

EFFECT OF TEMPERATURE – TIME COMBINATION AND CARBON DIOXIDE
ADDITION ON SHELF LIFE OF CHILLED PASTEURIZED MILK

By

NARAYANA MUDIYANSELAGE NAYANA KUMARI NARAYANA ✓

Thesis

Submitted in partial fulfillment of the requirements

for the degree of

MASTER OF PHILOSOPHY

in the

POSTGRADUATE INSTITUTE OF AGRICULTURE

of the

UNIVERSITY OF PERADENIYA

PERADENIYA

NOVEMBER 2004

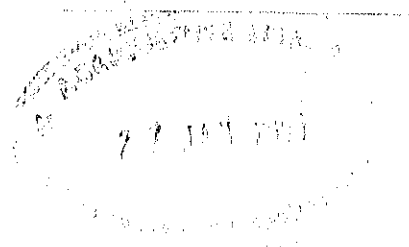
C 637.1333

N16



557114

AGRICULTURE LIBRARY
UNIVERSITY OF PERADENIYA



557114 ✓

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 CO₂ 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 (TT₁), 74.5 °C/13 sec (TT₂), 77 °C/12 sec (TT₃), 79.5 °C/10 sec (TT₄), 82 °C/8 sec (TT₅)}. 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 CO₂ 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 CO₂ that can be added into milk. Pasteurized bottled milk was treated with 3 levels of CO₂ (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 CO₂ (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 CO₂ was 15.61 mM. The pH value decreased significantly with the increase of CO₂ concentration except for TT₃ on 10th day of storage period and TT₁ at 0 and 7 mM level of CO₂ on 21st 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 CO₂ added milk was significantly increased with the increase of dissolved CO₂ 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 TT₅ at 0 level of CO₂ on day 6. There was no clear relationship between each TT combination and CO₂ level for thermoduric counts. The thermodurics increased with storage period and in most cases this increment was significant. Different TT combinations have different

psychrotrophic killing effects. A significant reduction of psychrotrophs was observed with the increase of CO₂ concentration in most of the TT combinations. Although CO₂ reduces the growth of the psychrotrophs in refrigerated pasteurized milk, they increased significantly during the storage period in some TT combinations at all CO₂ concentrations.

The time needed for pasteurized milk to reach VPC of 5×10^4 cfu/ml varied among the treatment combinations. The highest shelf life of 11 days was obtained by TT₃ at 15 mM CO₂ level. Addition of CO₂ 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 CO₂ concentrations of 0, 7, 15 and 18.5 mM, the pH decreased and acidity increased with the increase of dissolved CO₂ concentration and storage period. Study on the microbial parameters of raw milk treated with CO₂ showed that the addition of slightly higher amounts of CO₂ has an effect of controlling the VPC, thermotolerant coliforms, psychrotrophs and coliforms extending the keeping quality.