Pakistan Journal of Nutrition 10 (9): 879-883, 2011
ISSN 1680-5194

Effects of Mango (*Mangifera indica* L.) and Guava (*Psidium guajava* L.) Extract on Frozen Chicken Meat Balls' Storage Quality

A. Norhidayah[1], A.S. Babji[2], M.S. Shazali[1], M.N. Norazmir[3] and H. Norazlanshah[4]
[1]Department of Food Service Management, Faculty of Hotel Management and Tourism,
Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia
[2]School of Chemical Sciences and Food Technology, Department of Food Science,
Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia
[3]Department of Nutrition and Dietetics, Faculty of Health Sciences,
Universiti Teknologi MARA, 42300 Puncak Alam, Selangor, Malaysia
[4]Department of Nutrition Sciences, Kuliyyah of Allied Health Sciences,
International Islamic University Malaysia, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia

Abstract: A study was carried out to determine the effect of mango and guava extract on frozen Chicken Meat Balls (CMB) storage quality. CMB were added with four different formulations; mango extract (400 ppm); guava extract (800 ppm); synthetic antioxidant (BHA) (200 ppm) and a control group. Antioxidant activities, Total Phenolic Compound (TPC), Ferum (III) Reducing Power (FRAP) and Ferric Thiocyanate (FTC) were also analyzed. Determination of Thiobarbituric Acid (TBA) test and Peroxide Value (PV) were done on CBM samples which had been stored in -18°C for 0, 1, 2 and 3 months and sensory evaluation for 0 and 2 months. TPC showed that mango had higher value at 548.77 μg/100 g fresh weight compared to guava at 222.09 μg/100 g fresh weight. FRAP value significantly ($p<0.05$) indicated that mango extract able to reduce ferric ions more effectively compared to guava extract. FTC test significantly ($p<0.05$) showed that both mango and guava extracts efficient slowed down the oxidation process compared to control group after seven days of incubation. PV control group was significantly high ($p<0.05$); 3.38 meq/kg as compared to other formulation groups. TBA analysis showed that mango and guava extract able to inhibit the oxidation process which similar to BHA. In conclusion, additional mango and guava extract did not affect on frozen CBM storage quality and consumers' acceptance.

Key words: Chicken meat balls, food quality, *Mangifera indica*, *Psidium guajava*, storage quality

INTRODUCTION

Lipid oxidation is one of the major problems encountered by the meat industry during processing, cooking and refrigerated storage. It will affect the quality of the product due to loss of desirable colour, odour and flavour, reduced shelf life and thus resulting in their deterioration (Ruiz *et al*., 1999). The changes of taste and aroma of the oxidized product are also criteria for consumers' rejection. Besides, lipid oxidation has been found to cause pathological changes in the mucous membrane of alimentary tract, inhibit activity of enzymes, increase the content of cholesterol and peroxides in blood serum and activate the process of atherosclerosis (Karpinska *et al*., 2001). According to Ames (1983), lipid oxidation also shows carcinogenic activity. In addition, reactive oxygen species from lipid oxidation will induce some oxidative damage to biomolecules such as lipids, nucleic acids, protein and carbohydrate (Aruoma, 1999). These damages will lead to ageing, cancer, heart disease, stroke and diabetes (Alho and Leihonen, 1999).

Since the oxidized lipid is harmful to the body it is important to minimize occurrence of lipid oxidation in food products. Hence, the antioxidants have been widely used in processed foods to inhibit lipid oxidation. Synthetic antioxidants such as tert-butyl-4-hydroxyanisole (BHA) and tert-butyl-4-hydroxytoluene (BHT) are frequently used in the food industry. However, scientists have for long noted the noxiousness of synthetic antioxidants such as BHA and BHT, occurring as carcinogen in living organisms (Baardseth, 1989).

Recently, interest has considerably increased in finding naturally occurring antioxidant for usage in foods or medicinal materials in order to replace the synthetic antioxidants, which are being restricted legitimately due to their side effects (Guilcin *et al*., 2003). Natural antioxidants are able to minimize the body from the destruction of free radicals which is a major factor that leads to the occurrence of many chronic diseases and retard the lipid oxidative rancidity in foods (Aruoma, 1994; Siddhuhuraju *et al*., 2002).

Corresponding Author: A. Norhidayah, Department of Food Service Management, Faculty of Hotel Management and Tourism, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

High consumption of fruits and vegetables has been associated with a lowered incident of degenerative disease including cancer, heart disease, arthritis and cataract (Feskanich *et al*., 2000). Remarkably, mango (*Mangifera indica* L.) is high in carotenoid. Carotenoid is responsible for the change of yellow to orange colour of ripe mango flesh, providing high provitamin A value and antioxidative capacity. The total carotenoid content ranges 0.9-9.2 mg/100 g in mango (Litz, 1997). According to Bendich (1993) carotenoids possess the function as quenchers of singlet oxygen, antioxidants and modulator of lipoxygenase in immune processes and protector in the prevention of cancer, cardiovascular disease, cataracts and molecular disease as well as neurologic, inflammatory and immune disorders. Study by Setiawan *et al*. (2001) showed mango has a higher carotenoid content (1150 µg/100 g) compared to guava (353 µg/100 g).

Guava (*Psidium guajava*) is widely cultivated and Malaysia is the largest producer and exporter of pink guava puree (Norazmir *et al*., 2010). Previous study also showed it has anti-hypertensive (Ayub *et al*., 2010) and lipid-lowering properties (Norazmir and Ayub, 2010). It is believed that ascorbic acid may act as an effective antioxidant and is able to slow down or prevent the uncontrolled cells proliferation due to the damage of DNAs and cells. The objectives of this study were to determine the effect of mango and guava extract on frozen chicken meat balls storage quality.

MATERIALS AND METHODS

Sample preparation: Fruit materials used in this study include the peel, skin and seed of mango (*Mangifera indica*) and guava (*Psidium guajava*) purchased from the market around Bandar Baru Bangi, Selangor, Malaysia. 150 g sample was blended with 450 ml distilled water by waring blender for 15 min. Then the extract was filtered over Whatman No. 1 paper and the filtrate was collected. Next, the distilled water was removed by a rotary evaporator at 60°C to obtain the dry extract. Both extracts were placed in a glass bottle and then stored at -18°C until used.

Determination of total phenolic compound: Total phenolic compound in mango and guava extracts were determined according to Waterman and Mole (1994) using tannic acid as a standard phenolic compound. Briefly 0.05 mg extract was diluted with 10 ml of distilled water in a volumetric flask. Then 1.0 ml of solution was taken out into a volumetric flask and 0.5 ml of Folin-Ciocalteu reagent was added. The solution was stirred so that the content of the flask mixed thoroughly. Three minutes later, 1.0 ml Na_2CO_3 (2%) was added and the solution marked up to 10 ml with distilled water. The mixture was then stored for 1-hr in dark condition. The absorbance of the react mixture was measured at 760 nm. The concentration of mango and guava extracts was determined as µg/100 gram using the following formula: total phenolic compound = 10 RD/W µg/100 gram; where R = abs at 760 nm, D = dilution factor, W = sample weight.

Ferric reducing power: Ferric reducing power of mango and guava extracts was determined according to Oyaizu (1986). Different concentrations of mango and guava extracts (1.6-9.6 mg) in 1.0ml of distilled water were mixed with 2.5 ml phosphate buffer (0.2 M, pH 6.6) and 2.5 ml potassium ferricyanide [$K_3Fe(CN)_6$] (1%). The mixtures were incubated at 50ºC for 20 min. Aliquots (2.5 ml) of trichloroacetic acid (10%) were added to the mixtures, which were then centrifuged for 10 min at 3000 rpm. The supernatant (2.5 ml) was mixed with 2.5 ml distilled water and 0.5 ml of 1% $FeCl_3$. The absorbance of the reaction mixtures was measured at 700 nm. Increased absorbance of the reaction mixture indicates increased reducing power.

Determination of antioxidant activity: Antioxidant activity was determined by ferric thiocyanate method by Osawa and Namiki (1981). 4 mg of sample extract in 99.5% ethanol was mixed with 4.1 ml of 2.51% linoleic acid in 99.5% ethanol, 8 ml of 0.05M phosphate buffer, pH 7.0 and 3.9 ml of distilled water and kept at 40°C in dark condition. 0.1 ml of this solution was added to 9.7 ml of 75% ethanol and 0.1 ml of 30% ammonium thiocyanate. Then 0.1 ml of 2 x 10^{-2} M ferrous chloride in 3.5% hydrochloric acid was added to the reaction mixture. After 3 min the absorbance was measured at 500 nm every 24-hrs until the control reached maximum. The control and standard were subjected to the same procedure where the control sample was a sample without addition of extract whereas the standard sample was a sample which is replaced by 4 of BHA.

Peroxide value: Peroxide value was determined based on PORIM (1995) method. 1.0 ml of fat is weighed in 250 ml volumetric flask. 30 ml of acetic acid-chloroform (1:3) was added and the flask was swirled until the sample was dissolved in the solution. Saturated potassium iodide (0.5 ml) was added and the flask was swirled again before the addition of 30 ml of distilled water. A few drops of starch solution were added as the indicator and the mixture was titrated with 0.01N sodium thiosulphate until the blue colour disappears.

Thiobarbituric acid test: Malonaldehyde compound as an index of secondary lipid peroxidation was determined using Buege and Aust (1978) method. In brief, 0.5 g sample was homogenized in 2.5 ml stock solution (0.375% TBA, 15% TCA, 0.25N HCl). The mixture was allowed to stand in hot water (100°C) for 10 min. The mixture was then centrifuged for 25 min at 5500 rpm.

The absorbance was measured at 523 nm. The TBA value was determined according to this formula: TBA value = OD at 532 nm x 2.77

Sensory evaluation: A hedonic test, which was conducted on 100 panels were used to evaluate the overall acceptance of the 4 formulations of CBM on colour, tenderness, juiciness, flavour and consumer acceptability at 0 to 3 months of frozen storage. For overall acceptability evaluation, CBM were warmed before being served to the panelists. The panelists were required to indicate how much they like or dislike each of the product on a 7-point hedonic scale, from scale 1 = dislike extremely until scale 7 = like extremely.

Statistical analysis: All the experiments were conducted in replicate and statistical analysis was done by SPSS 11.0. Analysis of Variance (ANOVA) was performed by the ANOVA procedure. Duncan's multiple range tests was used to determine the significant difference between the means at the confidence level of 95% ($p<0.05$).

RESULTS AND DISCUSSION

Total phenolic compound: Phenolic compound are important plant constituents that mostly contribute to radical scavenging ability due to their hydroxyl groups (Guilcin *et al*., 2003). In water extract of 0.05 mg mango, 548.77 µg/100 gram of phenol compound was detected while 222.09 µg/100 gram in guava. The higher content of phenolic compound detected in mango is due to higher concentration of tannin 56.5 g/kg wet weight (Sivakanesan and Ravindra, 1996).

Ferric reducing power: Figure 1 shows the reductive capabilities of mango and guava extracts as compared to BHA. The ability to reduce the Fe^{3+} to Fe^{2+} may serve as a significant indicator of its potential antioxidant activity. The reducing power of mango and guava extracts increased significantly ($p<0.05$) with the sample increasing concentration. Mango extract showed the higher reducing activities (0.923-4.394) compared to guava extract at all the described concentrations. No significant difference was observed between the reducing power of mango and guava extracts with BHA. Reducing power of water extracts of mango, guava and standard compounds can be exhibited in the following order: BHA > mango > guava.

Antioxidant activity: Antioxidant activities of mango and guava extracts were determined by thiocyanate method. Both mango and guava extracts exhibited effective antioxidant activity on all the concentrations. The antioxidant activity of both extracts increased with increased concentration. Figure 2 showed the mango and guava extract possesses the highest oxidized

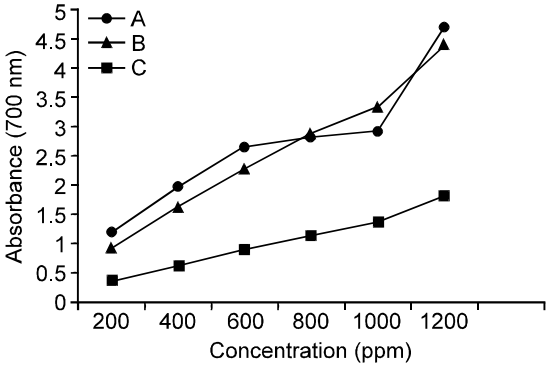

Fig. 1: The reducing power of mango and guava extracts as compared to BHA at different concentrations. A (BHA); B (Mango); C (Guava)

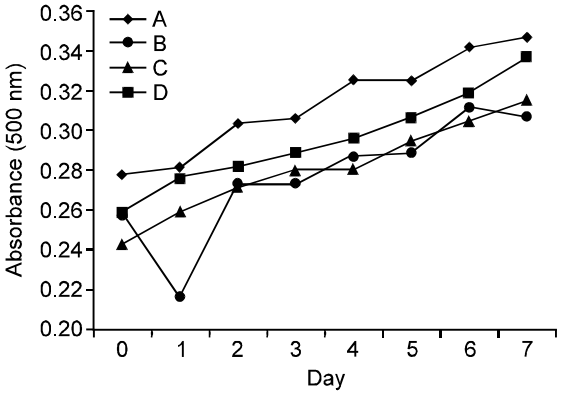

Fig. 2: Antioxidant activity of different concentrations of water extracts from mango (400 ppm) and guava (800 ppm) and BHA (200 ppm). A (Control); B (BHA); C (Mango); D (Guava)

linoleic acid compared to control group. However there was no significant difference between the antioxidant activities of both extracts with BHA.

Peroxide value: Figure 3 showed the peroxide value of CBM samples which were stored in -18°C for 0, 1, 2 and 3 months. The control sample had the highest peroxide value (0.551% meq/kg) compared to other formulation groups. Generally, the peroxide value for all the tested samples after 3 months of frozen storage are in the following sequence: Control > Guava > Mango > BHA. No significant differences were found between the peroxide value of guava, mango and BHA. The result indicates that presence of both extracts in chicken meat balls were able to retard the formation of peroxides in the lipid.

Thiobarbituric acid test: As shown in Fig. 4, TBA values of all CBM samples increased gradually throughout the entire storage period. The TBA value of mango

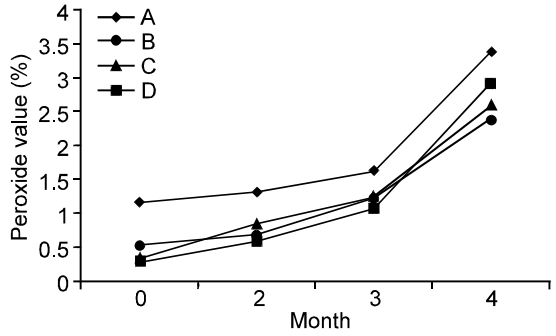

Fig. 3: Peroxide value of various chicken meat ball samples. A (Control); B (BHA); C (Mango); D (Guava)

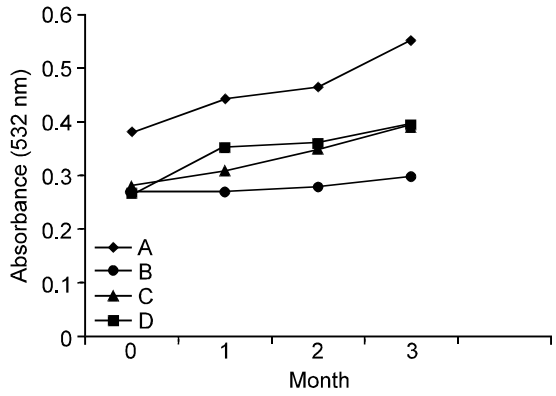

Fig. 4: TBA value of various chicken meat ball samples throughout 3 months of frozen storage. A (Control); B (BHA); C (Mango); D (Guava)

(0.281-0.393) and guava (0.263-0.39) extract were significantly lower ($p<0.05$) compared to control group (0.380-0.551). It showed that the addition of both extracts reduced the rate of malondialdehyde formation in CBM. However both mango and guava extracts demonstrated insignificantly higher TBA value compared to BHA.

Sensory quality characteristics

Colour: Colour scores of all the tested samples were reduced insignificantly with 3 months frozen storage. CBM with mango extract turned slightly darker compared to other formulation products which made it less acceptable but there was no significant difference reported. The product with guava extract was scored similar to the product added with commercial antioxidant. Addition of mango gave a little impact on colour with no statistical differences.

Tenderness and juiciness: Briefly there were no significant differences found in the tenderness and juiciness scores of all the tested samples which had been stored for 0 to 3 months.

Off-flavour: There were increased off-flavour scores for all samples after 3 months of frozen storage. The control sample of CBM performed the highest score of off-flavour compared to other tested samples. Addition of mango (400 ppm) and guava (800 ppm) insignificantly resulted in similar off-flavour scores of CBM added with BHA. The addition of both extracts which contain natural antioxidant caused fewer observations of undesirable off-flavours.

Consumer acceptability: 3 months frozen storage reduced the overall consumer acceptability score for all samples analyzed. Control CBM had the highest consumer acceptability score at 0 month but had the lowest during the 3rd months. The sensory panelists highlighted rancid off-flavours in the control sample, which significantly decreased the final score for this product. CBM with the addition of mango and guava had a higher consumer acceptability score ($p<0.05$) compared to the control sample.

Conclusion: TPC showed that mango had higher value at 548.77 μg/100 g fresh weight compared to guava at 222.09 μg/100 g fresh weight. FRAP value significantly ($p<0.05$) indicated that mango extract able to reduce ferric ions more effectively compared to guava extract. FTC test significantly ($p<0.05$) showed that both mango and guava extracts efficient slowed down the oxidation process compared to control group after seven days of incubation. PV control group was significantly high ($p<0.05$); 3.38 meq/kg as compared to other formulation groups. TBA analysis showed that mango and guava extract able to inhibit the oxidation process which similar to BHA. In conclusion, additional mango and guava extract did not affect on frozen CBM storage quality and consumers' acceptance.

ACKNOWLEDGEMENT

The authors would like to thank Ministry of Science, Technology and Environment (MOSTE), Malaysia for financing the project and the Faculty of Science and Universiti Kebangsaan Malaysia for the laboratory facilities.

REFERENCES

Alho, H. and J. Leihonen, 1999. Total antioxidant activity measured by chemiluminescence method. Method in Enzymology, 299: 3-15.

Ames, B.M., 1983. Dietary carcinonogens and anticarcinogens: oxygen radical and degenerative diseases. Science, 221: 1256-1263.

Aruoma, O.I., 1994. Nutrition and health aspects of free radicals and antioxidants. Fd. Chem. Tox., 62: 671-683.

Aruoma, O.I., 1999. Free radicals, oxidative stress and antioxidants in human health and disease. J. Am. Oils Chem. Soc., 75: 199-212.

Ayub, M.Y., M.N. Norazmir, S. Mamot, K. Jeeven and H. Hadijah, 2010. Anti-hypertensive effect of pink guava (*Psidium guajava*) puree on Spontaneous Hypertensive Rats. Int. Fd. Res. J., 17: 89-96.

Baardseth, P., 1989. Effect of selected antioxidants on the stability of dehydrated mashed potatoes. Fd. Add. Cont., 6: 201-207.

Bendich, A., 1993. Biological fuctions of dietary carotenoids. In Canfield, L.M., Krinsky N.I. and Olson Eds, J.A. Carotenoid in Human Health. New York. Ann N.Y. Acad Science.

Buege, J.A. and Aust, S.D. 1978. Microsoml Lipid Peroxidation. Method in Enzymology, 52: 306.

Feskanich, D., R.G. Ziegler, D.S. Michaud, E.L. Giovannucci, F.E. Spiezer, W.C. Willet and G.A. Colditz, 2000. Prospective study on fruit and vegetable consumption and risk of lung cancer among men and women. J. Nat. Cancer Inst., 92: 1812-1823.

Guilcin, I., M. Oktay, E. Kirecci and O.I. Kufrevioglu, 2003. Screening of antioxidant and antimicrobial activities of anise (*Pimpinella anisum L.*) seed extracts. J. Fd. Chem., 83: 371-382.

Karpinska, M., J. Borowski and M. Danowska-Oziewicz, 2001. The use of natural antioxidants in ready-to-serve food. Fd. Chem., 72: 5-9.

Litz, R.E., 1997. The Mango: Botany, Production and Uses. CAB International. Wallingford. New York.

Norazmir, M.N., M.Y. Ayub and M.M.A. Ummi, 2010. Enzyme activities and histology study on high fat diet-induced obese rats by pink guava puree. Pak. J. Nutr., 9: 1100-1106.

Norazmir, M.N. and M.Y. Ayub, 2010. Beneficial lipid-lowering effects of pink guava puree in high fat diet induced-obese rats. Mal. J. Nutr., 16: 171-185.

Osawa, T. and M. Namiki, 1981. A novel type of antioxidant isolated from leaf wax of Eucalyptus Leaves. Agr. Bio. Chem., 3: 735-739.

Oyaizu, M., 1986. Studies of products of browning reaction. Antioxidative activity of products of browning reaction prepared from glucosamine. J. Nutr., 44: 307-315.

PORIM, 1995. Method of Test for Palm Oil and Palm Oil Product. Malaysia. Palm Oil Research Institute of Malaysia.

Ruiz, J.A., A.M. Perez-Vendrell and E. Esteve-Garcia, 1999. Effect of β-carotene and vitamin E on oxidative stability in leg meat of broilers fed different supplemental fats. J. Agric. Fd. Chem., 47: 448-454.

Setiawan, B., A. Sulaeman, D.W. Giraud and J.A. Driskell, 2001. Carotenoid content of selected Indonesian fruits. J. Fd. Comp. Anal., 14: 169-176.

Siddhuhuraju, P., P.S. Mohan and K. Becker, 2002. Studies on the antioxidant activity of Indian Laburnum (*Cassia fistula L.*): A preliminary assessment of crude extracts from stem bark, leaves, flowers and fruits pulp. Fd. Chem., 79: 61-67.

Sivakanesan, R. and V. Ravindra, 1996. The nutritive value of mango seed kernels for starting chicks. J. Fd. Sci. Agric., 71: 245-250.

Waterman, P.G. and S. Mole, 1994. Analysis of Phenolic Plants Metabolites. London. Oxford Blackwell Scientific Publications.