

Effect of fish bone gelatin supplementation on protein contents and acceptability of rice-based traditional food

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Abstract. This research was aimed at determining the effect of fish bone gelatin supplementation on protein content and consumer acceptability of rice-based traditional foods. Three types of traditional foods, i.e. dange, surabeng and onde-onde were supplemented with fish bone gelatin at concentrations of 0, 5, 10, 15 and 20% (w/w) with three replicates for each treatment and for each type of foods. The protein contents were analyzed using micro-kjeldahl method whereas the consumer acceptability was determined organoleptically by employing 15 panelists. Data on the protein contents were subjected to ne-way Anova, while those of consumer acceptability were analyzed descriptively using percentage of frequency of occurrence. Results indicated that addition of fish bone gelatin significantly increased the protein contents of the foods and that the protein content of each type of foods was differ between the gelatin concentration treatments. The protein contents of foods were increased by 1.68-4.77 folds, and may be predicted using a simple regression formula: $Y=0.578x + 6.037$, $R^2=0.978$ for dange; $Y=0.660x + 4.068$, $R^2=0.992$ for surabeng; and $Y=0.554x + 5.39$, $R^2=0.967$ for onde-onde. The level of consumer acceptability showed that the addition of 10% of fish bone gelatin into each of the three traditional foods produced food products with good acceptability levels.

Keywords: gelatin, extraction, fish bone, rice, protein, organoleptic.

Introduction

Gelatin is widely used in the fields of food, beverage, pharmaceutical industries, as well as photography. Application gelatin in food generally serves as an emulsifier, stabilizer, and binder, while the beverage is intended as a purifier (Juniato *et al.*, 2006; Suryani *et al.*, 2009). Production of processed meats such as sausages using gelatin aims to enhance the water holding capacity (WHC) and improve consistency. The same case on dairy products like yogurt and ice cream, gelatin is added to improve product stability and avoid syneresis. Gelatin serves to maintain product moisture and texture in the bread industry, as a purifier in the beer and wine industry. Gelatin is also used in coating pore fruits that will be distributed to avoid dryness and damage by microbial activity. In pharmaceutical industry, gelatin is to microencapsulate vitamins and minerals in manufacture capsules and tablets. Stability of emulsions in cosmetic and medical industries also rely on using of gelatin, especially on diet products and healthy drinks. Product consistency and power settings in the mouth sticky candy and chocolate products can also be achieved perfectly by using gelatin (Wasswa *et al.*, 2007).

Besides as a staple food, rice is also used to make different kinds of processed foods. Products made from rice generally low nutritional value because it is naturally very low in protein. Improving of nutritional value of rice-based processed products is necessary to increase the protein content. This study applied the gelatin to increase the value of nutrition, especially protein content in rice-based processed foods. Gelatin used in this study is from fish bone produced based on the optimum conditions as was reported in previous studies (Metusalach *et al.*, 2010).

Materials and Methods

Sample preparation and Demineralization

Raw materials such as fish bones are removed from the freezer then let some time under running water to melt the ice and then cleaned and cut into smaller sizes (10-15 cm). Samples were steamed for 30 minutes and cooled then cleaned of meat attached to the bone. Bones were washed with water and then drained and dried in air convection oven at 50°C for 24 hours. The dried samples were further crushed by using a stone mortar to obtain fish bone fragments. Sample were weighed as much as 5 kg and put in 20-liter plastic bucket and then added 5% HCl with solvent-bone ratio 1: 5 (w/v). Demineralization process was for 48 hours at room temperature with stirring every 6 hours. The solvent was separated from the soft bone (ossein) by filtration using 50 dan 100 mesh filter. Ossein was washed repeatedly with ranning water to remove residual solvent that indicated by neutral pH of ossein. Furthermore, ossein was dried in a convection oven overnight at 50 °C.

Gelatin extraction and Deodorizing and decolorization

Gelatin was extracted from Ossein by distilled water with 1:3 ratio (w/v) at 90-95°C for 7 hours. Stirring was carried out during the extraction process to minimize temperature fluctuations. Extract of gelatin was cooled until it reaches about 45°C and then filtered using a 200 mesh filter to obtain a liquid gelatin. Waste material was extracted again in the same way to maximize the yield of gelatin. Gelatin liquid was poured over plastic gutters that had been coated heat-resistant plastic; gelatin layer thickness of about 1 cm. Gelatin was dried in oven at 50°C of temperature to obtain flake dried gelatin. Furthermore gelatin rough was grinded into powder using a stone mortar.

Process of deodorizing and decolorization of gelatin were made by 32% butanol. Sample was put into a glass beaker and then added butanol in ratio 1:3 (w/v). Gelatin-butanol mixture is stirred for 30 minutes then gelatin was separated by filtering using a 200 mesh filter, then dried in oven at 50°C. Gelatin was ground up to powder.

Application gelatin in food and Determination of protein content and product acceptance test

Three traditional foods made from rice supplemented with gelatin were dange, surabeng and onde-onde. Products made separately with the addition of gelatin 0, 5, 10, 15, and 20%. Making each product refers to the way it is commonly known by the public. The resulting of gelatinous products was tested for their qualities especially protein content and level of consumer acceptance.

Protein content of gelatinous products at various concentrations was determined by Micro-Kjeldahl method (Sudarmadji *et al.*, 1993). Organoleptic test by level of consumer preference for the product was performed by 15 panelists. Testing parameters include: color, aroma, crispness / firmness, texture, and taste. Panelists were asked to provide an assessment based on liking for each parameter in question for each product. The assessment criteria are : raelly like = 5, like = 4, quite like = 3, less like = 2, and do not like = 1.

Experimental design and data analysis

Experimental design used was completely randomized design with 5 treatments of gelatinconcentration added to each product (0, 5 10, 15, and 20%) with 3 replications. Data of protein contents were analyzed using one way analysis of variance. If the results of analysis showed differences between each treatment then continued with further test to determine differences between treatments. Significant difference test protein was conducted by the Bonferroni test. The relationship between the concentration of protein levels were analyzed using simple linear regression. Data level of preference / acceptance descriptive panelists treated as a percentage calculated from the frequency values given by the panelists. The data analysis was done with the help of the program SPSS Version 14.0

Results and Discussion

This study was aimed to determine whether fish bone gelatin is effective in increasing the protein content of traditional foods made from rice (dange, surabeng, onde-onde), and whether the gelatin added does not adversely affect on the organoleptic properties of the foods so that they are still well received by consumers .

Protein Content

Content of protein traditional food that material base rice experiences of improvement after supplemented with fishbone gelatine (Picture 1). Result Anova indicates that gelatine that enhanced at concentration differ in significant ($p < 0,05$) have an effect on to content of product protein that produced.

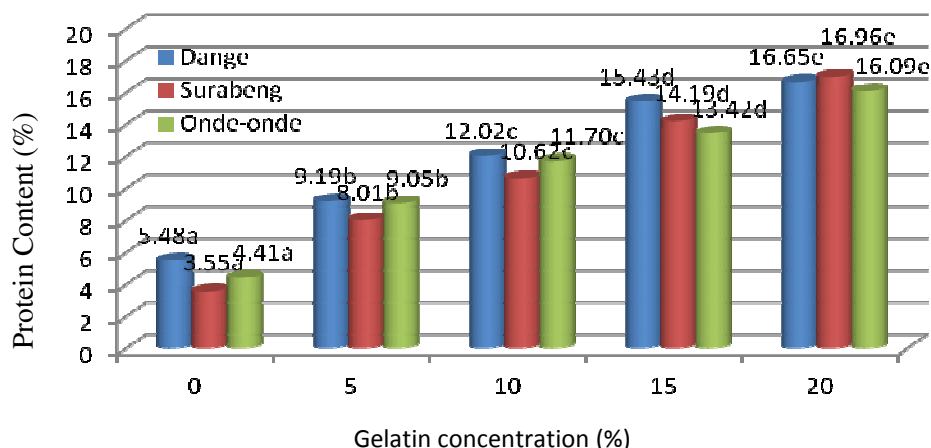


Figure 1. Change of protein traditional food that material base rice after addition of fishbone gelatine with concentration differ.

Figure 1 show that happened improvement of protein content in significant in each product at the height of gelatine concentration enhanced. This condition designates gelatine addition affects positive to content of product protein. Protein Content at dange level from 5,48% at treatment without gelatine become 16,65% at addition 20% gelatine. At surabeng, gelatine addition causes improvement of protein content from 3,55% become 16,96% (gelatine 20%), and at onde-onde level from 4,41% at control become 16,09% after enhanced 20% gelatine. Increasing of protein content in each food product that enhanced gelatine ranges from 1.68 – 3.04 times (67.7-203.8%) at dange, 2.25 – 4.77 times (125.6-377.7%) at surabeng, and 2.05 – 3.65 times (105.2-264.9%) at onde-onde (Table 1).

Table 1. Improvement of protein content product traditional food that material base rice that supplemented with fishbone gelatine at various of concentrations.

Gelatine concentration enhanced (%)	improvement of protein content (x fold)		
	Dange	Surabeng	Onde-onde
0	0.00 (0/0)	0.00 (0.0)	0.00 (0.0)
5	1.68 (67.7)	2.25 (125.6)	2.05 (105.2)
10	2.19 (118.3)	2.99 (199.2)	2.65 (165.3)
15	2.82 (181.6)	3.99 (299.7)	3.04 (204.3)
20	3.04 (203.8)	4.77(377.7)	3.65(264.9)

The result of Bonferroni test shows protein content at each product differ ($p < 0.05$) between treatment. Regression analysis indicates that change of protein content at dange, surabeng and onde-onde correlates very strong with change of gelatine concentration that enhanced with coefficient of regression correlation (R) successively as high as 0,989, 0,996 and 0,983. Protein Content at third traditional foods are referred if enhanced fishbone gelatine can be predicted use simple regression equation as the same manner as gauged in Figure 2. Coefficient determinasi (R^2) explain that as high as 97.8% improvement of protein content at dange, 99.2% at surabeng and 96.7% at onde-onde produced from gelatine addition.

Level of product acceptance bases parameter organoleptic

Parameter organoleptic product dange, surabeng (serabi) and onde-onde assessed by panelist including colour, aroma, elasticity, texture and flavor. Table 5 following present panelist percentage that accept characteristic organoleptic calculated base value frequency = 3 given by panelist when product assessment. Data on table 2 indicate that panelist acceptance in general go down at the height of concentration of fishbone gelatine that enhanced into product. For all parameters organoleptic, gelatine addition >10% into third product bases on rice causes >50% panelist states its deduction to product. Acceptance of

third product go down incisively in gelatine concentration 15 and 20%. Colour of consequence yellowness decoloration that in rough at powder of fish gelatine cause strong bruising at high concentration. If reached perfect dekolorasi was at gelatine then gelatine powder then white colored and when dissolved in water will produce solution that transparent, until if used at food product, product will not experience of bruising. Parameter organoleptic the most affected its acceptance is aroma and flavor. This condition are maybe caused have not yet thoroughfulness deodorasi to fishbone gelatine until aroma and flavor product that enhanced gelatine still quite affected.

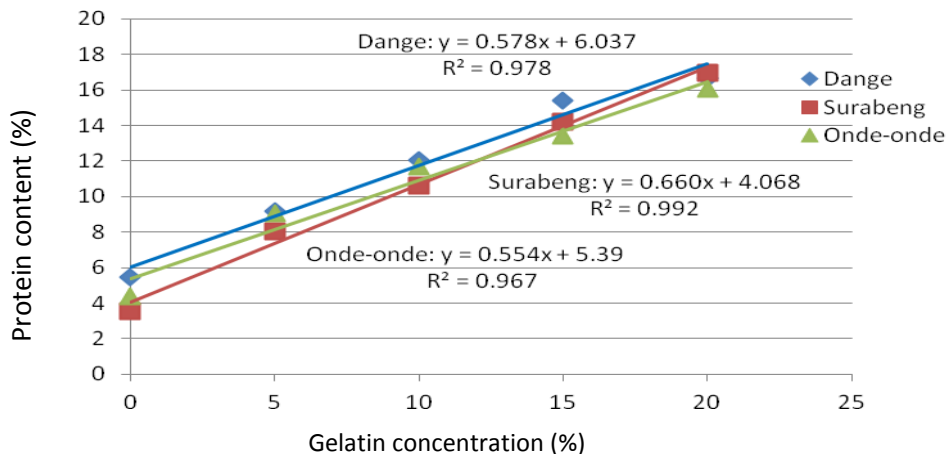


Figure 2. Graph linear regression protein content and gelatine concentration from fishbone that enhanced at rice product.

The usage of fishbone gelatine at concentration = 10% cause acceptance of parameter organoleptic aroma and downhill flavor drastic. Gelatine was that perfect be deodorasi in character odourless and not had felt until when used at food product, food product is referred as will not experience of aroma change and flavor. Make proper also noted that specific aroma appearance fish after gelatine are mixed with other materials at end product making not forever caused by process imperfect deodorasi. Anonim (200x) explain that at a number of cases, gelatine aroma reappears after mixed with other component at end product making though gelatine that have been free aroma (odorless). Gelatine Addition at concentration 5% produce more popular texture by panelist at product dange and surabeng (serabi) and gelatine addition as high as 10% produce elasticity and texture that its acceptance level equal to control acceptance. At product onde-onde, same level of panelist acceptance between control and product that enhanced 5% gelatine, and its acceptance remain to be high (92.9%) at gelatine concentration 10%. Gelatine measure up toes gel form (Glicksman, 1969; Wassawa *et al.*, 2007) cause product becomes more compact and consistence until is not easy broken and interspersed. Low its acceptance of elasticity parameter and texture at concentration >10% possibility is caused growing compact and its consistence product until product became too chewy and hard, as the same manner as that reported Wiryono (2001) that the usage of gelatine at high concentration cause product becomes ossify.

In general, addition hidrokoloid at bread making repair stability and dough quality like the increasing of water absorbtion, specific volume bread, and characteristics viskoelastik (Tavakolipour and Kalbasi-Ashtari, 2006). Kohajdová and Karovicová (2008) conclude that any type hidrokoloid that used in positive influence dough stability and prove higher its ability absorb water. Influence hidrokoloid to characteristic of sensoris bread for example is its ability produces soft bread texture and maintain its solidarity.

Tables 2. Acceptance Percentage by panelist to product base on rice that enhanced fishbone gelatine bases parameter organoleptic.

Product	Parameter organoleptic	Gelatin concentration (%)				
		0	5	10	15	20
Dange	Color	64.3	64.3	64.3	35.7	28.6
	Aroma	78.6	57.1	57.1	28.6	28.6
	Elasticity	71.4	57.1	42.9	21.4	28.6
	Texture	64.3	85.7	78.6	57.1	42.9
	Flavor	85.7	64.3	57.1	14.3	21.4
Surabeng	Color	92.9	71.4	64.3	42.9	28.6
	Aroma	92.9	85.7	42.9	21.4	7.1
	Elasticity	78.6	92.9	50	21.4	28.6
	Texture	78.6	85.7	78.6	21.4	7.1
	Flavor	85.7	71.4	42.9	28.6	14.3
Onde-onde	Color	85.7	92.9	71.9	57.1	42.9
	Aroma	100	100	35.7	35.7	42.9
	Elasticity	100	100	92.9	71.4	57.1
	Texture	85.7	78.6	57.1	42.9	42.9
	Flavor	100	85.7	21.4	21.4	21.4

Gelatine is one of biopolimer the by far the most popular and many used in the field of food because characteristic functional and unique technological (Karim and Bhat, 2009). In industry of gelatine food used as materials penstabil, filler, thickener, that form texture, emulsifier, that form brooding, water fastener, that form cream sensation, and flavor. Recently, gelatine that stem from animal start many used in food and beverage product as the source nutrient, specially as the protein source and amino acid. Nagatsuka *et al.* (2007) mention that gelatine not even as good protein source, but also useful for old people that have difficulty problem swallows. Fish Gelatine is need to applied in so many food type specially at cake making, sausage and ice cream, nevertheless its use has been more focused at exploit characteristic from gelatine upon which fastener and thickeners as a mean to repair texture and product consistency, whereas its use to improve value nutrient product have not yet many explored. If fishbone gelatine with characteristic similar to gelatine that used at this research applied at food product base on particularly rice at dange, surabeng and onde-onde, then more precise concentration is used evaluated from fifth parameter organoleptic is concentration 10%. Product Acceptance admit ofs improved by using fishbone gelatine that not induce appearance returns specific aroma fish at gelatine or by using gelatine that already be deodorasi and be dekolorasi in complete.

Emoto (2002) use gelatine to create brooding food formulation soft (soft gelatinous food) with bracing flavor (pH 3.3 – 4) that addressed for supply water and nutrient well-balanced for patient disphagia (difficult swallow), typical patient advantage in years and patient of brain tissue disease (cerebrovascular disease). Serrano (2010) had also formulate and explain process of food of have the shape of brooding protein that contain 5% protein. Protein Component that the of is mixture between 30% glycerine, 14% prolin, 8% hidroksiprolin, 45% other amino acid, 1.2% water and 1.8% mineral salt. This research proves that traditional food that naturally nutritious low can be produced become high nutriment with addition of fish protein in the form of gelatine. Fishery result is known as source of value protein high nutrient because protein that it contains easy digested, have complete and well-balanced amino acid composition, and have value high biological. Gelatine that stem from fishery result have prospect that good to used in the rising value nutrient low food and beverage protein because gelatine can be produced in the form of a piece of run dry or in the form of powder. Dry gelatine loos or strong and stable powder is kept old until its distribution can be conducted to remote area.

Conclusions

Fishbone Gelatine that enhanced at traditional food low protein rice with concentration 5 – 20% effectively and significant improve content of food protein is referred from 3.55% become 16.96%. From characteristic side organoleptic, gelatine addition till 10% at product rice has been accepted by consumer majority. Boundary of addition acceptance 10% fish gelatine at food rice will provide protein in food referred as high as 10 – 12%.

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