CHAPTER V

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

5.1.1 Quality of raw and pasteurized milk

From the studies, it could be summarized that most of the microbiological qualities of both raw and pasteurized milk from each dairy had no significant difference except lactic acid bacterial counts from dairy B and psychrotrophic bacterial counts from dairy D which were the lowest.This may be the result of different method in handling and transportation of milk that made the types and numbers of bacteria different. However, it can be concluded that the microbiological quality of raw milk in Thailand was rather uniform. The standard plate counts and psychrotrophic counts of raw milk were in the range of 10^5 cfu/ml while both coliform and lactic acid bacterial counts were in the range of 10^{3-4} cfu/ml. This shows that the quality of raw milk in our country is a little bit lower than Grade A milk in Europe and USA which is defined that the maximum standard plate counts for grade A milk should not exceed 10^5 cfu/ml (17).

For pasteurized milk, the total bacterial count of milk was about 10^3 cfu/ml which followed the standard of pasteurized milk in Thailand with the limit of not over 5×10^4 cfu/ml (14). In the study, both psychrotrophic and lactic acid bacteria were found in pasteurized milk, whereas they should be destroyed by HTST pasteurization (26). This might come from post-pasteurization contamination due to poor sanitation condition. The results of coliform count from some lots of

dairy B, C and D were more than 50 cfu/ml which was over the standard of pasteurized milk which limited the counts only 10 cfu/ml (17). It suggested that careful attention of the processing should be applied in the plants.

The study of linear regression correlation showed no correlation of all counts between raw and pasteurized milk which implied that it could not be expected the quality of pasteurized milk from quality of raw milk if raw milk quality was uniform. The amount of microorganisms destroyed in milk may depend largely upon the heat treatment and post-pasteurization contamination.

The acidity of both raw and pasteurized milk also followed the standard of milk which was in the range of 0.14-0.16%.

The organoleptic properties-color, flavor, mouthfeel and overall quality of pasteurized milk from various dairies were not significantly different. This implied that the quality of pasteurized milk among various dairies was equally accepted.

There was no presence of protease both in raw and pasteurized milk. It may be said that storage time of raw milk in Thailand which is not over 48 hours is too short for psychrotrophic bacteria to produce protease which is heat-resistant. But the presence of lipase in pasteurized milk still a question for this study.

5.1.2 Quality of pasteurized milk stored at various temperatures and times

From the experiment, data from 5 dairies can be divided into 3 groups according to packaging materials used and sanitation conditions. The microbiological qualities i.e. standard plate count, psychrotrophic count, coliform count and lactic acid bacterial count- of all three groups increased with storage time. At all storage temperatures,the counts increased with storage times. The growth rate constantly increased with increasing storage temperature and shortened shelf-life of pasteurized milk. When the storage temperature was higher, there was less difference of counts among groups. The relationship of growth of microorganisms followed the theory of growth rate that the relationship between log number of counts and times was linear (38).

It was also found that standard plate count had linear relationship with psychrotrophic count, coliform count and lactic acid bacterial count. The relationship can be expressed as the equations below (see appendix E 3 for calculation).

$$\log P/ml = -1.00+1.08 \log SPC/ml$$

$$\log C/ml = -2.97+1.12 \log SPC/ml$$

$$\log L/ml = -1.85+0.93 \log SPC/ml$$

In addition, there are also multiple linear correlation among counts which can be expressed as the equations below. (see appendix E 4 for calculation)

$$\log SPC/ml = 1.1689+0.7294 \log P/ml +0.1775 \log L/ml$$

$$\log SPC/ml = 1.9791+0.7027 \log P/ml +0.1941 \log C/ml$$

log SPC/ml = 3.0591+0.3930 log C/ml +0.3844 log L/ml

It was found that organoleptic qualities of pasteurized milk stored at various temperatures decrease with storage times and the decreasing was faster at higher temperature. At all storage temperatures and times, the milk was not accepted when flavor score was ≤ 4 from a 9 Hedonic Scale.

The composition of pasteurized milk for all dairies stored at various temperatures and times was not signifieantly different but the difference was significant among dairies. For dairy B, the fluctuation of fat was very high compared with other dairies. This was due to lack of homogenization process in this dairy. When the storage time extended, the more separation of fat occurred and especially at lower temperature.

In addition, the acidity of milk increased with storage time and the increasing was faster at higher temperature. At all storage temperatures and times, the milk was not accepted when acidity $\geq 0.2\%$.

Somatic cell counts of pasteurized milk were found at all storage temperatures and times. They showed high fluctuation. In fact, these cells should be destroyed by HTST pasteurization, the presence of them in pasteurized milk is still doubtful and there is no report shown in this area.

No enzyme protease was found in stored pasteurized milk at all storage temperatures and times though the milk clotted or had flavor deterioration except a lot of stored pasteurized milk from dairy B and E at 20°C storage temperature on the day the milk was not accepted. This shows that pasteurized milk in Thailand has no effect of enzyme protease.

In constrast, the presence of lipase was rather constnat in stored pasteurized milk at all storage temperatures and times. It may be said that presence of lipolytic bacteria in milk was not enough to produce lipase so that it was found unchange during storage.

For all qualities studied, it can be concluded that pasteurized milk stored at various temperatures between 5 and 20°C was unacceptable when the standard plate count and psychrotrophic count reached log 7-9 cfu/ml. The flavor score was ≤ 4 from a 9 scale and the acidity (as lactic acid) was $\geq 0.2\%$ while the composition remained unchanged.

The shelf-life of pasteurized milk of each dairy was significantly different among various temperatures and the difference was also significant among various dairies at storage temperature < 10°C. However, at storage temperature between 15 and 20°C, there was no difference of shelf-life among dairies. For all dairies, the higher was the storage temperature. the less was the shelf-life of pasteurized milk. From this result, it was reasonable to divide 5 dairies into 3 groups with respect to packaging material and sanitation condition, where sanitation condition appeared to be the most important factor. At all storage temperatures except at 5°C, milk from dairy E (group III) had the longest shelf-life while milk from dairy C and D (group II) had the shortest though all of them used the same pasteurization process and packaging material. This can be concluded that sanitation condition is very important to limit shelf-life of pasteurized milk because dairy E sanitation is much better compared with diary C and D.

Considering the packaging material, paperboard used by

dairy A and B gave shorter shelf-life of milk at all storage temperatures except at 5°C compared with dairy E. This may be explained that paperboard packaging material which is thicker and more rigid can endure high pressure and packaging's leakage while polyethylene sachet which is thinner and flexible can endure less pressure and ease for the leakage. When storage time was longer, effect of packaging material was involved and shorten shelf-life of stored pasteurized milk.

From all results obtained, it was possible to estimate shelf-life of pasteurized milk at all storage temperatures between 5 and 20°C from various dairies as discussed in 4.3.2.

5.2 RECOMMENDATIONS

1. Shelf-life of pasteurized milk can be extended by storing milk as low temperature as possible and kept the temperature constant during storage. It should be stored at temperature between 5 and 7°C for extending shelf-life to two and a week respectively. If it is kept constantly at these two temperatures, the limitation of shelf-life of pasteurized milk should be extended undoubtedly. This will also enable the distribution of pasteurized milk to the remote area.

2. Control of temperature during transportation and storage on shelf is very important, this will be the most critical poist to prolong the shelf-life of pasteurized milk.

3. The dairy man should be reminded of the sanitation of the process. The good sanitation will reduce the microbial load especially psychrotrophs which are post-pasteurization contamination and can grow quickly during the storage of products and deteriorate the quality of pasteurized milk.

4. Although the paperboard can keep the surrounding and extend the quality of pasteurized milk better for a longer period, its price is still higher than polyethylene film. So polyethylene sachet can be used properly together with good sanitation condition.