EFFECTS OF ADDING CLOVE BUDS AND CINNAMON BARK EXTRACTS ON THE OXIDATIVE STABILITY OF CHICKEN MEATBALLS

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Introduction

Lipid oxidation is one of the major deteriorations in meat products, thus the prevention of lipid oxidation in meat products during processing and storage is vital to maintain its quality and safety (Buckley *et al.*, 1995). In order to retard lipid oxidation, synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) are widely used (Verhagen *et al.*, 1990). Somehow, the usage of these chemicals is always related to health risk (Shahidi and Wanasundra 1992). Thus, the interest in using natural antioxidants in meat products has increased in recent years. Clove and cinnamon are important ingredients in Malaysian curry powder. Yet, the bioavaibility and functionality of the polar/water soluble compound/oleoresins are seldom studied since their essential oils can quote a higher price in the market. The objective of this study was to evaluate the antioxidant activities of clove buds (*Eugenia caryophylata)* and cinnamon bark (*cinnamomum burmanii*) water extracts on the oxidative stability of chicken meatballs.

Materials and Methods

Clove buds (*Eugenia caryophylata)* and cinnamon bark (*cinnamomum burmanii*) extracts were obtained through hot water extraction. Generally, 30 g of spice powder was stirred with 600ml of freshly boiled distilled water for 15 minutes. The mixture was then filtered through filter paper Whatman No 1. and the filtrate was dried at 70°C with a rotary evaporator (Buchi Rotovapor R-114) until a constant weight was attained. Extracts were stored in the dark and frozen (- 18°C) prior to usage. A set of 6 treatment samples differing only in the extract/antioxidant added were prepared in this study (C: control meatball; T1:meatball + 200 ppm clove buds extract; T2: meatball + 200 ppm cinnamon bark extract; T3: meatball + 100 ppm clove buds extract + 100 ppm cinnamon extract ;T4: meatball + 200 ppm ascorbic acid; T5: meatball + 100 ppm BHA +100 ppm BHT). Meatballs were prepared according to a conventional formula: 65% chicken breast meat, 20% palm fat, 6.5% water, 6% potato starch, 1.5% sunflower oil and 1% salt. Firstly, chicken meat, salt, water and potato starch were homogenized in a bowl mixer for 1.5 minutes, followed by addition of palm fat and sunflower oil (3.5 minutes). Then, spice extract/ antioxidant was mixed into the emulsion for 5 minutes. Meatballs were formed manually (15g, 20-25mm) and flash fried in palm oil at 190°C for 30s. Subsequently, the meatballs were cooked in a forced draught oven at 250 °C for 4 minutes. The cooked meatballs were then placed in a chiller (2-5°C) immediately to reach a product temperature below 12 °C. After reaching the packing temperature, samples were placed into plastic containers and sealed with a layer of semi-permeable PVC film. A 12 day shelf-life study was conducted on the meatballs which were stored at 8±1 °C in darkness to follow an accelerated shelf-life study determination protocol (IFST, 1993). Sampling and storage conditions records from each treatment took place at 1,3,6,9 and 12 days (storage time) and every sample was analysed promptly. Peroxide values (PV) of samples were determined using AOAC methods (1984). Fat extraction was carried out using Kinsella *et al.*, (1977) extraction method with slight modification. Thiobarbituric acid reactive substances (TBARS) analysis was performed as described by Buege and Aust (1978).The statistical analysis (ANOVA and Duncan grouping) was performed using SAS 6.12 package (SAS Institute, 1995) to identify the significant difference ($P<0.05$) between samples. All experiments in this study were conducted in replication.

Results and Discussion

In this study, ascorbic acid and the combination of butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) (in ratio of 1:1) were used as reference antioxidants due to its efficacy and solubility/polarity. Ascorbic acid is a water soluble natural identical antioxidant whereas BHT and BHA are fat soluble synthetic antioxidant. Figure 1 shows the peroxide value (POV) changes in respective chicken meatball sample (8±1 °C) during 12 days of chilled storage. POV is the most commonly used method and a good indicator for primary lipid autoxidation, which will express its value in milliequivalent active oxygen or peroxides per kilogram sample. Generally, all the samples with antioxidants/extracts did not showed significant increse ($P>0.05$) in POV throughout the shelf–life. Yet, the control sample (C) exhibited significant POV change ($P<0.05$) after every six days of storage duration. This indicated that the studied spice extracts (T1, T2 and T3) were able to lengthen the induction period (IP) of lipid oxidation and subsequently delay the occurrence of lipid deterioration. Samples with spice extracts and reference antioxidants (T1, T2, T3, T4 and T5) were found to have lower POV ($p<0.05$) as compared to the control sample after 6 days of storage. No significant differences in POV were observed between samples with extracts and antioxidants (T1, T2, T3, T4 and T5). The result indicated that clove buds extract,

cinnamon bark extract and their combination (1:1) were good primary antioxidants able to inactivate free radicals that contribute to the formation of hydroperoxides even in low concentration (200 ppm).

Thiobarbituric acid reactive substances (TBARS) analysis is a most widely used analysis to quantify the content of malonaldehyde (a secondary lipid oxidation product) in meat products. Secondary lipid oxidation products like malonaldehyde (MDA) are always related to the development of rancidity in food. Figure 2 shows the TBA value changes in respective chicken meatball sample (8±1 °C) during 12 days of chilled storage. MDA content in all studied samples remained stable ($P>0.05$) throughout the shelf life study. Somehow, the control sample exhibited a higher TBA value ($P<0.05$) compared to other samples (T1,T2, T3 T4 and T5) throughout the storage. No significant differences in TBA values were observed between samples with extracts and antioxidants (T1, T2, T3, T4 and T5). The TBA analysis result indicated that clove buds extract, cinnamon bark extract and their combination (1:1) were efficient secondary antioxidants that were comparable to strong natural identical antioxidant (ascorbic acid) and synthetic antioxidant (BHA and BHT) at the same concentration in meat products. The major function of a secondary antioxidant is to prevent the decomposition of hydroperoxides in fat.

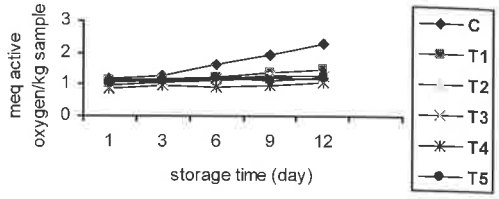

Figure 1: Effects of spice extracts and reference antioxidants on the peroxide value (POV) in chicken meatballs (8±1 °C). C: control meatball; T1: meatball + 200 ppm clove buds extract; T2: meatball + 200 ppm cinnamon bark extract; T3: meatball + 100 ppm clove buds extract + 100 ppm cinnamon extract ;T4: meatball + 200 ppm ascorbic acid;T5: meatball + 100 ppm BHA+100 ppm BHT.

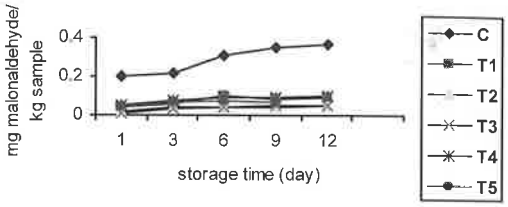

Figure 2: Effects of spice extracts and reference antioxidants on 2-thiobarbituric acid (TBA) value in chicken meatballs (8±1 °C). C: control meatball; T1:meatball + 200 ppm clove buds extract; T2: meatball + 200 ppm cinnamon bark extract; T3: meatball + 100 ppm clove buds extract + 100 ppm cinnamon extract ;T4: meatball + 200 ppm ascorbic acid;T5: meatball + 100 ppm BHA+100 ppm BHT.

Conclusions

This study concluded that clove buds and cinnamon bark water extracts were good primary and secondary antioxidants, which were comparative to ascorbic acid and synthetic antioxidants (BHA-BHT) at the same concentration. Yet, no significant synergistic antioxidant effect was observed in a mixture of both extracts (T3). The addition of 200 ppm of clove buds extract, cinnamon bark extracts or their combination (1:1) were able to improve the oxidative stability of chicken meatballs.

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