Evaluation of the Effect of Anti-Fungal and Anti oxidative Properties of Cinnamon (*Cinnamomum verum* L.) Bark Oil on the Storage Stability of Butter

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Abstract

Synthetic preservatives have been reported to cause health hazards in humans. The anti-oxidative and anti-microbial properties of spices such as cinnamon bark oil have been well researched and documented. The effect of extracted cinnamon *(Cinnamomum verum L.)* bark oil on storage stability of butter was investigated in the present study. Accordingly, the objective of the study was to evaluate anti-oxidative and anti-microbial potential of cinnamon bark oil on the storage stability of butter. Distilled extract of cinnamon bark oil was added to butter in 0.25, 0.50, 0.75, and 1.00 % (w/w) levels. Ascorbic acid added commercial butter was used and evaluated as a control in the experiment. The butter samples were stored at 8°C for 60 days and the free fatty acid (FFA) content and the peroxide value (PV) of butter were determined by the conventional titration methods. Addition of cinnamon bark oil in 0.50, 0.75, and 1 % concentrations showed significantly lower ($P<0.05$) free fatty acid content compared to the commercial product. Free fatty acid content and the peroxide value of the butter showed some degree of concentration dependency as addition of 0.5, 0.75 and 1% cinnamon bark oil percentages gave lower peroxide and free fatty acids values over the entire storage period of time for butter. Cinnamon bark oil at all inclusion levels appeared to suppress the growth of microorganisms. Yeast and moulds count and Total plate count were not exceeding 70 CFU/g and 50000 $CFUg^{-1}$ of recommended levels. Cinnamon oil in 0.25 and 0.50 percentages gave improved characters on aroma and taste compared to other treatments. Therefore, it can be concluded that cinnamon bark oil (0.5%) can be successfully introduced to the butter industry as a natural antioxidant and natural microbial preservative to produce butter with improved sensory properties.

Keywords: Butter, Storage stability, Peroxide value, Free fatty acids, Cinnamon bark oil

Introduction

Butter is produced from milk fat and is considered as a nutritious product with high content of edible fat. Butter manufacturers now-a-days face a major problem of rancidity and spoilage that limits the shelf-life of the product. One of the major reasons for rancidity is lipid oxidation (Shelly, 2012). Butter has a high lipid content with unsaturated fatty acids and as a result tends to become rancid due to lipid oxidation during prolonged storage. Yeast and moulds are important spoilage microorganisms of butter and as a result can cause surface discoloration and development of off-flavors (Meshref, 2010).

The amount of free fatty acids and peroxide value in the butter need to be taken into consideration (Ahmet, 2010) in determining storage stability of butter. Free fatty acids are an indication of hydrolytic rancidity even though other lipid oxidation processes can produce free fatty acids. Peroxide value of the butter is a measure of the oxidation of fatty acids in butter. In commercial manufacture, butter is generally protected from oxidation using synthetic antioxidants. The addition of antioxidants is effective in delaying the oxidation and extending the shelf-life. Concerns about the safety issues of use of synthetic preservatives have

surfaced and as a result the researchers focus on the use of natural sources of antioxidants and antimicrobial preservatives. Consumers prefer to use butter added with natural food additives over synthetic ones. There is an increasing trend to use natural antioxidants from spice herbs, fruits and vegetables as they are possible alternatives to replace the synthetic preservatives (Izzreen and Noriham, 2011). Cinnamon bark oil contains several antioxidant and antimicrobial compounds such as Cinnamaldehyde and Eugenol. Cinnamon is thus one of the most important spices for curtailing or preventing oxidative stress and spoilage. Therefore, this study was carried out to determine the effective concentration of the Cinnamon bark oil (Cinnamaldehyde) on storage stability of butter stored at 8ºC.

Materials and methods

Cinnamon bark oil *(Cinnamomum verum)* was extracted using a distillation unit which containing boiler, steal still and condenser. Steam distillation method was used to extract cinnamon bark oil and oil was individually added to the butter with 0.25, 0.50, 0.75 and 1.00 % w/w treatment levels with four replicates using Completely Randomized Design (CRD). The free fatty acids content and the peroxide value of the butter were determined by the conventional titration methods (AOAC, 1990). Sensory evaluation of the butter was conducted with 30 untrained panelist using a 5 point hedonic scale to find out the suitable concentration of cinnamon bark oil added butter which give better taste, appearance, texture, aroma and overall acceptability. The results of the sensory evaluation were analyzed using Kruskal Wallis Non-parametric one-way ANOVA method with SAS system (ver 9.1) for Windows. Coliform (McConkey broth (purple), Oxoid LTD UK),Yeast and Moulds counts (Potato dextrose agar, Oxoid LTD, UK) and Total colony counts (Milk agar culture, Oxoid LTD, UK) were used to determined microbial quality of the developed butter. Data were analyzed using the statistical software package SAS (ver 9.1) for Windows. ANOVA was used to analyze data and significantly different means were separated using LSD.

Results and discussion

According to results of sensory evaluation, there were no significant differences ($P>0.05$) among all treatments in terms of appearance and texture. Commercial - Highland butter (A), 0.25% Cinnamon oil added butter (B) and 0.50% Cinnamon oil added butter (C) were significantly different ($P<0.05$) from 0.75% Cinnamon oil added butter (D) and 1.00% Cinnamon oil added butter (E) in terms of aroma and taste (Fig. 1). Ahmet (2010) also observed that addition of cinnamon extract imparted desired odor and taste to the product.

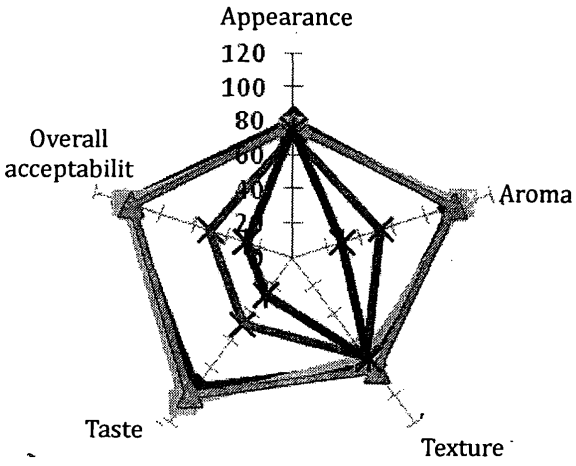

Figure 1. Web diagram showing sensory properties of butter produced using different treatments

(◆) Commercial butter- Highland butter, (▲) 0.25% Cinnamon oil added butter, (■) 0.5% Cinnamon oil added butter, (✖) 0.75% Cinnamon oil added butter, (*) 1% Cinnamon oil added butter

Ahmet *et al.* (2010) reported that in determining storage stability of butter, the amount of free fatty acids and peroxide value in the butter need to be taken into consideration. An off flavor was observed in butter

when FFA reached 0.3% and peroxide value reached 10 meq O_2/ Kg (SLS 773, 1987). With reference to the FFA and PV values, treatment A, B and F exceeded the recommended maximum levels and treatment C, D and E did not exceed the recommended maximum levels during the study period (Table 1). After 10th week, 0.23% FFA value was recorded by 1.00% Cinnamon oil added butter sample. These results show that with the storage time, free fatty acids level of different samples decreased with the addition of higher percentages of cinnamon bark oil added to the samples.

Addition of cinnamon bark oil in concentrations 0.25%, 0.5%, 0.75 and 1.0% were not significantly different ($P>0.05$) to each other in terms of free fatty acids values and butter without preservatives showed significantly different ($P<0.05$) free fatty acids values with all other samples. After 10th week, minimum PV value of 2.30 O_2/ Kg was given by 1.00% cinnamon oil added butter sample. These results also show less degree of concentration dependency as all extract concentrations gave lower peroxide values over the entire storage period (Table 1).

El-Baroty *et al.* (2010) reported that cinnamon bark oil has anti-fungal and anti-microbial properties. It was observed in the present study that yeast and mould count of samples prepared using cinnamon bark oil did not exceed the recommended level (70 CFU/g) during the whole study period. Coliform was not detected in all the samples. The total plate count of samples prepared using cinnamon bark oil did not exceed the

Table 1. Changes in peroxide and free fatty acid contents in butter during ten-week storage period

	Treatment											
Time (Week)	A	B	C	D	E	F	A	B	C	D	E	F
	FFA						PV					
1	0.20^{b}	0.20^{b}	0.20^{b}	0.19^{b}	0.19^{b}	0.27^{a}	1.25^{b}	1.03^{bc}	0.85^{c}	0.88^{c}	0.88^{c}	2.95^{a}
2	0.20^{b}	0.21^{b}	0.20^{b}	0.20^{b}	0.20^{b}	0.36^{a*}	1.58^{b}	1.10^{c}	1.03^{c}	1.05^{c}	1.08^{c}	3.30^{a}
3	0.23^{b}	0.21^{b}	0.21^{b}	0.21^{b}	0.21^{b}	0.37^{a*}	1.75^{b}	1.38^{c}	1.07^{d}	1.13^{d}	1.08^{d}	3.60^{a}
4	0.23^{b}	0.22^{b}	0.21^{b}	0.21^{b}	0.21^{b}	0.39^{a*}	2.00^{b}	1.55^{c}	1.30^{cd}	1.40^{cd}	1.35^{d}	3.80^{a}
5	0.26^{b}	0.26^{b}	0.21^{c}	0.22^{c}	0.23^{c}	0.39^{a*}	2.28^{b}	1.73^{c}	1.65^{c}	1.70^{c}	1.70^{c}	4.00^{a}
6	0.28^{b}	0.27^{b}	0.22^{c}	0.23^{c}	0.22^{c}	0.39^{a*}	2.60^{b}	1.95^{c}	2.00^{c}	2.03^{c}	2.03^{c}	4.40^{a}
7	0.31^{b*}	0.27^{c}	0.23^{d}	0.24^{d}	0.22^{d}	0.41^{a*}	2.70^{b}	2.13^{c}	2.15^{c}	2.15^{c}	2.13^{c}	4.70^{a}
8	0.32^{b*}	0.28^{c}	0.25^{d}	0.24^{d}	0.23^{e}	0.40^{a*}	2.78^{b}	2.80^{b}	2.45^{c}	2.25^{d}	2.20^{d}	5.10^{a}
9	0.33^{b*}	0.30^{c*}	0.25^{d}	0.25^{d}	0.23^{e}	0.44^{a*}	2.83^{b}	2.80^{b}	2.48^{c}	2.38^{c}	2.25^{d}	5.50^{a}
10	0.32^{b*}	0.31^{c*}	0.25^{d}	0.25^{d}	0.23^{e}	0.46^{a*}	3.25^{b}	2.88^{c}	2.60^{d}	2.43^{e}	2.30^{f}	5.70^{a}

(A) Commercial butter (Highland butter), (B) 0.25% Cinnamon oil added butter, (C) 0.50% Cinnamon oil added butter, (D) 0.75% Cinnamon oil added butter, (E) 1.00% Cinnamon oil added butter, (F) Butter without preservatives.* - Exceed Recommended Level. Means with different superscript letters are significantly different ($P < 0.05$)

recommended level (50000 $CFUg^{-1}$) during the whole study period. It was observed that the growth of yeast and moulds and other microorganisms are successfully suppressed by the cinnamon bark oil.

Conclusions

Cinnamon bark oil can be successfully introduced to the butter considering its antioxidativ, anti-fungal and anti-microbial properties in order to increase the self-life of butter instead of adding artificial antioxidant and anti-fungal chemicals. It was observed that addition of 0.75% and 1% cinnamon oil gives negative effect on sensory properties in butter. In contrast, addition of 0.25% and 0.5% cinnamon oil gave improved sensory properties in butter.

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