PAPER • OPEN ACCESS

Sensory and Chemical Characteristics of *Koya* Made from Snakehead Fish (*Channa striata*) and Soybean Flour (*Glysine max*)

View the article online for updates and enhancements.

Sensory and Chemical Characteristics of *Koya* Made from Snakehead Fish (*Channa striata*) and Soybean Flour (*Glysine max*)

R B K Anandito[1], Siswanti[1], R E Saputro[1] and L Purnamayati[2]

[1]Department of Food Science and Technology, Faculty of Agriculture, Universitas Sebelas Maret, Jl. Ir. Sutami No.36A, Kentingan, Surakarta, Indonesia
[2]Department of Fish Product Technology, Faculty of Fisheries and Marine Science, Diponegoro University, Jl. Prof. H. Soedarto, SH, Tembalang, Semarang50275, Indonesia

Correponding author:anandito_ito@yahoo.com

Abstract: The objectives of this study were to determine the best formula of fish *koya* made from snakehead fish and soybean flour based on its sensory characteristics and to determine chemical properties of the best fish *koya* formula. *Koya* is a savory powder used as a topping on food. *Koya* powder is usually added to Indonesian traditional foods such as *soto* and noodles. This study was using a completely randomized designwith one variable, namely the variation of snakehead fish meat and soybean flour composition. The variations of snakehead fish meat and soybean flour were 40:60; 50:50; and 60:40. All treatments were carried out sensory evaluation using hedonic test. Chemical properties of the best formula based on sensory evaluation were to determined using proximate analysis. The result showed that the best formula of fish *koya* based on sensory evaluation had composition of snakehead fish meat 60% and soybean flour 40%. The chemical properties of the best formula showed that its moisture, ash, protein, fat, and carbohydrate were 11.50 %; 3.45 %; 42.20 %; 18.73 %; and 22.92 % respectively.

1. Introduction

Protein is needed by the human body for growth, especially in childhood. Proteins, mainly the amino acids lysine and arginine, affect the release of growth hormones in the body [1]. There are often cases of protein malnutrition in children, especially the ageundertwo years [2]. In addition to growth, the availability of protein in the body is also needed for daily activities [3]. One of main resource protein with complete amino acid content is animal protein, especially fish protein.

Snakehead fish (*Channa striata*) contains high amount of protein. Prastari *et al.,*[4] states that snakehead fish protein hydrolysate contains more than 90% protein. The amount of protein content was also shown by Tan & Azhar [5] in powdered snakehead fish. These types of amino acids foundin high amountare glutamate acid, arginine, lysine, leucine and tryptophan [6]. In addition there are also amino acids glycine, threonine and phenylalanine [7]. Snakehead fish also contains albumin which is necessary for health purposes,namely for surgical patients and hypoalbuminemia. Moreover, albumin is also beneficial for child's growth [8,9,10].

Protein sources are not only derived from animals. Plant protein like grains are no less important than animal protein. Soybean (*Glysine max*) is one of source ofplant protein. Soybean seeds contain 40% of protein. This protein is greater than sesame, peanuts and melon seeds [11]. The amino acid content in soy protein ranges from 31 - 49% which consists of essential and non-essential amino acids [12]. These amino acids are glutamate acid, isoleucine, leucine, lysine, aspartate acid and phenylalanine [13]. Besides having high amino acids, another advantage of soybean is that they contain bioactive components that are beneficial to health such as isoflavones, this bioactive component is necessary for those who have kidney function disorders, cancer, cardiovascular diseases and diabetes [14,15,16].

In Indonesia, snakehead fish and soybean are native food sourcesin Indonesia. Snakehead fish is commonly found in South Sumatra with production rate 5300 g/m^2[17]. While soybean production in Indonesia is able to produce 2,4 tons/ha[18]. High production of snakehead fish and soybean in Indonesia promotesproduct diversification. Snakehead fish in Indonesia is usually processed intocooking and protein extracted. While soybean have been widely used as products such as bread, biscuits, soy milk, soy flour and fermentation products [19]. Snakehead fish and soybean have the potential to be used as processed food that is popular within the community in order to increase protein nutritional intake, bothfor children, adolescents, and also adults.

Koya is one of processed food, it is a savory powderused as a complementary food.*Koya* can be eaten directly or sprinkled as a topping on food such as *soto*. *Koya* is usually made from a mixture of softened prawn crackers along with garlic [20]. The application of fish as main ingredientto produce*koya* has never been done,hence the mixture of snakehead fish and soybean presumably impact consumer on sensory acceptance. In order to make*koya* that can beorganoleptically acceptable, it was necessary to use the right composition of snakehead fish and soybean. Furthermore, it is also expected that the selected formula has a complete nutritional content that is able to increase the nutritional intake. Therefore, the purpose of this study was to determine the best formula *koya* based on sensory characteristics and to determine the chemical properties of the selected formula.

2. Research Methods
2.1. Result
The main ingredients used in this study weresnakehead fish obtained from Waduk Cengklik, Central Java, Indonesia. Soybean and *koya* spices (onion, garlic, galangal, ginger, lemongrass, bay leaves, kaffir lime leaves, coriander, coconut milk, candlenut, brown sugar and salt) were collected from local market in Surakarta, Central Java, Indonesia.

2.2. Methods
2.2.1. Preparation of Soybean flour
Soybeans were roasted for 30 minutes then grounded using a blender and sieved with an 80 mesh sieve.

2.2.2. Preparation of Snakehead fish-soybean flour koya
Steamed snakehead fishfillet and soy flour with ratio 40:60 (B1); 50:50 (B2); and 60:40 (B3) respectively wasis added to the fine *koya* seasoning which hadhas been boiled. The mixture wasis cooked until brown and dry, then smoothed using a blender to form fine *koya* powder [20,21]. *Koya* formula wasis shown in Table 1.

2.2.3. Analysis of snakehead fish-soybean flourkoya
Snakehead fish-soybean flour *koya*analysis wasis carried out by sensory evaluation using a hedonic test with 30 panelists. A hedonic test used7-point scale with scale of 1 tovery much dislike, 2 to dislike, 3 to dislike slightly, 4 to neither like nor dislike, 5 to like slightly, 6 to like, and 7 to be very much like[22]. The chemical properties of *koya* include moisture, ash, protein, fat and carbohydrate content by different [23].

2.2.4. Statistical Analysis

The experimental design used in this study was a Completely Randomized Design (CRD) with one factor, namely the variation of the composition of soybean flour and snakehead fish fillet as the basic material for *koya*production. The data obtained were analyzed statistically by *one way* ANOVA method. If it showed significant results, then continue to proceed with a significant difference test using *Duncan's Multiple Range Test* (DMRT) at significance level α = 0.05.

Table 1. Formula of snakehead fish-soybean flour *koya*

Materials	B1	B2	B3
Snakehead fish fillet (g) / (%)	108 / 40	135 / 50	162 / 60
Soy flour (g) / (%)	162 / 60	135 / 50	108 / 40
Onion (g)	20	20	20
Garlic (g)	40	40	40
Candlenut (g)	0.13 0,13	0.13	0.13
Corriander (g)	0.01	0.01	0.01
Coconut milk (ml)	150	150	150
Ginger (g)	4.3	4.3	4.3
Galangal (g)	4.67	4.67	4.67
Lemongrass (g)	3.33	3.33	3.33
Bay leaf (lembar)	2	2	2
Kaffir lime leaf (lembar)	4	4	4
Brown sugar (g)	32	32	32
Salt (g)	0.056	0.056	0.056

3. Results and Discussion

Table 2. Chemical characteristics of Snakehead fishfillet and soybean flour

No	Parameter	Snakehead Fish Fillet	Soybean Flour
1	Moisture (%wb)	78.66 78,66	2.57
2	Ash (%wb)	0.44	6.24
3	Fat (%wb)	0.01	23.10
4	Protein (%wb)	15.64	33.88
5	Carbohydrate (%wb)	5.25	34.18

3.1. Chemical characteristics of Snakehead fish meat and soybean flour

The chemical composition of snakehead fishfillet used in this study is presented in Table 2. Snakehead fish fillet has 15.64% protein, 0.01% fat and 5.25% carbohydrate. The protein content of snakehead fishfillet used in this study is lower than Firlianty *et al.,* where snakehead fish has 20.83% of protein, 0.49% of fat and does not contain carbohydrates[24]. Similar results were also shown by Mustafa *et al.,*[8] which stated that the protein content of Snakehead fish was 16.2%.

Soybean flour contains 33.88% protein, 23.10% fat, and 34.18% carbohydrate. This protein content is lower than Ciabotti *et al.,* where soybean contains protein ranging from 35 - 39%[15]. While the soybean fat and carbohydrate contents are 18-19.5%, and 23-25.65%,respectively.The same results were also shown by Akinola & Owoseni [25] which stated that soybean flour contain 37%of protein, 16.4% fat and 30.68% carbohydrate.The difference in the chemical composition of snakehead fishfillet and soy flour is associated with habitat differences.

3.2. Sensory evaluation of snakehead fish-soybean flour koya

Sensory evaluation of snakehead fish-soybean flour koya isshown in Table 3, it is known that from various formulations in the parameters of colour, aroma, taste, texture do not give a significantly different effect. All formulas are liked by panelists based on the results of sensory evaluation. Based on color, the *koya* produced in this study is brown. Addition of snakehead fish fillet and soy flour to *koya* contributes to the color of *koya*. The browning appears because of Maillard reaction during the process. Maillard reaction occurs between reducing sugars and amino acids in the presence of heat treatment process [26, 27, 28].

Table 3. Sensoryevaluations of snakehead fishfillet and soybean flour

No	Sample	Colour	Aroma	Taste	Texture	Overall
1	B1	5.07[a]	4.63[a]	4.83[a]	4.87[a]	4.83[a]
2	B2	5.17[a]	5.07[a]	4.63[a]	4.43[a]	5.63[b]
3	B3	4.90[a]	5.07[a]	4.93[a]	4.67[a]	5.97[c]

Note: The same superscript on the same column indicates not significant different ($\alpha > 0.05$)

The result of aroma is also related to the Maillard reaction through the process. Maillard reactions produce flavors and aromas of the product during the processing [29]. Maillard reactions that form also affect taste [30, 31]. *Koya* texture is influenced by the size of the *koya* powder granule. Sensory evaluation of snakehead fish-soybean flour *koya* overall gives a significantly different effect on each formula. Panelist likes sample B3 at most.

3.3. Chemical properties of snakehead fish-soybean flour koya

Table 4. Chemical properties of selected *koya* formula

No	Parameter	Snakehead fish + Soybean Flour *Koya*(B3)	Studies of *koya* from various type of fish[*]
1	Mosisture (%wb)	11.50	13.10–21.21
2	Ash (%wb)	3.45	5.54–5.99
3	Fat (%wb)	18.73	15.55–21.76
4	Protein (%wb)	42.20	27.13–29.83
5	Carbohydrate (%wb)	22.92 22,92	30.28–31.92

Description: **Koya* fish studies with various types of fish, namely mackerel, catfish, tilapia, tuna withthe addition of soy flour [21].

Snakehead fish-soybean flour *koya*selected formula (B3) is analyzed by chemical properties using proximate analysis which includes moisture, ash, fat, protein, and carbohydrate content. The results of analysis were compared with the chemical properties of *koya* made from various types of fish [21]. The moisture, ash, and carbohydrates conctent of snakehead fish-soybeanflour*koya* in B3 are 11.50%, 3.45% and 22.92% respectively.This result is lower than Regina *et al.,*[21] which ranged from 13.10 - 21.21% for moisture content, 5.54 - 5.99% for ash content, and 30.28 - 31.92% for carbohydrate.

Protein and fat content of snakehead fish with soybean flour *koya*is higher than Regina *et al.,*[21]. This is because the fillet of snakehead fish has a high protein and fat content respectively 15.64% and 5.25%. The addition of Snakehead fishfillet in B3up to 60% contributed to enrichment in protein and fat content of *koya* produced in this study.

4. Conclusion

The formula for snakehead fish-soybean flour*koya*B3is selected formula based on sensory evaluation. Formula B3 contains a chemical propertieswhich are 11.50% moisture content; 3,45% ash;18.73% fat; 42.20% protein and 22.92% carbohydrate.

References

[1] Uauy R, Kurpad A, Tano-Debrah K, Otoo G E, Aaron G A, Toride Y and Ghosh S 2015 *Role of protein and amino acids in infant and young child nutrition : protein and amino acid needs and relationship with child growth.*J. Nutr Sci Vitaminol. **61** 192-194.

[2] Jati D K and Nindya T S 2017 *Intake of energy and protein related to malnutrition in children 6-24 months.* Amerta Nutr. 124-132. [Bahasa Indonesia]

[3] Liu G, Li Z G and Wu H W 2017 *Protein metabolism and exercise in children – a review.* European Review for Medical and Pharmacological Sciences. **21**(4) 70-73.

[4] Prastari C, Yasni S and Nurilmala M 2017 *Characteristics of snakehead fish protein as antihiperglycemic.* JPHPI.**20**(2) 413-423. [Bahasa Indonesia]

[5] Tan B H and Azhar M E 2014 *Physicochemical properties and composition of snakehead fish (Channa striatus) whole fillet powder prepared with pre-filleting freezing treatments.* International Food Research Journal. **21** 1255-1260.

[6] Funmilayo S M 2016 *Proximate composition and amino acid profiles of snakehead (Parachanna obscura) mudfish (Clarias gariepinus) and african pike (Hepsetus odoe) in Igboho dam, South-West Nigeria.* Global Journal of Fisheries and Aquaculture. **4**(4) 317-324.

[7] Aliyu-Paiko M, Hashim R and Amuzat A O 2012 *Comparison of the whole body composition of fatty acids and amino acids between reared and wild snakehead fish Channa striata (Bloch 1793) juveniles.*Asian Fisheries Science. **25** 330-342.

[8] Mustafa A, Widodo M A and Kristianto Y 2012 *Albumin and zinc content of snakehead fish (Channa striata) extract and its role in health.* International Journal of Science and Technology.**1** 1-8.

[9] Asfar M, Tawali A B, Abdullah N and Mahendradatta M *2014 Extraction of albumin of snakehead fish (Channa striata) in producing the fish protein concentrate (FPC).*International Journal of Scientific & Technology Research. **3**(4) 85-88.

[10] Romadhoni A R, Afrianto E, Pratama R I and Grandiosa R 2016 *Extraction of snakehead fish [Ophiocephalus striatus (Bloch, 1793)] into fish protein concentrate as albumin source using various solvent.*Aquatic Procedia. **7** 4-11.

[11] Adebisi A K, Stephen E C, Chinedu I and Emmanuel U 2017 *Quantification of protein and amino acid composition in some oilseeds.*Biochemistry and Molecular Biology. **2**(2) 8-11.

[12] Carrera C S, Reynoso C M, Funes G J, Martinez M J, Dardanelli J and Resnik S L 2011 *Amino acid composition of soybean seeds as affected by climatic variables.* Pesq. Agropec. Bras. Brasilia. **46**(12) 1579-1587.

[13] Bujang A and Taib N A 2014 *Changes on amino acids content in soybean, garbanzo bean and groundnut during pre-treatments and tempe making.* Sains Malaysiana. **43**(4) 551-557.

[14] Keefe S O, Bianchi L and Sharman J 2015 Soybean nutrition. SM Journal of Nutrition and Metabolism. **1**(1) 1-9.

[15] Ciabotti S, Silva A C B B, Juhasz A C P, Mendonca C D, Tavano O L, Mandarino J M G and Goncalves C A A 2016 *Chemical composition, protein profile, and isoflavon content in soybean genotypes with different seed coat colors.* International Food Research Journal. **23**(2) 621-629.

[16] Rizzo G and Baroni L 2018 *Soy, soy food and their role in vegetarian diets.* Nutrients.**10**(43) 1-51.

[17]   Muthmainnah D 2013 *Growout of striped snakehead (Channa striata) in swamp water system using fences and cages*. International Conference on Biology, Environment and Chemistry. **58** 52-55.

[18]   Hasan N, Suryani E and Hendrawan R 2015 *Analysis of soybean production and demand to develop strategic policy of food shelf sufficiency : a system dynamic framework*. Procedia Computer Science.**72** 605-612.

[19]   Gandhi A P 2009 *Quality of soybean and its food product*. International Food Research Journal.**16** 11-19.

[20]   Anandito R B K, Siswanti, Purnamayati L and Sodiq H 2017 *Shelf-life determination of fish koya using critical moisture content approach.*Proceedings of Pakistan Academy of Sciences. **54** 201-206.

[21]   Regina M, Affandi D R, Riyadi N H *2012 Study of fish koya from many fish and soy flour (Glycine max)*. J Teknosains Pangan**1**: 75-85. [Bahasa Indonesia]

[22]   Setyaningsih D, Apriyantono A and sari M P 2010 *Sensory analysis for food and agro industry*. IPB Press. Bogor, Indonesia. [Bahasa Indonesia]

[23]   Assosiation of Official Analytical Chemist 2002Official Methods of Analysis.AOAC. Washington, United States.

[24]   Firlianty, Suprayitno E, Nursyam H, Hardoko and Mustafa A 2013 *Chemical composition and amino acid profile of Channidae collected from Central Kalimantan, Indonesia*. International Journal of Science and Technology. **2** 25-29.

[25]   Akinola O T and Owoseni A A 2017 *Analysis of the shelf life of soya bean (Glysine max) flour*. Microbiology Research Journal International. **20**(4) 1-6.

[26]   Jaeger H, Janositz A and Knorr D 2010 *The maillard reaction and its control during food processing. The potential of emerging technologies*. Pathologie Biologie. **58** 207-213.

[27]   Golon A, Kropf C, Vockenroth I and Kuhnert N 2014 *An investigation of the complexity of maillard reaction product profiles from the thermal reaction of amino acids with sucrose using high resolution mass spectrometry*. Foods. **3** 461-475.

[28]   Yu A N, Li Y, Yang Y and Yu K 2017 *The browning kinetics of the non-enzymatic browning reaction in L-ascorbic acid/basic amino acid system*. Food Science and Technology.

[29]   Tamanna N and Mahmood N 2015 *Food processing and maillard reaction products : effect on human health and nutrition*. International Journal of Food Science. 1-7.

[30]   Lund M N and ray C A *2017 Control of maillard reactions in food : strategies and chemical mechanisms.*Journal of Agricultural and Food Chemistry. **65** 4537-4552.

[31]   Kranz M and Hofmann T 2018 *Food-grade synthesis of maillard-type taste enhancers using natural deep eutectic solvents (NADES).*Molecules. **23**(261) 1-13.