the SCC is usually below 200 10^3 cells/ml (Harmon 1994; Ruegg 2001). The most important factor affecting the SCC in the quarter, cow or tank milk is an infection in the mammary gland (Dohoo and Meek 1982). When there is an infection in the udder, the number of white blood cells passing from the blood to the udder increases in response to this situation, and as a result, the number of somatic cells increases (Blowey and Edmondson 2010).

The bulk tank somatic cell count (BTSCC) provides information on the prevalence of udder infection and loss of milk yield in a herd. Eberhart et al. (1982) found that the rate of infected mammary quarters and milk yield loss increased as BTSCC increased. The reason for the decrease in milk yield is the damage caused by the infection in the milk-producing mammary tissues (Blowey and Edmondson 2010). In many studies, it was determined that as SCC or BTSCC increased, milk yield decreased (Moxley et al. 1978; Hutton et al. 1990; Fenlon et al. 1995; Barkema et al. 1998; De Vliegher et al. 2004; Chassagne et al. 2005; Rodrigues et al. 2005; Wenz et al. 2007).

According to the European Union's Directive 92/46/EEC, the SCC geometric mean of a three-month period (with at least one milk sample per month) in raw cow's milk to be used in the production of drinking milk, dairy products and milk-based products must be ≤400 10^3 cells/ml (European Council 1992). Considering this regulation, it becomes clear how important it is to keep BTSCC low (≤400 10^3 cells/ml).

Using high-quality raw milk, larger quantities of milk products of high quality and with a long shelf life are obtained. The amount of cheese obtained from raw milk with high SCC is lower (Politis and Ng-Kwai-Hang 1988; Barbano et al. 1991; Klei et al. 1998). The quality of pasteurised milk obtained from raw milk with high SCC also decreases (Ma et al. 2000), the shelf life is shortened (Barbano et al. 2006), and the formation of undesirable taste and aroma occurs faster (Santos et al. 2003). For these reasons, the dairy industry makes premium payments for milk with low SCC. Thus, producers who keep BTSCC at low values gain more.

Many studies have been carried out in many countries to determine the relationship between herd management practices and SCC or BTSCC (Moxley et al. 1978; Erskine et al. 1987; Hutton et al. 1990; Fenlon et al. 1995; Barkema et al. 1998; Barnouin et al. 2004; De Vliegher et al. 2004; Jayarao et al. 2004; Chassagne et al. 2005; Rodrigues et al. 2005; Wenz et al. 2007; Kelly et al. 2009; Sterrett and Bewley 2013). However, the number of studies revealing the relationship between herd management practices and SCC (Koc 2008) and subclinical mastitis (Uzmay et al. 2001) in Türkiye is very low.

The aim of this study is to determine the herd management practices which influence BTSCC on the member farms of the Cattle Breeders Association of the Izmir Province (ICBA). In this context, the situation has been presented in terms of herd management practices that may affect BTSCC on farms with different BTSCC levels.

MATERIAL AND METHODS

Selection of the farms. This study consisted of a total of 81 farms that are members of ICBA in 9 districts of Izmir. According to the BTSCC values of customer farms from two big milk processing plants in Izmir, preliminarily a total of 136 farms were selected. To personally monitor the average BTSCC on the 136 selected farms, they were visited at regular intervals (approximately once a month) and from each farm 11–15 milk samples (on average 12.35 samples per farm) were taken. Sampling was carried out between October 2014 and December 2016. During this time, a total of 1 680 tank milk samples were taken and analysed to determine BTSCC. The average BTSCC level of each farm was determined by taking the geometric mean of the BTSCC values. Finally, 81 out of these 136 farms were selected to examine the relations between BTSCC and herd management practices. By the final selection, average BTSCC and less variation between sample SCC values and willingness to cooperation of the farm owner were considered. According to the average BTSCC values of the farms, two different BTSCC categories were created. The first category (low BTSCC) included 40 farms with an average BTSCC of ≤400 10^3 cells/ml (≤400), the second category (high BTSCC) included 41 farms with an average BTSCC >400 10^3 cells/ml (>400).

https://doi.org/10.17221/62/2026-CJAS

Tank milk samples and SCC analysis. Tank milk samples were taken cold (around +4 °C) in the early hours of the morning, after morning milking was completed, and the tank cooling process was also completed. To take a homogeneous sample, the mixer of the tank is turned on manually and it is kept running in tanks with a capacity of ≤1 000 kg for at least 2 min, and at least 5 min in tanks with larger capacity (Goodridge et al. 2004; Servello et al. 2004). As soon as the mixing was finished, 40–45 ml milk samples were taken from the top of the tank into 50 ml plastic tubes with a long-handled stainless steel ladle.

In the samples, electronic somatic cell counting was performed using the Somacount 150 somatic cell counter (Bentley Instruments, Inc., Chaska, Minnesota, USA) in the Dairy Laboratory of the Ege University, Faculty of Agriculture, Department of Animal Science. The instrument counts somatic cells using the flow cytometry technique (Somacount 150 Operator's Manual; Bentley Instrument 1998).

Survey work. A detailed survey work was carried out on the selected 81 farms. A survey form was created to determine the situation on farms in terms of herd management practices (Table 1). Many sources were used to determine the information to be included in the survey form (Barkema et al. 1998; Barnouin et al. 2004; De Vliegher et al. 2004; Rodrigues et al. 2005; Svensson et al. 2006; Lievaart et al. 2007; Wenz et al. 2007; Kelly et al. 2009; Nyman et al. 2009).

Survey form filling works were carried out between January 2015 and January 2017. In this context, each selected farm (n = 81) was visited once, apart from milk sampling visits, and a survey form was filled out. In addition, observations were made during sampling visits. The information in the survey form has been collected through personal observation on each farm, by asking questions to the owner and/or employees.

Statistical analysis. SPSS statistical package program was used in statistical analysis (SPSS v25, 2017; SPSS, USA). The relationship between herd management practices and farm BTSCC categories (low and high) was tested using binary logistic regression analysis. The logistic regression analysis was carried out in two steps. In the first step, the relationship between each individual herd management practice and BTSCC categories was analysed (univariate analysis). In the second step, the herd management practices, whose relationship with the BTSCC categories alone was significant (P < 0.05) or tended to be significant at the level of P < 0.10

Table 1. The topics included in the questionnaire (survey) form created to determine the situation in terms of herd management practices on farms

Housing practices	Barn type for milking cows (structure of the resting surface). The cleanliness of the resting area for milking cows. Availability of outside exercise area in milking cow barns. Cleanliness of outside exercise area for milking cows. Availability of calving pen. Availability of a cooling system in milking cow barn.
Udder health control practices	Use of California Mastitis Test (CMT). Administration of mastitis vaccine. Application of dry period treatment (DPT). Keeping udder health records.
Milking practices	Number of milkings per day. Performing pre-milking. Performing pre-milking teat disinfection (pre-dipping). Wetness of the teats while the milking cluster is being attached. Shutting off vacuum to the claw before removing cluster. Performing machine stripping. Performing teat disinfection after milking (post-dipping). Availability of automatic cluster remover in the milking system.

https://doi.org/10.17221/62/2026-CJAS

according to the Wald test statistic in the univariate analysis, were analysed together in the multiple logistic regression model in which the variable elimination (backward) approach was used. On the other hand, the logistic regression analysis could not be used in the evaluation of the relationship between some management practices (CMT application, the number of milkings per day, performing pre-milking) and BTSCC, because of reasons of the calculation technique (expected value was less than 5 in one of the 4 cells in the cross table). To obtain accurate results in the logistic regression analysis, there should be no cells with 0 observations in the cross tables created between the dependent variable and the independent variables and the rate of cells with an expected value less than 5 should be 20% at most (Field 2017).

The mathematical model of the logistic regression analysis used to determine the herd management practices that distinguish the farms with low BTSCC (≤400) from the farms with high BTSCC (>400) is given below:

$$P(Y) = [1 + \exp - (\beta_0 + \beta_1 X_1 + \beta_2 X_2 + + \dots + \beta_k X_k)]^{-1} \quad (1)$$

where:

$P(Y)$ – the probability that a farm is in the low BTSCC category (1) or not (0);

X – independent variables;

β – regression coefficients.

In addition, cross tables were prepared to show the distribution of subcategories (levels) of the independent variables considered in the study within the BTSCC categories. Pearson's chi-square test was used to reveal the statistical significance of differences in the distributions. BTSCC means of the subcategories of the independent variables were compared using one-way analysis of variance (one-way ANOVA). Log_{10} BTSCC values of the farms were used in the one-way analysis of variance.

RESULTS

Descriptive statistics for BTSCC and number of bulk milk samples per farm according to the BTSCC categories are presented in Table 2. According to the BTSCC categories, the geometric means of BTSCC were determined as 240 10^3 and 649 10^3 cells/ml, the means of $\log_{10}$ BTSCC were determined as 5.36 and 5.79 cells/ml, and the average number of samples per farm was 12.48 and 12.51, respectively.

Relationship between housing practices and BTSCC. On all the farms examined, the barns are of the "semi-open" and free type. According to the structure of the lying area, the barns are generally divided into two types as "with stanchions (individual stalls)" and "non-stanchion barns". As can be seen in Table 3, 29.6% of the barns have stanchions as individual lying area. Non-stanchion barns are divided into two types according to the structure of the lying area as "concrete floor" and "soil floor". Almost half of the barns have hard concrete floor (48.2%), while 22.2% have soil floor as lying area. No bedding material is used in any of the non-stanchion barns. On 29.6% of farms, cows lie on a clean floor, while in 37.1% of farms they lie on a dirty floor. On 33.3%

Table 2. Descriptive statistics for BTSCC according to the BTSCC categories

Traits	n	$\bar{x}$	SD	Minimum	Maximum
Geometric mean of BTSCC (cell/ml; ×10^3)					
≤400	40	240	70	107	373
>400	41	649	205	422	1 184
Log_{10} BTSCC mean (cell/ml)					
≤400	40	5.36	0.14	5.03	5.57
>400	41	5.79	0.13	5.63	6.07
Number of bulk tank samples per farm					
≤400	40	12.48	0.91	11	15
>400	41	12.51	0.87	11	15

BTSCC = bulk tank somatic cell count; n = number of farms; SD = standard deviation; $\bar{x}$ = arithmetic mean from the geometric mean values of the farms

https://doi.org/10.17221/62/2026-CJAS

Table 3. The average BTSCC level of the farms according to the housing practices

Factor	n	%	BTSCC (cell/ml; ×10^3)		Log$_{10}$ BTSCC (cell/ml)		P
			$\bar{x}$	$S_{\bar{x}}$	$\bar{x}$	$S_{\bar{x}}$	
Barn type (structure of the resting surface)							<0.001
Concrete floor without stanchions	39	48.2	574	45	5.70^a	0.04	
Soil floor without stanchions	18	22.2	339	31	5.50^b	0.04	
Stanchions (indvidual resting area)	24	29.6	322	38	5.45^b	0.05	
The cleanliness of the resting surface							<0.001
Dirty	30	37.1	649	47	5.78^c	0.04	
Moderate	27	33.3	386	33	5.55^b	0.04	
Clean	24	29.6	262	28	5.37^a	0.04	
Outside exercise area							0.898
Absent	20	24.7	429	46	5.59	0.05	
Present	61	75.3	453	35	5.58	0.04	
Cleanliness of outside exercise area							<0.001
Dirty	24	39.4	638	57	5.76^b	0.04	
Moderate	21	34.4	375	48	5.50^a	0.06	
Clean	16	26.2	276	31	5.40^a	0.05	
Calving pen							<0.001
Absent	41	50.6	548	41	5.68	0.04	
Present	40	49.4	344	33	5.47	0.04	
Barn cooling system for lactating cows							0.004
Absent	60	74.1	495	35	5.63	0.03	
Present	21	25.9	311	35	5.44	0.04	

[a–c]Means in the same column within each factor with different superscript letters differ significantly according to the significance level of 0.05 (according to Games–Howell)

BTSCC = bulk tank somatic cell count; n = number of farms; P = significance value of the factor according to one-way ANOVA (single-factor analysis of variance) using log$_{10}$ BTSCC values; $S_{\bar{x}}$ = standard error; $\bar{x}$ = arithmetic mean from the geometric mean values of the farms

of farms the cleanliness level of the floor was determined as moderate. On 75.3% of farms, there was an outside exercise area. The outside exercise area was clean on 26.2% and dirty on 39.4% of these farms. And on 34.4% of farms, the cleanliness level was moderate. 49.4% of farms had a calving pen. A barn cooling system for lactating cows was installed on 25.9% of farms (Table 3).

The average log$_{10}$ BTSCC (5.70 cells/ml) in non-stanchion barns with concrete floor as lying area was significantly higher than that (5.50 cells/ml) in barns with soil floor. The log$_{10}$ BTSCC was lowest (5.45 cells/ml) in barns with stanchions as individual lying area (P < 0.001). On farms with a dirty lying area the average log$_{10}$ BTSCC (5.78 cells/ml) was higher than that on farms with a moderate level of cleanliness and farms with clean lying area (5.55 and 5.37 cells/ml, respectively) (P < 0.001) (Table 3).

There was no difference between farms with and without exercise area according to the log$_{10}$ BTSCC. But as the cleanliness of the outside exercise area worsened, the average BTSCC also increased. While the average log$_{10}$ BTSCC on farms with the clean exercise area was 5.40 cells/ml, it was 5.50 cells/ml on those with moderate cleanliness and 5.76 cells/ml on those with dirty exercise area (P < 0.001). The mean log$_{10}$ BTSCC was found to be lower on farms with a calving pen than on farms without it (5.47 cells/ml vs 5.68 cells/ml) (P < 0.001). The mean log$_{10}$ BTSCC was found to be lower on farms with a barn cooling system compared to the farms without a barn cooling system (5.44 and 5.63 cells/ml, respectively) (P < 0.01) (Table 3).

https://doi.org/10.17221/62/2026-CJAS

Among the non-stanchion barns with soil floor as resting surface, the majority of farms (72.2%) are in the ≤400 category, while the majority of those with concrete floors are in the >400 category (74.4%). Among barns with stanchions, the majority (70.8%) are in the ≤400 category. Most of the farms whose cows lie on clean and moderate clean lying ground are in the ≤400 category (79.2% and 59.3%, respectively). On the other hand, most of farms with dirty lying areas (83.3%) are in the >400 category. Most of the farms with clean and moderate clean outside exercise area are in the ≤400 category (68.7% and 61.9%). Most of the farms with dirty exercise area (79.2%) are in the >400 category. Most of the farms (70.0%) with calving pen are in the ≤400 category, while the majority of those (70.7%) without calving pen are in the >400 category. Most of the farms (76.2%) with barn cooling system are in the ≤400 category, while many of the farms (60.0%) without cooling are in the >400 category. These differences in the distribution of the farms within the BTSCC categories according to structure of the lying area, lying area cleanliness, outside exercise area cleanliness, presence of calving pen and presence of a barn cooling system were significant according to Pearson's chi-square test results ($P < 0.001$, $P < 0.001$, $P < 0.01$, $P < 0.001$ and $P < 0.01$, respectively).

On the other hand, 47.5% of the farms with an outside exercise area and 55.0% of the farms without an outside exercise area are in the ≤400 category. Differences in the distribution of farms within the BTSCC categories according to the presence of an outside exercise area were not significant (Table 4).

According to the results of the univariate logistic regression analysis, the probability for a farm to belong to the low BTSCC category increased signifi-

Table 4. The distribution of farms by BTSCC categories and the odds ratio and the significance values of univariate logistic regression analysis according to the housing practices

Factor	n	Distribution by BTSCC category (%)		P_1	Logistic regression	
		≤400	>400		odds ratio	P_2
Barn type (the structure of the resting area)				<0.001		<0.001
Concrete floor without stanchions	39	25.6	74.4		1	
Soil floor without stanchions	18	72.2	27.8		7.540	
Stanchions (individual resting area)	24	70.8	29.2		7.043	
The cleanliness of the resting area				<0.001		<0.001
Dirty	30	16.7	83.3		1	
Moderate	27	59.3	40.7		7.273	
Clean	24	79.2	20.8		19.000	
Outside exercise area				0.563		0.563
Absent	20	55.0	45.0		1.349	
Present	61	47.5	52.5		1	
Cleanliness of outside exercise area				0.003		0.006
Dirty	24	20.8	79.2		1	
Moderate	21	61.9	38.1		6.175	
Clean	16	68.7	31.3		8.360	
Calving pen				<0.001		<0.001
Absent	41	29.3	70.7		1	
Present	40	70.0	30.0		5.639	
Barn cooling system for lactating cows				0.004		0.006
Absent	60	40.0	60.0		1	
Present	21	76.2	23.8		4.800	

BTSCC = bulk tank somatic cell count; n = number of farms; P_1 = significance level according to Pearson's chi-square test; P_2 = significance level of the relationship according to the Wald test statistics

https://doi.org/10.17221/62/2026-CJAS

cantly when not preferring a non-stanchion barn with concrete floor as resting surface, maintaining the clean resting surface, maintaining the cleaner outside exercise area, having a calving pen, and with the presence of a cooling system in the dairy barn. When compared to non-stanchion barns with concrete floor as lying area (reference level), the probability of being in the low BTSCC category for farms with stanchion barns was 7.04 times higher, and for farms with soil floors it was 7.54 times higher ($P < 0.001$). When compared to farms with dirty lying area, the probability to be in the ≤400 category was 19.0 and 7.27 times higher for farms with a clean or moderate clean lying area ($P < 0.001$). When compared to farms with dirty outside exercise area, the probability of a farm with a clean or moderate clean outside exercise area being in the ≤400 category was 8.36 and 6.18 times higher, respectively ($P < 0.01$). The probability of being in the ≤400 category was 5.64 times higher on a farm with a calving pen compared to farms without a calving pen ($P < 0.001$). The probability of farms with a cooling system to be in the ≤400 category was 4.80 times higher compared to farms without a cooling system ($P < 0.01$). According to the logistic regression analysis no significant relation could be found between the presence of an outside exercise area and BTSCC. So, this management factor was not included in the multiple logistic regression analysis (Table 4). Also, the cleanliness of the outside exercise area could not be included in the multiple logistic regression analysis, since not every farm in the study had an exercise area.

Relationship between udder health control practices and BTSCC. Only 12.3% of the investigated farms use CMT. Most of the farms (60.5%) apply mastitis vaccination. On most farms (70.4%), DPT is applied. No records regarding the udder health are kept on most of the farms (72.80%) (Table 5).

The mean $\log_{10}$ BTSCC on farms with CMT application was lower than that on farms without it (5.39 and 5.61 cells/ml, respectively) ($P < 0.05$). Also, the $\log_{10}$ BTSCC on farms with DPT tended to be lower than that on farms without it (5.54 and 5.66 cells/ml, respectively) ($P = 0.058$). The mean $\log_{10}$ BTSCC on farms where records on udder health were kept was lower than that on farms where no records were kept (5.45 and 5.63 cells/ml, respectively) ($P < 0.01$). On the other hand, the average $\log_{10}$ BTSCC for farms applying mastitis vaccination and for farms not applying it was equal (5.58 and 5.58 cells/ml, respectively) (Table 5).

The vast majority (90%) of the farms that used CMT are in the ≤400 category, while 56.3% of those that have not applied CMT are in the >400 category. More than half of the farms (56.1%) applying DPT are in the ≤400 category, while the majority of those

Table 5. The average BTSCC level of the farms according to the udder health control practices

Factor	n	%	BTSCC (cell/ml; ×10^3)		$\log_{10}$ BTSCC (cell/ml)		P
			$\bar{x}$	$S_{\bar{x}}$	$\bar{x}$	$S_{\bar{x}}$	
CMT							0.012
Not being done	71	87.7	465	29	5.61	0.03	
Being done	10	12.3	315	99	5.39	0.09	
Mastitis vaccine							0.972
Not being done	32	39.5	439	43	5.58	0.04	
Being done	49	60.5	452	38	5.58	0.04	
DPT							0.058
Not being done	24	29.6	520	54	5.66	0.05	
Being done	57	70.4	416	33	5.54	0.03	
Keeping udder health records							0.004
Not being done	59	72.8	488	33	5.63	0.03	
Being done	22	27.2	336	51	5.45	0.06	

BTSCC = bulk tank somatic cell count; CMT = California Mastitis Test; DPT = dry period treatment; n = number of farms; P = significance value of the factor according to one-way ANOVA (single-factor analysis of variance) using $\log_{10}$ BTSCC values; $S_{\bar{x}}$ = standard error; $\bar{x}$ = arithmetic mean from the geometric mean values of the farms

https://doi.org/10.17221/62/2026-CJAS

not applying it (66.7%) are in the >400 category. Most of the farms keeping udder health records (72.70%) are in the ≤400 category, while more than half of those without health records (59.30%) are in the >400 category. These differences in the distribution of the farms within the BTSCC categories according to CMT application, DPT application and status of keeping udder health records were significant or tended to be significant according to Pearson's chi-square test ($P < 0.01$, $P = 0.061$ and $P = 0.01$, respectively). The farms were distributed similarly within the BTSCC categories according to the status of mastitis vaccine application (Table 6).

According to the results of the univariate logistic regression analysis, the probability of being in the ≤400 category is 3.89 times higher on a farm that keeps records compared to farms that do not keep any records on udder health ($P < 0.05$). Compared to farms that did not apply DPT, the probability for a farm applying DPT being in the ≤400 category was 2.56 times higher ($P = 0.065$). No significant relationship could be found between mastitis vaccine application and BTSCC (Table 6). So, this management factor was not included in the multiple logistic regression analysis.

Relationship between milking practices and BTSCC. Most farms (93.8%) milk cows twice a day. Only 12.3% of the farms performed pre-milking. On 19.8% of the farms, teat disinfection is performed before milking. It was found that the cows on 45.7% of the farms had dry teats when the milking cluster was attached. The majority of the farms (67.9%) performed machine stripping. On 59.3% of the farms, the vacuum is shut off before the milking cluster is removed. Only 27.2% of the farms perform post-milking teat disinfection. Only 13.6% of the farms had automatic cluster removers on their milking system (Table 7).

The mean $\log_{10}$ BTSCC was significantly lower on farms where pre-milking teat disinfection was performed than on farms that did not use this practice (5.42 and 5.62 cells/ml, respectively) ($P < 0.01$). The mean $\log_{10}$ BTSCC was lower on the farms where the teats were dried before attaching the milking cluster than on the farms with cows with wet teats (5.51 and 5.64 cells/ml, respectively) ($P < 0.05$). The mean $\log_{10}$ BTSCC was higher on the farms where machine stripping is performed than on the farms where it is not performed (5.62 and 5.48 cells/ml, respectively) ($P < 0.05$). The mean $\log_{10}$ BTSCC was lower on the farms where the milking cluster was removed by shutting off the vacuum than on the farms where it was removed without shutting it off (5.51 and 5.69 cells/ml, re-

Table 6. The distribution of farms by BTSCC categories and the odds ratio and the significance values of univariate logistic regression analysis according to the udder health control practices

Factor	n	Distribution by BTSCC category (%)		P_1	Logistic regression	
		≤400	>400		odds ratio	P_2
CMT				0.006		–
Not being done	71	43.7	56.3		#	
Being done	10	90.0	10.0		#	
Mastitis vaccine				0.928		0.928
Not being done	32	50.0	50.0		1.042	
Being done	49	49.0	51.0		1	
DPT				0.061		0.065
Not being done	24	33.3	66.7		1	
Being done	57	56.1	43.9		2.560	
Keeping udder health records				0.010		0.013
Not being done	59	40.7	59.3		1	
Being done	22	72.7	27.3		3.889	

#The logistic regression analysis could not be performed due to the imbalance in distribution

BTSCC = bulk tank somatic cell count; CMT = California Mastitis Test; DPT = dry period treatment; n = number of farms; P_1 = significance level according to Pearson's chi-square test; P_2 = significance level of the relationship according to the Wald test statistic

https://doi.org/10.17221/62/2026-CJAS

Table 7. The average BTSCC level of the farms according to the milking practices

Factor	n	%	BTSCC (cell/ml; ×10^3)		Log_{10} BTSCC (cell/ml)		P
			$\bar{x}$	$S_{\bar{x}}$	$\bar{x}$	$S_{\bar{x}}$	
Number of milkings per day							0.741
2	76	93.8	451	30	5.58	0.03	
3	5	6.2	392	95	5.54	0.10	
Pre-milking							0.180
Not being done	71	87.7	463	31	5.59	0.03	
Being done	10	12.3	333	58	5.48	0.06	
Teat disinfection before milking							0.005
Not being done	65	80.2	486	33	5.62	0.03	
Being done	16	19.8	287	35	5.42	0.04	
Wetness of the teats while attaching milking cluster							0.018
Wet	44	54.3	516	43	5.64	0.04	
Dry	37	45.7	365	31	5.51	0.04	
Machine stripping							0.020
Not being done	26	32.1	355	41	5.48	0.05	
Being done	55	67.9	490	36	5.62	0.03	
Shutting off vacuum before removing cluster							0.002
Not being done	33	40.7	541	44	5.69	0.04	
Being done	48	59.3	382	35	5.51	0.04	
Teat disinfection after milking (post dipping)							0.002
Not being done	59	72.8	497	35	5.63	0.03	
Being done	22	27.2	312	34	5.44	0.05	
Automatic cluster remover							0.003
Absent	70	86.4	477	31	5.61	0.03	
Present	11	13.6	254	34	5.37	0.05	

BTSCC = bulk tank somatic cell count; n = number of farms; P = significance value of the factor according to one-way ANOVA (single-factor analysis of variance) using $\log_{10}$ BTSCC values; $S_{\bar{x}}$ = standard error; $\bar{x}$ = arithmetic mean from the geometric mean values of the farms

spectively) ($P < 0.01$). The mean $\log_{10}$ BTSCC was lower on the farms where post-milking teat disinfection was performed compared to those that did not perform it (5.44 and 5.63 cells/ml, respectively) ($P < 0.01$). The mean $\log_{10}$ BTSCC on the farms with automatic cluster remover was lower than on the farms without it (5.37 and 5.61 cells/ml, respectively) ($P < 0.01$). The mean $\log_{10}$ BTSCC on the farms milking cows three times and twice a day were quite close to each other (5.54 and 5.58 cells/ml, respectively). The mean $\log_{10}$ BTSCC was lower on the farms performing pre-milking than on those not performing this practice (5.48 and 5.59 cells/ml, respectively). However, the difference between the means was not statistically significant (Table 7).

Most of the farms where pre-milking is performed (80.0%) are in the ≤400 category, while the farms where pre-milking is not performed are predominantly (54.9%) in the >400 category. Most of the farms (87.5%) that apply pre-milking teat disinfection are in the ≤400 category, while many of the farms (60.0%) that do not apply it are in the >400 category. Most of the farms where the milking cluster is attached to dry teats are in the ≤400 category (62.2%), while many of the farms where it is attached to wet teats are in the >400 category (61.4%) (Table 8).

Most of the farms (65.4%) which do not perform machine stripping are in the ≤400 category, while the farms which perform it are predominantly

https://doi.org/10.17221/62/2026-CJAS

Table 8. The distribution of farms by BTSCC categories and the odds ratio and the significance values of univariate logistic regression analysis according to the milking practices

Factor	*n*	Distribution by BTSCC category (%)		P_1	Logistic regression	
		≤400	>400		odds ratio	P_2
Number of milkings per day				0.624		–
2	76	48.7	51.3		#	
3	5	60.0	40.0		#	
Performing pre-milking				0.039		–
Not being done	71	45.1	54.9		#	
Being done	10	80.0	20.0		#	
Teat disinfection before milking (pre-dipping)				0.001		0.003
Not being done	65	40.0	60.0		1	
Being done	16	87.5	12.5		10.500	
Wetness of teats while attaching milking cluster				0.035		0.037
Wet	44	38.6	61.4		1	
Dry	37	62.2	37.8		2.609	
Machine stripping				0.048		0.051
Being done	55	41.8	58.2		1	
Not being done	26	65.4	34.6		2.628	
Shutting off vacuum before removing cluster				0.001		0.001
Not being done	33	27.3	72.7		1	
Being done	48	64.6	35.4		4.863	
Teat disinfection after milking (post dipping)				0.010		0.013
Not being done	59	40.7	59.3		1	
Being done	22	72.7	27.3		3.889	
Presence of automatic cluster remover				0.003		0.016
Absent	70	42.9	57.1		1	
Present	11	90.9	9.1		13.333	

#The logistic regression analysis could not be performed due to the imbalance in distribution
BTSCC = bulk tank somatic cell count; *n* = number of farms; P_1 = significance level according to Pearson's chi-square test; P_2 = significance level of the relationship according to the Wald test statistic

in the >400 category (58.2%). Most of the farms (64.6%) where the milking cluster was removed by shutting off the vacuum were in the ≤400 category, while many of the farms (72.7%) where it was removed it without shutting off the vacuum were in the >400 category. Most of the farms (72.7%) where post-milking teat disinfection is performed are in the ≤400 category, while the farms that do not perform this practice are predominantly (59.3%) in the >400 category. Almost all the farms with automatic cluster removers (90.9%) are in the ≤400 category, while more than half of the farms without cluster remover (57.1%) are in the >400 category. These differences in the distribution of the farms within the BTSCC categories according to pre-milking application, pre-dipping application, wetness of the teats while attaching the milking cluster, performing machine stripping, status of shutting off the vacuum before removing the milking cluster, post-dipping application and presence of automatic cluster removers were found to be significant according to Pearson's chi-square test ($P < 0.05$, $P = 0.001$, $P < 0.05$, $P < 0.05$, $P = 0.001$, $P = 0.01$ and $P < 0.01$, respectively). On the other hand, 48.7% of the farms milking cows twice a day are in the ≤400 category, while 60.0% of the farms milking cows three times a day are in the ≤400 category. The differences in the distribution of the farms within

https://doi.org/10.17221/62/2026-CJAS

the BTSCC categories according to the number of daily milkings were not significant (Table 8).

According to the results of the univariate logistic regression analysis, the probability for a farm to belong to the low BTSCC category increased significantly ($P < 0.05$) when applying pre-milking teat disinfection (pre-dipping), ensuring that the teats are dry while attaching the milking cluster, shutting off the vacuum before removing the milking cluster, applying post-milking teat disinfection (post-dipping), and having an automatic cluster remover in the milking system. The probability of being in the ≤400 category is 10.50 times higher on a farm where pre-milking teat disinfection is applied compared to farms where pre-milking teat disinfection is not applied ($P < 0.01$). Compared to farms where the milking cluster is attached to wet teats, the probability of a farm where the cluster is attached to dry teats being in the ≤400 category is 2.61 times higher ($P < 0.05$). The probability of being in the ≤400 category is 4.86 times higher on a farm where the milking cluster is removed by shutting off the vacuum, compared to farms where the milking cluster is removed without shutting off the vacuum ($P = 0.001$). The probability of being in the ≤400 category is 3.89 times higher for a farm that performs post-milking teat disinfection compared to farms that do not perform any post-milking teat disinfection ($P < 0.05$). The probability of being in the ≤400 category is 13.33 times higher on a farm with automatic cluster removers compared to farms without automatic cluster removers in the milking system ($P < 0.05$). The probability for a farm belonging to the low BTSCC category tended to increase on the farms where no machine stripping is performed ($P < 0.10$). The probability of a farm which does not perform any machine stripping to be in the ≤400 category is 2.63 times higher ($P = 0.051$) (Table 8).

Table 9 presents the results of the multiple logistic regression analysis in which 12 herd management practices, whose individual relationships with the BTSCC categories were found to be significant ($P < 0.05$) or tended to be significant ($P < 0.10$) according to the univariate logistic analysis and Wald test statistics, were evaluated together in the model.

Table 9. The results of the final logistic regression analysis model which includes 5 factors whose relationship with the BTSCC category (low, high) was found to be significant ($P < 0.05$) or tended to be significant ($P < 0.10$)

Factor	β	$S_{\bar{x}}$	OR	CI		P
				lower	upper	
Barn type (the structure of the resting area)						0.070
Concrete floor without stanchions	–	–	1.000	–	–	–
Soil floor without stanchions	1.476	0.829	4.377	0.862	22.209	0.075
Stanchions (individual resting area)	–0.990	0.951	0.371	0.058	2.397	0.298
The cleanliness of the resting area						0.053
Dirty	–	–	1.000	–	–	–
Moderate	1.558	0.781	4.750	1.028	21.949	0.046
Clean	2.005	0.881	7.425	1.321	41.733	0.023
Calving pen						0.033
Absent	–	–	1.000	–	–	–
Present	1.589	0.744	4.901	1.139	21.086	0.033
Pre milking teat disinfection (pre-dipping)						0.018
Not being done	–	–	1.000	–	–	–
Being done	2.287	0.968	9.844	1.477	65.600	0.018
Shutting off vacuum before removing cluster						0.021
Not being done	–	–	1.000	–	–	–
Being done	1.637	0.706	5.138	1.287	20.516	0.021

β = regression coefficient; CI = 95% confidence interval values of OR; OR = odds ratio; P = significance level of the relationship according to the Wald test statistic; $S_{\bar{x}}$ = standard error

https://doi.org/10.17221/62/2026-CJAS

The multiple logistic regression model, which started with twelve herd management practices, turned into a model in which only 5 herd management practices were found to have a significant effect on the BTSCC category a farm would be included. As can be seen in Table 9, the cleanliness of the resting area in dairy barns, the presence of a calving pen, the application of pre-milking teat disinfection (pre-dipping) and shutting off the vacuum before removing the milking cluster were found to have a significant ($P < 0.05$) effect on the BTSCC category a farm would be included. In addition, the type of barn (structure of the resting surface) tended to have a significant effect ($P < 0.10$) on the BTSCC category a farm would be included.

DISCUSSION

One of the most important design criteria for housing dairy cows is to provide a comfortable lying place (Ito et al. 2009). On almost half of the farms examined in the present study, dairy cows are kept in non-stanchion barns with floors made of hard and impermeable materials such as concrete. In addition, no bedding is used in these barns, and the cows lie on the hard concrete floor. It has been observed that these types of barns, which have poor housing conditions, do not provide a comfortable resting area for the cows and the conditions become worse, especially in the winter months. The univariate logistic regression analysis showed that the probability of being included in the low BTSCC category was higher on the farms where dairy cows were kept in stanchion barns or in non-stanchion barns with a floor made of softer and permeable materials such as soil or sand, compared to the farms that kept their dairy cows in non-stanchion barns on concrete floor. Uzmay et al. (2001) reported that the probability of getting subclinical mastitis was lower on farms using sand bedding than on farms not using bedding in the resting area. Also, our results show that BTSCC tends to be lower on farms where cows are housed on soil or sand floor instead of on hard concrete floors without stanchions.

According to our results, the probability of being in the low BTSCC category increases as the cleanliness of the resting surface for milking cows improves. The udders of cows that must lie on a dirty floor get dirty. Schreiner and Ruegg (2003) found that infectious (contagious) and environmental microorganisms were detected more frequently and the number of somatic cells was higher in the milk of cows with dirty udders than in cows with clean udders. In addition, Ellis et al. (2007) found that BTSCC was higher on farms with dirty cows. In a study by Sterrett and Bewley (2013), who examined farms with an average annual herd SCC value of <250 10^3 cells/ml, when farmers were asked which herd management practice was most effective in keeping SCC low, the first two answers were keeping cows and barns clean and keeping bedding dry and clean. In other studies, SCC was found lower on farms where cows had a dry (Hutton et al. 1990) and clean (Barkema et al. 1998; Kelly et al. 2009) resting area.

In terms of animal welfare, it is very important that the cattle have access to pasture or at least to an outside exercise area. However, in bad weather (winter) conditions, the situation in open areas may also deteriorate. In poorly designed outside exercise areas with poor drainage, the soil, manure and rainwater combine to create a dirty and muddy ground structure. In cows staying on such a surface, mastitis cases caused by environmental microorganisms may increase. Barnouin et al. (2004) concluded that dairy farms where the cows were not taken out to pasture in bad weather conditions and the heifers were not kept in muddy pastures were more likely to be in the low somatic cell score category. According to results of the univariate logistic regression analysis in our study, as the cleanliness level of the outside exercise area improves, the probability of farms being in the low BTSCC category increases. On the other hand, the presence of the outside exercise area has no significant effect on the BTSCC category the farm would be included.

We found that farms which have calving pens were more likely to be in the low BTSCC category. Cows are more vulnerable to intramammary infections during the calving period due to reasons such as changes in the defence mechanisms of the mammary gland and due to opening of the teat canal (leakage from the udder) because of the increase in udder pressure at that time (Sordillo and Streicher 2002). Barnouin et al. (2004) found that farms where the cattle, especially heifers, were moved into a calving pen before calving were more likely to be in the low somatic cell score category. They stated that giving birth in a calving pen provides cleaner conditions. Bartlett et al. (1992) drew a conclusion that less clinical mastitis was seen

https://doi.org/10.17221/62/2026-CJAS

on the farms where most of the calving took place in calving pens. In studies examining the calving pen conditions, SCC was lower on farms that kept the bedding in the pen drier (Hutton et al. 1990; De Vliegher et al. 2004) and renewed it after each calving (Barkema et al. 1998).

The immune system is suppressed in heat-stressed cows, and as a result, cows are more vulnerable to intramammary infections (Smith et al. 1985; Becker et al. 2020). In addition, the hot and humid conditions of the summer months provide a suitable environment for the development of coliform bacteria in the manure (Smith et al. 1985). According to the univariate logistic regression analysis in our study, the high probability of farms with cooling systems to be in the low BTSCC category suggests that cows on these farms are less affected by heat stress and that the fans used for cooling have an inhibitory effect on the development of pathogenic microorganisms by ensuring the drier environment.

CMT is the best practical method for determining which quarter or quarters are causing high SCC in a cow with high SCC (Bradley and Green 2005). Chassagne et al. (2005) found that CMT was applied at a higher rate on farms in the low somatic cell score (SCC) category than on farms in the medium SCC category (31.5% and 20.5%, respectively), and the probability of being in the low SCC category was 1.91 times higher on farms that applied CMT to at least 1 cow during milking compared to farms that did not apply it at all. Busato et al. (2000) determined in their study that CMT was performed regularly on 29.6% of the farms and the probability of subclinical mastitis incidence on these farms was 1.22 times lower compared to farms that did not perform CMT regularly. Koc (2008) reported that regular CMT was associated with lower SCC. Our study determined that BTSCC was lower on farms where CMT was performed.

It is reported that mastitis vaccines do not reduce the incidence of intramammary infection but they reduce the severity of clinical mastitis cases caused by coliform organisms (Ruegg 2017). Wenz et al. (2007) found that nearly half of the investigated farms (49.5%) used coliform mastitis vaccine and that the probability of being in the high BTSCC category was 1.65 times higher on farms that did not use it compared to those that used it. Uzmay et al. (2001) reported that 52.2% of the farms applied mastitis vaccine to all their cows and the probability of subclinical mastitis incidence in non-vaccinated cows was 1.55 times higher than in cows that were vaccinated. In our study, we confirmed that the cows were vaccinated against mastitis on 60.5% of the farms, however, the effect of the mastitis vaccine on the BTSCC category was not significant.

Dry period treatment (DPT) aims to treat existing intramammary infections and prevent new intramammary infections that may occur during the dry period (Halasa et al. 2009a, 2009b). While some studies associated the use of DPT with lower SCC (Erskine et al. 1987; Barkema et al. 1998; Koc 2008; Kelly et al. 2009; Schewe et al. 2015), others did not find a significant relationship between DPT and SCC (Hutton et al. 1990; Rodrigues et al. 2005). Wenz et al. (2007) determined that DPT was applied on 81.2% of the farms and according to the univariate statistical analysis, BTSCC tended to be lower on the farms where this practice was applied, but there was no significant relationship between DPT and BTSCC in the multiple statistical analysis. In our study, DPT was applied on 80% and 61% of the farms in the low and high BTSCC category, respectively (not shown in Table). According to the univariate logistic regression analysis, the probability to be in the low BTSCC category tended to be higher for farms applying DPT. In the multiple logistic regression analysis, no significant effect of DPT application on the BTSCC category distribution could be found. Uzmay et al. (2001) reported that DPT was applied on 82.6% of the farms examined and according to the univariate logistic regression analysis, there was no significant relationship between DPT and subclinical mastitis.

Keeping records is very important to reveal the udder health status in a herd and to take the necessary precautions. Rodrigues et al. (2005) found that the frequency of recording clinical mastitis cases tended to be lower on farms in the high BTSCC category than on farms in the low and medium BTSCC categories (37.9%, 54.3% and 62.0%, respectively). Hutton et al. (1990) also found that awareness of the mastitis status of the herd was higher in the low SCC category than in the high SCC category. Barkema et al. (1999) stated that the percentage of dairy farms keeping good records was the highest in the low BTSCC category (75.4%), somewhat lower in the moderate BTSCC category (50.9%) and the lowest in the high BTSCC category (27.5%). In our study, the percentage of farms keeping records on the udder health was also found

https://doi.org/10.17221/62/2026-CJAS

to be higher in the low BTSCC category (72.7% and 40.7%, respectively). And according to the univariate logistic regression analysis, the probability of being in the low BTSCC category was higher for farms keeping records.

On the majority of modern dairy farms in the world, milking is done twice a day, however, on some intensive production farms, milking can be done 3–6 times a day to increase milk yield (Stelwagen et al. 2013). In our study, milking is done twice a day on most of the farms. Although BTSCC was found to be lower on farms milking three times a day compared to farms milking twice a day, this difference was not significant in the univariate variance analysis. Studies by Rodrigues et al. (2005) and Wenz et al. (2007) also found no significant relationship between the number of milkings per day and BTSCC.

Abnormalities in milk (clinical mastitis) can be detected by pre-milking, which involves expressing milk a few times by hand before attaching the milking cluster (Blowey and Edmondson 2010; Ruegg and Pantoja 2013). If clinical mastitis cases can be diagnosed early, the response to treatment will be high and, more importantly, the spread of the infection to the herd can be prevented (Blowey and Edmondson 2010). The authors also emphasize that if mastitis (abnormal) milk is separated, the increase in the number of bacteria and somatic cells in bulk tank milk can be prevented. On farms with the low herd SCC value (annual average <250 10^3 cells/ml), when the farmers were asked which herd management practice was most effective in keeping SCC low, the fourth out of the five responses given was pre-milking (Sterrett and Bewley 2013). However, many studies have not found a clear relationship between pre-milking and SCC (Rodrigues et al. 2005; Wenz et al. 2007; Kelly et al. 2009). Even, Jayarao et al. (2004) reported that BTSCC was significantly higher on farms where pre-milking was applied than on those without it (357 060 and 295 760 cells/ml, respectively). Blowey and Edmondson (2010) suggested that milkers should wear gloves and clean their gloved hands with disinfectant solution to prevent the risk of transmitting infection from cow to cow during pre-milking. In our study, only 12.3% of the examined farms applied pre-milking and most of the farms (80%) performing pre-milking were in the low BTSCC category. On the other hand, BTSCC was found to be lower on farms where pre-milking was applied than on those without it (333 10^3 and 463 10^3 cells/ml, respectively), but this difference was not significant.

The present study shows that the farms that applied pre-milking teat disinfection were more likely to be in the low BTSCC category compared to those that did not apply it. Supporting the findings of our study, Wilson et al. (1997) found the lower BTSCC in herds that used pre-milking teat disinfection. To reduce the microbial load on the teats and intramammary infections caused by environmental microorganisms the teat disinfection is applied before milking in many countries (Bohm et al. 2017). Many studies demonstrated that on farms where teat cleaning and drying are performed before milking and post-dipping is applied, the rate of new intramammary infections caused by environmental microorganisms is reduced by additional pre-dipping (Pankey et al. 1987; Galton et al. 1988; Oliver et al. 1993, 2001). Rodrigues et al. (2005) reported that the monthly clinical mastitis incidence was significantly lower on farms (with free stall barns) where pre-milking teat disinfection was applied than on those not applying such treatment (6.0% and 19.4%, respectively). On the other hand, the authors found no significant relationship between pre-milking teat disinfection and BTSCC category. In this study pre-milking teat disinfection was applied at high rates in all BTSCC categories (low, medium and high: 91.7%, 92.6% and 86.7%, respectively). Smith and Hogan (2008) stated that intramammary infections caused by environmental microorganisms are less likely to cause herd problems associated with subclinical mastitis, such as high BTSCC, compared to intramammary infections caused by contagious microorganisms.

Pankey (1989) stated that the main purpose of the pre-milking udder preparation is to milk clean and dry teats. Ruegg (2004) also reported that probably the most important udder preparation process before milking is to dry the teat well. Galton et al. (1986) observed that the number of bacteria on wet-cleaned teats decreased further as a result of drying. Barkema et al. (1998) determined that the teat drying rate on farms was 89.0%, 82.2% and 74.5% in low, medium and high BTSCC categories, respectively. In the same study, the probability of being in the high BTSCC category was 25.0 times higher on farms where drying was not performed compared to farms performing drying. In our study we showed that many of the farms (62.2%) where

https://doi.org/10.17221/62/2026-CJAS

teats were dry when attaching the milking cluster were in the low BTSCC category, and according to the results of the univariate logistic regression analysis, the probability of being in the low BTSCC category was higher for those farms.

In machine milking, situations when the air is sucked into the teat cup suddenly and rapidly cause vacuum fluctuations of 150–300 kPa per second in the claw, and as a result of this action milk droplets are pressed into the teats by high pressure. This situation increases the risk of new infection inside the udder (Mein 2012). It is reported that this action is caused by practices and events such as teat cup slippage, performing machine stripping by pressing on the cluster in a way that causes the teat cups to separate from the teat, removing the milking cup suddenly and harshly at the end of milking without vacuum shut off or being kicked out by the cow (Mein 2012). In our study most of the farms (67.9%) performed machine stripping, which causes air being sucked into the teat cups. According to the univariate logistic regression analysis, the probability to be in the low BTSCC category tended to be higher for farms that did not apply machine stripping, while in the multiple logistic regression analysis, the effect of the machine stripping on the farm BTSCC category was not significant. Also, it was stated that removing the milking cluster without shutting off the vacuum at the end of milking was the case on 40.7% of the farms. According to our results, the probability of being in the low BTCC category was found to be significantly higher on farms where the vacuum was shut off before the cluster was removed.

It has been reported that by disinfecting the teat after milking, the rate of new intramammary infections in a herd can be reduced by 70% or more (NMC 2020). Also in many studies, teat disinfection after milking has been associated with lower SCC (Moxley et al. 1978; Erskine et al. 1987; Fenlon et al. 1995; Barkema et al. 1998; Koc 2008; Kelly et al. 2009). Post-milking teat disinfection was performed on only 27.2% of the farms in our study. It was concluded that most farms (72.7%) that applied post-milking teat disinfection were in the low BTSCC category, and according to the univariate logistic regression analysis the probability of being in the low BTSCC category was higher for farms that performed this practice.

In many studies, SCC was found to be lower on farms with automatic cluster removers in the milking system (Hutton et al. 1990; Fenlon et al. 1995; Jayarao et al. 2004; Wenz et al. 2007; Kelly et al. 2009). Blowey and Edmondson (2010) also reported that using the automatic cluster remover, excessive milking which can damage the teat end and increase the risk of mastitis can be prevented. In addition, one of the important benefits of the automatic cluster remover for udder health is that it removes the milking cluster by shutting off the vacuum. Only 13.6% of the farms in our study have automatic cluster removers, and 90.9% of the farms with this system are in the low BTSCC category. In the univariate logistic regression analysis, it was demonstrated that the probability of being in the low BTSCC category was higher for farms with automatic cluster removers.

CONCLUSION

On the farms examined within the scope of our study, different levels of relationships were determined between BTSCC and many herd management practices.

If improvements are made in these practices that are effective in controlling udder diseases and therefore BTSCC, the frequency of udder health problems will decrease and consequently BTSCC will decrease. This will increase milk yield on the farms on the one hand and increase milk sales prices due to the improvement in milk quality on the other hand, thus increasing the profitability of the enterprise. It will also improve the welfare of the cows.

Acknowledgement

We wish to thank the Cattle Breeders' Association of Izmir, to the Tire Milk Producers Agricultural Development Cooperative and Pınar Milk Products Industry Company, to all dairy farmers who accepted us and spent their valuable time with us and to the Scientific Research Projects Commission of Ege University for providing financial support to conduct this study.

Conflict of interest

The authors declare no conflict of interest.

https://doi.org/10.17221/62/2026-CJAS

REFERENCES

Barbano DM, Ma Y, Santos MV. Influence of raw milk quality on fluid milk shelf life. J Dairy Sci. 2006 Mar;89 (Suppl_1):E15-9.

Barbano DM, Rasmussen RR, Lynch JM. Influence of milk somatic cell count and milk age on cheese yield. J Dairy Sci. 1991 Feb;74(2):369-88.

Barkema HW, Schukken YH, Lam TJ, Beiboer ML, Benedictus G, Brand A. Management practices associated with low, medium, and high somatic cell counts in bulk milk. J Dairy Sci. 1998 Jul;81(7):1917-27.

Barkema HW, Van der Ploeg JD, Schukken YH, Lam TJ, Benedictus G, Brand A. Management style and its association with bulk milk somatic cell count and incidence rate of clinical mastitis. J Dairy Sci. 1999 Aug;82(8): 1655-63.

Barnouin J, Chassagne M, Bazin S, Boichard D. Management practices from questionnaire surveys in herds with very low somatic cell score through a national mastitis program in France. J Dairy Sci. 2004 Nov;87(11):3989-99.

Bartlett PC, Miller GY, Lance SE, Heider LE. Environmental and managerial determinants of somatic cell counts and clinical mastitis incidence in Ohio dairy herds. Prev Vet Med. 1992 Dec;14(3-4):195-207.

Becker CA, Collier RJ, Stone AE. Invited review: Physiological and behavioral effects of heat stress in dairy cows. J Dairy Sci. 2020 Aug;103(8):6751-70.

Bentley Instruments. Somacount 150 operator's manual: A guide for installation, operation, and maintenance. Rev. ed. Chaska (MN): Bentley Instruments; 1998.

Blowey R, Edmondson P. Mastitis control in dairy herds. 2nd ed. Wallingford: CAB International; 2010.

Bohm F, Klocke D, Paduch JH, Kromker V. Pilot study on the influence of premilking iodine-based teat disinfection on milk iodine content. Milk Sci Int. 2017 Mar;70(1):2-5.

Bradley A, Green M. Use and interpretation of somatic cell count data in dairy cows. In Pract. 2005 Jun;27(6):310-5.

Busato A, Trachsel P, Schallibaum M, Blum JW. Udder health and risk factors for subclinical mastitis in organic dairy farms in Switzerland. Prev Vet Med. 2000 Apr 28; 44(3-4):205-20.

Chassagne M, Barnouin J, Le Guenic M. Expert assessment study of milking and hygiene practices characterizing very low somatic cell score herds in France. J Dairy Sci. 2005 May;88(5):1909-16.

De Vliegher S, Laevens H, Barkema HW, Dohoo IR, Stryhn H, Opsomer G, de Kruif A. Management practices and heifer characteristics associated with early lactation somatic cell count of Belgian dairy heifers. J Dairy Sci. 2004 Apr;87(4):937-47.

Dohoo IR, Meek AH. Somatic cell counts in bovine milk. Can Vet J. 1982 Apr;23(4):119-25.

Eberhart RJ, Hutchinson LJ, Spencer SB. Relationships of bulk tank somatic cell counts to prevalence of intramammary infection and to indices of herd production 1. J Food Prot. 1982 Oct;45(12):1125-8.

Ellis KA, Innocent GT, Mihm M, Cripps P, McLean WG, Howard CV, Grove-White D. Dairy cow cleanliness and milk quality on organic and conventional farms in the UK. J Dairy Res. 2007 Aug;74(3):302-10.

Erskine RJ, Eberhart RJ, Hutchinson LJ, Spencer SB. Herd management and prevalence of mastitis in dairy herds with high and low somatic cell counts. J Am Vet Med Assoc. 1987 Jun 1;190(11):1411-6.

European Council. Council Directive 92/46/EEC of 16 June 1992 laying down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products. Off J Eur Communities. 1992; L268:1-32.

Fenlon DR, Logue DN, Gunn J, Wilson J. A study of mastitis bacteria and herd management practices to identify their relationship to high somatic cell counts in bulk tank milk. Br Vet J. 1995 Jan-Feb;151(1):17-25.

Field A. Discovering statistics using IBM SPSS statistics. 5th ed. London: Sage Publications; 2017.

Galton DM, Peterson LG, Merrill WG. Effects of premilking udder preparation practices on bacterial counts in milk and on teats. J Dairy Sci. 1986 Jan;69(1):260-6.

Galton DM, Peterson LG, Merrill WG. Evaluation of udder preparations on intramammary infections. J Dairy Sci. 1988 May;71(5):1417-21.

Goodridge L, Hill AR, Lencki RW. A review of international standards and the scientific literature on farm milk bulk-tank sampling protocols. J Dairy Sci. 2004;87(9): 3099-104.

Halasa T, Osteras O, Hogeveen H, van Werven T, Nielen M. Meta-analysis of dry cow management for dairy cattle. Part 1. Protection against new intramammary infections. J Dairy Sci. 2009a Jul;92(7):3134-49.

Halasa T, Nielen M, Whist AC, Osteras O. Meta-analysis of dry cow management for dairy cattle. Part 2. Cure of existing intramammary infections. J Dairy Sci. 2009b Jul;92(7):3150-7.

Harmon RJ. Physiology of mastitis and factors affecting somatic cell counts. J Dairy Sci. 1994 Jul;77(7):2103-12.

Hutton CT, Fox LK, Hancock DD. Mastitis control practices: Differences between herds with high and low milk somatic cell counts. J Dairy Sci. 1990 Apr;73(4):1135-43.

Ito K, Weary DM, von Keyserlingk MA. Lying behavior: Assessing within- and between-herd variation in free-stall-housed dairy cows. J Dairy Sci. 2009 Sep;92(9):4412-20.

https://doi.org/10.17221/62/2026-CJAS

Jayarao BM, Pillai SR, Sawant AA, Wolfgang DR, Hegde NV. Guidelines for monitoring bulk tank milk somatic cell and bacterial counts. J Dairy Sci. 2004 Oct;87(10):3561-73.

Kelly P, O'Sullivan K, Berry D, More S, Meaney W, O'Callaghan E, O'Brien B. Farm management factors associated with bulk tank somatic cell count in Irish dairy herds. Ir Vet J. 2009 Apr 1;62 Suppl 4(Suppl 4):S45-51.

Klei L, Yun J, Sapru A, Lynch J, Barbano D, Sears P, Galton D. Effects of milk somatic cell count on cottage cheese yield and quality. J Dairy Sci. 1998 May;81(5):1205-13.

Koc A. A study of somatic cell counts in the milk of Holstein-Friesian cows managed in Mediterranean climatic conditions. Turk J Vet Anim Sci. 2008;32(1):13-8.

Lievaart JJ, Barkema HW, Kremer WD, van den Broek J, Verheijden JH, Heesterbeek JA. Effect of herd characteristics, management practices, and season on different categories of the herd somatic cell count. J Dairy Sci. 2007 Sep;90(9):4137-44.

Ma Y, Ryan C, Barbano DM, Galton DM, Rudan MA, Boor KJ. Effects of somatic cell count on quality and shelf-life of pasteurized fluid milk. J Dairy Sci. 2000 Feb;83(2):264-74.

Mein GA. The role of the milking machine in mastitis control. Vet Clin North Am Food Anim Pract. 2012;28(2):307-20.

Moxley JE, Kennedy BW, Downey BR, Bowman JST. Survey of milking hygiene practices and their relationships to somatic cell counts and milk production. J Dairy Sci. 1978 Nov;61(11):1637-44.

NMC – National Mastitis Council. Post-milking teat disinfection fact sheet [Internet]. Madison (WI): NMC; 2020.

Nyman AK, Emanuelson U, Gustafsson AH, Persson Waller K. Management practices associated with udder health of first-parity dairy cows in early lactation. Prev Vet Med. 2009 Feb 1;88(2):138-49.

Oliver SP, Gillespie BE, Lewis MJ, Ivey SJ, Almeida RA, Luther DA, Johnson DL, Lamar KC, Moorehead HD, Dowlen HH. Efficacy of a new premilking teat disinfectant containing a phenolic combination for the prevention of mastitis. J Dairy Sci. 2001 Jun;84(6):1545-9.

Oliver SP, Lewis MJ, Ingle TL, Gillespie BE, Matthews KR, Dowlen HH. Premilking teat disinfection for the prevention of environmental pathogen intramammary infections. J Food Prot. 1993 Oct;56(10):852-5.

Pankey JW, Wildman EE, Drechsler PA, Hogan JS. Field trial evaluation of premilking teat disinfection. J Dairy Sci. 1987 Apr;70(4):867-72.

Pankey JW. Premilking udder hygiene. J Dairy Sci. 1989 May;72(5):1308-12.

Politis I, Ng-Kwai-Hang KF. Association between somatic cell counts of milk and cheese yielding capacity. J Dairy Sci. 1988 Jul;71(7):1720-7.

Rodrigues AC, Caraviello DZ, Ruegg PL. Management of Wisconsin dairy herds enrolled in milk quality teams. J Dairy Sci. 2005 Jul;88(7):2660-71.

Ruegg PL, Pantoja JCF. Understanding and using somatic cell counts to improve milk quality. Ir J Agric Food Res. 2013;52(2):101-17.

Ruegg PL. A 100-year review: Mastitis detection, management, and prevention. J Dairy Sci. 2017 Dec;100(12):10381-97.

Ruegg PL. Managing for milk quality. Madison (WI): University of Wisconsin; 2004.

Ruegg PL. Milk secretion and quality standards. Dairy Updates: Milking and Milk Quality No. 404. Madison (WI): The Babcock Institute, University of Wisconsin; 2001.

Santos MV, Ma Y, Barbano DM. Effect of somatic cell count on proteolysis and lipolysis in pasteurized fluid milk during shelf-life storage. J Dairy Sci. 2003 Aug;86(8):2491-503.

Schewe RL, Kayitsinga J, Contreras GA, Odom C, Coats WA, Durst P, Hovingh EP, Martinez RO, Mobley R, Moore S, Erskine RJ. Herd management and social variables associated with bulk tank somatic cell count in dairy herds in the eastern United States. J Dairy Sci. 2015 Nov;98(11):7650-65.

Schreiner DA, Ruegg PL. Relationship between udder and leg hygiene scores and subclinical mastitis. J Dairy Sci. 2003 Nov;86(11):3460-5.

Servello V, Hill AR, Lencki RW. Towards an optimum mixing protocol for on-farm bulk milk sampling. J Dairy Sci. 2004 Sep;87(9):2846-53.

Smith KL, Hogan JS. Environmental mastitis: Know your opponent. In: NMC Regional Meeting Proceedings; 2008 Mar; Green Bay (WI). Madison (WI): National Mastitis Council; 2008. p. 1-7.

Smith KL, Todhunter DA, Schoenberger PS. Environmental mastitis: Cause, prevalence, prevention. J Dairy Sci. 1985 Jun;68(6):1531-53.

Sordillo LM, Streicher KL. Mammary gland immunity and mastitis susceptibility. J Mammary Gland Biol Neoplasia. 2002 Apr;7(2):135-46.

Stelwagen K, Phyn CV, Davis SR, Guinard-Flament J, Pomies D, Roche JR, Kay JK. Invited review: Reduced milking frequency: Milk production and management implications. J Dairy Sci. 2013 Jun;96(6):3401-13.

Sterrett AE, Bewley JM. Characterization of management practices used on Kentucky dairy farms with low somatic cell counts. Prof Anim Sci. 2013 Aug;29(4):359-66.

Svensson C, Nyman AK, Persson Waller K, Emanuelson U. Effects of housing, management, and health of dairy heifers on first-lactation udder health in southwest Sweden. J Dairy Sci. 2006 Jun;89(6):1990-9.

Uzmay C, Kaya A, Kaya I, Akbas Y. Izmir ili Holstein damizlik sut sigiri yetistiricileri birligi isletmelerinde mastitisin

https://doi.org/10.17221/62/2026-CJAS

yayginlik duzeyi ve etkileyen etmenler uzerine arastirmalar 2. Yonetim uygulamalari ile subklinik mastitis arasi iliskiler [Studies on prevalence of mastitis and factors affecting prevalence in herds of Izmir Holstein Breeders Association. 2. Relationships between managerial practices and subclinical mastitis]. J Fac Agric Ege Univ. 2001;38(2): 71-8. Turkish.

Wenz JR, Jensen SM, Lombard JE, Wagner BA, Dinsmore RP. Herd management practices and their association with bulk tank somatic cell count on United States dairy operations. J Dairy Sci. 2007 Aug;90(8):3652-9.

Wilson DJ, Das HH, Gonzalez RN, Sears PM. Association between management practices, dairy herd characteristics, and somatic cell count of bulk tank milk. J Am Vet Med Assoc. 1997 May 15;210(10):1499-502.

Received: May 15, 2026
Accepted: July 26, 2026
Published online: August 25, 2026