Assessment of somatic cell count, milk production, and hygiene in dairy cows housed in a compost-bedded pack barn

by

Emily Grosskreutz

A thesis presented to the Honors College of Middle Tennessee State University in partial fulfillment of the requirements for graduation from the University Honors College

Spring 2015

Assessment of somatic cell count, milk production, and hygiene in dairy cows housed in a compost-bedded pack barn

by
Emily Grosskreutz

APPROVED:

Dr. Jessica Carter
School of Agribusiness & Agriscience

Dr. Warren Gill
School of Agribusiness & Agriscience

Dr. Donald Snead
Department of HC Representative
Honors Council Representative

Dr. Robert D. Sieg
UHC Administrative Representative

Abstract

Increased somatic cell count (SCC) reduces the quality of milk, and causes a decrease in the profits for the farm. The objective of this project was to monitor somatic cell count of cows housed in a compost-bedded pack barn through SCC testing, treatments for clinical signs, and measuring cow hygiene scores. This project was conducted at the MTSU Experiential Learning and Research Center which included Holstein, Jersey, and crossbred cows. The herd was evaluated for 84 days and tested every 28 days for SCC. Milk quality data were collected monthly through the Dairy Herd Improvement Association (DHIA). Cows were compared by treatment group, breed, and over time. Significant differences between the groups were found in somatic cell score, conductivity, and average activity. Between breeds significant differences were only found in conductivity and average activity. There were no significant correlations between somatic cell score and hygiene.

Table of Contents

List of Tables

List of Figures

Introduction

Milk quality is a major factor contributing to the profit of a dairy farm. Increased somatic cell count (SCC) reduces the quality of milk, and therefore, causes a decrease in the profits for the farm. Discounts for high SCC milk (> 400,000 cells/ml) on a dairy farm can be as high as $0.25 to $1.50/cwt. This is a loss that most family-operated farms cannot afford. This project was designed to assess the health, hygiene, and milk production of a dairy herd. We hoped to increase the quality of milk produced by the cows and subsequently, increase the profits of the MTSU dairy herd.

Somatic cell count is calculated by the concentration of leukocytes, or white blood cells, per milliliter of milk (University of Arkansas, 2012). The increase of white blood cells indicates an infection of the mammary gland, commonly known as mastitis (University of Arkansas, 2012). The degree of the mastitis infection can be determined by the number of leukocytes found from a SCC test (University of Arkansas, 2012). Leukocytes, or somatic cells, are necessary for the mammary glands to fight infection. Somatic cells are used as proxy for determining the degree of disease, with a threshold of > 200,000/ml, being infected. A low (< 100,000/ml) SCC also increases the risk of mastitis, giving an exponential curve to the risk of mastitis by SCC (Bradley *et al*., 2012).

There are two kinds of mastitis: clinical and subclinical. Clinical mastitis can be observed due to unusual milk qualities such as globs, pinkness (bloody) inflamed, hot or swollen udder, therefore, the biggest risk would be subclinical mastitis, where there are no signs of infection besides SCC. This makes monitoring SCC in dairy herds extremely important for the health of the cow, and the quality of the milk. Many tests, such as the California Mastitis Test, have been developed for easy diagnosis of mastitis. Generally, mastitis is caused by pathogenic bacteria entering the teat, infecting the udder, but can also be caused by udder trauma (Herlekar *et al*., 2013). These microorganisms are classified as either contagious or environmental. The smooth muscle teat sphincter is the primary barrier against pathogens entering the mammary gland, and it provides both a physical barrier and a fatty acid based chemical barrier (Bradley *et al.*, 2012). However, the integrity of this barrier can be comprised by damage to the teat or nutritional deficiency. Inflammation of the udder due to the introduction of microorganisms stimulates the immune system, and this response is then measured by SCC.

There are many ways to try to prevent or reduce mastitis. The optimal way to prevent a high SCC is to keep a clean living environment for the cows to minimize bacteria from getting into the udder. Poor hygiene has been demonstrated to be associated with higher SCC and possibly higher risk of subclinical mastitis in dairy cattle (Barkema *et al*., 1999; Schreiner and Ruegg, 2003, Reneau *et al*., 2005, Dohmen *et al*., 2010). One major area affecting cow hygiene is the free-stall area, or their lying area. Cleanliness and cow behavior patterns have been associated with elevated SCC. Barn management and cow nutrition have been determined as factors that contribute to the contraction of mastitis. If mastitis has already been contracted, an antibiotic control is often used as treatment (Cicconi-Hogan *et al*. 2013). Culturing the milk to find the specific bacteria causing the mastitis is helpful for treating the infected cow for the specific type of bacteria, and then also checking the SCC throughout the treatment process will show whether or not the actions taken are, in fact, reducing the bacterial growth.

Literature Review

A study conducted by DeVries *et al*. 2012, determined the association of bovine behavior, barn and cow hygiene and the risk of elevated somatic cell count (eSCC). This was done in a freestall barn with an automatic milking system. The study was conducted over the course of 4 consecutive 28-day periods, 112 days total. This project included variations in the frequency of floor scraping, the standing and lying behavior of the cows, the cleanliness score given to the cows based on dirtiness of upper leg/flank, lower legs and udder, stall hygiene scores, and milk quality samples in order to find if a correlation existed between hygiene and elevated somatic cell count. In this study, cows that spent more time lying down in the freestall area had poorer udder hygiene, along with older cows and high milk producing cows. Researchers also concluded that the longer durations of pre-milking standing increased the dirtiness of udders, and shorter lying periods were associated with poor hygiene of the lower legs. Elevated somatic cell count risk rose in cows of higher days in milk (DIM), lower milk yields, and higher initial SCC when stalls were dirtier. However, cows with a high milk yield had a decreased risk of eSCC. Unsurprisingly, when the floor was scraped more often, hygiene of the cows increased. For this study, there was no discernible connection between the hygiene of the cows and the risk of SCC, assumed to be because the hygiene scores of the cows were too high on average to be affected by the extra infectious pressure (DeVries *et al*. 2012).

Another study, by Dufour *et al*. 2011, reviewed associations of dairy farm management and udder health, and it's relation to herd-level somatic cell count. Thirty-six manuscripts were sought from five data bases (PubMed, Medline, CAB, Agricola, and Web of Science) in English, French and Dutch, and only literature published after 1979 was used in order to keep the study as relevant as possible. All manuscripts used had to include some udder health management practice, somatic cell counts, no case reports or series, ≥7,000 kg milk production average for 305-day herds, and a herd size of ≥40 milking cows (Dufour *et al*. 2011). Every manuscript used was an observational study. For each reviewed study, only one effect (management practice) was calculated for SCC. In the case of a study having more than one effect for SCC the review focused on the herd-level SCC rather than the group specific SCC. The effects or management practices were grouped into three categories based on whether they increased, decreased or had no effect on SCC.

This study found that there are many links provided in studies between management and herd SCC. However, this study did not focus on the magnitude of the relationships between management and SCC, just the correlations, which is one of this study's limitations. This study was able to provide good information on which associations have an effect on SCC even across populations, time, and circumstances. Much of the study's results showed that management practices being used today work on lowering or maintaining a low SCC. Clean housing plays a role in reduced SCC. Milking procedures should include wearing gloves, proper timing with automatic milkers, a post-dip, with high SCC cows being milked last, or having the milk claw washed before it is used on the next cow. Many practices have been demonstrated to have a connection with SCC, and should be taken into consideration when organizing a management plan for a dairy (Dufour *et al*., 2011).

A study conducted by Watters *et al*., 2013, investigated the association between cow activity periods and elevated somatic cell count at herd and individual cow levels. Five commercial dairy farms in Ontario with freestall type barns participated in this study. Forty randomly selected Holsteins from each herd were chosen provided that they had a SCC <

100,000 cells/ml, and were < 200 days in milk. If a cow's SCC jumped up to > 200,000cells/ml, then it was documented as a case of eSCC and subclinical mastitis. These farms were monitored for 4, 5 week periods. Cows were also observed for hygiene and lameness and scored by trained individuals. The study found that cows that lie down < 90 minutes after milking were more likely to experience eSCC, along with multiparous cows and cows that had a higher SCC at the beginning of the study. Prior research would show that the teat canal is expanded after milking and therefore more susceptible to bacteria. Cows were encouraged to stay standing after milking by feeding at that time (Watters *et al.*, 2013).

Objective

The objective of this project was to monitor somatic cell count of cows housed in a compost-bedded pack barn through SCC testing, milk sampling for bacterial populations, treatments for clinical signs, and measuring cow hygiene scores over an 84 day period.

Materials and Methods

We used the MTSU Experiential Learning and Research Center dairy herd for this project. This herd includes Holstein, Jersey, and Holstein x Jersey crossbred cows. The cows were housed in a compost-bedded pack barn with cedar shavings as the bedding. The cows were fed a total mixed ration (TMR) that included a grain supplement and alfalfa haylage (or small grain silage when alfalfa was not available). The milking parlor was an 8 x 8 parallel design and was equipped with AfiMilk® monitors to record milk data. Each cow also had a leg band that includes a micro-chip to record activity levels (number of steps taken, time spent lying down, etc.). A group of 45 cows was evaluated over a period of 84 days and tested every 28 days for SCC (d0 d28, d56, d84).

Data on milk quality, such as SCC, was collected monthly through regular Dairy Herd Improvement Association (DHIA) milk testing. In addition, we tested milk samples of cows with a > 200,000 cells/ml SCC identified by the DHIA testing using a PortaSCC test and digital reader (Nelson Jameson). Cows identified as having a high SCC (greater than 200,000 cells/ml) were assigned to the treatment group (TRT) and cows with a low SCC (< 200,000 cells/ml) were included in the control group (CNTRL). Cows in the TRT group received antibiotics for treatment of mastitis if clinical signs were observed or elevated SCC was measured. Treatments included oxytetracycline (4.5 mL per 100 lb body weight; 96-hr milk withdrawal), Today (96 hr milk withdrawal), or Spectramast (72 hr milk withdrawal), depending on the severity of symptoms and level of SCC.

Daily records were obtained on each cow for milk production, milk conductivity, and activity level (amount of time spent lying) through leg pedometers (AFI Milk). Live observations for cow hygiene were assessed for 4 days at the end of each 28-day period. Cows were scored on a 4-point cleanliness scale (1 = very clean to 4 = very dirty), evaluating the udder, lower legs, and upper legs/flank separately (Vet Med Hygiene Scoring Card). Milk samples were collected from the cows on the last day of the 28 day period and tested with the PortaSCC Test and digital reader. The reader was used to monitor selected cows' SCC throughout the course of the project. The readings were not included in the data analysis due to no actual numerical value being assigned to scores read by the tester as Hi (> 3,000,000 cells/ml) or Lo (< 50,000 cells/ml).

Data Analysis

Data were analyzed with SAS software (v 9.3) using a mixed model procedure with repeated measures and an analysis of variance was performed to access significance of the treatments (SAS, 2012). For all analysis, values of $p < 0.05$ were considered significant. Somatic cell score (SCS) was calculated by transforming the somatic cell count measurements using the following formula: SCS=log2 (SCC/100) + 3; Shook, 1993). Other measurements included daily milk yield, days in milk (DIM), average activity (the average number of steps taken per hours), average rest bout (the average time spent lying down), cow hygiene scores, and milk conductivity levels. Cows were compared by treatment group (CNTRL, low SCC) versus TRT (high SCC), by breed, and over time (d0 – d84). A regression model was used to evaluate the subjective hygiene score compared with SCS.

Results

Production measures compared by control and treatment SCS groups are included in Table 1. As expected, cows in the treatment group had a significantly higher SCS than cows in the Control group ($p = 0.001$). Significant differences also were found in conductivity and average activity (steps/hour), with cows in the treatment group having a higher conductivity and activity. Table 2 compares the data between breeds which included Holstein, Jersey and Crossbred. Significant differences by breed were detected only in conductivity and average activity (steps/hour). Table 3 displays the regression results from the subjective hygiene scores and SCS. There were no significant differences. Table 4 shows the *p* values and adjusted r-squared values for the subjective scores. The *p* value for the udder subjective score was significant, but the r-squared value was not. Table 5 shows the regression analysis for the control group. Figure 6 shows the regression analysis results of the treatment SCC group. The means compared between the tables 5 and 6 show that the treatment cows had higher hygiene scores on average though there was no significant relation between SCS and hygiene. Table 7 gives correlation coefficients for the variables of the hygiene scoring when compared to the other variables (upper leg/ flank, lower leg, udder and SCS). There were no significant associations found. This table does show, however, that if a cow scored dirty in one area, she most likely scored dirty in another. Figure 1 graphs the differences in SCS between the CNTRL and TRT groups, based on the information from Table 1. Figure 2 expresses average conductivity (Mmho) by breed. Significant differences were found between Holstein and Jersey, but not Jersey and Crossbred or Holstein and Crossbred. Figure 3 shows conductivity by day (Day 28, 56, and 84). Day 28 was the lowest and significantly different than day 56, though neither 28 nor 56 were significantly different than day 84. Figure 4 graphs conductivity by group, breed and day. Figure 5 gives conductivity comparison by breed and day of CNTRL group. Jerseys were lower on conductivity all through the study. Figure 6 gives conductivity comparison by breed and day of the TRT group. Figure 7 shows milk yield by day (pounds per day). Figure 8 gives daily milk yield (pounds per day) by breed by day.

Discussion

There has been a lot of documentation that shows associations between farm management, animal health and milk quality (Zwald *et al.*, 2004; Pol and Ruegg, 2007; Dufour *et al*., 2011). It has been noted that somatic cell count has been known to fluctuate due to seasonal effects, increasing in summer and decreasing in winter (K.M Cicconi-Hogan *et al*. 2013). For the purpose of this study, seasonal effects were not taken into consideration; since the project ran through the winter months there was no summer data for comparison.

In a study by DeVries *et al*. (2012), it was found that cows with a higher milk yield tended to have poorer hygiene. This was hypothesized to be because older cows are likely to have bigger, lower udders which are more likely to become dirty because they are in closer proximity to the floor. Other studies found this particular result too (Ellis *et al*. 2007, Reneau *et al*., 2005). While we did not assess the scores by age of cow or number of parturitions by cow, it would be interesting to see if this dairy herd followed the trend of the one in the DeVries *et al*. 2012, study. Barn cleanliness is associated with bulk tank SCC (Barkema *et al*. 1999). While there was no official observation and/or scoring of the pack in the freestall area, cows tended to have a high score when pack was wetter than usual. Alley floor hygiene can be related to the cow hygiene scores, the scores are most likely too high on average to make a difference on the infectious pressure on the cows (DeVries *et al*., 2012). The subjective score data for the cows we received indicated that there was no relationship between SCS and hygiene (Table 3).

Conductivity is a measure of how well a substance can conduct electricity. This changes depending on the compounds found in the substance. With mastitis, the makeup of the milk has higher concentrations of sodium, potassium and chloride, which can then be detected by a measure of conductivity (Lactoscan.com). Although this is not the only useful measure of conductivity, it is the most relevant to this study. The conductivity was significantly higher in the TRT group than the CNTRL group, which was expected since

SCS was significant as well. Jerseys were significantly lower in conductivity than the Holsteins and the crossbreds, though their SCS was not significantly different.

The productivity, or milk yield, of the herd was low (Fig. 7) during the project period, however, days in milk was not taken into account when cows were chosen for this project. Many cows were far along in their lactation during the study, thus milk yield was low. Differences in yield between breeds was not significantly different, which is not the norm, but days in milk was not taken into consideration during comparison.

It should be noted that the results we received were only representative of a small time period for this dairy herd. Many cows from the herd were dried off to calve in, or calved in during the project. It should also be noted that there were undocumented seasonal effects. Results would be expected to differ if the study was conducted over a full year or more, and would be expected to be much more representative of the actual herd averages. If this project were to be repeated, we recommend doing the subjective scoring over a longer period of time, and assessing the cleanliness of the pack.

Conclusion

Somatic cell count varied greatly by month and by individual cow. The use of leg bands to measure activity and conductivity greatly helps monitor the cow herd. Additional tools for early detection of mastitis will help us to continue to improve cow health and productivity. Although it is seemingly impossible to eradicate mastitis, there are many means by which it can be monitored and treated. With early detection of mastitis by eSCC through conductivity, bulk tank SCC should be managed. Even though our subjective scores had no significant correlation with SCS, management and hygiene of cows should be ideal in order to reduce herd level SCC.

Literature Cited

Barkema, H. W., J.D. van der Ploeg,Y.H. Schukken, T.J. G. M.Lam, G. Benedictus, and A. Brand. 1999. Management style and its association with bulk milk somatic cell count and incidence rate of clinical mastitis. J. Dairy Sci. 82:1655-1663.

Cicconi-Hogan, K. M., M. Gamroth, R. Richert, P. L. Ruegg, K. E. Stiglbauer, and Y. H. Schukken. 2013. Associations of risk factors with somatic cell count in bulk tank milk on organic and conventional dairy farms in the United States. J. Dairy Sci. 96:3689-3702.

Cook. N. B., University of Wisconsin, Madison. Hygiene scoring card. Web. Sept. 28, 2015. www.vetmed.wisc.edu/dms/fapm/fapmtools/4hygiene/hygiene.pdf

DeVries, T.J., M.G. Aarnoudse, H. W. Barkema, K.E. Leslie, and M.A.G. von Keyserlingk. 2012. Associations of dairy cow behavior, barn hygiene, cow hygiene, and risk of elevated somatic cell count. J. Dairy Sci. 95:5730-5379.

Dohmen, W., F.Neijenhuis, and H. Hogeveen. 2010. Relationship between udder health and hygiene on farms with and automatic milking system. J. Dairy Sci. 93:4019-4033.

Dufour S., A. Fréchette, H. W. Barkema , A. mussell , and D. t. Scholl. 2011. Invited review: Effect of udder health management practices on herd somatic cell count. J. Dairy Sci. 94 :563–579 doi: 10.3168/jds.2010-3715

Ellis, K. A., G. T.,Innocent, M Mihm, P. Cripps, W. G. Mclean, C. v. Howard, and D. Grove-White. 2007. Dairy cow cleanliness and milk quality on organic and conventional farms in the UK. J. Dairy Res. 74:302-310.

Herlekar, D.A., C.S. Shashikant, A.A. Gurjar, and B.M. Jayarao. Presence of viral and bacterial organisms in milk and their association with somatic cell counts. J. Dairy Sci. 96:6336-6631

Lactoscan. 2015. Useful Information –Conductivity Measurement. http://www.lactoscan.com/usefull_info/english/conduct.html (accessed 12 March, 2015).

Reneau, J. K., A. J.Seykora, B. H. Heins, M. I. Endres, R. J. Farnsworth, and R. F. Bey. 2005. Association between hygiene and somatic cell count in dairy cattle. J. Am. Vet. Med. Assc. 227:1297-1301

Schreiner, D.A., and P.L. Ruegg. 2003. Relationship between udder and leg hygiene scores and subclinical mastitis. J. Dairy Sci. 86:3460-3465.

Shook, G. E. 1993. Genetic improvement of mastitis through selection on somatic cell count. Vet. Clin. North Am. Food Anim. Pract. 9(3):563-581.

University of Arkansas, (System), Service. Cooperative Extension, Michael L. Looper, and 1969-. 2012. "Reducing somatic cell count in dairy cattle." *AGRIS*, EBSCO*host*.

Watters, M.E. Alexandrea, Karin M.A. Meijer a, Herman W. Barkema b, Kenneth E. Lesliec, Marina A.G. von Keyserlingk d, Trevor J. DeVries. 2013. Associations of herd- and cow-level factors, cow lying behavior, and risk of elevated somatic cell count in free-stall housed lactating dairy cows. J. Preventative Veterinary Medicine. 111 (2013) 245–255.

APPENDIX

Table 1. Production Measures (± standard error) for dairy cows in the control and treatment groups[a].

Measure	**Control**	**High**	***P*-value**
No. of cows	23	22	
Milk Yield, lb/d	46.4 ± 4.63	39.0 ± 4.75	0.269
Days in milk	305 ± 34.19	316 ± 34.97	0.824
Somatic cell score[b]	12.5 ± 0.26	15.6 ± 0.28	0.0001*
Conductivity	9.42 ± 0.21	10.6 ± 0.21	0.0003*
Avg. Activity, steps/hr	88.8 ± 5.38	109.0 ± 5.56	0.011*
Avg. rest bout, times/d	7.03 ± 0.42	7.51 ± 0.44	0.430

[a] Control = < 200,000 cells/ml somatic cell count; Treatment = > 200,000 cell/ml somatic cell count.

[b] Somatic cell count data was transformed using the following formula: SCS = log2(SCC/100) + 3.

* Significant difference at $p < 0.05$.

Table 2. Production Measures (± standard error) compared by dairy cow breed.

Measure	Holstein	Jersey	Crossbred	*P*-value
No. of cows	19	16	10	
Milk yield, lb/d	50.1 ± 4.94	39.2 ± 5.39	38.7 ± 6.73	0.246
Days in milk	298 ± 36.42	296 ± 39.75	336 ± 49.76	0.787
Somatic cell score[a]	14.2 ± 0.29	14.1 ± 0.32	13.9 ± 0.38	0.915
Conductivity	10.4 ± 0.22	9.39 ± 0.24	10.2 ± 0.30	0.011*
Avg. activity, steps/hr	80 ± 5.90	117 ± 6.22	100 ± 7.83	0.0005*
Avg. rest bout, times/d	7.56 ± 0.45	6.67 ± 0.50	7.79 ± 0.61	0.345

[a] Somatic cell count data was transformed using the following formula: SCS = log2(SCC/100) + 3.

* Significant difference at $p < 0.05$.

Table 3. The subjective hygiene score means and somatic cell score (SCS)[a] comparisons by a regression model.

Variable	N	Mean	Standard deviation	Minimum	Maximum
Upper Leg/ Flank	98	1.56	0.5267	1.0	3.25
Udder	98	1.53	0.5046	1.0	3.25
Lower Leg	98	2.10	0.5358	1.0	3.5
SCS	98	10.79	4.7354	0.06	18.57

[a] Somatic cell count data was transformed using the following formula: SCS = log2(SCC/100) + 3.

Table 4. The adjusted r-squared values and p values for the subjective hygiene scores.

Variable	**Adjusted R-squared Value**	***P*-value**
Upper Leg /Flank	-0.0080	0.6301
Udder	0.0830	0.0023*
Lower Leg	0.0027	0.2632
Variables Combined	0.1571	.

* Significant difference at $p < 0.05$.

Table 5. Subjective hygiene scores and somatic cell score (SCS)[a] regression means of the control[b] group.

Variable	N	Mean	Standard deviation	Minimum	Maximum
Upper Leg/ Flank	59	1.51	0.4888	1.0	2.75
Udder	59	1.46	0.4415	1.0	2.50
Lower Leg	59	2.05	0.5144	1.0	3.0
SCS	59	9.35	4.2449	0.06	14.06

[a] Somatic cell count data was transformed using the following formula: SCS = log2(SCC/100) + 3.

[b] Control = < 200,000 cells/ml somatic cell count; Treatment = > 200,000 cell/ml somatic cell count.

Table 6. Subjective hygiene scores and somatic cell score (SCS)[a] regression means of the treatment[b] group.

Variable	N	Mean	Standard deviation	Minimum	Maximum
Upper Leg/ Flank	39	1.63	0.5788	1.0	3.25
Udder	39	1.63	0.5788	1.0	3.25
Lower Leg	39	2.17	0.5647	1.0	3.50
SCS	39	12.97	4.6558	0.06	18.57

[a] Somatic cell count data was transformed using the following formula: SCS = log2(SCC/100) + 3.

[b] Control = < 200,000 cells/ml somatic cell count; Treatment = > 200,000 cell/ml somatic cell count.

Table 7. Correlation coefficients of subjective hygiene scores and somatic cell score (SCS)[a] compared among themselves.

Variables	**Upper Leg/ Flank**	**Udder**	**Lower Leg**	**SCS**
Upper Leg/ Flank	-	0.357	0.510	0.049
Udder	0.357	-	0.475	.304
Lower Leg	0.510	0.475	-	-0.114
SCS	0.049	0.304	-0.114	-

[a] Somatic cell count data was transformed using the following formula: SCS = log2(SCC/100) + 3.

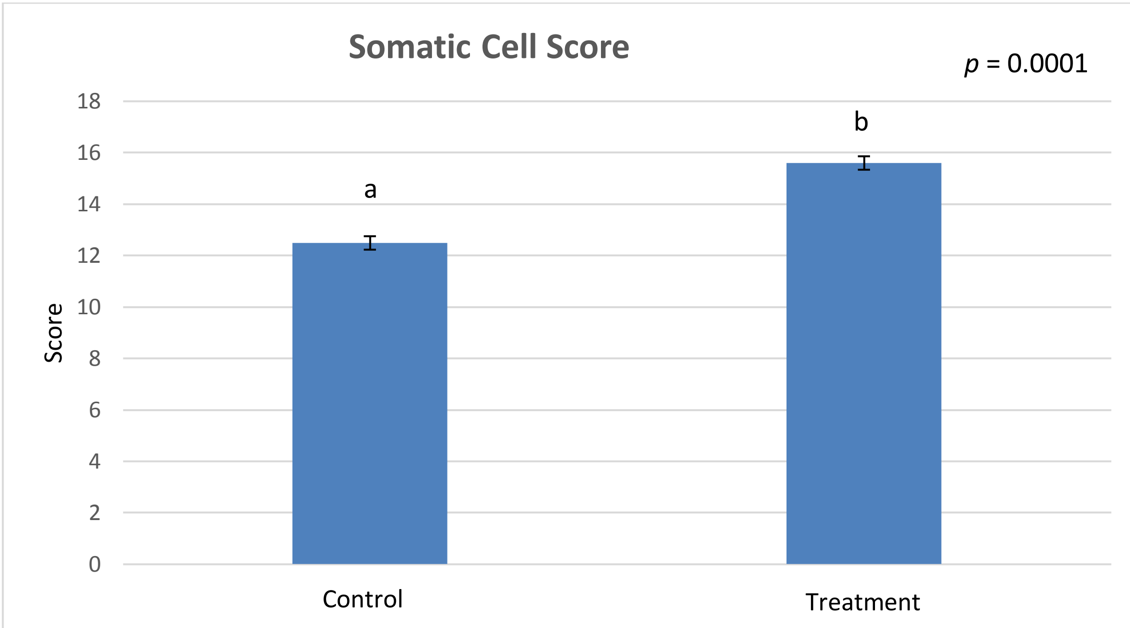

Figure 1. Somatic cell score (SCS) for Control (< 200,000 cells/ml) and Treatment (> 200,000 cells/ml) treatment groups. Somatic Cell Count (SCC) data were transformed using the following formula: SCS = log2(SCC/100) + 3.

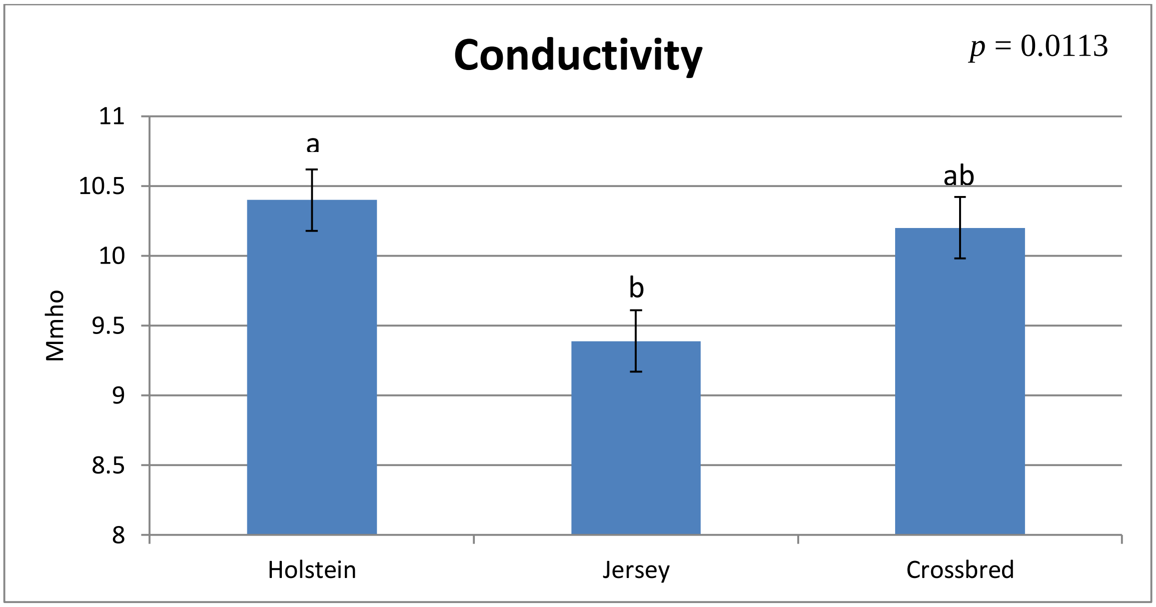

Figure 2. Average conductivity (Mmho) of milk from Holstein, Jersey, and Crossbred cows.

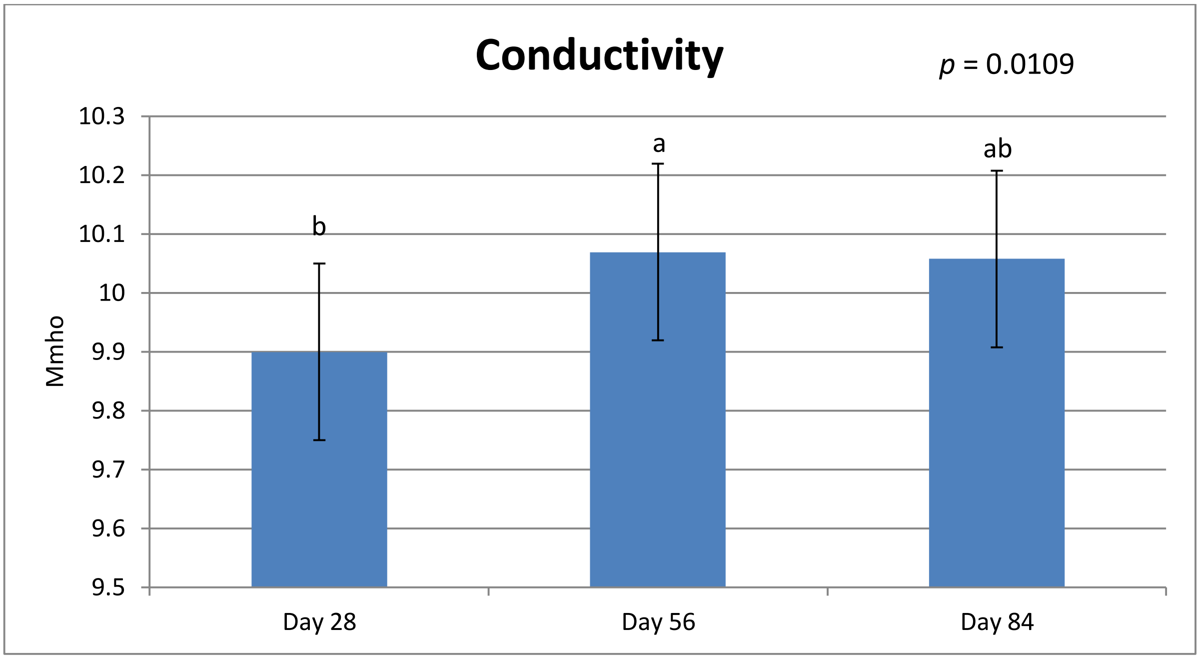

Figure 3. Average conductivity (Mmho) of milk by day (d0-28, d29-56, and d57-84).

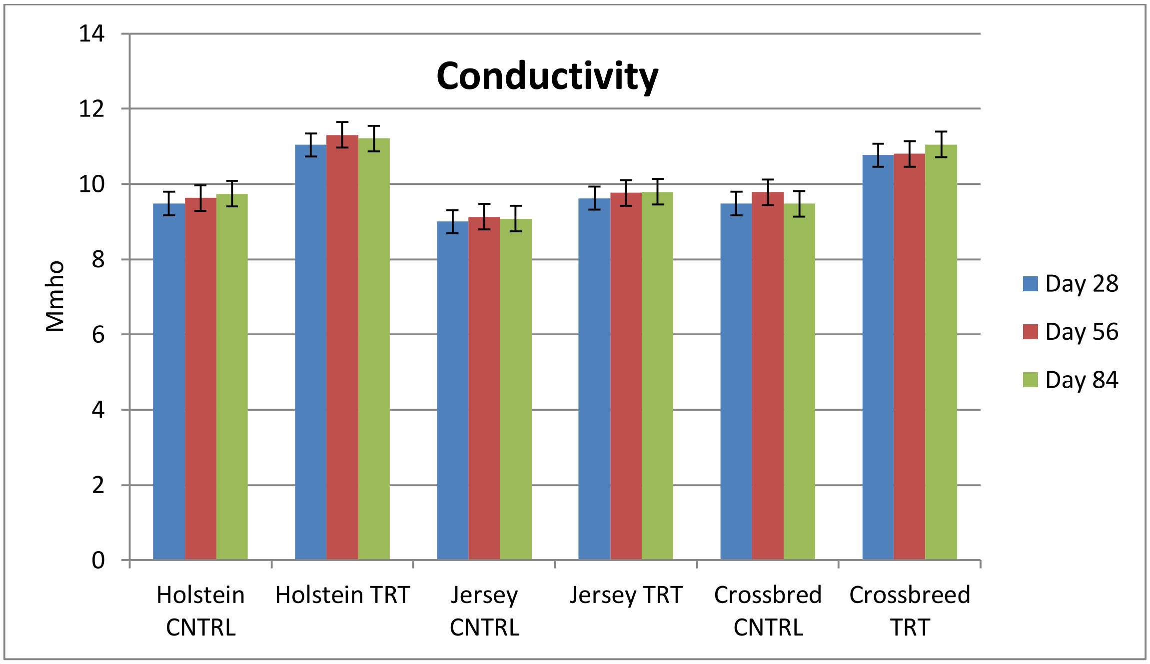

Figure 4. Average conductivity (Mmho) of milk shown by treatment group (Control (CNTRL) = < 200,000 cells/ml SCC; Treatment (TRT)= > 200,000 cell/ml SCC), breed and day.

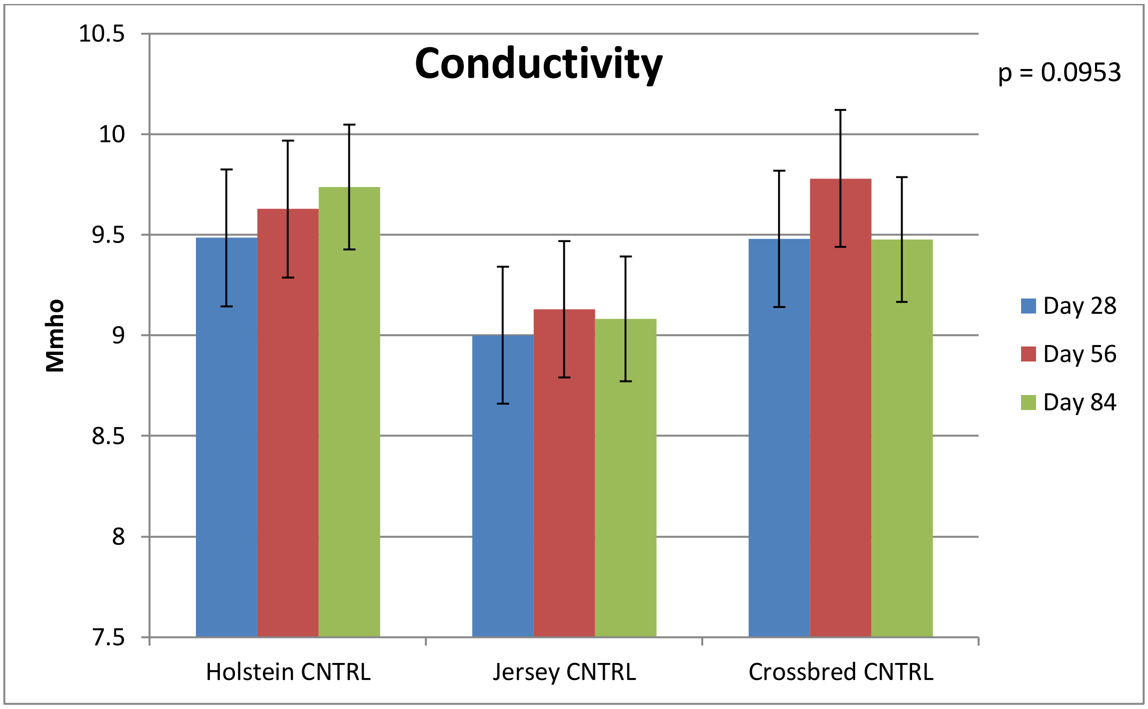

Figure 5. Average conductivity (Mmho) of milk shown by breed and day of the control group (control (CNTRL) = < 200,000 cells/ml SCC).

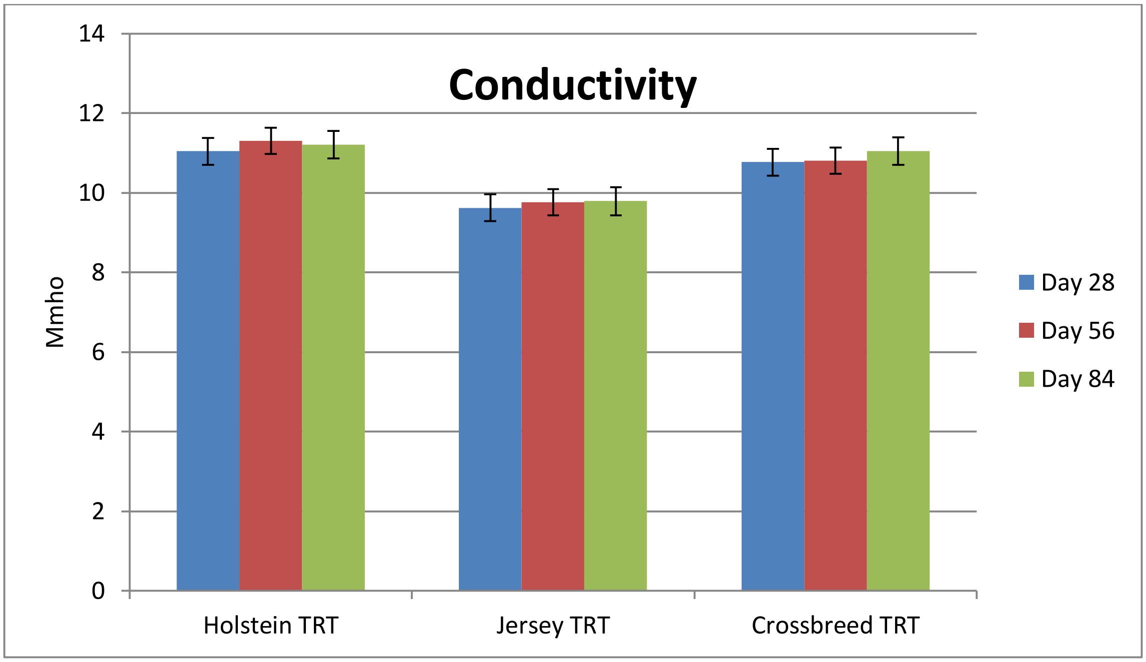

Figure 6. Average conductivity (Mmho) of milk shown by breed and day of the treatment group (treatment (TRT) = > 200,000 cell/ml SCC).

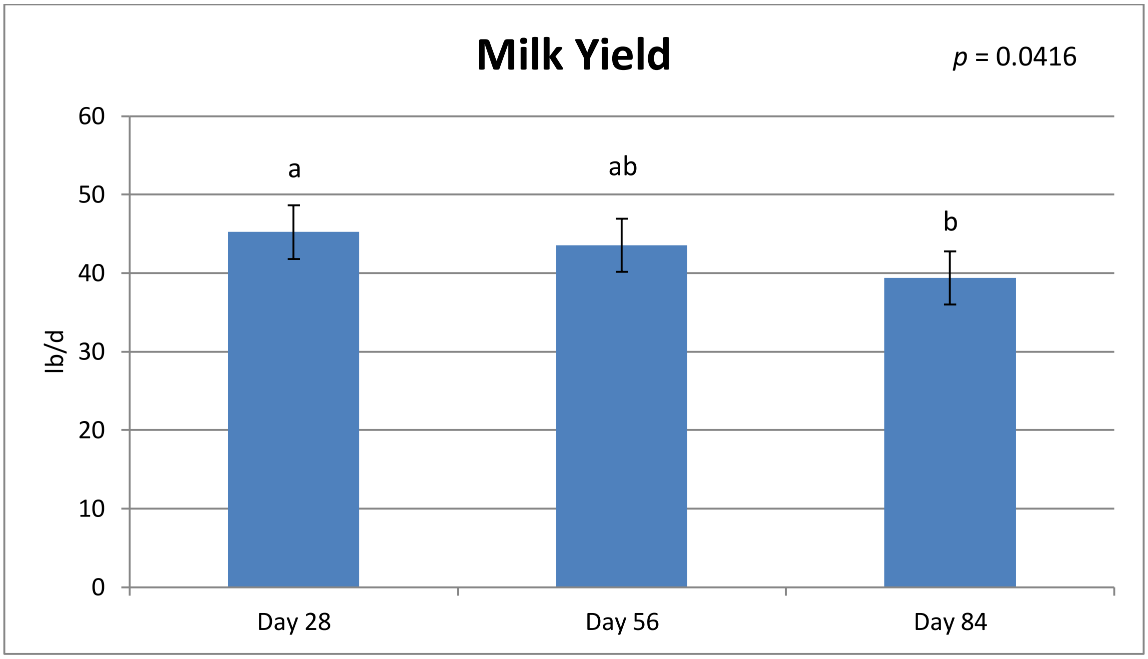

Figure 7. Cow milk yield (lb/d) by day.

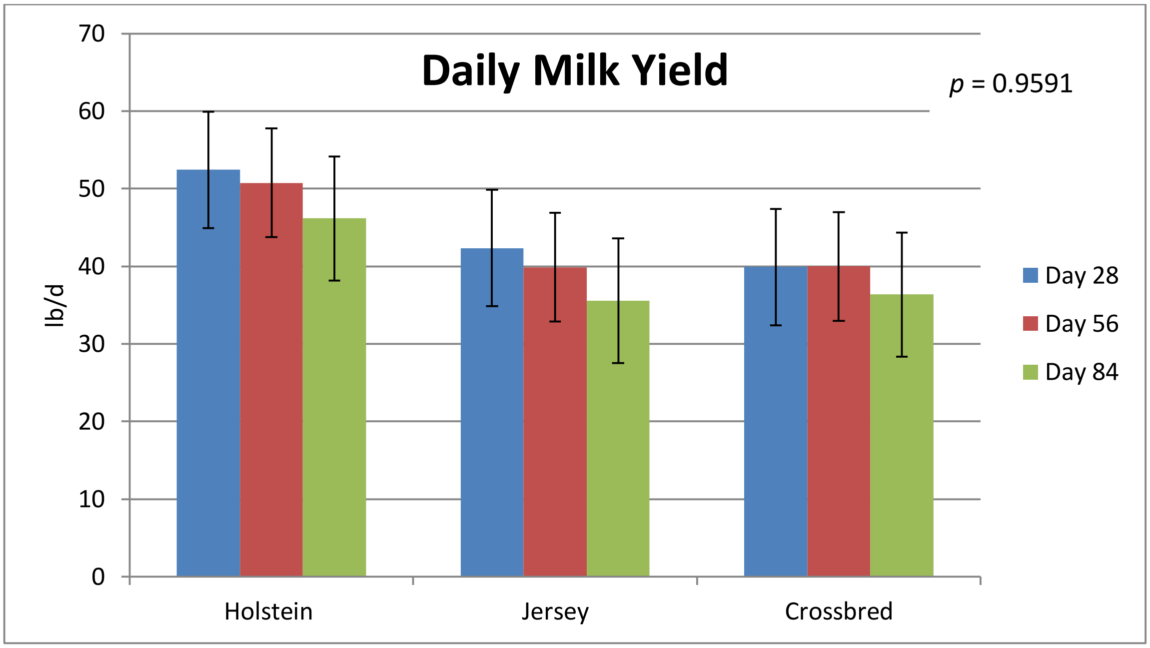

Figure 8. Daily milk yield (lb/d) by breed by day.

Image 1. Cows feeding at bunk after milking. This encourages cows to stay standing for a while after they exit the parlor.

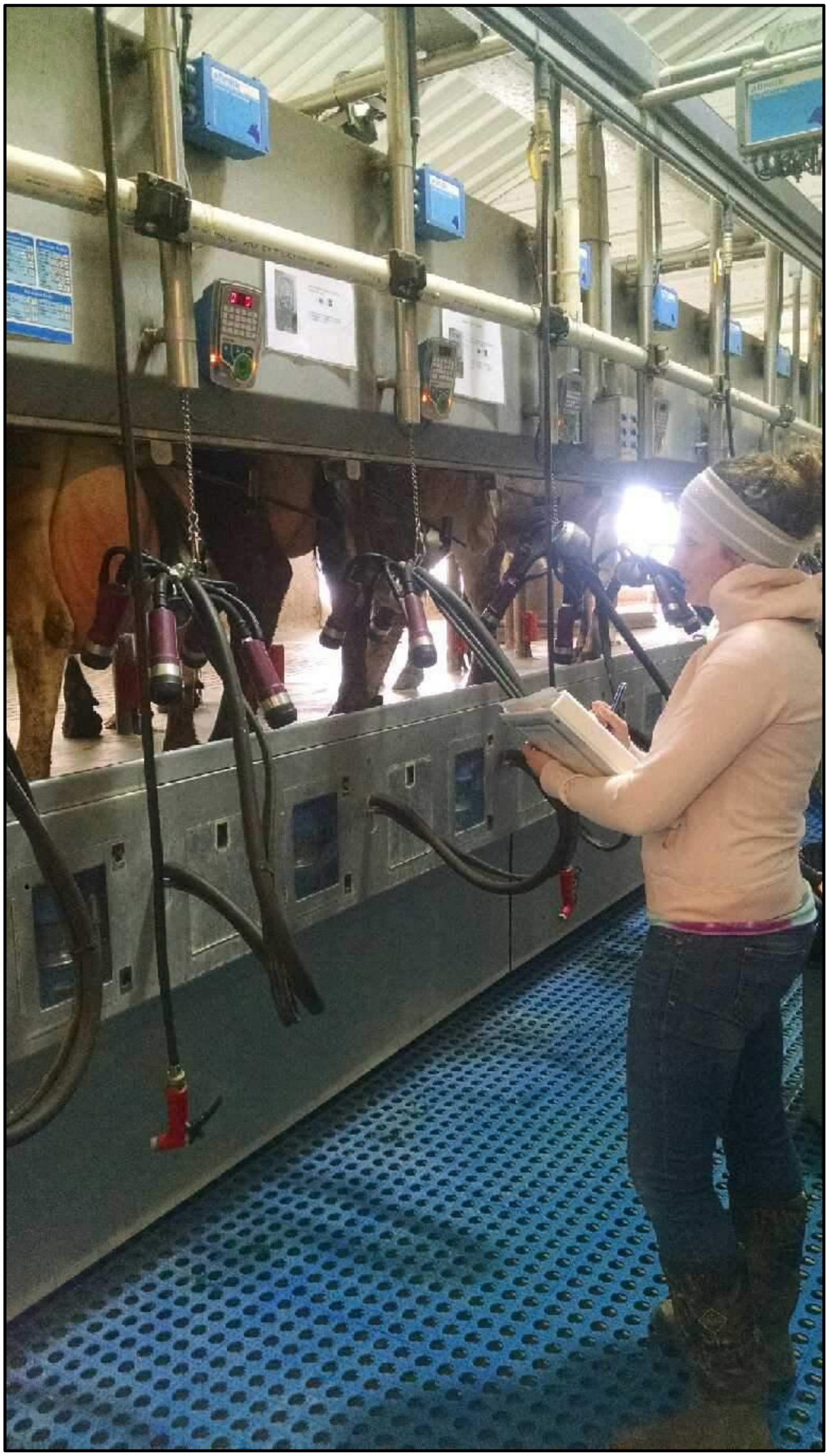

Image 2. Observation and scoring of cow hygiene of lower legs, udder and flank.

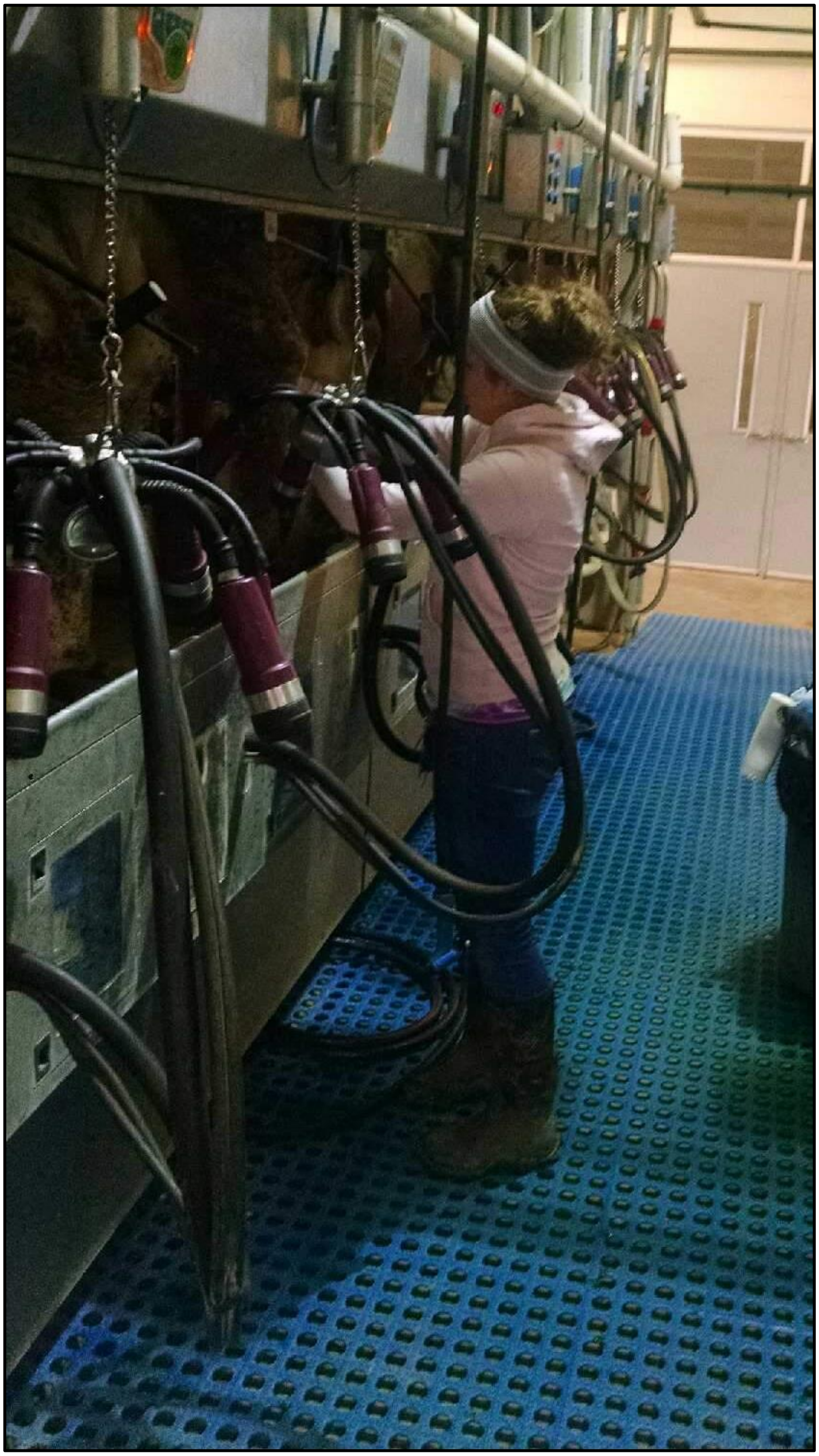

Image 3. Collection of milk samples for PortaSCC testing.

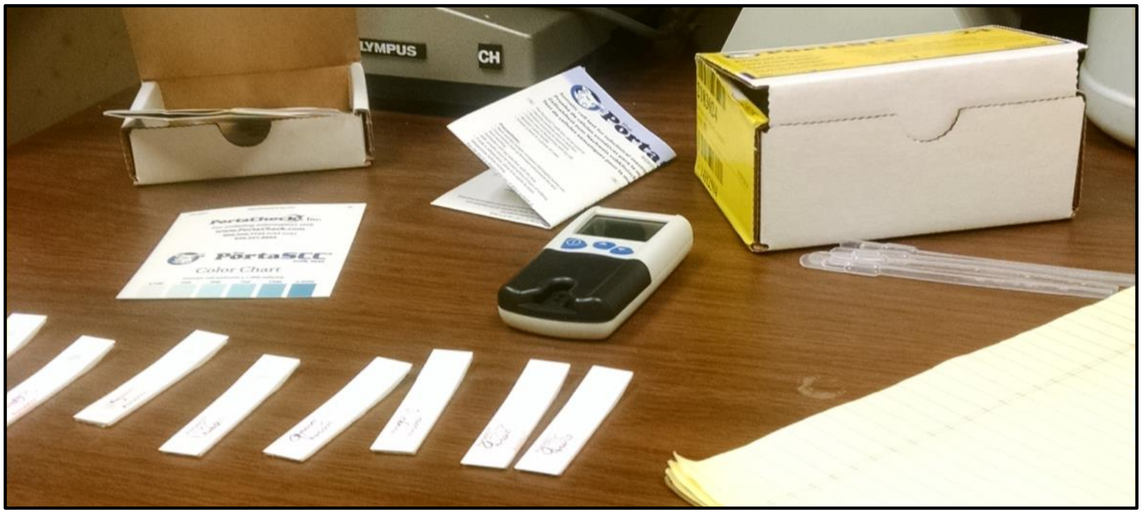

Image 4. PortaSCC handheld tester and test strips.

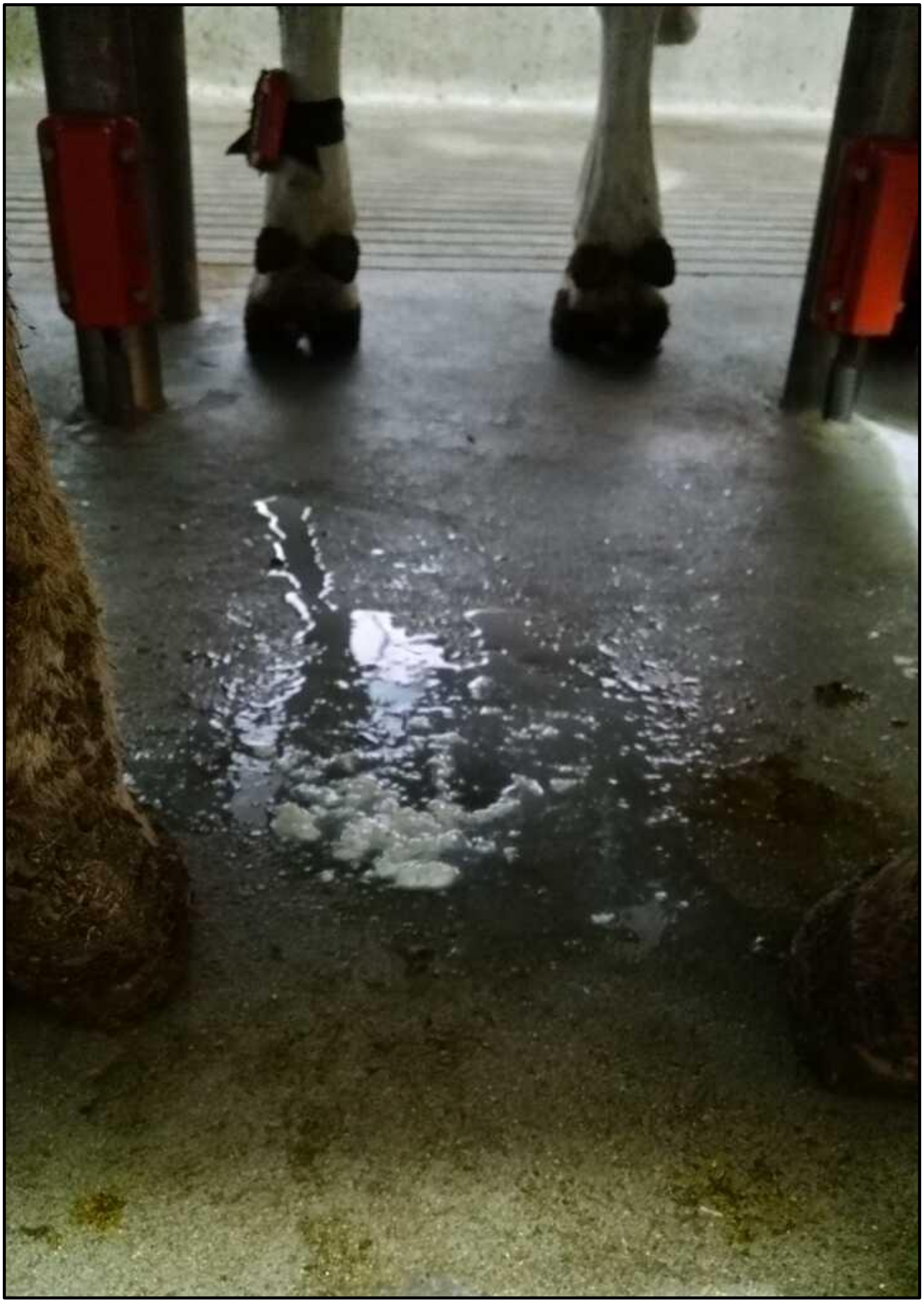

Image 5. Clinical mastitis noted by the clumps in the stripped milk.

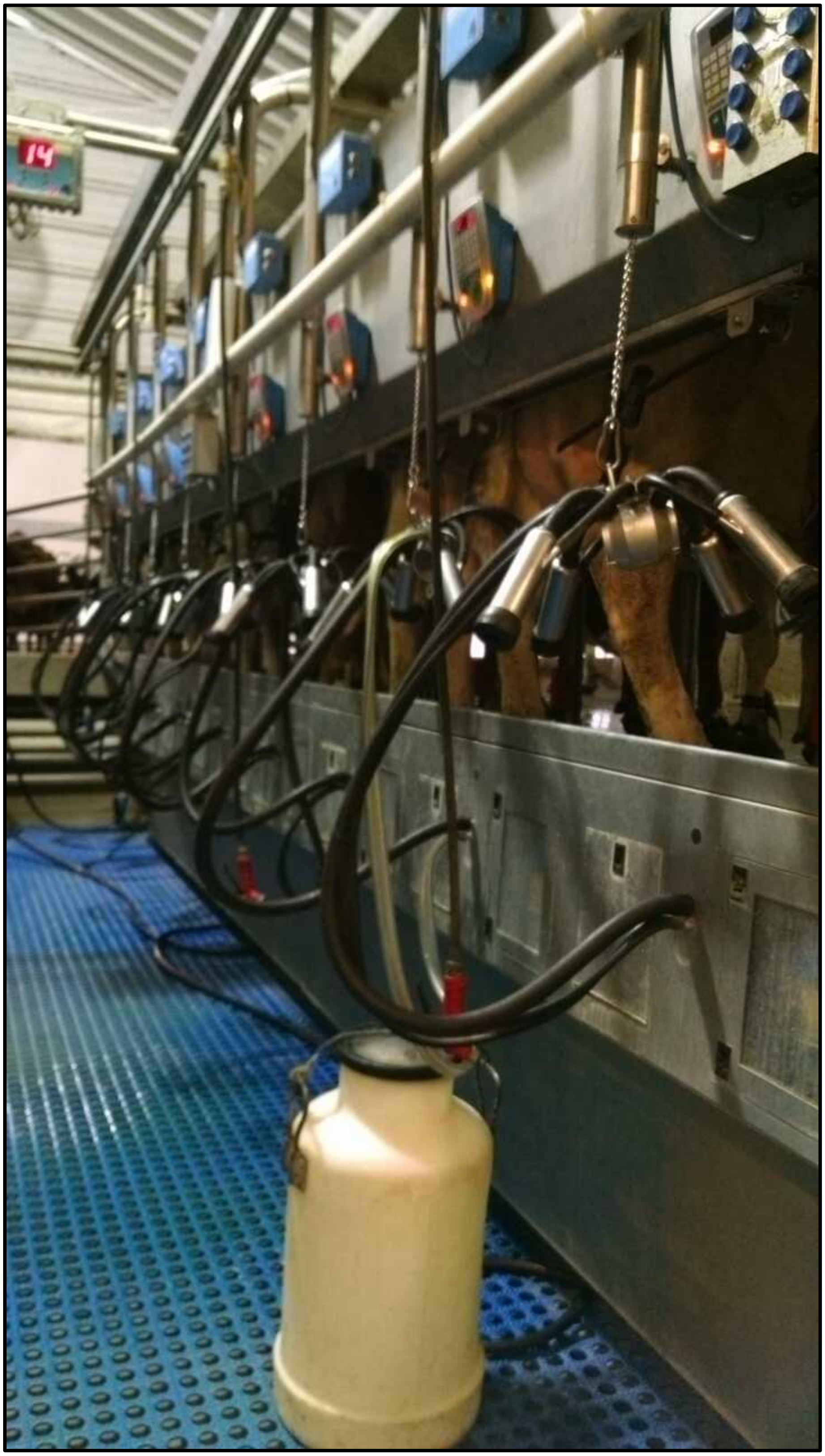

Image 6. A dump tank used to collect milk from cows treated with antibiotics in order to keep milk containing antibiotic residue from entering the bulk tank.

Image 7. Hygiene score card that was used as a model for the subjective scoring of the dairy cows (Universtiy of Wiscon).

Glossary

Conductivity – Measure of electrical current through a substance, measurement of degree of mastitis.

DHIA – Dairy Herd Improvement Association.

DIM – days in milk.

Dry – term for a cow that has come to the end of her lactation, or has been dried off via treatment.

eSCC – Elevated Somatic Cell Count.

Fresh – term for a cow that has just calved and started her lactation period.

Mastitis – Inflammation of the mammary gland, caused by bacteria or trauma.

Quarter – One the four mammary glands of the udder.

SCC – Somatic Cell Count, the concentration of leukocytes, or white blood cells, per milliliter of milk.

SCS – Somatic cell score (formula: SCS = log2 (SCC/100) + 3; Shook, 1993).