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Procedia Food Science 6 (2016) 136 – 142

Procedia Food Science

International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015)

Effects of Cinnamon *(Cinnamomum verum)* extract on functional properties of butter

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Abstract

Butter is a dairy product made by churning fresh or fermented cream or milk. It is generally used as a spread and as an ingredient in cooking purposes. The incorporation of natural ingredients with health benefits into butter is one way to increase its intake. The potential health benefits of cinnamon (*Cinnamomum verum*) derived primarily from bioactive ingredients such as antioxidants, polyphenols and flavonoids. The objective of the present study was to improve the quality of butter made from cream with the addition of cinnamon extract. Milk cream with 36% fat was churned at 10ºC to maintain the fat at high level with low moisture content. Based on preliminary investigation, soxhelt extraction of cinnamon quills was carried out with 39% (v/v) ethanol. Butter was prepared by incorporating cinnamon extract into butter at 1, 3, and 5% (w/w). Sensory evaluation was done using 20 semi trained panelists based on 5 point hedonic scale. It was found that cinnamon extract can be incorporated in to the butter formulation up to 3% (w/w) without compromising the sensory attributes. It was subjected to further analysis with 1000 ppm potassium sorbate added butter. Changes in peroxide value, free fatty acids value and pH were monitored at weekly intervals. Microbiological studies (Total plate count and yeast and mold) were done at two weeks interval during two months storage period. Storage stability was tested at refrigeration (4ºC) condition. Total phenolic content and free radical scavenging activity of the 3% cinnamon extract incorporated butter were 135.62±1.00 µg GAE/mg and 38.73±0.01% DPPH, respectively.The cinnamon extract incorporated butter has shown low levels of peroxide value, free fatty acids value and low microbial count when compared to ordinary butter (without adding preservative) and potassium sorbate added butter. Antioxidant activity of cinnamon extends the shelf life of butter. This study demonstrates the 3% cinnamon extract can be used to formulate an antioxidant rich butter and it can be placed as a natural preservative for preparation of butter.

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).

Keywords: Antioxidant; butter; cinnamon; peroxide value

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Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).
doi:10.1016/j.profoo.2016.02.033

1. Introduction

Butter is widely used as a seasoning in cooking, suggesting that it plays an important role in the formation of flavors during heating[1]. Besides fats, butter contains small percentages of proteins, milk sugar and water which make it a suitable substrate for microorganisms[2]. Although butter spoilage is most often due to the development of chemical rancidity, microbiological problems do also occur in the form of cheesy, putrid or fruity odors and the rancid flavor produced by hydrolysis[3]. Many psychrotropic strains of bacteria, yeasts and molds have been implicated in spoilage and lipolysis of butter at temperatures below 5°C and some even below 0°C. Moreover, some pathogenic bacteria such as *Staphylococcus aureus* and *Listeria monocytogenes* remained recoverable in butter stored in low temperatures[4]. So, butter is one of the highly preserved conditions needed dairy product.

Spices are known to possess potential as natural agents for food preservation[5]. In addition, their components are gaining increasing interest because of relatively safe status, their wide acceptance by consumers, and their exploitation for potential multi-functional use[6]. Bioactive compounds commonly found in fruits, vegetables, herbs, and other plants have been shown to have possible health benefits with antioxidative, anticarcinogenic, atherosclerosis, antimutagenic, and angiogenesis inhibitory activities[7].

Cinnamon (*Cinnamomum verum*) contains a number of antioxidant compounds which can effectively scavenge reactive oxygen species including superoxide anions and hydroxyl radicals as other free radicals[8]. Antimicrobial activity of cinnamon bark and oil is described against many bacterial and fungal strains. They are well known inhibitors of microorganisms. The cinnamon essential oils have been proved to inhibit the growth of molds, yeasts and bacteria[9]. Since, cinnamaldehyde is highly effective in inhibiting the growth of microorganisms with comparatively synthetic preservatives. Furthermore, it reduces the butter spoilage from development of chemical rancidity and fat degradation produce by hydrolysis. Food and Drug Administration of U.S.A. has approved cinnamaldehyde as a safe food additive due to its special flavor and other functional properties.

As a result of nutritional and functional properties of cinnamon, it is extensively used in production of diverse food items. Cinnamon is predominantly employed in cuisine as a condiment and flavoring material. Cinnamon can be used in pickling. It is also used in various dessert recipes, such as apple pie, doughnuts and cinnamon buns in addition to spicy candies, tea, hot cocoa and liqueurs and cinnamon powder is used in variety of thick soups, beverages and candies. Accordingly, there is an opportunity for researches to modify the formulation of butter idyllically deprived of any major loss of the inherent sensory attributes. Furthermore the dairy products industry is examining to sustain its competitiveness investing in value added novel products and developments. Hence a butter prepared with cinnamon would be an applicant functional food due to the health promoting properties of cinnamon

The aim of this study was to formulate a Cinnamon incorporated butter with higher consumer acceptability. Another objective of this study was to evaluate the effect of Cinnamon additive on sensory, chemical and microbiological properties of the butter.

2. Materials and methods

This research was carried out in the laboratory of Department of Food Science and Technology of Wayamba University of Sri Lanka. Fresh cream samples were purchased from a local market at Negombo.

The cream was analyzed for different physicochemical parameters to assess the quality of raw cream. All the values were obtained as three replications. The cream was pasteurized by heating it at 72°C for 30 minutes. Pasteurized cream was kept in refrigerator overnight for aging process. Cream samples were subjected to cold water bath to maintain the appropriate churning temperature (10°C). Salt (0.5%) was added to the butter samples. Then three butter samples were prepared with different cinnamon extract levels 1, 3 and 5% w/w. Butter samples were packed and stored at 4ºC temperature in refrigerator. Organoleptic evaluations were carried out and the most acceptable sample was selected. Most acceptable level of cinnamon extract and K Sorbate (1000 ppm) were added separately to prepare three different butter samples for comparison of the storage studies with the reference sample. Salt was kept constant in all formulas.

2.1 Sensory evaluation

Sensory evaluations were conducted using 20 semi trained panelists drawn from the Wayamba University of Sri Lanka. First sensory evaluation was done to select the best inclusion rate of Cinnamon extract incorporated butter among the three coded samples (1, 3, and 5%). Second sensory evaluation was done to evaluate the consumer preference for Cinnamon butter which was selected from the first sensory evaluation. Panelists were instructed to indicate their preference for the samples. Five-point hedonic scale was used, in which 5 as the highest score and 1 as the lowest for each attributes namely color, texture, taste, spreadability and overall acceptability.

2.2 Proximate analysis

Butter samples were analyzed for moisture content using an oven drying method, whereas the fat, protein and ash contents were determined according to the A.O.A.C (1995) Protocols[10].

2.3 Chemical analysis

Standard pH meter (Eutech instrument, model 510, Malaysia) was used for the determination of pH. While peroxide value and free fatty acid values were determined according to the A.O.A.C (1995) Protocols[10].

2.4 Phytochemical properties

The antioxidant activity was determined by DPPH method, whereas the Total phenolic content was measured using Folin Ciocalteu method[11].

2.5 Microbiological analysis

Prepared butter samples were analysed for total bacterial count, yeast and mold count in every two weeks interval. Peptone water was used for the serial dilution. One gram (1g) of butter sample was taken into a culture tube and dissolved with 9 mL of peptone water. Plate count agar was used as the culture media for the determination of total plate count and incubated at 36°C for 48 hours. Colony counter was used for the enumeration of total plate count. Yeast and mold count was determined by inoculating the sample on potato dextrose agar and incubated at 25°C for 5 days according to the A.O.A.C (1995) Protocols[10].

2.6 Statistical Analysis

Data obtained for chemical and proximate analysis were analyzed using SAS 9.2 version. Data obtained for sensory evaluation were analyzed SAS 9.2 version and Kruskal-Wallis test in MINITAB 15. All the significances were determined at $\alpha = 0.05$.

3. Results & Discussion

3.1 Sensory evaluation

As shown in the figure 1, 3% w/w extract level incorporated butter was obtained the highest consumer preference while 5% w/w was obtained least preference. 3% w/w was selected as final product. Other than the ranking preference test, consumers have given different preference for the different parameters of the products. According to the statistical results, figure 2 was illustrated that variations of sensory attributes among different extract levels of butter. Scores assigned to the butter samples for color, taste and overall acceptability were vary significantly ($p<0.05$) by the different extract levels. Scores assigned to the butter samples for texture and spreadability were not significantly different ($p<0.05$). According to the overall results of sensory evaluation, it was was revealed that 5% was taken the highest score values for color, taste and overall acceptability while 1% was taken the lowest. 5% was shown that intermediate score value for sensory attributes. Finally, 3% cinnamon incorporated butter was confirmed as a final product which was the most consumers preferable and regarding the highest mean scores value for different sensory attributes.

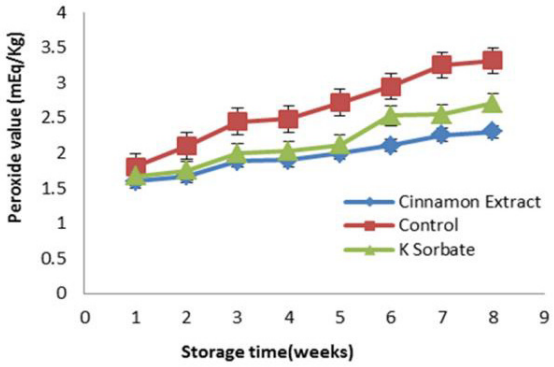


Figure 1: Changes in mean scores of sensory attributes among different treatments

3.2 Proximate analysis

Table 1: Proximate composition of cinnamon incorporated dairy butter

Constituents	g/100g
Crude fat	82.12±0.015
Crude protein	0.76±0.011
Moisture	14.65±0.017
CHO	0.08
Total ash	2.39±0.02

Chemical composition of cinnamon butter is shown in table 1; Butter contains fat 82.12% fat content and 14.65% moisture content according to the standards. Cinnamon butter sample was characterized with the fat and moisture contents which met the standard requirement for the butter. (Fat content ≥80%; Moisture content ≤16%). Protein, CHO and ash content were in very low values. There was no crude fiber contains in butter sample.

3.3 Chemical analysis

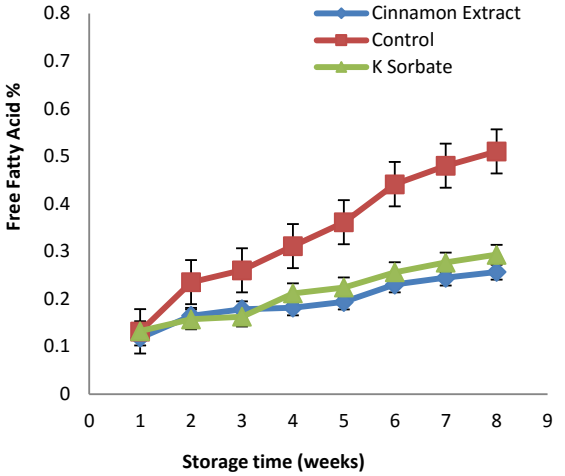
Table 2: Mean values for phytochemical properties of Cinnamon extract and cinnamon butter (mean± SD, n=3)

Samples	TPC (µg GAE/mg)	DPPH activity (%)
C.extract	428.41 ± 3.226	81.33 ± 0.002
C.butter	135.62 ± 1.008	38.73 ± 0.017

It could be discovered that Cinnamon extract was high in Total Phenolic Content (TPC) and DPPH activity. When it comes to the butter, TPC was decreased up to 135.62 µgGAE/mg and DPPH activity was reduced up to 38.73%. Moreover it was revealed that butter contains some antioxidant activity by addition of cinnamon.

Figure 2: Variation of Peroxide value (mEq/kg) in butter samples during storage

Results of the changes in peroxide value during the storage period of three butter samples could be discovered



that there was a significant different ($p < 0.05$) for peroxide value between butter samples with time. So, peroxide values were highly influenced by the butter type. Peroxide value of three samples has increased with time due to oxidative rancidity of fat. The cinnamon added butter shows low peroxide value compare to the control and K Sorbate owing to antioxidant activity of cinnamon. The addition of Cinnamon resulted in lower peroxide value of butter and during the storage time (nearly 2 months)Figure 3: Variation of free fatty acid value% in butter samples during storage

It has shown (figure 3) the increasing trend of free fatty acid value all butter samples as consequence of hydrolytic fat decomposition into free fatty acids. When consider about the free fatty acid value there was a significant different between butter sample with storage time ($p < 0.05$). The cinnamon added butter shows low free fatty acid value compare to the control and K Sorbate added sample. The addition of cinnamon resulted in lower value and during the storage time and its increment was low. K Sorbate added sample was also very low increment than control. So, this analysis was revealed that the preservative action of cinnamon in butter sample.

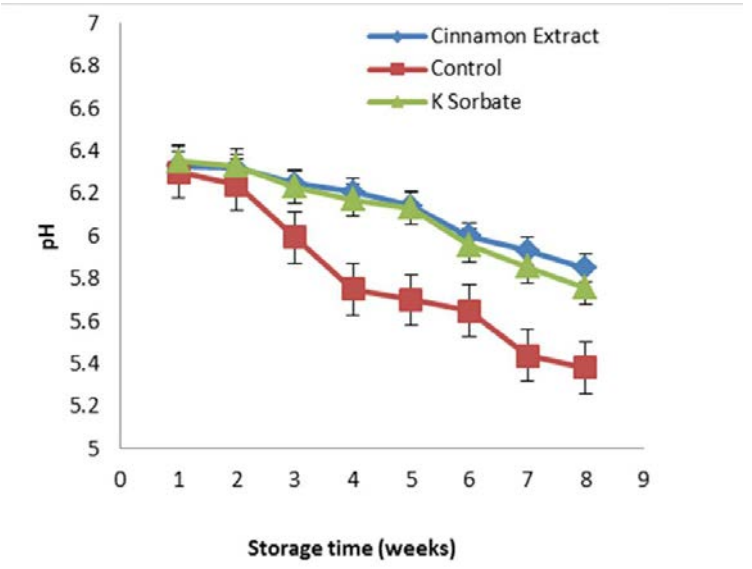


Figure 4: Variation of pH in butter samples during storage

Results of the changes in pH during the storage period of three butter samples were illustrated in the Figure 4. Significant difference in pH change was observed throughout the storage period at 4oC ($P<0.05$). According to the figure 4, there was a decreasing trend for three samples corresponding to acidity increment of butter samples. It was decreased as increasing the free fatty acid format (figure 3). So the reducing pH value also was confirmed that increasing free fatty acid value and vice versa. That was revealed that one reason for reducing pH is free fatty acids. The graph has shown cinnamon added butter was characterized with higher pH value when compared to the control (figure 4). So, there was significant difference between cinnamon and the control throughout the storage period. It could be found that there was no significant different between cinnamon and K Sorbate added butter samples ($p < 0.05$). Both samples have same effect on pH changes with time and cinnamon shows its preservative action on butter.

3.4 Microbiological analysis

Table 3: Changes in Total plate count of butter samples during storage (CFU/g)

Weeks	Cinnamon	K Sorbate	Control
0	1.33×10^{1a}	1.67×10^{1a}	2.67×10^{1a}
2	6.67×10^{1a}	6.33×10^{1a}	9.33×10^{1a}
4	1.23×10^{2b}	1.47×10^{2ab}	2.43×10^{2a}
6	1.57×10^{2b}	1.63×10^{2ab}	2.77×10^{2a}
8	1.63×10^{2c}	2.00×10^{2b}	2.00×10^{2b}

Means in each column with the different lowercase superscript letters are significantly different ($p < 0.05$)

Table 4: Changes in yeast and mold count of butter samples with time (CFU/g)

Weeks	Cinnamon	K Sorbate	Control
0	ND	ND	3.33×10^{1}
2	ND	ND	3.33×10^{1}
4	ND	ND	6.66×10^{1}
6	ND	ND	1.00×10^{2}
8	ND	ND	1.33×10^{2}

TPC results revealed that, there was a trend on increasing the number of count with the time for all samples but there is no significant difference between three samples up to 2nd week. After one month there was a significant difference between three samples. Cinnamon butter has taken low microbial count when compare to others due to antimicrobial activity of cinnamon. It was revealed that yeast and mold was not detected (ND) in cinnamon and K Sorbate added samples throughout the storage period. Control sample was observed yeast and mold even at the 0th week and it was increased during the storage. So, there was highly impact on yeast and mold count by adding cinnamon. K Sorbate was also similar to that.

Overall results were revealed that both chemical and microbiological characterization of the cinnamon butter developed falls within the acceptable standard value.

4. Conclusion

Based on the results, it can be concluded that the cinnamon added butter has good physiochemical properties and lower microbial growth during the storage period due to its antioxidant activity. Moreover, retards the spoilage of butter. Therefore, this research clearly shows that cinnamon can be successfully incorporated as an ingredient as well as the natural preservative of butter instead of synthetic preservatives without altering the sensory properties.

Acknowledgment

Financial assistance through Wayamba University Research Grant 2013 is greatly acknowledged.

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