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Savory Salt Production by Enzymatic Hydrolysis from Low Economic Value of Freshwater Fishes and Saltwater Fishes

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Small and Medium Enterprises (SMEs) in East Java—Indonesia, has been proven to make a major contribution to the Gross Domestic Income. Nevertheless, production management that is applied often still traditional. This research is a case study conducted in one of the coffee bean processing SMEs is "Kopi Sembilan," and aims to determine the composition of the most optimal product sales of nine kinds of processed coffee products. The results using the method of linear programming showed that the the most optimal products mix per day is Kopi Caffe Dos total of 133 boxes, Kopi Krishna "9" (20 packs), Kopi Aroma "9" (20 packs), Kopi Robusta "9" A1 (25 packs), Kopi Robusta Plastik (30 packs), Kopi Robusta Mantap (31 packs), Kopi Robusta Plus Jahe "9" (20 packs), Kopi Jawara "9" (14 packs), and Kopi Luwak "9" as much as 8 packs. These results provide the most optimal profit compared with the previous determination traditional product mix.

Keywords: Product Mix, Coffee, Linear Programming.

1. INTRODUCTION

Indonesia has a rich of fishery resources including freshwater fishes (FF) and saltwater fishes (SF). By year of 2015, SF product reach 4.39 million tons and FF 10.40 million ton.[1] Generally, utilization of fish in Indonesia is still limited to local consumption as side dishes, yet its commercial value is still low. Exported fisheries just dominated by frozen shrimp and tuna. It cause another fishes have cheaper price and low economic value. One possible way to enhance the commercial value of this fishes is by generating savory salt based on fish protein hydrolysates (FPH) for widely used in the food industries.

Fish savory salt was produce from FPH and adding by some ingredients (salt, garlic powder, sugar, and etc.). FPH was produced from fish by hydrolysis process. It can be done by heating with acid or addition of enzymes.

Hydrolysis of protein by proteolytic enzymes (often referred as protease) is a widely used technique to modify the physicochemical properties (e.g., emulsification, solubility, etc.) and sensory properties of food proteins.[2] Several proteases can be used potentially for making hydrolysates. There are plant-derived enzyme such as papain and biduri protease and animal-originated enzymes for example trypsin.[3–5] Protease from Biduri (*Calotropis gigantea*) be characterized as exo-peptidase and has been proven to be one of the enzyme used in the preparation of saltwater fish protein hydrolysates.[4] Biduri is one kind shrub with 0.5–3 meters height that grows in place with dry periods such as Indonesia. Enzymatic hydrolysis of proteins produce a decrease in peptide size, which can modify functional characteristics of the proteins and improve their quality.[6]

The objective of this research was to produce and analyse the properties of savory salt from FF hydrolysate and SF hydrolysate by adding some ingredients (salt, garlic powder, and lime).

2. MATERIALS AND METHODS

2.1. Materials

Freshwater fishes (FF) including 'wader' (*Rasbora jacobsoni*), catfish (*Pangasius djambal*), 'bader' (*Barbonymous gonionotus*) were purchased from Tanjung Market, a local market of Jember district, Indonesia. Saltwater fishes (SF) including 'lidah' (*Cynoglossus lingua*), 'bibisan' (*Apogon albimaculosus*), 'baji–baji' (*Platycephalidae cymbacephalus*) were purchased from Talango, Madura island, Indonesia. Biduri (*Calotropis gigantea*) obtained from the coast of Papuma beach, Jember, Indonesia as source of exopeptidase enzyme. All the chemical reagents of analytical grade were purchased from Sigma (Sigma-Aldrich).

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Table I. The composition of savory salt.

Material	Savory salt	
	Freshwater fishes (FF)	Saltwater fishes (SF)
Mixed FF fillet (g)	20	–
Mixed SF fillet (g)	–	20
Salt (g)	144	144
Garlic powder (g)	4.5	4.5
Lime (g)	13.5	13.5

Table II. Proximate composition of savory salt.

Parameter	(% w/w)*	
	FF	SF
Protein	11.71 ± 0.07	11.40 ± 0.26
Fat	0.32 ± 0.03	0.22 ± 0.03
Ash	75.38 ± 0.01	81.54 ± 0.57
Moisture	1.93 ± 0.00	1.90 ± 0.00

Note: *Average ± STDEV.

2.2. Preparation of Savory Salt

Mixed FF fillet (wader, bader, catfish (1:1:1)) and mixed SF fillet (lidah, bibisan, baji-baji (1:1:1)) was added with NaOH 0.1 N (1:4 (w/v)). The solution was added by protease biduri at the concentration 1.5% (v/w), pH 7, temperature of 55 °C and incubated for 3 hours. After that, the solution was heated at 100 °C for 10 min to inactivate the protease. The solution was weighed and be added by salt, garlic powder, and lime. The composition is in Table I. Sample be dried at the temperature 60 °C for 24 hours and then grinded until the size reach 60 mesh. The dried of savory salt kept in plastic and be stored at room temperature for further experiments.

2.3. Proximate Analysis

The savory salt of FF and SF was used for moisture, protein, lipid, and ash analysis. The moisture content was measured using an oven method according to Association of Official Analytical Chemists (AOAC International) standard.[7] The Kjeldahl method was used for protein determination and the Soxhlet method was used for the lipid content. For ash content, the sample was weigh and transfer to a muffle furnace at 550 °C until a white or light grey ash is obtained. Three replications of all of these measurements were carried out.

2.4. Color of Savory Salt

The color of savory salt was measured using a colorimeter (Miniscan, Hunterlab, Va, USA) in CIE L^*, a^*, b^* color space. The powder was placed on the light port of Color Reader. Each value represents a mean of triplicate determination of three different positions for each sample. The values were reported as ^{o}Hue. Before measuring the color, the Color Reader was standardized with black and white calibration tiles supplied with the instrument.

2.5. Morphology of Savory Salt

The appearance, size and shape of the powder samples were examined with scanning electron microscope (SEM) (JEOL, JSM-5800 LV, JOEL Ltd., Tokyo, Japan). The samples were mounted on an aluminum stub using a double sided adhesive tape and thereafter making it electrically conductive by coating with a thin layer of gold in vacuum condition. The scanning electron microscope was operated at 10 kV an acceleration voltage.

3. RESULTS AND DISCUSSION

3.1. Chemical Composition of Savory Salt

The chemical compositions of savory salt are presented in Table II. The highest protein content was in savory salt from FF (11.79%) followed by SF (11.40%) but the highest of ash content was in SF (81.54%) followed by FF (75.38%). The chemical compositions of savory salt are depend on the fish nutrition that influence by biotic and abiotic factors related to the species and culture, such as age, season, sex, gonadal development and diet which affected the physical and organoleptic characteristics and shelf life of fish and derivatives.[8] Protein and fat content of culture fishes (FF) (14–17%; 2.34–10.03%, respectively) is higher

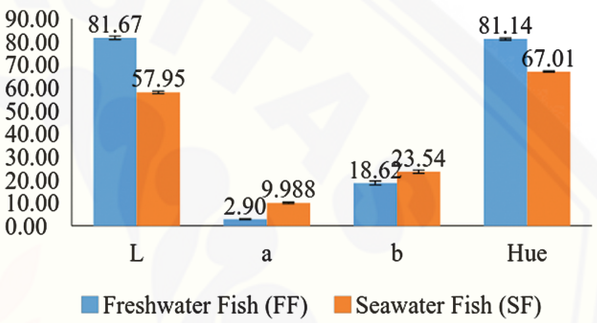

Fig. 1. The color properties of savory salt from FF and SF hydrolysates.

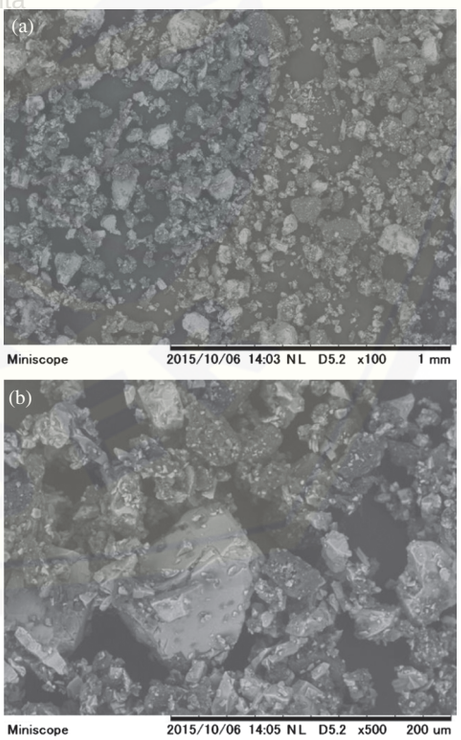

Fig. 2. Scanning electron microscope of savory salt from (a) freshwater fish (FF) hydrolysates and saltwater fish (SF) hydrolysates.

than marine fishes (SF) (12–16%; 2.15–5.02%), but the ash content of SF (0.93–4.78%) is higher than FF (0.60–0.33).[9]

3.2. Color of Savory Salt

Color of savory salt from FF was 81.67 ± 0.78 in L^* value, 2.90 ± 0.17 in a^* value, and 18.62 ± 0.84 in b^* value. From ^{o}Hue value (81.4), the color of savory salt from FF was catergorized as yellow red. The savory salt color of SF from ^{o}Hue value was (67.01) yellow red in color with L^* value was 57.95 ± 0.55, a^* value was 9.99 ± 0.34 and b^* value was 23.54 ± 0.71 (Fig. 1). L^* value of the FF was higher than SF, but a^* value and the yellowness (b^* value) was the opposite of it.

3.3. Particle Size Distributions and Scanning Electron Microscope (SEM) of Savory Flavor

Typically, particle size had impacted on bulk density when particle size decreased, the bulk densities increased. In addition, particle in spherical shape also had the highest bulk density value.[10, 11] Particle size of savory salt of FF were in range of 35.56 ± 0.81–118.06 ± 2,11 μm and the average of particle size of savory salt of SF was 181.14 ± 2.26 (Fig. 2). This indicated that savory salt from FF is smaller than SF. The particle size may aid in the slightly increased solubility of the powder.[10]

4. CONCLUSION

Savory salt producing from freshwater fish (FF) and saltwater fish (SF) hydrolysates was yellow red in color. Protein content in savory salt from FF is higher than SF, but the ash content FF is lower than SF. Particle size of savory salt of FF were in range of 35.56 ± 0.81–118.06 ± 2,11 μm and the average of particle size of savory salt of SF was 181.14 ± 2.26. This savory salt could be used as flavor enhancer or flavor supplement in various food products.

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