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Short Communication: Preservation effect of Javanese turmeric and red ginger essential oils on coated frozen patin fillets

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Abstract. *Utami R, Kawiji, Praseptiangga D, Manuhara GJ, Khasanah LU, Anggraini N, Lestari FM. 2016. Short Communication: Preservation effect of Javanese turmeric and red ginger essential oils on coated frozen patin fillets. Nusantara Bioscience 8: 264-267.* Due to antimicrobial and antioxidant properties of essential oil, Javanese turmeric and red ginger potentially used as preservation agents on food. Cassava starch-based edible coating enriched with Javanese turmeric and red ginger essential oils were applied to maintaining of patin fillets quality during frozen storage. Fillets quality were analyzed based on microbiological (total plate count) and chemical properties (total volatile bases; thiobarbituric acid value). Different concentration of Javanese turmeric and red ginger essential oil enrichment were studied (0, 0.1, and 1% (v/v of distilled water)). Javanese turmeric and red ginger essential oils enrichment on coating solution significantly inhibited microbial proliferation, retarded protein deterioration and delayed lipid oxidation in fillet during frozen storage for four months. Increasing essential oil concentration showed on the increase in maintaining fish quality. The results indicated that Javanese turmeric and red ginger essential oil addition on cassava starch-based edible coating could maintain quality and extend the shelf life of frozen fish fillets and can be used as an alternative fish fillets preservation.

Keywords: edible coating; essential oil; Javanese turmeric; red ginger; preservation
Abbreviation: CFU = colony forming unit, TBA= thiobarbituric acid, TPC = total plate count, TVB = total volatile base

INTRODUCTION

Indonesia is a country with mega biodiversity with the total known species about 1.46 million. More than 940 species of medicinal plants have been used for traditional medicine. Spices have been obtained from 70 species, and 40 species for beverages (FAO, 2015). Zingiberaceae is one of the largest families that provide many useful products for food, spices, and medicines. Javanese turmeric and red ginger, members of the family Zingiberaceae, are used to make traditional medicine and potentially used as natural food preservation agent. Antimicrobial activity of spices bioactive compounds contributed to the extension of food shelf life (Souza et al. 2005). Bioactive compounds of the plant can be concentrated into essential oil.

Essential oil of Javanese turmeric contains xanthorrhizol, camphene, curcumin, pinene, α-thujene, β-pinene, myrcene, linalool and zingiberene (Mary Helen et al. 2012). Essential oil of red ginger rhizome from Malaysia (*Zingiberofficinale var. rubrum* Theilade) contains camphene (14,5%), geranial (14,3%), and geranyl acetate (13,7%) (Sivasothy et al. 2011). This bioactive compound showed antimicrobial activity that potentially can be used as preservative agents.

However, the intense aroma of essential oil could limit their uses for food preservation. To reduce the concentration of essential oil while keep maintains the effectiveness, the essential oil could be incorporated into the edible film/coating solution (Sánchez-González et al. 2011).

Hence, this research aimed to investigate the preservative effects of Javanese turmeric and red ginger essential oils enrichment on cassava starch-based edible coating to frozen patin fillets.

MATERIALS AND METHODS

Material preparation

Javanese turmeric and red ginger rhizomes obtained from local market (Surakarta, Central Java, Indonesia) were sliced (2-3 mm) and air dried for 4 hours. Dried rhizomes were distilled by water vapor distillation to produce essential oil. Fresh patin (300-350 g) were quarantined for one day. Skinless patin fillets were produced by heading off, gutting, filleting, skinning, and cleaning the fish samples at the farm. Cleaned fillets were transported to the laboratory in a cooler box.

Coating solution preparation

Distilled water (100 ml) and cassava starch (5 g) were mixed and heated at 60°C for gelatinization. Glycerol (2 ml) as plasticizer were added to the previous mixture and heated at 60°C for 30 minutes. Each essential oil was added

and mixed with the solution (Utami et al. 2014). The concentration of each essential oil enrichment were 0.1, and 1% (v/v of distilled water). No essential oil addition on edible solution was applied on a control sample.

Coating application

All fillets samples were double dipped into each solution and dried in drying box. Coated fillets were packed in polyethylene frozen bag, sealed, and placed in a styrofoam box. Samples were stored in the freezer (-10±2°C) for 4 months. Samples were analyzed microbiologically (Total Plate Count of mesophilic microorganism) and chemically (Total Volatile Bases and Thiobarbituric Acid) at 0, 1, 2, 3, and 4 months of storage. All samples were made in duplicates. Total plate count (TPC) value was expressed as log CFU/g (Utami et al. 2014). Total volatile bases (TVB) value were expressed as mg N/100g (SNI, 2009). Thiobarbituric acid (TBA) were expressed as mg malonaldehyde/kg (Apriyantono et al. 1989).

Statistical analysis

The data were subjected to one-way analysis of variance (ANOVA) at the level of $p < 0.05$ to determine significant differences as a result of essential oil concentration and duration of frozen storage and followed by Duncan's multiple range test ($p < 0.05$). Data were statistically evaluated using SPSS version 16 for Windows.

RESULTS AND DISCUSSIONS

Total plate count

The initial total microbes of all samples ranged from 2.57-3.05 log CFU/g indicating fresh fish quality. TPC values of all samples significantly increased during frozen storage. At the end of storage (months 4), TPC value of control sample reached 6.78 log CFU/g and significantly higher than that of enriched samples which were 4.90-4.94 log CFU/g for Javanese turmeric essential oil enrichment samples and 6.00-6.15 log CFU/g for red ginger essential oil enrichment samples (Figure 1). This indicated that essential oil enrichment on edible coating solution could inhibit the microbial growth of patin fillets.

Microbial inhibition also performed by Javanese turmeric (Utami et al. 2014) and red ginger (Utami et al. 2013) essential oil enrichment on cassava starch-based edible coating to refrigerated patin fillets. The chemical compound of each Javanese turmeric and red ginger essential oil that showed antimicrobial activity contributed to the microbial growth inhibition.

Essential oil of Javanese turmeric contains xanthorrhizol, camphene, curcumin, pinene, α-thujene, β-pinene, myrcene, linalool, and zingiberene. Javanese turmeric essential oil also showed antimicrobial activity against pathogenic bacteria (Helen et al. 2012). Essential oil of *Zingiber officinale* var. *rubrum* Theilade rhizome contains camphene (14,5%), geranial (14,3%), and geranyl acetate (13,7%). The oil could inhibit the growth of Gram-positive bacteria (*Bacillus licheniformis, Bacillus spizizenii, Staphylococcus aureus),* and Gram-negative bacteria *(Escherichia coli, Klebsiella pneumonia, Pseudomonas stutzeri*) (Sivasothy et al. 2011).

Total volatile bases

TVB values represented proteins degradation due to proteolytic bacteria action that followed by nitrogenous materials formation (Kilincceker et al. 2009). This condition caused the results of TVB values compatible with the TPC values. As same as the TPC results, TVB values of samples significantly increased during frozen storage. However, the increasing of TVB value showed by control samples significantly higher than other essential oils treatments samples. TVB value of control samples increased from 20.39 to 34.95 mg N/100g and exceeded the limit of acceptability of fish regarding TVB value (30 mg N/100g) at month 2. The preservative effect was showed by Javanese turmeric and red ginger essential oil enrichment on edible coating solution. At 4 months of frozen storage, TVB values of 1% Javanese turmeric treatments samples and 0.1% and 1% red ginger treatments samples remained below maximum standard (Figure 2).

Thiobarbituric acid

The thiobarbituric acid value represented the degree of lipid oxidation. TBA values of all samples significantly increased during frozen storage. Delaying of lipid oxidation only proved at 1% Javanese turmeric essential oil treatment due to no significant differences in TBA values in control samples and 0.1% of Javanese turmeric essential oil treatment samples and TBA values in all red ginger essential oil samples (Figure 3). However, the trend of lowering TBA values was presented by the essential oil enrichment treatments samples through at an insignificant level ($p > 0.05$). At the end of storage, TBA values of all samples ranged from 0.195-0.32 mg malonaldehyde/kg and were lower than the maximum level of acceptability limit (1-2 mg malonaldehyde/kg) according to Gill (1990) report. Lipid oxidation protection of Javanese turmeric essential oil related to the antioxidant activity of its chemical compounds. Jantan et al. (2012) reported that essential oils of *C. xanthorrhiza* showed high LDL antioxidant activity due to the high levels of xanthorrhizol.

Similar studies also reported the lipid oxidation protection to frozen fish. Enrichment of cinnamon oil on chitosan coating could prevent the lipid oxidation of frozen rainbow trout. The mechanism of cinnamon oil oxidative stability related to the phenolic compounds that showed antioxidant and radical scavenging activity (Ojagh et al. 2014). Antioxidant activity of natural substances from barley husks which coated on low-density polyethylene films contributed to the reduction of thiobarbituric acid values of frozen Atlantic salmon, Atlantic halibut, and blue shark. The higher concentration of natural substrate generated a greater lipid oxidation protection (Abreu et al. 2010, 2011a,b).

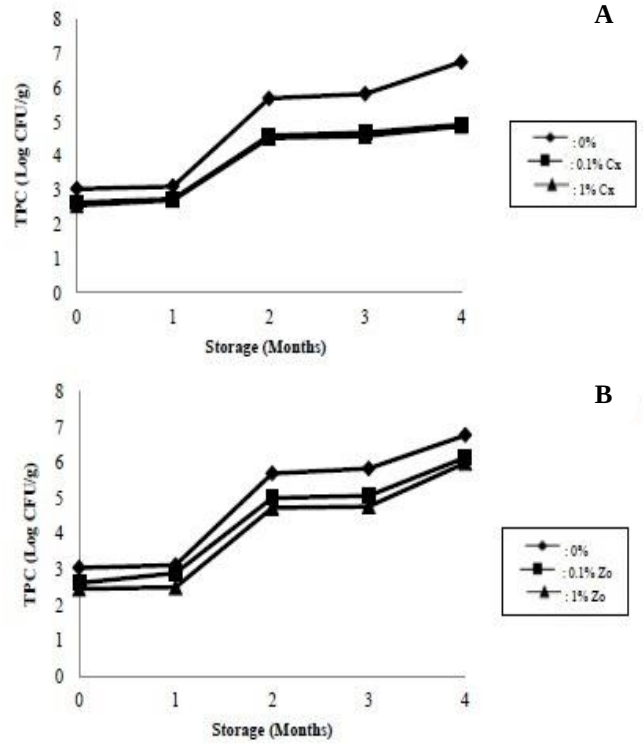

Figure 1. The effect of edible coating enriched with (a) Javanese turmeric (Cx) (b) red ginger (Zo)essential oil on total plate count (TPC) values of patin fillets during storage at-10±2°C.

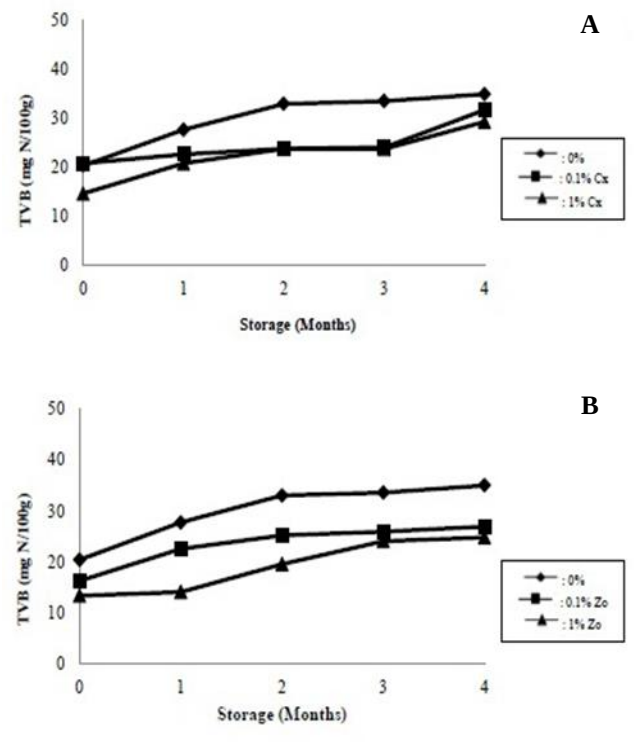

Figure 2. The effect of edible coating enriched with (a) Javanese turmeric (Cx) (b) red ginger (Zo) essential oil on total volatile bases (TVB) values of patin fillets during storage at-10±2°C.

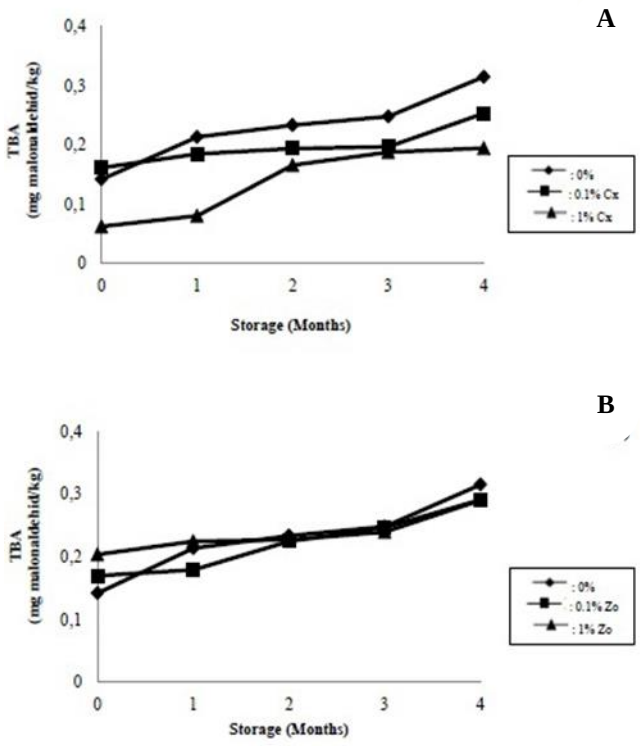

Figure 3. The effect of edible coating enriched with (a) Javanese turmeric (Cx) (b) red ginger (Zo)essential oil on thiobarbituric acid (TBA) values of patin fillets during storage at-10±2°C.

To conclude, Javanese turmeric and red ginger essential oils enrichment on coating solution significantly inhibited microbial proliferation, retarded protein deterioration and delayed lipid oxidation in fillet during frozen storage for four months. Increasing essential oil concentration showed on the increase in maintaining fish quality. The results indicated that Javanese turmeric and red ginger essential oil addition on cassava starch-based edible coating could maintain quality and extend the shelf life of frozen fish fillets and can be used as an alternative fish fillets preservation.

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