

Determination of Optimum Time-Temperature Combination for HTST Pasteurization to Extend Shelf Life of Liquid Milk Obtained From Kandy District

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Introduction

Milk is one of the most nutritionally complete natural liquid food that consist of all the required nutrients including high quality proteins, minerals and vitamins. Heat treatments are generally used in the dairy industry for preheating, thermization, pasteurization, sterilization, ultra high temperature treatment and ultra-pasteurization. According to the available information, the present pasteurization process employed in Sri Lanka is not officially validated with regards to the objectives achievable. Therefore, the objective of this study was to determine suitable pasteurization parameters applicable under the prevalent Sri Lankan conditions in the Kandy District.

Materials and methods

As raw milk samples, four batches of cow milk and two batches of buffalo milk were obtained from cattle and buffalo units of the University Livestock Field Station (ULFS). Another two batches of cow milk were procured from a private farm. Four sub samples from above batches of milk were subjected to HTST pasteurization under four different temperatures (72 °C, 75 °C, 80 °C and 85 °C) for a 15-second constant holding time and immediately cooled to <10 °C. Each sample of raw and pasteurized milk was subjected to microbiological and chemical analysis. The chemical parameters, milk fat %, specific gravity (SG), solids non-fat % (SNF %) and total solids% (TS %) in samples were determined as described in AOAC (2003). Total viable count (TVC), coliform count (CC), and Psychotropic count (PTC) of raw milk and pasteurized milk were determined according to the standard methods described by Gary (1985). Organoleptic properties were analysed by a tasting panel of thirty untrained panellists using a five point hedonic scale.

Results and discussion

According to the chemical analysis, average cow milk fat %, SNF%, TS% and SG, were $3.8 \pm 0.20\%$, $8.23 \pm 0.04\%$, 12.03% and 1.04 ± 0.04 respectively. When the above values are considered there are no significant differences between the raw and pasteurized milk ($P > 0.05$) indicating that any major heat induced changes have not occurred even at higher temperature applications. Microbiological analysis showed that all the raw milk log TVC and log CC were 9.32 ± 0.58 cfu/mL and 5.70 ± 0.99 cfu/mL, respectively. There were significant differences between all raw and pasteurized milk samples, when their TVC, CC and PTC, ($P < 0.05$) are considered.

In addition, when TVC and PTC are considered there were significant differences ($P < 0.05$) between all four heat treatments. Comparison of milk from ULFS, which is managed efficiently under professional personnel, showed that it has significantly lower log TVC (9.30 ± 0.67) and log CC (5.32 ± 0.68) when compared to that of milk from private farm where log TVC (11.13 ± 0.16) and log CC (6.77 ± 0.52) were significantly higher. This strongly indicates the existence of a significant difference between the two

dairy management systems in the two farms. Comparison of microbiological properties of cow milk log TVC (9.28±0.54), log CC (5.57±0.77) and buffalo milk log TVC (5.82±0.27), log CC (4.12±0.49), showed a significant difference between dairy cattle and buffalo management systems especially the difference that exists in milking management. When all the microbiological counts (TVC, CC and PTC) of pasteurized milk obtained throughout the storage (<6 °C) period of nine days starting from the day of pasteurization are considered, it showed that the pasteurization temperatures of 80 °C and 85 °C had significantly lower counts. The mean values of microbiological counts are indicated in Table 1.1. However, sensory evaluation data showed that milk heat treated at 72 °C had a high overall acceptability followed by the milk treated at 80 °C. The sensory evaluation data are indicated in Table 1.2.

Table.1.1 Mean values of microbiological counts (log cfu/ml)

Treatment	Microbiological counts	Day 1	Day 2	Day 5	Day 7	Day 9
Raw milk	TVC	9.32	N/A	N/A	N/A	N/A
	CC	5.70	N/A	N/A	N/A	N/A
	PTC	N/A	N/A	N/A	N/A	N/A
72 °C	TVC	5.39	5.51	5.75	5.61	6.74
	CC	0.00	0.00	0.00	0.00	0.00
	PTC	6.10	6.34	6.51	7.01	7.22
75 °C	TVC	5.11	5.26	5.70	5.78	6.91
	CC	0.00	0.00	0.00	0.00	0.00
	PTC	5.40	5.40	5.52	5.61	5.89
80 °C	TVC	4.89	5.12	5.49	5.39	5.01
	CC	0.00	0.00	0.00	0.00	0.00
	PTC	4.60	4.68	4.67	4.80	4.88
85 °C	TVC	4.62	4.69	4.74	4.81	4.95
	CC	0.00	0.00	0.00	0.00	0.00
	PTC	4.46	4.54	4.60	4.65	4.72

N/A- Not evaluated

Table.1.2 Sensory evaluation results

Quality Attribute	Means Value					Probability (P)
	T1	T2	T3	T4	T5	
Colour	3.50	3.70	4.00	3.20	3.10	0.053
Odour	3.50	3.50	3.60	2.50	3.40	0.038
Taste	4.00	4.00	4.00	3.00	4.00	0.006
Overall Acceptance	3.95	4.05	3.95	2.95	2.85	0.001

T1-72 oC/15 second, T2-75 oC/15 second, T3-80 oC/15 second, T4-85 oC/15 second, T5-63 oC/30 minutes

Conclusions

Microbiological counts of raw cow milk samples from the two sources show that University Farm had better quality milk. However, when the same counts of the buffalo unit and cow unit are considered, the former unit had better quality milk. Microbiological data on heat treatments showed that a temperature of 85 °C for 15 second holding time was the best temperature-time combination in terms of reducing all the bacterial counts which is in line with previous finding by Deshapriya *et al.* (2006). However, sensory evaluation data indicated that both milk heated at 72 °C and 80 °C had better overall acceptability, indicating that at 85 °C undesirable heat induced changes are taking place. Therefore, it could be strongly suggested that a temperature of 80 °C and 15 second holding time are the optimum HTST pasteurization conditions to achieve a nine-day shelf life for the liquid milk subjected to this investigation.

References

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