CHAPTER V

DISCUSSION

The effects of milking machine performance on the quarter somatic cell count

Most of the small holder dairy farms in the northern of Thailand use the bucket type of milking machine. From the descriptive statistics of milking machine performances, the vacuum levels ranged between 35.60 – 67.50 kPa and the mean vacuum level was 52.20 kPa. A Vacuum between 48 to 52 kPa was the most favorable for udder health (Osteras and Lund, 1988). Moreover, Rasmussen and Madsen (2000) recommended that mean vacuum in the short milk tube should not be lower than 32 kPa.

Following the International Organization for Standardization (ISO) 1996, the low-level system should stay within 32 to 42 kPa measured in the claw during peak milk flow and the high-level system would be 46 to 48 kPa in milkline vacuum. However, the bucket type of milking machine has neither low nor high-level of milking system. Therefore, the vacuum levels should be approximately according to those standard guidelines.

The different phases in the pulsation cycle has been defined by ISO, 1977. Each cycle of pulsation chamber vacuum is described as having four phases : A, increasing vacuum phase; B, maximum vacuum phase; C, decreasing vacuum phase and D, minimum vacuum phase. The duration of each phase as a percentage of the total cycle time is measured between the points at which the record intersects abscissas drawn at 4 kPa below nominal working vacuum and above atmospheric pressure. These phases express the physical forces transmitted from milking machine through the liner movement to living teat tissue (Osteras, et al., 1995).

The suction (A+B) phase should not be over 70 %, while the pressure (C+D) phase should not be under 30 %, the B phase should not be under 30 % of the total, the D phase should not be under 15 % (Anon, 1988). The machine setting suitable for at milking to a low (30 to 40 kPa) vacuum level and /or a pulsator ratio of approximately 50 % would substantially reduce the degree of edema in the teat tissues (Hamann and Mein, 1990). In the addition, Mahle, et al. (1982) predicted that the most favorable pulsation ratio would be 62: 38 when the pulsation cycle was standardized to 60 pulsation per minute.

In this study, the A to D phases were acceptable in the standard values. One reason for support this results, the phase A to D or pulsation ratio was unable to adjust from the supplier setting because the pulsation ratio was fixed by the company.

The fact that effects on udder health were found for D phase and pulsation rate, but not for other phases could mean that D phase and pulsation rate are more physiologically critical than the other phases. The D phase should not be as short as 25 % and should preferable be approximately 30 %, and the pulsation rate should be at least over 55 cycles per min (Osteras, et al., 1995). The differences in pulsation characteristics apparently have little effect on milking and udder health (Wilson, et al., 2000).

A high pulsation rate is also correlated with a short D phase. This mean that the effect of D phase could be compensated for by the effect of pulsation rate. High pulsation rates could increase the possibility of such events, simply because of the higher frequency of movement of the liner. Raising the pulsation rate from 55 to 60 cycles per minute. However, a low pulsation rate would be having an adverse effect on the length of the D phase (Osteras, et. al., 1995).

The mean of pulsation rate is 62.63 cycles per minute and maximum rate was still highest from the standard values. The reason was opposite the pulsation ratio, the pulsation rate was adjustable by turning the external knot of the pulsator. Furthermore, the farmers believe that the higher pulsation rate can milk faster than the lower pulsation rate.

Limping is defined in international standard as a number, in percentage units, indicating the unintentional difference between two pulsation ratio of an alternating pulsator. Although, limping should not exceed 3% according to specifications (www.cowtime.com.au).

In this study, the mean of the limping percentage is in an acceptable standard but some farms had the limping percentage out of the standard. A high prevalence of quarters with mastitis with coagulase-negative staphylococci was associated with a high pulsator limping ratio (Osteras and Lund, 1988). The limping can correct by changing the dual diaphragm, adding the diaphragm solution and pulsator cleaning. After repair finished, there must to measure the pulsation performances again before milking.

From the results, the milking machine performance parameters of both groups were within the standard and acceptable values, except the limping percentage. The differences have a little, but for statistical analysis that data were highly significant difference. From this reason, the milking machine may have an effect on the quarter somatic cell count.

There are many reports the effect of the milking machine performances on the udder health or SCC. The absence of pulsation markedly increased SCC and IMI compared with any pulsation (Capuco, et al., 1994). The pulsasion rate and ratio had little effect on mastitis, but that complete failure of pulsation leads to new IMI (Spencer, 1988).

In contrast, many researches are reports a little effect or no effect of milking machine performances on SCC. There are milking machine performances were not strongly related to prevalence of contagious mastitis or SCC, respectively. Pulsation parameters were not significantly associated with mastitis (Benda, 1997). The differences in pulsation rate and ratio apparently have little or no effect on milking and udder health (Wilson, et al., 2000). The rate of clinical mastitis, milk production, cull rate, and bulk tank SCC were not affected by pulsation ratio (Thomas, et al., 1993). The faulty pulsation and changes in pulsation rate did not affect SCC or electrical conductivity of milk (Ichikawa, et al., 1988).

The effects of teat structures on the quarter somatic cell count

The ultrasonography would be expected to be a very suitable method for imaging liquid cavities in all kinds of tissues, including mammary gland cistern. (Bruckmaier and Blum, 1992). Therefore, this study used the ultrasound machine to determine the teat structures.

From the descriptive statistic of teat structures, all of the teat structures showed the difference between minimum and maximum values in wide range. Meaning that the teat structures were more varied in teat structures, but the mean value of teat structures were approximately in the same other reports (Neijenhuis, et al., 2001 and Geishauser and Querengasser, 2000).

There were no significant difference in the teat structures between high quarter somatic cell count group(≥ 200,000 cells/ml.) and low quarter somatic cell count group (< 200,000 cells/ml.) at before milking and after milking.

In contrast, there were highly significant differences in the teat structures between before and after milking. The significance difference was found in the teat-canal length (TCL), the teat-cistern width (TCW), and the teat-wall thickness (TWT), respectively. But in the teat-diameter (TD), it was founded a trend to significant difference or a little change.

The TCL and TWT were increasing changed in the length and the thickness after milking. The TCW was decreasing changed in the cistern size, which the TD had decreased or a little change in the diameter but not significant difference after milking.

There are many reports about teat structures changing after milking which support there results. Teat-wall thickness and teat-cistern width showed the highest relative changes after milking. Teat-wall thickness and teat-cistern width change through the milking process in the opposite direction. The milk is withdrawn from the teat-cistern during milking. As the cistern decreases, the dimension of the teat-wall increases. Teat-canal length increased relatively more than teat-end width, which indicates that the teat tip is more pliable or more under stress during milking in length than width (Neijenhuis,et al., 2001).

Hamann and Mein (1990) found that the mean percentage changes in teat end thickness, relative to pre milking values for individual teats, varied from 10% decrease up to 20% or more increase depending the particular milking system used. They gave the reasons in such changes in thickness may be affected by one or more of the followings.

1. Reduce in intramammary pressure.
2. Changes in the geometric and conformation of the teat.
3. Changes in the degree of contraction and/or the tone of smooth muscles.
4. Degree of machine-induced edema in the tissue of the teat apex.

The degree of machine-induced congestion, appears to have little or no direct influence on the post-milking measurement of teat thickness for the following reasons.

1. The wall of the blood vessels in the teat are thick, muscular and well designed cope with short-term change in teat congestion.

2. The slow rate of recovery of the teat thickness to the pre-milking values is more consistent with removal of edema than removal of teat congestion.

3. The percentage changes in teat thickness measured before and after milking were independent of the pressure applied by the jaws. If changes in teat congestion were a major factor, then the percentage changes at low levels of applied pressure should have been greater than those at higher jaw pressures. Furthermore, the teats

with over 5 % changes in thickness had significantly increased teat duct colonization and a slight significant increase in quarter infection (Zecconi, et al., 1992).

Nevertheless, the completely recovery of teat structures after milking did not study in this research, but Neijenhuis, et al. (2001) had fully studied. Teat recovery after milking took a considerable amount of time: teat-wall thickness, 6 hours; teat-end width, over 8 hours; teat-canal length, over 8 hours, teat-cistern width for rear teats, 3 hours; and front teat 8 hours, and the ratio of teat-wall thickness and teat-cistern width, 6 hours.

A number of changes in teat condition observable after milking, easily quantificable and possibly related to milking conditions, equipment and technique have been described. The scoring systems will be beneficial from more standardization and experience. There was also a need to understand the cause of the effects observed. The consequence for mastitis of the marked change in teat color, teat touch, teat ringing and teat orifice closure caused by machine milking are not clear. However, The changes are truly distinctive and vary widely according to the milking system (Hillerton, et al., 2000).

From the teat end score and the teat structures results, the cistern width has an opposite direction between the teat end score. The teat-cistern width or the higher score has the narrow cistern after milking. The teat diameter has decreasing the size after milking but the trend is not related with teat end score.

The teat canal length and the teat wall thickness have an increased the size after milking but the trend is not constantly or not related with teat end score. The score 2 has higher increase of the teat canal length.

It is possible to explain the relation between the teat end score and the teat structures. As the teat end score increases the teat cistern decreases. May be the result of the teat wall thickness swelling but the teat wall thickness did not increases related with the teat end score.

The correlations between teat end score before attach and after detach were found highly significant. Most of the teat end score stayed in same score but some changed after detachment. Its mean the teat end can change the score after milking.

However, in this study the teat end score was divided only into 3 score scales. It is narrow score scales which can not show the clearly difference among the scores.

From the result of the descriptive statistic and significant difference between the quarter somatic cell count and the teat end score after detachment, there were not found significant difference among the teat end score after detach and the log of quarter somatic cell count.

There were many reports about the teat end score and the udder health. Teat end scores for the experimentally and conventionally milked cows, respectively, were good (6.5 and 11.7 %), intermediate (68.2 and 66.9 %), poor (25.3 and 21.4 %), not significantly different (Wilson, et al., 2000). A high teat end score of cows milked at 42.5 or 51 kPa compared with 34 kPa (Langlois, et al., 1981). There were no differences in SCC among any hyperkeratosis scores when teats were disinfected after milking, however, a correlation was evident with hyperkeratosis scores greater than 1 in the absence of teat disinfecting (Gleeson, et al., 2004).

The recent study in Thailand, showed no significant difference in CMT, SCC and bacteria identification between teat end score 1 and score 2. Intramammary infection of teat end score 2 tended to be higher than that of teat end score 1 (82.5 % and 73.5 %). Poor milking hygiene can result in higher intramammary infection rates in both normal and lesion teat end. The teat end lesions are also caused by improper milking machines (Chareonsil, et al., 2003).

The effects of individual cow management and farm management on the quarter somatic cell count

Following the cow management results, the lactation number and milking time tended to be significant different ($P \leq 0.1$) between high somatic cell count (≥ 200,000 cells/ml.) group and low somatic cell count (< 200,000 cells/ml.) group. The milk yield has considered significant difference ($P \leq 0.05$) between the two groups.

There were no significant difference between high somatic cell count (≥ 200,000 cells / ml) group and low somatic cell count (< 200,000 cells / ml) group in day in milk (DIM), udder preparation time, milking rate, and ordering to milked, respectively.

The lactation number in the low somatic cell count group tended to be lower than the high somatic cell count group. Because SCC increased with lactation stage (Ayadi et al., 2003). The variation in the shape and level of the SCS pattern is related to lactation number (Wiggans and Shook, 1987). Nevertheless, this value is not clearly different. Effects of age and days post partum may have different absolute levels between populations, but it is reasonable to assume that the epidemiological properties of these effects can also been applied for the population (Dohoo and Meek, 1982).

The other reasons to support this result, the main teat sinus injury were to the epithelial lining, which had increased red blood cell numbers. There were some differences between milking systems for teat sinus injury with increasing lactation number (Glesson, et al., 2003). The epithelial layers which surround the teat canal increase in thickness with increasing age of cows (Michel, et al., 1974).

The milking time in the low somatic cell count group tended to be lower than the high somatic cell count group. This may be indicated the over milking problem in the farms. Over-milking of teat resulted in increased pathological changes including hyperemia, hemorrhage, and oedema of the sub-epithelial tissues, depending on milking system (Peterson, 1964). Overmilking for > 1 min. predisposes to subclinical mastitis in the field (Osteras and Lund, 1988).

In theory, milk within the teat acts as a cushion against the collapse of the teat-cup liner and prevent frictional irritation to the epithelial lining of the teat sinus and glands (Glesson, et al., 2003). After overmilking, the teat injury occurred. The expanding and collapsing action of teat-cup liners on empty teats was shown to be injurious to teat tissue (Pier, et al., 1956).

The milk yield in low somatic cell count group has a considered significant difference lower than the high somatic cell count group. Following the result of the milking time, it is normal when there were found in the same direction of high kilogram of milk has more longer than in the milking time. In addition, in the high kilogram of milk and the longer milking time, they stay in day in milk about 150 day. This period is peak of production in lactation. Another reason about the experimental design, the cross sectional study was used and the data collected the quarter somatic cell count at one time.

There are many reports for somatic cell on milk production. We found that SCC was negatively correlated with milk yield, and positively correlated with percentage of milk fat, and percentage of milk protein ($P < 0.05$) (Suriyasathaporn, et al., 2000). A decrease in SCC may occur due to a dilution effect resulting from an increased milk yield as a result of an increased milking frequency (Hillerton, 1994 and Kelly, et al., 1998). New infection risk increased significantly with herd size and prevalence, but was not significantly affected by milk yield or breed (Emanuelson, 1997). The prevalence of elevated SCC increased significantly with milk yield and herd size

(Emanuelson, 1997). While, the cow with very low SCC would be more susceptible to mastitis (Kehrill and Shuster, 1994).

Following the categorical farm management, results were found highly significant difference in variables as; the disinfectant, the dry cloth, the strip milk test, the teat cup fall off, the vacuum pipeline diameter, and the replacement of liner, respectively. The sodium hydroxide (NaOH) cleaning and the vacuum pipeline cleaning were found the considered significant and trend to significant respectively. In other variables not found the significant difference between the low somatic cell count group and the high somatic cell count group.

The teat dipping after milking is the one of important factors related to udder health. Teat dipping is considered as an effective method to reduce subclinical mastitis (Erskine and Eberhart, 1991) and the strongest factors associated with high prevalence of Str. agalactiae (Dargent-Molina, et al., 1988). Post-milking teat dip has been implicated as a risk for increased levels of mastitis in low cell count herds (Lam, et al., 1997 and Peeler, 2001).

This study did not include teat dipping in the variable lists, because all farms used teat dipping immediately after milking. Therefore, no difference in the teat dipping in the both of low and high somatic cell count groups.

Almost of disinfectant in the small holder dairy farms are chlorine powder, it is necessary to dissolve with water to make a concentrate stock solution and then diluted again before disinfecting the udders.

The low somatic cell count group has the udder preparation with disinfectant more than high somatic cell count group. This result can prove that using disinfectant in milking process is important In addition, some farmers believe that if they use disinfection in milking process, they can not pass the antibiotic residual checking at milk collecting center.

Many studies reported the disinfectant affected to somatic cell count. BMSCC was less likely to be 200,000 cells/ml. when teats were washed with water containing disinfectant compared with plain water (Tadich, et al., 2003). Increased milk production, repeated mastitis control visits and use of particular pre-dip compounds were significantly associated with reduced BMSCC (Wilson, 1997). A highly significant increase in the BMSCC of herds using only continuous water or with bucket and multiple-service cloths (Gunn, 1995).

In the udder preparation before milking, only disinfectant cleaning cloth is not enough to sanitize the udder. It should be always dry completely with disinfection and single-service cloth together. The results like the herds using a common cloth or sponge had significantly greater odds of having a high prevalence of infection than herds using individual paper towels (Dargent-Molina, et al., 1988). A higher BMSCC figures for the herds using multiple-service cloths for udder preparation (Wilson, et al., 1996).

Failure to teat dip and use of common cloths or sponges for udder preparation increased the odds of high prevalence for both organisms. Selective or no dry cow therapy, having tie stall or stanchion housing and using dry massage or no udder preparation increased the risk for Str. agalactiae, but not for S. aureus infection. Milking machine function played a role in the risk of both infections (Dargent-Molina, et al., 1988).

Strip milk test is the discard of foremilk in the teat cistern before attach the teat cups. The strip cup is used for check the characteristic of abnormal milk at 2-3 strips and contained the foremilk before attachment. The foremilk exposes other cows to mastitis pathogen, when the stripped milk is not disposed of correctly. Stripping foremilk before attaching the clusters was also identified as a risk factor for clinical mastitis (Peeler, et al., 2000).

The recent study in Thailand showed that the premilking samples had higher in the number and bacterial types than postmilking samples (Wongpurananont, et al., 2005). Therefore, cows need to do pre strip milk before milking to enhance milk quality in dairy farm.

In this study, the teat cup fall off was observed during milking between attachment to detachment. Most of the teat cup fall off came from the teat cup slipping but some farms which have the teat cup slipping with no teat cup fall off. However, the teat cup slipping was not significant difference. Furthermore, there were found the highest incidence rate is estimated to be 6.07 times higher than not fall off.

The liner slip or any sudden in-rush rapidly of air toward the teat end which often happens during machine stripping. There are a lot of disadvantages of teat cup slipping and teat cup fall off that cause milk droplet impacts on teat ends and increase the new infection rate, especially during periods of low milk flow such as near the end of milking (Cousins, et al., 1973, O'Callaghan, et al., 1976, O'Shea, et al., 1976, and Thompson, 1977). Liner slip is related to high rates of new cases of mastitis. The differences in slips at milking were mainly due to liner design, mainly in barrel bore (O'callaghan, 1996).

Most of the vacuum pipeline in the small holder dairy farms were plastic pipe for water supply instead of metal or stainless because of the economic problems. The diameter of vacuum pipeline can be divided into 2 sizes as one inch and one-half inch.

The results were very surprise in this study. In the low somatic cell count group, the one inch pipeline diameter was used more than one-half inch. From my opinion, the larger diameter needs more reserving from large pump capacity. The general vacuum pump for bucket system have capacity not more than 350 liters/min., for 5 milking units, and suitable with one inch pipe diameter for stability of the vacuum level. Furthermore, there were found the higher incidence rate is estimated to be 2.75 times higher than in one-half inch vacuum pipeline.

Some studies reported about undulation of milking pipeline, cross-infection from one cow to another via the milking pipeline (Osteras and Lund, 1988). But in this study, the undulation of pipeline was not observed.

The liner is a very important part of milking unit because it is the only part of the milking machine that has direct contact with the teat. The liner must exert pressure or compressive load on the teat to decrease fluid accumulation in the teat tissue. Therefore, the liner has to fit nicely to the teat tip as well as higher up on the teat to avoid congestion (Mein, et al., 1987) and prevent the liner slipping or teat cup fall off.

Another reason, the price of liner is expensively, usually over one thousand bath per set. The farmers used it until they found the defect or the mastitis had occurred. Some farmers had another liner set for switched using which can prolong the life time of liner.

Fair liner was associated with the poorest udder health (Osteras and Lund, 1988). The role of the teat cup liner is crucial in maintaining the health of the udder (Butler and Adley, 1994). Any changes that reduce or minimize congestion in the teat will also reduce machine induced edema, e.g. the use of a narrow bore liner limits the tensile stress applied to the tissue of the teat wall (Williams and Mein 1982).

From this reasons, the good liners have maintenances the good udder or teat health together. Continuous to next variable as the sodium hydroxide using for clean up and prolong life time of the liner.

The sodium hydroxide (NaOH) solution was used to clean the liner and help to prolong the lifetime. There was found the significant difference between the low somatic cell count group and the high somatic cell count groups in using NaOH solution.

The NaOH solution for cleaning can be prepared by using NaOH 1 kilogram dissolved with 40 liters of clean water. This solution has one month life time. Then, soak the liner under the solution 7 day and switch another set to milking.

This result can proof the advantage of using the NaOH solution for cleaning and prolong the life time of liner. Therefore, we must to promote the sodium hydroxide using in dairy farms.

Because the bucket type of milking machine can not install the clean in place (CIP) system for self-cleaning machine. All of the cleaning systems are manual by the farmers. They have been used the base detergent, as washing powder, and acid detergent, as phosphoric acid, for manual cleaning.

Normally, the vacuum pipeline of the bucket type of milking machine is permanently installed on the milking parlor. This is the weak point for cleaning.

Some farms have short pipeline, they can remove the total pipeline for cleaning, but in other farms they can not remove.

The pipeline cleaning system needs the solution of 0.3 kilogram of NaOH per 10 liters of water. The vacuum force sucks the 1 liter of NaOH solution per 1 vacuum tap and rinses with cleaning water again.

From the study, the vacuum pipeline cleaning tended to be significant difference. This result can prove the advantage of using the NaOH solution for vacuum pipeline cleaning. Furthermore, there were found the higher incidence rate is estimated to be 2.94 times higher than not using the NaOH for vacuum pipeline cleaning.

From the result, there were no significant difference among the typing barns (tied-stall, free-stall, and free in limited area) and the quarter somatic cells. Most of the small holder dairy farms have a limited barn area with tied-stall system. Only a few has enough field for free-stall system.

Nevertheless, many reports were found the risk factors of free-stall system. Cow on alpine pastures had higher SCC and were more often diagnosed with udder infections than cow in home barns located in the same region (Regi, 1986). A higher log of SCC in herds having byre systems (Yalcin, et al., 1999). Cows that were sampled when staying in alpine dairies had considerably higher risks of subclinical mastitis than cows staying in home barns (Busato, et al., 2000). Collecting cows in a yard before milking increased the risk of BMSCC > 200,000 cells/ml. (Peeler, et al., 2000).

Explanations of these adverse effects on udder health in alpine dairies include various stress factors such as increased physical strain, changes in milking management practices, restructuring of herds, and suboptimal constructions of barns. Furthermore, effects of inadequate nutrition, followed by corresponding metabolic and endocrine changes, cannot be excluded (Zemp, et al., 1989).

Nevertheless, the factors did not multivariable analysis. There are possible to some factors interfered another factors. The results of this study analyzed by Chi-square test in each factors. It may be full fill the report if this study has bacteriological identification in the high somatic cell count group. From the results, there found some points in milking management and sanitation were high significant difference. Therefore, the methylene blue reduction test should be study. This is overall of the necessary to study further more in the future.

CONCLUSION

The milking machine performances are significant difference between the high quarter somatic cell count ($\geq$ 200,000 cells/ml.) and the low quarter somatic cell count (< 200,000 cells/ml.). But the performances of both groups are acceptable in standard.

The teat structures are not significant difference between the high quarter somatic cell count group ($\geq$ 200,000 cells/ml.) and the low quarter somatic cell count group (< 200,000 cells/ml.).

The mean $\pm$ S.D. of the teat structures are the teat canal length 1.98 $\pm$ 0.3, the teat diameter 3.22 $\pm$ 0.28, The teat cistern width 1.73 $\pm$ 0.38, and the teat wall thickness 0.96 $\pm$ 0.17, respectively.

There are find the highly significant difference ($P < 0.01$) between before and after milking in the teat canal length, the teat cistern width, and the teat wall thickness, respectively. The teat diameter is found to have trend to significant difference ($P<0.10$).

The milk yield is considered significant difference ($P = 0.05$), the lactation number, and the milking time are found to have trend to significant difference ($P = 0.10$ and 0.09) between the high somatic cell count group ($\geq$ 200,000 cells/ml.) and the low somatic cell count group (< 200,000 cells/ml.), respectively.

From the management results, the disinfectant, dry cloth, strip milk test, teat cup fall off, pipe diameter, and liner replacement are highly significant difference ($P < 0.01$). The NaOH cleaning is considered significant ($P = 0.041$) and the pipe line cleaning tended to be significant ($P = 0.052$) between the high somatic cell count group ($\geq$ 200,000 cells/ml.) and the low somatic cell count group (< 200,000cells/ml.), respectively.