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The investigation on the relationship between dairy cow hygiene scores and intramammary infections

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Keywords

hygiene scores, intramammary infections, dairy cow, California mastitis test, somatic cell count

Abstract

The "cow hygiene score" system is a management tool for assessment of cow's body hygiene and cleaning of the barn. In this study, the correlation between body hygiene scores and intramammary infections (IMI), California Mastitis Test (CMT) and Somatic Cell Count (SCC) were evaluated in two different seasons. Hygiene scoring of 1096 dairy cows in 4 herds was performed on five body areas including: udder, rear legs, flanks and upper legs, abdomen, and tail head. After doing CMT, milk samples were taken from quarters with score 2 or more for microbiological culture. SCC data were taken in two consecutive months. The results of this study showed no significant differences between the median of all hygiene scores except for tail head that were significantly greater in high than low rainy seasons ($p < 0.05$). There was no significant correlation between hygiene scores and the chance of positive bacterial culture ($p > 0.05$), but a statistically significant relationship was found between udder hygiene score and isolation of environmental bacteria ($p < 0.05$). There were no statistically significant differences between SCC or CMT and hygiene scores of all parts of the body and similarly between teat cleanliness score after premilking preparation and SCC in two consecutive months ($p > 0.05$). Finally, it seems that udder hygiene scoring is an useful tool for predicting of intramammary infections caused by environmental bacteria.

Abbreviations

SCC: Somatic Cell Count
IMI: Intramammary Infections
CMT: California Mastitis Test

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Introduction

Mastitis in subclinical or clinical forms can result in significant reductions in animal welfare and productivity of the dairy herd. The organisms that cause mastitis can be classified as "contagious" or "environmental. Contagious infections occur when teats of healthy cows are exposed to bacteria present in milk (coming from infected udders), and environmental mastitis is caused by bacteria found in housing areas. Moisture, mud, and manure are common sources of these pathogens. Exposure to manure in housing areas and poor hygiene in cows can influence the rate of clinical mastitis [8]. Successful control of environmental pathogens is based on efficient pre-milking preparation and cleanliness of farm environment. Bartlett et al. [1992] showed that an index of environmental sanitation based on the amount of manure on the cow was able to predict the occurrence of clinical coliform mastitis [3]. The use of subjective measures like body condition scoring, lameness scoring, and teat condition scoring are effective means of assessing animal health and herd management. The cow hygiene score system is a management tool to evaluate and monitor cow cleanliness and the farm environment [1-3,5,6]. The cow hygiene scorecard is broken down into five general areas: Tail head, Flank, Belly, Udder, and Rear legs and feet. These scores use simple drawings to illustrate the degree of cow hygiene. Furthermore teat end cleanliness is a good indicator of the effectiveness of pre-milking cow preparation. Most studies that have evaluated the hygiene of dairy cows had been performed with animals housed in free-stalls. In addition, little information is available about relationship between type of microorganisms and season variation of these scores.

Table 1
Average monthly rainfall in this study

Farm	Dry season [mm]	Rainy season (mm)
1	0	19.05
2	0	30.99
3	6.6	42.93
4	0	25.91

Data collected from www.wunderground.com

Therefore, the aim of this study was to investigate if there is any correlation between hygiene scoring and measures of IMI by isolation of bacteria, CMT and SCC in cows that are not housed in stalls and to determine the effect of season variation on hygiene scores.

Results

In this study, we did not find any significant differences betweenthe median of all hygene scores except for tail head that were significantly greater in high than low rainy seasons ($p < 0.05$) (Table2). In overall, 461 milk samples were taken from quarters with score 2 or more in CMT. After microbiological culture, 191 microorganisms were isolated from milk samples of 108 cows. Major bacterial isolates were contagious bacteria including *Staphylococcus aureus* (39.7%), *Streptococcus agalactiae* (7.85%), *Corynebacterium* (7.32%) and environmental bacteria included coliforms (8.9%), *bacillus cereus* (3.14%), environmental *streptococcus* (13.61%) and yeast (1.57%). Other isolated agents were negative coagulase *staphylococcus* (17.8%). Statistically, there was no significant correlation between hygiene scores and the chance of being positive in bacterial culture ($p > 0.05$). Udder hy-

Table 2
The relationship between hygiene scores in different seasons

Mastitis	Season	Udder	Tail Head	lower legs	upper legs & flanks	Abdomen
Median	Dry season	3	2 [a]	3	3	3
	Rainy season	3	1 [b]	3	3	3
lower quartile	Dry season	2	1	3	2	2
	Rainy season	2	1	3	2	2
upper quartile	Dry season	3	2	4	3	4
	Rainy season	4	2	4	3	4

Values within columns with different superscripts (a, b) are significantly different ($p < 0.05$).

Table 3
The relationship between hygiene scores and somatic cell count before and after scoring

	Hygiene Score	SCC *1000 [The month before scoring]	P Value	SCC* 1000 [The month after scoring]	P Value
Udder	1	127	0.863	111	0.311
	2	145		101	
	3	120		88	
	4	178		123	
Tail Head	1	148	0.538	110	0.133
	2	122		91	
	3	122		73	
	4	121		120	
Lower legs	1	137	0.381	89	0.204
	2	147		105	
	3	132		95	
	4	123		91	
Upper legs& flanks	1	131	0.739	139	0.943
	2	152		101	
	3	122		85	
	4	133		139	
Abdomen	1	321	0.791	194	0.484
	2	158		101	
	3	123		99	
	4	132		91	

giene scores showed a significant relationship with isolation of environmental bacteria of the same cows ($p < 0.05$), but there was not any significant difference between other hygiene scores and isolation of environmental bacteria ($p > 0.05$) (Table 4). The probability of isolation of environmental bacteria in cows with hygiene score of 4 was greater than cows with score 1 (12.8% vs. 0%) ($p < 0.05$). There was no significant statistical differences between SCC or CMT with hygiene scores of all parts of the body ($p > 0.05$). There was not any difference between teat cleanliness score after pre-milking preparation and SCC in two consecutive months ($p > 0.05$).

Discussion

The rate of infection is decreased by utilization of proper milking hygiene, properly functioning milking machines, and teat dipping, while the duration of infection is controlled by treatment of infections and culling. The purpose of mastitis control programs are prevention of new infections and elimination of existing infections. Poor cow hygiene can contribute to presence of mastitis pathogens on teat ends and increasing the rate of new infections. Our results did not find significant differences between the median of all hygiene scores except fot tail head that were significantly greater in high than low rainy seasons. Our results do not support the previous study [7] that observed the dirtiest cows in summer (January – march) and related it to the raining and increasing of humidity in this season and its negative effect on cows' hygiene scores. According to Table 1 there is not a large difference in the amount of rainfall in most cities of Iran including Mashhad. Thus, the hygienic scores do not have a seasonal pattern in the studied area. In present study, the significant and inverse relationship between tail head hygiene score and season can be attributed to using of mist cooling in low rainy season in these farms that increasing the moisture levels in the tail head. This may cause more manure to adhere to this area of the body.

In the present study absence of a significant

Table 4
The relationship between hygiene scores and microbiological culture

hygiene score	Mastitis Type	Udder n (%)	Tail Head n (%)	Lower legs n (%)	Upper legs & flanks n (%)	Abdomen n (%)
1	Contagious	10(32.3)	46(19.5)	0(0)	4(21.1)	2(28.6)
	Enviromental	0(0)*	21(8.9)	0(0)	1(5.2)	0 (0)
	Total	10(32.3)	67(28.4)	0(0)	5(26.3)	2(28.6)
2	Contagious	32(18.8)	34(16.7)	21(29.1)	18(18.2)	19(25)
	Enviromental	9(5.3)	12(5.9)	2(2.8)	9(9.1)	3(3.9)
	Total	41(24.1)	46(22.6)	23(31.9)	27(27.3)	22(28.9)
3	Contagious	25(16.5)	4(20)	20(14.2)	36(18.6)	19(18.6)
	Enviromental	11(7.3)	1(5)	14(9.9)	15(7.7)	6(5.9)
	Total	36(23.8)	5(25)	34(24.1)	51(26.3)	25(24.5)
4	Contagious	17(15.6)	0(0)	43(17.6)	26(17.4)	44(15.9)
	Enviromental	14(12.8) *	0(0)	18(7.3)	9(6)	25(9.1)
	Total	31(28.4)	0(0)	61(24.9)	35(23.4)	69(25)

*Within each column values with different superscripts represent significant differences ($p < 0.05$)

relationship between hygiene scores of all parts of the body with bacterial isolation can be attributed to dominant pathogen of mastitis is in studied farms. In our study, more than half of the isolated bacteria were contagious pathogens. In one hand, the transmission pattern of this pathogens are different from the causative agents of environmental mastitis and less dependent on the hygiene score of the cows and on the other hand, by entering the causative agent of contagious mastitis to the udder, there will be no opportunity for engagement of environmental pathogens. Thus, it is not unexpected that there was not any correlation between the hygiene scores of the cow and the absolute separation of bacteria. Furthermore, detection of a significant correlation between udder hygiene score and isolation of environmental bacteria in studied cows can be attributed to direct contact of udder and teat with the bed and easier penetration of bacteria into the mammary tissue. In a similar study [8] it was found that the risk of contamination with main environmental pathogens in cows with scores 3 and 4 is approximately 1.5 times of cows with scores 1 and 2. Although previous studies have found that by increasing the hygiene score of the body, levels of SCC are increased [4,6,8,9], in this study, absence of significant relationship between hygiene score of the body and SCC can be related to the dominant pattern of mastitis pathogens (contagious mastitis). Occurrence of this result is not unexpected because in farms with high prevalence of contagious mastitis, high somatic cell count mostly is related to contagious pathogen rather than exposure to environmental pathogens. In conclusion, it seems that there was not a significant relationship between the hygiene scores and SCC or CMT that are mostly increased in response to contagious mastitis. In addition, udder hygiene score is a useful tool for prediction of intramammary infection which is caused by environmental bacteria.

Materials and methods

The present study was performed on 1096 Holstein dairy cattle in 4 herds in Mashhad, Iran. In dairy farms with populations of total cows below 100, all cows, and in farms with over 100 heads of milking cows, 25% of cows in each barn were included in the study. A scoring system scale from 1 to 4 was selected. The cow hygiene score was carried out on five areas of each animal's body: udder, rear legs, flanks and upper legs, abdomen, and tail head [6,8]. The scores were defined as follows: 1 = entire area was clean, with no dirt; 2 =2-10% of the surface area was dirty; 3 = 10-30% of the surface area was covered with dirt; 4 = >30% of the surface area was covered with caked on dirt. Teat Cleanliness Score performed using a 4-point scale to assess the degree of manure and bedding contamination at the teat end after completion of the preparation procedure, prior to unit attachment. The scores were defined as follows: 1=Clean: no manure, dirt, or teat dip solution; 2=teat dip solution is present, no manure or dirt; 3=Small amount of dirt and manure is present; 4=Larger amount of

dirt and manure is present. The CMT was done and milk samples were taken from quarters with score 2 or more in CMT and cultured on microbiological medias. Collection of milk samples and microbiological procedures were performed as outlined by the National Mastitis Council [National Mastitis Council, 1999]. SCC data were taken in two times, simultaneous with hygiene scoring and one month later for the present status of the animals and the effect of hygiene on SCC, respectively. It seems that the level of raining and season may affect contamination of cow's body with manure and therefore hygiene scoring, so this study was performed in two seasons [high and low rainfall]. Average monthly rainfall in two different sampling times for each farm are shown in Table 1. To compare the SCC and hygiene scores, Kruscal-wallis test was used. Spearman correlation test was used for surveying the relationship between hygiene score and CMT. The relationship between hygiene score with the culture results were evaluated by *Chi* square and fischer's exact tests. Comparison between hygiene score in each farm in two seasons [high or low rainy] were analyzed by Mann-Whitney U test.

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Author Contributions

Conceived and designed the experiments: B.K., S.A.T.R. Performed the experiments: I.R. Analyzed the data: M.A. Wrote the paper: BK, S.A.T.R.

Conflict of Interest

None of the authors of this paper have a financial or personal relationship with other people or organizations that could inappropriately influence or bias the content of the paper.

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