Journal of Agriculture and Value Addition
June 2022, Vol. 5(1): 107-114
https://dx.doi.org/10.4038/java.v5i1.37

SHORT COMMUNICATION

Impact of cardamom, cinnamon and ginger essences on keeping quality of butter

M.A.J.P. Munasinghe[a], H. Alwis[a], R.M.A.S. Bandara[a*] and G. Weerakkody[a]

[a]*Department of Livestock Production, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, 70140, Sri Lanka*

Submitted: February 18, 2022; Revised: May 19, 2022; Accepted: June 07, 2022
*Correspondence:rmamilabandara@gmail.com,ORCID: https://orcid.org/0000-0001-7933-5185

ABSTRACT

Rancidity is one of the major quality deteriorations which occurs in unsalted butter. This study evaluated the effects of different concentrations of commercially available natural extracts of cardamom (0.15, 0.20 and 0.25%), cinnamon (0.05, 0.10 and 0.15%) and ginger (0.10, 0.15 and 0.20%) essences on degree of rancidity in unsalted butter. The treated and control fresh butter samples were stored at 4 °C. Free fatty acid value (FFAV), peroxide value (PV) and lipolytic bacteria count (LBC) were examined on the 7th, 21st and 35th day. The reduction of FFAV, PV and LBC values were significant (P<0.05) in all treated samples comparing to the control during the whole storage period. The highest rank for overall acceptability in sensory evaluation test was observed for the minimum concentration level of all three treatments. In conclusion, rancidity development in unsalted butter can be reduced by adding cardamom, cinnamon and ginger essences at the rate of 0.25, 0.15 and 0.20%, respectively.

***Keywords**: Butter, rancidity, spices, free fatty acid value, peroxide value, lipolytic bacteria count*

INTRODUCTION

Presently a wide variety of dairy products are available and they are abundantly used by the consumers. Among them, butter is one of the primarily fat sources and an important source of dietary energy. Butter contains 80% milk fat and can be salted or unsalted. Besides fats, butter contains small percentages of proteins, vitamins, sugar and water (Idoui *et al.*, 2010). Butter fats are a combination of saturated fats and unsaturated fats. Saturated fatty acids are very stable. Unsaturated fatty acids have the most reactive sites on the fatty acid chain and are easily attacked by oxygen, hydrogen, and enzymes (Hamilton, 1989).

According to fat content and fat composition of butter, it can be quickly spoiled due to the development of rancidity. Rancidity is the development of any off flavors, odors, colors and textures due to decomposition of butter fat. There are four types of rancidities occurring in butter, namely, hydrolytic, microbial, and oxidative and odors absorbed rancidities (Rady and Badr, 2003). In hydrolytic rancidity, water hydrolyzes the ester bonds in triglycerides. Microorganisms use their enzymes such as lipases to break down fat in microbial rancidity. As a result of oxidative rancidity, the unsaturated fatty acids readily undergo oxidation

(Pamela and Richard, 1994). The keeping quality of butter is reduced because of the rancidity (Namki, 1990) and in rancid products, toxic compounds such as peroxides of fatty acids, polymeric material, oxidized sterols could occur. As a result of these toxic compounds consumers may face several health problems such as digestive distress, depletion of vitamins, heart disease, foster cancer development etc. Therefore, it is essential to eliminate the rancidity development in butter.

Microbial and oxidative rancidity can be effectively controlled by adding antioxidant and antimicrobial substance. Antioxidants are often added to fat-containing foods to delay the onset or slow the development of rancidity due to oxidation (Helmut, 1997). The addition of antimicrobial agents can also delay or prevent rancidity development by inhibiting the growth of bacteria or other micro-organisms (Leistner, 1992). Most of the spices have significant antioxidant (Suhaj, 2006) and antimicrobial properties (Zaika, 1988). Consumer awareness and concern that synthetic chemical additives may have some toxic or even carcinogenic effects, and has increased the demand for high-quality, minimally processed foods with extended shelf-life, preferably free from or with a reduced level of added chemical antimicrobial agents (Zink, 1997). Therefore, there is a growing interest in using natural antimicrobial compounds, including extracts of herbs and spices, as a natural preservative that can replace synthetic preservatives that have been linked to negative human health effects (Smid and Gorris, 1999; Samah and Ahmed, 2019). Spices contain products of secondary metabolism such as phenolics, phenolic acids, quinones, flavonoids, tannins. Many of these phytochemicals are rich sources of antioxidants (Deans and Ritchie, 1987).

The objective of the present study was to investigate the effect of antioxidaive and antimicrobial activities of cardamom (*Elettaria cardamomum*), cinnamon (*Cinnamomum zeylanicum*) and ginger (*Zingiber officinale*) on rancidity development of unsalted butter.

MATERIALS AND METHODS

The study was carried out at Pelwatte Dairy Industries (Pvt.) Ltd., Sri Lanka by using unsalted butter and commercially available 1.25% strengthens cardamom (*Elettaria cardamomum*), cinnamon (*Cinnamomum zeylanicum*) and ginger (*Zingiber officinale*) natural essences. Samples were prepared in triplicate by mixing unsalted butter with different levels of cardamom (0.15, 0.20 and 0.25%), cinnamon (0.05, 0.10 and 0.15%), and ginger (0.10, 0.15 and 0.20%) essences. Unsalted butter without adding any spice essence was used as the control. The treated and control fresh butter samples were stored at 4 °C.

Physiochemical analysis

Free fatty acid value (FFAV) and peroxide value (PV) of the treatments and controls were analyzed at the end of the 1st, 3rd and 5th weeks. Proximate composition (moisture content, fat content, crude protein content, ash content and Iodine value) of butter samples were examined at the 1st week. Moisture, ash, fat and protein contents were determined by using Halogen Moisture Analyzer (JT-K series), burning in muffle furnace, Gerber method and Kjeldahl method, respectively. The iodometric titration method described by AOAC (1995) was used for the determination of iodine and peroxide values. Free fatty acid value was analyzed by the methods described by AOAC (2000).

Microbiological analysis

Lipolytic bacteria count (LBC) of the treated and control butter samples were examined at the end of the 1st, 3rd and 5th weeks. Lipolytic bacteria count was estimated by using method described by Idoui *et al.* (2010). Coliform count was estimated by using violet red bile agar test. Yeast and mould were estimated by using potato dextrose agar test. Liquid phase of the butter samples was separated as described by Idoui and Karam (2008) for coliform bacteria count, yeast and mould count.

Sensory evaluation procedure

Sensory evaluation of the butter samples was performed for appearance, color, odor, taste, texture and overall acceptability on a nine-point hedonic scale according to a modified method of Stone and Sidel (1992). The evaluation was done by the panel of trained 20 assessors at Pelwatte Dairy Industries (Pvt.) Ltd.

Statistical analysis procedure of data

Data were statistically analyzed by ANOVA using SAS 9.0 (2002) software and means were separated by Tukey mean separation procedure. Sensory evaluation data were analyzed using non-parametric Kruskal-Wallis Test using Minitab computer analysis program.

RESULTS AND DISCUSSION

It was observed that values for FFAV, PV and LBC of all treated butter samples with spice essences were significantly ($P<0.05$) lower than that of the control; which indicates that spices have strong anti-oxidative and anti-microbial properties. All treatments followed the "common pattern" in which, by increasing the concentration of the treatment, the observed values (FFAV, PV and LBC) were decreased. The anti-oxidative effects of spices and their extracts on fatty acids and the anti-microbial effect of the spices on treated samples are reported in previous research works (Zaika, 1988; Suhaj, 2006; Samah and Ahmed, 2019; Setunga and Ranaweera, 2022).

The decrease in FFAV was observed with increasing the concentrations of the treatments (*P*<0.05). Untreated samples recorded the highest rancidity as FFAV. The highest reduction of FFAV (Figure 1) was observed on 0.25% concentration level of cardamom treated butter while the lowest reduction was on 0.15% concentration level. During the storage in five weeks, the FFA value in 20% ginger treatment was the highest (0.257±0.001 mg g^{-1}), while the lowest FFA value (0.184±0.002 mg g^{-1}) was observed in 0.15% cinnamon samples, provided evidence that 0.15% cinnamon has the higher ability of preventing hydrolytic rancidity over the other treatments (Setunga and Ranaweera 2022). Asimi *et al.* (2013) found in their study on determination of antioxidant activity of spice extracts using Ferric Reducing Antioxidant Power assay, cinnamon has higher antioxidant activity than ginger.

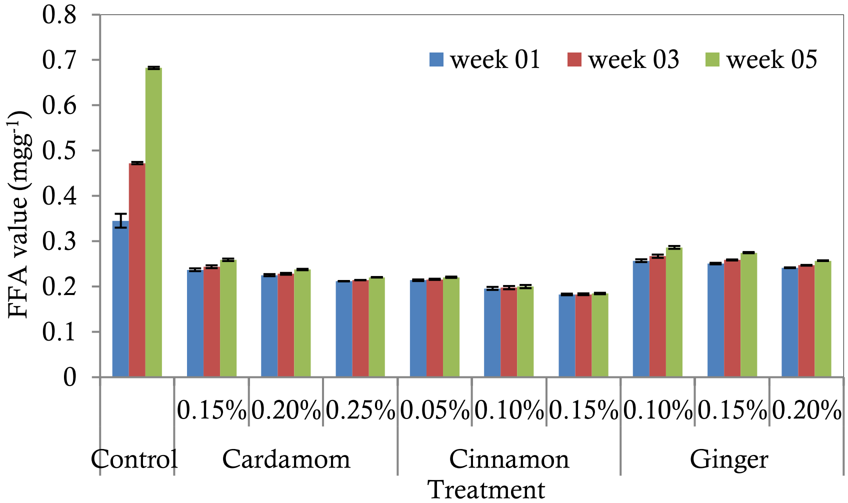

Figure 1: Effect of spice essences on free fatty acid value (FFA value) of butter.

Effect of spices essence on PV of butter

Effect of spice essences on peroxide value (PV) of butter is shown in Figure 2. Decrease of PV was also observed while increasing the concentrations of all three treatments. Peroxide values of all treatments were significantly (*P*<0.05) lower than the PV of the control. It means that the spice essences have a strong ability to prevent oxidative rancidity in butter. The peroxide values of treatments with the highest concentrations and for five-week stored butter samples (Figure 2) varied from 0.47 to 0.054 meq active oxygen kg^{-1} (*P*>0.05). Where 0.47±0.01 meq active oxygen kg^{-1} for cardamom, 0.473±0.011 meq active oxygen kg^{-1} for cinnamon and 0.54±0.02 meq active oxygen kg^{-1} for ginger. Therefore, the difference in PV of samples is reduced while increasing the treatment concentration. The results also revealed that higher the concentration of spice essences lower the susceptibility to oxidation of butter.

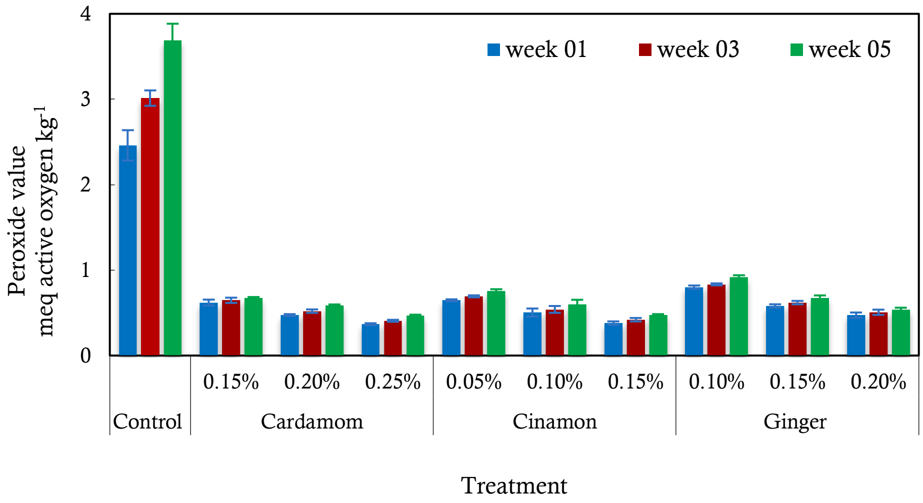

Figure 2: Effects of spice essences on peroxide value (PV) of butter.

Effect of spices essences on LBC of butter

Figure 3 depicts the effect of ginger essence on lipolytic bacteria count (LBC) of butter.

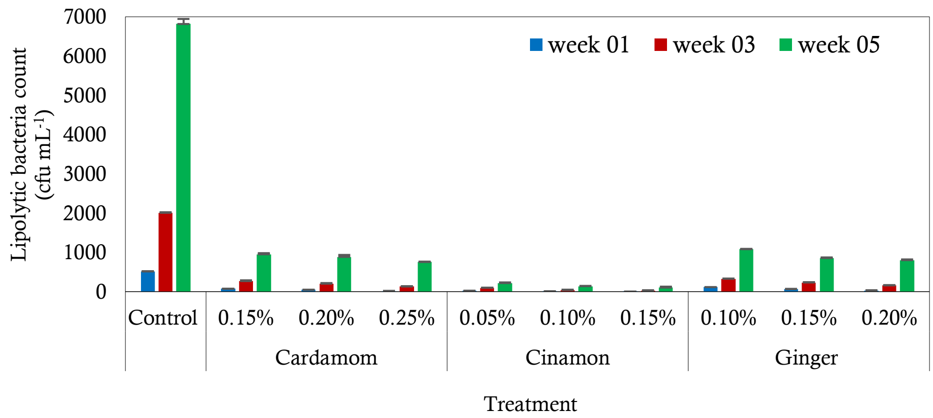

Figure 3: Effects of spice essences on lipolytic bacteria count (LBC) of butter.

It was observed a significantly higher (P<0.05) LBC in the control sample than the samples treated with ginger in all the weeks tested during the storage. The highest reduction of LBC was observed at 0.20% ginger essence treated butter. While the lowest reduction of LBC was observed at 0.10% ginger essence treated butter a "common pattern" was observed in other treatments and their concentration levels. Comparing the treatments with cinnamon and ginger, the lowest LBC was observed in 0.15% cinnamon (51.3 cfu mL^{-1}) while the highest

LBC was in 0.20% ginger (425.6 cfu ml^{-1}) treated samples of 5-week storage period, proving that cinnamon has stronger anti-microbial ability than cardamom and ginger treatments. Asimi *et al.* (2013) also reported in their experiment on cheese treated with cinnamon and ginger, cinnamon had the highest antimicrobial effect at maximum concentration on the growth of bacteria.

Effect of spices essence on yeast and mould count of butter

There were significant reductions (P<0.05) in yeast and mould count of the treated samples compared to the control. Figure 4 shows the effect of cinnamon on yeast and mould count. The highest reduction of yeast and mould count was experienced in cinnamon treatments where the lowest yeast and mould count (1 cfu mL^{-1}) showed the strongest anti-microbial effect. The lowest reduction was in 0.10% ginger treatment whereas the highest yeast and mould count (7.3 cfu mL^{-1}) was observed.

Proximate compositions of the treated butter samples were tested and there was no significant (P>0.05) difference among the treatments.

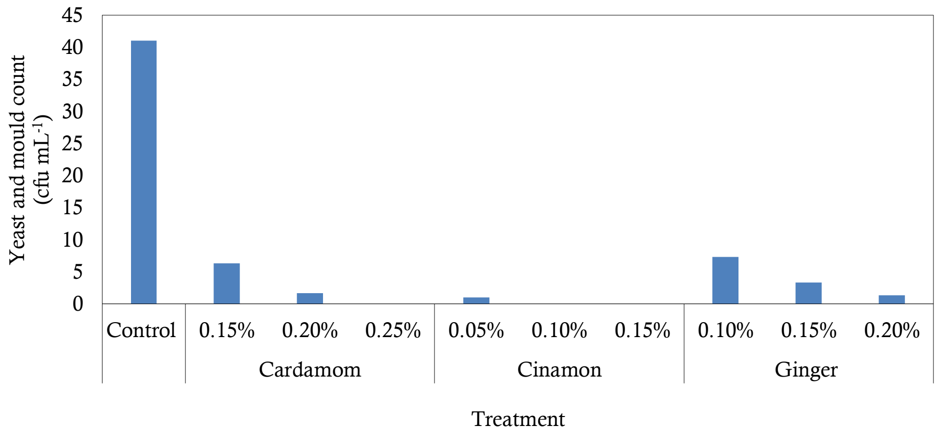

Figure 4: Effect of spice essences on yeast and mould count of butter.

Effect of spices on sensory evaluation

Figure 5 depicts the change of sensory characters of butter with spices essence. The observed data of the sensory evaluation were analyzed by using non-parametric Kruskal-Wallis Test. According to results, there was no significant (P>0.05) effect on the texture, color and appearance comparing to the control (Figure 5). The odor and the taste of the treated butter were ranked lower than the untreated control. The result from the sensory evaluation demonstrated that the use of 0.25% cardamom essence (0.25 g cardamom 100 g^{-1} of butter) had the highest negative effect on the odor while the butter treated with 0.15% cinnamon essence (0.15 g cinnamon 100 g^{-1} of butter) had the same negative effect on the taste.

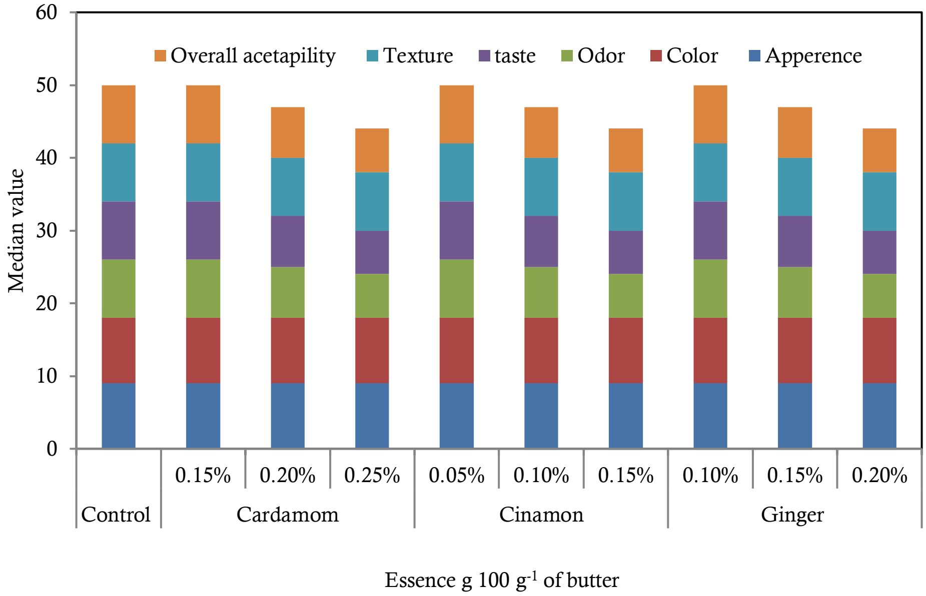

Figure 5: Change of sensory characters of butter with spices essence.

The treatments with the minimum concentration of spice essences had similar higher ranks for the overall acceptability. The untreated butter (control) sample got the highest rank for all sensory attributes while the butter treated with 0.25% cardamom essence showed the lowest average rank for overall acceptability. The samples treated with higher concentrations had the lowest rank for overall acceptability and is significantly (P<0.05) differ with the control.

CONCLUSIONS

It can be concluded that addition of commercially available essence of cardamom, cinnamon and ginger can decrease the rancidity of unsalted butter stored at 4 °C. Among the used concentrations, the minimum concentration of each essence can be recommended to ensure the overall acceptability of butter. It is recommended to carry out further studies for investigating the individual chemical compounds of each spice that are responsible for acting as an anti-microbial and anti-oxidative compound and the impacts of spice combinations on the control of rancidity of butter.

REFERENCES

AOAC (1995). Association of Official Analytical Chemists. 17th Ed., AOAC, Washington, DC.

AOAC (2000). Association of Official Analytical Chemists. 17th Ed., AOAC, Washington DC.

Asimi, O.A., Sahu, N.P. and Pal, A.K. (2013). Antioxidant activity and antimicrobial property of some Indian spices. Int. J. Sci. Res., 3(3): 1-8.

Deans, S.G. and Ritchie, G. (1987). Antibacterial properties of plant essential oils. Int. J. Food Microbiol., 5(2): 165-180.

Hamilton, R.J. (1989). Rancidity in Foods, Elsevier Sci., New York, NY: pp. 13.

Helmut, S. (1997). Oxidative stress: Oxidants and antioxidants, Exp. Physiol., 82 (2): 291–295.

Idoui T. and Karam N.E. (2008). Lactic acid bacteria from Jijel's traditional butter: Isolation, identification and major technological traits. Grasas y Aceites. 59: 361-367. Doi:10.3989/gya. 2008.v59. i4.530.

Idoui, T., Benhamada, N., Leghouchi, E. (2010). Microbial quality physicochemical characteristics and fatty acid composition of a traditional butter produced from cows' milk in East Algeria. Grasas Y Aceites: 61(3): 232-236.

Leistner, L. (1992). Food preservation by combined methods, Food Res. Int., 25(2): 151-158.

Namki, M. (1990). Antioxidants antimutagens in food. Crit. Rev. Food Sci. Nutr., 29: 273-300.

Pamela C. and Richard A.H. (1994). Biochemistry. 2nd Ed. Lippincott –Raven publishers: 163-185.

Rady, A.H., Badr, H.M. (2003). Keeping the quality of cows' butter by γ–irradiation. Grasas Y Aceites, 54: 410-418.

Samah, M.E. and Ahmed, M.Y. (2019). Potential application of herbs and spices and their effects in functional dairy products. https://www.researchgate.net/publication/334104327_Potential_application_of_herbs_and_spices_and_their_effects_in_functional_dairy_products [accessed April 2 2022].

Setunga, M., Ranaweera, K.K.D.S., Munaweera,I. *et al*. (2022). In-Vitro Antioxidant Activity of Essential Oils and Oleoresins of Cinnamon, Clove, Ginger and their synergistic interactions. DOI: 10.22541/au.165116343.37130323/v1.

Smid, E.J., Gorris, L.G.M. (1999). Natural antimicrobials for food preservation. In M. S. Rahman (Ed.), Handbook of Food Preservation. New York: Marcel Dekker: 285-308.

Stone H., Sidel J.L. (1992). Sensory evaluation practices. 2nd ed. San Diego: Elsevier, pp. 336.

Suhaj, M. (2006). Spice antioxidants isolation and their antiradical activity: a review. J Food Comp. Anal., 19(6–7): 531–537.

Zaika, L.L. (1988).Spices and Herbs: Their antimicrobial activity and its determination. J. Food Saf., 9: 97-117.

Zink, D.L. (1997). The impact of consumer demands and trends on food processing. Emerging Infectious Diseases, 3(4): 467-469.