

# The Relation between the Raw Milk and Barn Hygiene in Tied Dairy Cows

Silvana Popescu<sup>1</sup>, Eva Andrea Diugan<sup>2</sup>, Cristina El Mahdy<sup>3</sup>, Daniela Oros<sup>1</sup>,  
Radu Giupana<sup>1</sup>, Cristin Borda<sup>1</sup>

<sup>1</sup>Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine, 400372, Manastur street, no. 3-5, Cluj-Napoca, Romania

<sup>2</sup>Beclean Stud farm, Department for Horse Breeding, Exploitation and Amelioration, The National Forest Administration Romsilva, Romania

<sup>3</sup>Faculty of Animal Science and Biotechnologies; University of Agricultural Sciences and Veterinary Medicine, 400372, Manastur street, no. 3-5, Cluj-Napoca, Romania

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## Abstract

The aim of this study was to investigate the relation between the hygiene of the barns and of the raw milk in tie stall dairy barns. Ten dairy farms with tie stalls from Transylvania were included in the study. The barn hygiene was evaluated based on the cows' body hygiene. 820 dairy cows were assessed. The hygiene of the raw milk was investigated by the determination of the total bacteria count, in 359 individually milked samples. The data were analysed using the SPSS statistical software. The highest percentage of the 3 and 4 hygiene scores was recorded in the udder area, followed by the upper leg and flank and the lower leg. The total bacterial counts varied greatly in the milk from the investigated farms, from 100 CFU/ml to  $307 \times 10^3$  CFU/ml. Four of the ten assessed barns were considered dirty and in five barns the total bacterial count exceeded the admitted limit. The barn hygiene correlated significantly with the hygiene of the raw milk ( $r = 0.82$ ,  $P = 0.004$ ). The results of the study attested that the hygiene quality of raw milk depends largely on the cleanliness of the barn where the animals are housed.

**Keywords:** dairy cow, raw milk, total bacteria count

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## 1. Introduction

The total bacterial count (TBC) is one of the main indicators of hygienic quality of cow's raw milk. Milk and milk products derived from dairy cows can harbor a variety of microorganisms and can be an important source of food borne pathogens [1]. Milk from a healthy udder contains few bacteria but it picks up many microorganisms from the moment it leaves the teat of the cow until it is used for further processing [2].

Bacterial contamination of raw milk can originate from different sources such the health and hygiene

of the cow, the cleanliness of the environment in which the cows are housed and milked or the milking equipment sanitation [3, 4].

The system of dairy cow housing and the milking technology influences also the hygienic quality of milk [5, 6]. Cempirkova [7] states that the loose housing with littered cubicles, with milking in a parlour, the use of predipping in the udder preparation and especially summer grazing of dairy cows are considered as factors positively influencing the values of total bacterial count (TBC) in cow's raw milk.

The poor hygiene increases the risk of presence of pathogenic bacteria in raw milk [8, 9]. Teat disinfection before milking is an important factor that reduces the total bacterial count (TBC) or somatic cell count (SCC) in raw milk samples [10, 11].

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\* Corresponding author: Silvana Popescu, Tel: +40264596384, Fax: +40264593792, E-mail: [silvana.popescu@usamvcluj.ro](mailto:silvana.popescu@usamvcluj.ro)

In Romania limited studies are available regarding the factors that could influence the hygienic quality of raw dairy milk [12, 13, 14].

The aim of this study was to investigate the relation between the hygiene of the barns and of the raw milk in tie stall dairy barns.

## 2. Materials and methods

The study was done in 10 dairy farms (30-102 cows/barn) from Transylvania. All the barns were closed, with solid flooring and natural ventilation. The breeds were Romanian Spotted Cattle and Holstein Friesian, with an average milk production of 10-20 liters/cow/day. The milking was done manually (4 barns) or mechanically (6 barns) at stall. In 80% of the investigated barns the manure removal was done manually, once or twice a day. Each farm was visited once. The hygiene of the barns was assessed based on the cows' body hygiene, using the scoring system of Cook [15]. Three body regions were assessed: lower leg, udder and flank and upper leg, awarding points (from 1 to 4), depending on dejection soiling of these areas. Finally, the proportion of 3 and 4 scores (too dirty) was calculated for the three body regions of the cows from each barn. All the dairy cows (820) from the 10 barns included in the study were assessed. If the sum of the scores of 3 and 4 was above 50% in any of the assessed body regions, the barn was considered dirty and if it was below 50% in the three body regions, the barn was considered clean.

In each of the farms milk samples were collected from half of the cows, a total number of 359 individually milked samples. In all of the farms the udders of the cows were washed with water before milking. The milk sampling was made in sterile test tubes, directly from the teats. After collection, the samples were transported to the laboratory using ice boxes. Serial dilutions of the milk samples were done in order to determine the total bacterial count (TBC). Using a sterile pipette, 0.1 ml was collected from each dilution and inoculated on plain agar in Petri dishes, by means of a sterile glass loop. The plates were then incubated at 30 °C for 24-48 hours (SR EN ISO 4833/2003). After incubation, the colonies were counted and the plates with 30 to 300 colonies were taken into consideration. The average number of colonies in the Petri dishes was multiplied by the dilution factor to get TBC. This

was expressed as colony-forming units per ml (CFU/ml).

The obtained data were statistically processed using the SPSS version 17 software. The descriptive statistical indicators (mean, standard deviation, median, minimum and maximum) were calculated for the TBC and for the proportion of 3 and 4 scores of the three body regions of the cows in the investigated barns. For the statistical processing the clean barn was noted with 1, the dirty one was noted with 0, TBC  $\leq 1.00 \times 10^5$  CFU/ml was noted with 1, and TBC  $> 1.00 \times 10^5$  CFU/ml with 0. Because the data had abnormal distribution, the Spearman's rank correlation coefficient ( $r_s$ ) was calculated to test the relationship between investigate parameters. The Tukey-Kramer Multiple Comparisons Test-One-way ANOVA was used to compare the data. Statistical significance was defined as  $P < 0.05$ .

## 3. Results and discussion

Descriptive statistical parameters for the proportion of 3 and 4 hygiene scores for udder, lower leg and upper leg and flank areas in the 10 dairy tie-stall barns from Transylvania are shows in Table 1.

The hygiene scoring system was devised by Cook [15] in order to quantify hygiene at farm level and to evaluate improvements needed in hygiene management. This system is considered as a remedial tool for the existing deficiencies. Because a mean score of hygiene level for each body area does not present any importance for the farmer, only the proportion of the scores indicating the "too dirty" condition is considered, namely the 3 and 4 scores. In this study the proportion of scores of 3 and 4 is different in the three body areas of the dairy cows, the dirtiest area being the udder, followed by the upper leg and flank and lower leg. Significant differences ( $P < 0.05$ ) were found only between the udder area and that of the lower leg. There were differences among the farms, as well. The mean proportion of the 3 and 4 scores in the three body regions (Table 1) is higher than other researches found in their studies [15, 16, 17]. Poor hygiene is a big problem in tie-stalls as the cow is both eating and lying in the same stall and the claws are often standing in manure.

Our results are in agreement with the data in scientific literature which states that the cows kept

in tie-stall system have higher hygiene scores in the region of upper leg and flank and udder than in the region of lower leg, due to lying down in the dejections deposited in the stalls [15, 17].

Similar to other works [17, 18], the present study shows that the cleanliness of the udders and of the legs are positively correlated (Table 2).

**Table 1.** Descriptive statistical parameters for the proportion of 3 and 4 hygiene scores for udder, lower leg and upper leg and flank areas in the 10 dairy tie-stall barns from Transylvania

Parameter	Hygiene Scores 3 and 4 (%)		
	Udder	Lower Leg	Upper Leg and Flank
Mean	44.19	28.82	35.22
Standard deviation	9.86	9.22	8.38
Median	43.43	28.29	34.82
Maximum	56.81	40.00	45.45
Minimum	25.53	12.76	15.95

**Table 2.** Correlations between the hygiene degrees in the three body regions in the 10 dairy tie-stall barns from Transylvania

Correlation	Correlation coefficient (Spearman's r)	P value
Udder and lower leg	0.86	0.01
Udder and upper leg and flank	0.92	0.01
Lower leg an upper leg and flank	0.74	0.01

**Table 3.** Descriptive statistical parameters for total bacterial counts ( $\times 10^3$  CFU/ml) in raw milk samples in the 10 dairy tie-stall barns from Transylvania

Barn	Mean	Standard deviation	Median	Minimum	Maximum
1	120.52	40.32	111.33	100.25	271.00
2	116.85	33.10	110.05	100.00	268.00
3	19.02	11.73	14.50	85.10	54.00
4	35.02	23.43	30.28	85.10	77.65
5	173.43	14.26	175.75	151.00	193.00
6	171.50	7.23	171.50	157.00	187.00
7	76.10	13.02	80.50	52.75	92.00
8	0.33	0.23	0.19	0.10	0.68
9	37.64	16.53	40.50	18.50	66.80
10	255.41	50.71	283.50	190.00	307.00

Four of the ten assessed barns were considered dirty and six clean.

The descriptive statistics for the TBC in the investigated barns (mean, standard deviation, median, minimum and maximum) are shown in Table 3. The TBC had large variations in the studied barns with averages ranging between  $330 \times 10^3$  CFU/ml (barn 8) and  $255.41 \times 10^3$  CFU/ml (barn 10).

The minimum values were between  $100 \times 10^3$  CFU/ml and  $190 \times 10^3$  CFU/ml, and the maximum between  $680 \times 10^3$  CFU/ml and  $307 \times 10^3$  CFU/ml. In 50% of the barns, the TBC exceed the limits allowed by the EU standards ( $\leq 100\ 000$  CFU/ml). TBC values in this study were

similar to other reported results [13, 19]. Cempirkova [7] and Franciosi et al. [20] reported lower values in their studies, while in other researches higher values of TBC in the raw dairy milk were found [21]. The microbial contamination of raw cow milk are influenced by the dairy cows' health and hygiene, by the hygiene of the environment where dairy cows are housed and milked, by methods of udder preparation and milking technique, methods of cleaning and sanitation of milking machines and milk cisterns, tenders' hygiene, speed of milk cooling to a required temperature and milk storage time [3, 4]. The higher values of microbial contamination of milk in five barns were connected with the barns'

dirtiness and dairy cow udders with faeces and with the insufficient drying of udders with a synthetic cloth after their pre-milking washing. Similar findings were reported by other researchers [11, 22].

According to Galton et al. [23], performing pre-dipping along with manual drying of the udder reduces bacterial contamination by about 54%. Another cause could be the cows having mastitis [22]. Maintaining the udders clean and dry is very important for lowering the bacterial count in dairy milk. Schreiner and Ruegg [18] report that the primary sources of exposure of environmental mastitis pathogens to the cow are the presence of moisture, mud and manure in the environment of the cow. The hygiene of milking and milk collecting equipments can not be incriminated, because the milk for this study was collected directly from the teats of the cows. In this study barn hygiene correlated significantly with the hygiene of the raw milk ( $r = 0.82$ ,  $P = 0.004$ ). Similar results are reported also by other researchers [24, 25].

#### 4. Conclusions

The results of the study attested that the hygiene quality of raw milk depends largely on the cleanliness of the barns where the animals are housed.

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