Improvement of Quality and Shelf Life of Buffalo Curd by Adding Cinnamon (*Cinnamomum zeylanicum*) Essential Oil

R.A.P.D. Karunarathne, R.M.A.S. Bandara* and M.A.J.P. Munasinghe
Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

Abstract

Cinnamon essential oil (CEO), as a naturally occurring plant preservative has a wide spectrum of antimicrobial and antioxidant activity for food borne pathogens. Present study evaluated the effect of CEO at three different concentrations (0.025%, 0.05% and 0.075%) on the shelf life of buffalo curd in plastic (High Impact Polystyrene) containers under room temperature (27 °C).CEO treated buffalo curd samples and the control were analyzed for chemical (pH and acidity) and microbiological (yeast and mould and viable total colony count) tests for 7 days of storage period (27 °C). Highest ($P < 0.05$) pH (1st day) was observed in 0.075% of cinnamon oil added buffalo curd and the lowest ($P < 0.05$) pH was noted in the control sample. Highest ($P < 0.05$) value for titratable acidity was observed in the control sample from the 4th day onwards. However, addition of Cinnamon essential oil did not significantly affect the total colony count. The control sample exceeded ($P < 0.05$) the recommended yeast and mold count (1233CFU/ml ± 98.6) on the 4th day of the storage period. Organoleptic properties (flavor, smell, color, texture and overall acceptability) were evaluated by five-point Hedonic scale and data were analyzed in Friedman test. Results revealed that 0.025% of CEO was the most acceptable treatment. In overall, 0.025% of CEO can be recommended in order to increase the shelf life of buffalo curd up to 5 days in 27 °C.

Key words: Buffalo curd, Cinnamon essential oil, Shelf life, Organoleptic properties

Introduction

Buffalo curd is a traditional and nutritious dairy product in Sri Lanka. However, the shelf life of traditional buffalo curd is short, nearly around three days at room temperature (27 -30 °C) and the main problem of spoilage is continuous acidity development in the product due to fermentation process at room temperature. Yeast and molds are the major spoilage organisms in buffalo curd as the low pH of the product provides a selective environment for their growth. Reactions of those organisms are involved to change the physio-chemical structure of the curd in to undesirable condition. Commercially available antifungal chemical substances such as Notamicin, Potassium Sorbate, Sodium Sorbate, Propionic acid are used for the fermented dairy products. However, many health problems are caused by these chemical substances.

Naturally occurring preservatives in spices are used for the preservation of perishable food from the ancient time. CEO has a wide spectrum of antimicrobial and antioxidant activity with potential of controlling pathogenic and spoilage bacteria and fungus in dairy products (Byoumi, 1992). Behrad *et al.* (2009) found that addition of cinnamon did not change yogurt fermentation but sustain the growth of *Lactobacillus spp* during refrigerated storage. Therefore, present study aimed to evaluate the effect of cinnamon essential oil at different concentrations on the shelf life of the buffalo curd stored at room temperature (27°C).

Materials and Methods

Pasteurized (95 °C for 5 minutes) buffalo milk was used to produce the curd. The milk was cooled to 32°C and then 4% of the working culture (*Streptococcus cremoris*) was inoculated with the milk. Then the

**Corresponding author:* rmamilabandara@gmail.com

mixture was thoroughly agitated and distributed into four equal batches. One batch with no CEO was taken as the control. The other three batches were treated with CEO at the following concentrations of 0.025, 0.05 and 0.075 ml/L. Three replicates were used under each treatment. All the curd samples were incubated at 32 ± 2 °C for 3 hours in 80 g plastic cups. Incubated samples were stored in room temperature of 27 °C.

pH of the samples was measured using a digital pH meter during the 7 days of experimental period as described in AOAC (1984). The titratable acidity was determined by titrating 0.1M NaOH to a phenolphthalein (0.5%) end point and expressed as percent lactic acid according to the standard formulae (AOAC, 1984) during the 7 days of experimental period.

The total colony count was performed by using milk agar media. Colony forming units were calculated for each plate after 24 hours incubation at 32 °C and back calculated for CFU/ml using the following equation.

$$CFU/ml = \frac{\text{Colony count} \times 10^5 \times 1ml}{0.1ml}$$

Potato Dextrose Agar was used as the culture media for yeast and mold test. The Yeast and mold count was performed for 5 days of experimental period. Three replicates were tested from each treatment per day. Colony forming units were calculated for each plate and back calculated for CFU/ml using the above equation.

Prepared curd samples were evaluated for the sensory attributes by using a panel of 20 judges. The samples were scored for organoleptic properties such as taste, color, smell, texture and overall acceptability according to a five point hedonic scale.

Statistical Analysis

pH, acidity, total fungal colony count and total colony counts were statistically analyzed by using General Linear Model (GLM) of SAS 9.0 version and the model included replicates and treatment effects. Means were separated by the least significant difference (lsd) means separation test. Sensory evaluation of the products was done according to the Friedman test using Minitab 14 version.

Results and Discussion

Recommended ranges of total fungal colony count of curd or yogurt is < 1000 CFU/ml according to SLS standards. The Figure 1 shows CFU values of Yeast and Mould count of the buffalo curd treated with **CEO** during the 5 days of storage period in room temperature (27 °C). Colonies were absent in 0.025%, 0.05% and 0.075% on the 1st and 2nd days. However, the control sample exceeded the recommended yeast and mold count on the 4th day of the storage period (1233 CFU/ml ± 98.6) and it was significantly ($P < 0.05$) higher compared to the other treatments. Interestingly, 0.025%, 0.05% and 0.075% CEO added samples were not exceeded the recommended value even on the 5th day (466.67±236.8, 433.33±236.8 and 423.33±236.8 respectively). Most of the fungus species related with the food are well grown on the surface environment (oxygen is fulfilled). Essential oil dissolves in the lipid phase of the food (Mejlholm and Delgaard, 2002). Therefore, it can be suggested that CEO is dissolved in the surface cream layer of the curd and reduced the fungus growth.

pH decreased continuously in all the treatments throughout the 7 days of storage period and significantly ($P < 0.05$) different among the treatments except on the seventh day. Highest pH on the1st day (4.47±0.01) was observed in 0.075% of cinnamon oil added buffalo curd and the lowest pH was noted in control (4.35±0.01), followed by 0.025% (4.4±0.01)

and 0.05% (4.46± 0.01).Gradually these values were decreased over the period and the highest pH values were always reported in 0.075% sample and lowest values were recorded in the control sample in all 6 days of period. However, there was no significant difference among the treatments on the 7th day of storage period.

Mesophilic Bacterial fermentation of buffalo curd converts lactose in to lactic acid which resulted in development of acidity with storage time. The change in titratable acidity (TA) is a significant factor, since it affects the shelf life and acceptability of product. Recommended ranges of titrable acidity for curd or yogurt is 0.8% -1.25% according to the SLS. Increased acidity above the recommended levels results in undesirable acidic flavor of the dairy product and starter culture population gradually reduced. There was no significant difference ($P > 0.05$) among the treatments on the 2nd and 3rd days of storage. Significantly ($P < 0.05$) highest value for TA was observed in the control sample from the 4th day onwards during the experimental period. The control sample exceeded the recommended titratable acidity on the 5th day of storage period (1.27±0.01). 0.025% CEO treated sample reached to the upper limit of recommended titratable acidity level on the 6th experimental day. Acidity level did not reach to the upper limit in 0.05% and 0.075% during the experimental period (TA was 1.24 both in 0.05% and 0.075% on the 7th day).

According to the total viable colony count test, there was no significant ($P > 0.05$) difference among the four different concentrations of CEO added buffalo curds, after the 24hrs of inoculation. Ismail *et al.* (2006) reported that lactic acid bacteria is relatively resistant to the inhibitory effect of spices and essential oils. Therefore, it can be suggested that the bacterial population in the curd was not suppressed by treated CEO concentration values of 0.025%, 0.05% and 0.075% after 24 hrs from the inoculation.

According to the sensory evaluation, there was a significant difference among the treatments for taste of buffalo curd. 0.025% CEO added curd was the best in taste among the treatments according to the results of Friedman test. Cinnamaldehyde and phenolic compounds result in hot aromatic flavor. This may be the reason to observe lower consumer acceptance in higher concentrations of CEO (0.05% and 0.075%) added curd samples. Moreover, there was a significant difference among the treatments for smell of buffalo curd. According to the results 0.025% CEO added treatment was the best in smell. However, there was no significant difference among the treatments for color and texture of the buffalo curd. According to the results, 0.025% added buffalo curd was the best in overall acceptability among the treatments.

Based on the results it can be concluded that all three treatments of CEO concentrations (0.025%, 0.05% and 0.075%) extend the shelf life of the buffalo curd under room temperature of 27 °C. Further, the sensory evaluation studies revealed, 0.025% of CEO added buffalo curd was the most acceptable concentration. Therefore, 0.025% of CEO can be recommended to extend the shelf life and quality of buffalo curd.

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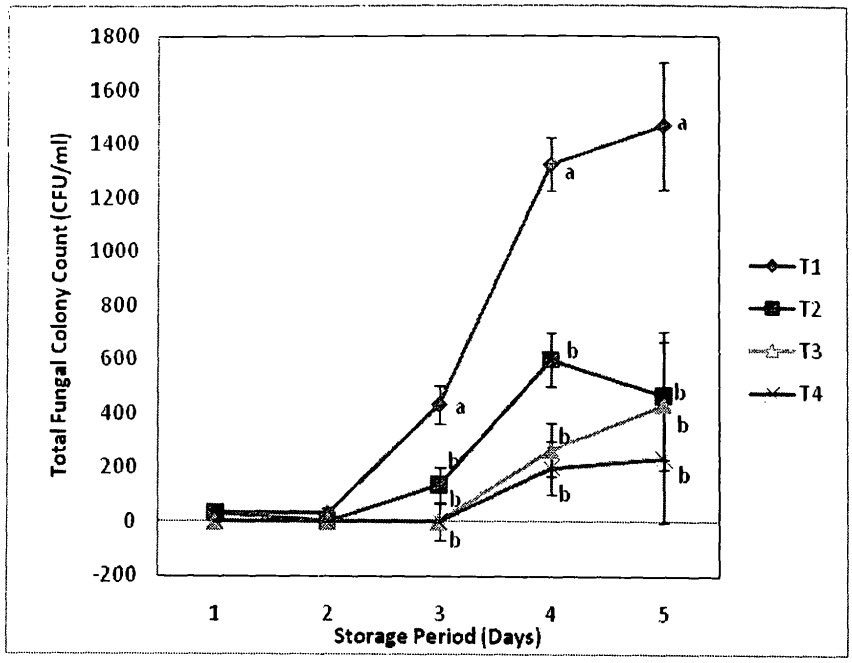

Figure 1. Variation of Total Fungal Colony Count of Buffalo curd during the storage at 27 °C
T1- 0% CEO, T2- 0.025% CEO, T3- 0.05% CEO and T4 - 0.075% CEO Different letters (a,b) show statistically significant ($P<0.05$) differences among the treatments.

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