

## ABSTRACT

Pasteurization is a common heat preservation method of milk and refrigerated pasteurized milk has a limited shelf life in tropical climates. Therefore the main objective of this research was to study the effect of temperature-time (TT) combination and CO<sub>2</sub> addition on chemical parameters, microbiological quality, sensory attributes and shelf life of chilled pasteurized milk.

Raw milk obtained from Udaperadeniya university farm was analyzed chemically for fat %, Solid Non Fat (SNF) %, lactose %, acidity % and pH and microbiologically for Viable Plate Count (VPC), coliforms, psychrotrophs, thermodurics and Methylene Blue Dye Reduction Time (MBDRT). Raw milk was standardized to 3.25 % fat and homogenized in a two-stage homogenizer (at 1500 and 2500 p.s.i), and High Temperature-Short Time (HTST) pasteurized using different TT combinations {(72 °C/15 sec (TT<sub>1</sub>), 74.5 °C/13 sec (TT<sub>2</sub>), 77 °C/12 sec (TT<sub>3</sub>), 79.5 °C/10 sec (TT<sub>4</sub>), 82 °C/8 sec (TT<sub>5</sub>)}. Pasteurized milk was chilled at 4 °C after bottling and phosphatase test was conducted to check the effectiveness of pasteurization. Products were evaluated for sensory qualities to determine the best combination using five-point hedonic scale. Pasteurized milk was treated with CO<sub>2</sub> and sensory threshold was determined using ASTM (American Society for Testing and Materials) E 679 Ascending Concentration Series Method of Limits to select the suitable level of CO<sub>2</sub> that can be added into milk. Pasteurized bottled milk was treated with 3 levels of CO<sub>2</sub> (0, 7 and 15 mM), chilled at 4 °C, analyzed chemically (pH and acidity), & microbiologically (VPC, coliforms, psychrotrophs, thermodurics) and shelf life was determined. Additionally, raw milk was

treated with 4 levels of CO<sub>2</sub> (0, 7, 15 and 18.5 mM) and changes of chemical parameters and microbial quality was studied.

Chemical parameters analyzed showed that the raw milk obtained had acceptable values almost comparable to the standard values. However, the microbial analysis showed that the values were slightly higher than the standard microbial counts. Mean (log cfu/ml) values of VPC, thermoduric count, psychrotrophic count and coliform count were 5.67, 3.49, 3.64 and 4.47 respectively in analyzed raw milk whereas the standard values in the United Kingdom are < 5.4 for VPC, < 3 for thermodurics, < 2 for coliforms.

There were no significant differences among TT combinations for sensory attributes of pasteurized milk. Sensory threshold level of CO<sub>2</sub> was 15.61 mM. The pH value decreased significantly with the increase of CO<sub>2</sub> concentration except for TT<sub>3</sub> on 10<sup>th</sup> day of storage period and TT<sub>1</sub> at 0 and 7 mM level of CO<sub>2</sub> on 21<sup>st</sup> day of storage period. There was no clear relationship between pH and TT combinations. The pH decreased with the storage period in all the treatment combinations and in most TT combinations this reduction was significant. Acidity of pasteurized CO<sub>2</sub> added milk was significantly increased with the increase of dissolved CO<sub>2</sub> levels. There was no relationship between TT combinations and acidity. The reduction of VPC (log cfu/ml) at 72 °C/15 sec, 74.5 °C/13 sec, 77 °C/12 sec, 79.5 °C/10 sec & 82 °C/8 sec TT combinations were 96.2 %, 96.6 %, 97.3 %, 91.5 % and 93.9 % respectively. VPC (log cfu/ml) increased with the storage period in all treatment combinations except in TT<sub>5</sub> at 0 level of CO<sub>2</sub> on day 6. There was no clear relationship between each TT combination and CO<sub>2</sub> level for thermoduric counts. The thermodurics increased with storage period and in most cases this increment was significant. Different TT combinations have different

### III

psychrotrophic killing effects. A significant reduction of psychrotrophs was observed with the increase of CO<sub>2</sub> concentration in most of the TT combinations. Although CO<sub>2</sub> reduces the growth of the psychrotrophs in refrigerated pasteurized milk, they increased significantly during the storage period in some TT combinations at all CO<sub>2</sub> concentrations.

The time needed for pasteurized milk to reach VPC of  $5 \times 10^4$  cfu/ml varied among the treatment combinations. The highest shelf life of 11 days was obtained by TT<sub>3</sub> at 15 mM CO<sub>2</sub> level. Addition of CO<sub>2</sub> up to 15 mM, increased the shelf life of pasteurized milk by 1, 2, 3, 2 and 3 days at 72 °C/15 sec, 74.5 °C/13 sec, 77 °C/12 sec, 79.5 °C/10 sec & 82 °C/8 sec TT combinations respectively.

In raw milk treated with CO<sub>2</sub> concentrations of 0, 7, 15 and 18.5 mM, the pH decreased and acidity increased with the increase of dissolved CO<sub>2</sub> concentration and storage period. Study on the microbial parameters of raw milk treated with CO<sub>2</sub> showed that the addition of slightly higher amounts of CO<sub>2</sub> has an effect of controlling the VPC, thermotolerant coliforms, psychrotrophs and coliforms extending the keeping quality.