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Protein, Fiber and Albumin Content of The Formulation of Snakefish Flour (*Channa striata*) and Cock Flour (*Stenochlaena palustris*) in Bingka Cake

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ABSTRACT
A type of food that is ready to consume known as "ready-to-use supplementary food" is strong in macronutrients like fat and protein and is high in energy content. It can be used as a nutritional supplement. Ready-to-use supplementary food is a category of prepared food that is high in macronutrients like protein and fat. One of the ready-to-use supplementary foods is Bingka Cake, which is made with a combination of kelakai flour and snakehead fish flour. Snakehead fish has many benefits as it forms new tissues in the body and also regulates fluid balance in tissues and blood vessels. Meanwhile, kelakai has benefits as a blood booster, anti-diarrhea, increases breast milk, and can treat cancer. This research aimed to examine the effect of bingka cake formulations using processed snakehead and kelakai fish flour on protein content, fiber content, and albumin content. This type of research is experimental using the RAL method. Using the formula by comparing the formulations of snakehead fish flour and kelakai flour at P0 (100:0), P1 (25:10), P2 (50:15), and P3 (75:20), with 6 repetitions. Testing protein levels using Kjedahl, fiber levels using Gravimetry, and albumin levels using Bromocresol Green. Data normality testing utilized Shapiro Wilk and was analyzed using the ANOVA test. One-way ANOVA results and further tests using Duncan and Kruskkal Wallis. The highest protein content test results were in P3 (8.59 ± 4.50). The highest fiber content test results were in P3 (3.54 ± 0.79). The highest albumin level test results were in P2 (17.87 ± 2.53). There was an effect of the formulation of snakehead fish and kelakai flour on protein content, fiber content, and albumin content.

Keywords: Bingka, Channa Striata, Stenochlaena Palustris, Protein Content, Fiber Content, Albumin Content.

ABSTRAK
Ready to use Supplementary Food menjadi salah satu bentuk makanan siap saji dengan kandungan padat energi dan kaya gizi dengan tinggi makronutrien seperti protein dan lemak yang dapat digunakan sebagai perbaikan gizi. Salah satu makanan tambahan siap pakai berupa Kue Bingka dengan formulasi Tepung kelakai dan Tepung Ikan Gabus. Ikan gabus banyak memiliki manfaat sebagai pembentuk jaringan-jaringan baru yang terjadi didalam tubuh dan juga mengatur keseimbangan cairan dalam jaringan dan pembuluh darah. Sedangkan kelakai memiliki manfaat sebagai penambah darah, antidiare, meningkatkan ASI, dan dapat mengobati kanker. Tujuan dari penelitian ini untuk menelaah pengaruh dari formulasi kue bingka dengan pemanfaatan bahan tepung olahan ikan gabus dan kelakai terhadap kadar protein, kadar serat, dan kadar albumin. Jenis penelitian ini experimental dengan penggunaan metode RAL. Menggunakan Formula melalui perbandingan formulasi tepung ikan gabus dan tepung kelakai sebesar P0 (100:0), P1 (25:10), P2 (50:15), P3 (75:20), dengan 6 kali pengulangan. Pengujian kadar protein menggunakan Kjedahl, kadar serat menggunakan Gravimetri, dan kadar albumin menngunakan Bromocresol Green. Pengujian normalitas data memanfaatkan Shapiro Wilk dan dianalisis menggunakan uji Anova. Hasil one way anova dan uji lanjut menggunakan Duncan dan Kruskkal wallis. Hasil uji kadar protein tertinggi ada pada P3 (8,59±4,50). Hasil uji kadar serat tertinggi ada pada P3 (3,54±0,79). Hasil uji kadar albumin tertinggi ada pada P2 (17,87±2,53). Terdapat pengaruh formulasi tepung ikan gabus dan tepung kelakai terhadap kadar protein, kadar serat dan kadar albumin bingka.

Kata Kunci: Bingka, Ikan Gabus, Stenochlaena Palustris, Kadar Protein, Kadar Serat, Kadar Albumin.

INTRODUCTION

Bingka cake is among the several traditional foods of Banjarmasin. This cake is slightly yellow and tastes sweet and chewy like a wet cake similar to mud cake. The main ingredients of bingka cake are potatoes, wheat flour, coconut milk, eggs, and sugar (Lestari, Kiptiah, & Apifah, 2017).

Ready to use Supplementary Food as a food with high protein content and energy-dense content. Supplementary food is a food based on high macronutrients such as protein and fat that can be used to improve nutrition. Ready-use Supplementary foods have a composition that can be easily digested, such as minerals, milk, animal fats, vitamins, sugar, and vegetable fats. This type of food can be found in various African and Asian countries (Amalia, Dieny, & Candra, 2021).

There are medicinal plants in South Kalimantan, such as Kelakai (Stenochlaena palustris), whose major bioactive ingredient is the flavonoid quercetin, which has anti-inflammatory qualities (Mahdiyah et al., 2021). Kelakai plants are spread almost throughout South Kalimantan, so they are easy to find. Kelakai is useful as a blood enhancer, prevents self-aging, anti-diarrhea, and irregular menstruation, relieves fever, treats skin diseases, increases breast milk production, and can be used in cancer treatment. In addition, the kelakai plant (Stenochlaena palustris) contains levels of 7.28% - 8.56%, ash content 9.19%, - 10.37%, crude fiber content 1.93% - 3.19%, protein content 1.89%, - 11.48%, fat content 1.37%. - 2,63% (Sulistyaningrum, Evnaweri, & Sitanggang, 2022). The fiber content of kelakai plants is significantly higher than the other plant materials. although poor in nutrition, kelakai plants help prevent and treat several ailments, including diabetes, obesity, gastrointestinal issues, colon cancer, lowered cholesterol, and heart disease.

Snakehead fish is a type of fish that lives in fresh waters and comes from the genus Channa with affordable value. Snakehead fish is also a type of fish rich in protein and albumin and contains chemical substances, such as protein (76.9%), fat (1.07%), carbohydrates (3.53%), and albumin (21%). The Protein functions as a building and regulating material because snakehead fish (Channa striata) protein is the main food component for the human body. The albumin substances contained in snakehead fish are also quite high. The function of snakehead fish albumin is to form new cells and accelerate the healing process of damaged cells, and albumin is also able to maintain the proportion of fluid in the body. the albumin substances are also able to maintain the proportion of fluid in the arterial cavity. Snakehead fish with high albumin substances are usually consumed by humans for wound healing (Andrie & Sihombing, 2017).

This study focused on Bingka as the authentic dessert with ready-to-use supplementary ingredients such as snakehead fish flour and kelakai plants. Investigating the protein, fiber, and albumin content of Bingka cake with kelakai and snakehead fish flour is important or relevant due to the diversity of snack types and nutritious food context in traditional food. This study aims to determine the content of protein, fiber, and albumin contained in Bingka cake using the formulation kelakai and snakehead fish flour.

METHODS

This research uses experimental research through Complete Randomized Design (CRD). This research uses snakehead fish flour and kelakai flour for making Bingka cake. The flour ratio is shown in Table 1. The processing of snakehead fish flour and kelakai flour was carried out at the Cendikia Nanotech Hutama Laboratory in Semarang. Then, the making of Bingka cake was carried out at the Food Technology Laboratory and MSPMI Laboratory, Universitas Muhammadiyah Semarang. The formulation of Bingka cake is shown in Table 2. The calculation was using the Federer formula. We found a six-repetition factor and used 24 samples as a reference for repetition.

Table 1. Flour Ratio for Bingka Cake

Formulation	Wheat flour	Snakehead fish flour	The addition of kelakai flour
P0	100%	-	-
P1	75%	25%	10%

Formulation	Wheat flour	Snakehead fish flour	The addition of kelakai flour
P2	50%	50%	15%
P3	25%	75%	20%

Table 2. Formulation of Bingka cake

Material	Unit	P0	P1	P2	P3
Wheat Flour	gram	100	75	50	25
Snakehead Flour	gram	-	25	50	75
Kelakai Flour	gram	-	10	15	20
Margarine	gram	20	20	20	20
Eggs	gram	100	100	100	100
Potato	gram	250	250	250	250
Coconut milk	Ml	300	300	300	300
Sweetened condensed milk	ml	40	40	40	40
granulated sugar	gram	60	60	60	60
Vanilla powder	gram	2	2	2	2
salt	gram	2	2	2	2

The Kjedahl method is used for protein analysis (Aprilia, Yusa, & Pratiwi, 2019), and the gravimetric method is used to measure fiber content (Novita & Razak, 2020). Albumin levels are analyzed using the Bromocresol Green Method (BCG). The BCG method was used because of its affordability, quick rate of analysis, low sample amount required, simplicity, specificity, and repeatability (Beng & Lim, 1973), the BCG method yields good albumin determination. Measurement of protein, fat, and albumin levels was conducted at the Cendikia Nanotech Hutama Laboratory in Semarang.

Data were tested by using Shapiro Wilk because the total sample less than 50. Data on fiber content was normally distributed using One-way ANOVA, followed by Duncan's test. Protein levels and albumin levels were not normally distributed using the Kruskal-Wallis test, followed by the Mann-Whitney U test. The best formulation was obtained using the Bayes method

RESULTS

According to the results of the data in Table 3, it was found that the protein analysis in the four bingka formulations had a value range of 6.03 ± 1.58 - 8.59 ± 4.50. The highest result on the protein of bingka cake was found in P3 (8.59 ± 4.50), while the lowest result on the protein was found in P2 (5.1 ± 0.99). The standard deviation has the highest result in the P3 treatment in increasing protein levels significantly compared to the P2 treatment. P2 experienced a decrease in protein due to protein denaturation during the processing of Bingka cake on snakehead fish with temperatures above 50^{o}C.

Table 3. Average protein content test of bingka

Formulation	Minimum	Maximum	Mean ± SD	p-value
P0	3.71	8.06	6,03±1,58^{b}	0.018
P1	4.65	8.43	6,60±1,29^{a}	
P2	3.45	6.48	5,10±0,99^{a}	
P3	1.97	15.50	8,59±4,50^{c}	

Notes: ^{a}, ^{b}, and ^{c} where different letters in the column indicate significant differences.

Based on the results of the data in Table 4, it was found that the fiber analysis of the four Bingka formulations has a value range of 0.66 ± 0.33 - 3.54 ± 0.79. The highest fiber is found in the P3 formulation (3.54 ± 0.79), while the lowest fiber is found in the P2 formulation (2,33±1,31). The highest standard deviation was found in the P2 treatment (1.31), and the lowest treatment was found in P3 (0.79). The lowest was found in P3 (0.79). The results of the P2 treatment were higher in significantly increased fiber content compared to the P3 treatment.

Table 4. Average fiber content test of bingka

Formulation	Minimum	Maximum	Mean ± SD	p-value
P0	0.38	1.23	0,66±0,33[a]	0.000
P1	0.94	3.87	2,36±1,20[b]	
P2	0.43	3.87	2,33±1,31[b]	
P3	3.34	5.23	8,59±4,50[c]	

Notes: a, b, and c where different letters in the column indicate significant differences.

Based on the results of the data in Table 5, the albumin analysis on the four Bingka formulations had a range of values of 14.12 ± 4.00 - 13.95 ± 2.55. The highest albumin is found in the P2 formulation (17.13 ± 2.53), while the lowest albumin is found in the P3 formulation, namely (13.95 ± 2.55). P3 formulation (13.95±2.55). The highest standard deviation was found in P1 (2.68) while the lowest was found in P2 (2.53). In P2, there was a decrease due to the denaturation process in protein levels.

Table 5. Average albumin content test of bingka

Formulation	Minimum	Maximum	Mean ± SD	p-value
P0	7.15	14.13	14,12±1,20a[a]	0.007
P1	9.46	15.04	14,23±2,68[a]	
P2	13.13	18.61	17,13±2,53[a]	
P3	3.34	13.66	13,95±2,55[a]	

DISCUSSION

Protein Content

According to (Abadi, 2022), denaturation occurs when a protein solution is heated to a high temperature. This happened in the results of the study, which showed that the P2 value decreased in protein due to protein denaturation during the processing of Bingka cake on snakehead fish at temperatures above 50^{o}C, causing the characteristics of proteins. Various values in protein are evidence of the process of the effects of heating, mixing, acid/base, and salt (Suryati, Darwati, & Nuraini, 2017)

Additionally, the denaturation of the food's protein occurs as a result of baking the bingka cake. Denaturation in proteins occurs when the temperature reaches 60–90^{o}C. The cause of denaturation in proteins is due to high temperatures, chemical compounds, and mechanics (Suryati, 2006). The results of this study found a sig (0.018) value (<0.05), so it is known that there is a significant effect on bingka cake with the formulation of snakehead fish flour and kelakai flour on protein levels. The heat treatment that is applied affects the various protein content levels (Bao, Yan, & Ma, 2023; Kim, Ryu, Cho, Yang, & Kim, 2000)

In the P0 treatment, bingka has a protein content of 10.6%, by using snakehead fish in a large proportion, the level of protein content of bingka cake will automatically increase. Protein refers to a form of macronutrient with various content benefits, such as fuel, regulators, and most important bodybuilders (Almatsier, 2001)

According to SNI (01-4309-1996), which is a kind of requirement for a high-quality bingka layer cake through the proper quantity of protein content with the amount of 9% / b, the results of this study's protein levels were confirmed. The P3 results in this study were able to meet the body's protein needs every day with a percentage (4.29%) through a total serving of 50g of bingka cake with snakehead fish flour and kelakai plant flour.

(Nugrahani, 2013) explained in her research that making bingka with residues based on snakehead fish flour and wheat through 5 steps obtained the amount of protein content with variations. High levels of protein levels were found when adding 95% residue (190g) of snakehead fish, and low levels of protein levels were found when adding 80% residue (160g) of snakehead fish. There are 3 types of protein classifications found in the fish body, namely myofibrils, sarcoplasm, and stroma. Myofibrils are fish proteins that are soluble when given a salt solvent with myosin, actin, and regulation. The more functional character of myofibrils can

affect food properties during processing, storage, and consumption. Then, sarcoplasm becomes a water-soluble protein based on myostatin, albumin, myoprotein, myoalbumin, and globulin. The protein content of fish is affected by the presence of amino acids in its composition, as well as during oven processing and water binding. The amino acid lysine refers to the formation of the highest albumin content in snakehead fish, whereas snakehead fish are very susceptible to destruction when exposed to high temperatures. This affects the level of protein content which is low (Nurilmala et al., 2022).

Fiber Content

Based on the results, treatment P2 is higher in increasing fiber content significantly compared to treatment P3. P2 The low fiber content of bingka cake is due to the use of fish flour, which tends to have a low fiber content. According to (Chang & Morris, 1990) the type of fiber and processing technique determine the variation in fiber content. The mechanical properties of fibers remain mostly unchanged when heated, although the fibers become more crystalline (Langhorst, Ravandi, Mielewski, & Banu, 2021).

According to (Sapika, Hamzah, & Ayu, 2021) (2022), the protein possessed by snakehead fish is very high, but snakehead fish has low fiber. So, when consuming snakehead fish, it must be balanced with other foods that have a lot of fiber content to provide the body with adequate fiber levels. The results of this study obtained sig (0.000) with a value of (<0.05). So, it is known that there is a significant effect on bingka with the formulation of snakehead fish flour and kelakai flour fiber content.

The fiber content contributed by the main ingredient, namely wheat flour, is 2.7 g, and kelakai flour is 3.19 g (Sulistyaningrum et al., 2022). The addition of kelakai flour to bingka fiber content is influenced by additional ingredients in making bingka, namely the kelakai plant. In the P0 treatment or without the addition of kelakai flour, bingka has a fiber content of 2.7%, and if kelakai flour is added in large quantities, it can become a fiber enhancer in food. This happens because kelakai flour itself contains 3.19% total fiber per 100 grams.

The fiber content of this study complies with SNI 01-4309-1996, specifically the quality standards for layer cakes, as bingka comprises layer cakes whose fiber content does not go above the maximum threshold of 8% fiber. Bingka cake, which in the process of making or processing uses snakehead fish flour and kelakai flour, can supplement fiber up to 1.77% with a volume of 50g. The type of fiber found in the kelakai plant is soluble fiber as a result of research. Bingka, with the addition of kelakai flour, has a different percentage of fiber content. This shows a straight comparison in the use of kelakai flour. So, adding the amount of kelakai flour to food will increase the percentage of fiber content.

Albumin levels

Based on the results of the study, P2 decreased due to the denaturation process in protein levels. It is known that the albumin content is a type of sarcoplasmic protein that will experience damage due to the influence of high temperatures. Albumin is a type of water-soluble protein that easily coagulates due to high temperatures. According to (Takeda, Wada, Yamamoto, Moriyama, & Aoki, 1989) heat treatment affects the denaturation of albumin. The results of the Sig value obtained amounted to (0.007) with a value of (0.05); thus, it is known that there is a significant effect on bingka with the formulation of snakehead fish flour and kelakai flour on albumin levels.

Albumin levels in this study are by SNI 01-4309-1996, namely the quality requirements for layer cakes with albumin levels not exceeding the maximum threshold of 20% albumin. In Bingka cake, which is in the process of being made or processed by using snakehead fish flour and kelakai plant flour, P3 can complement protein, reaching 8.5% with an amount of 50g. Bingka, which utilizes flour processing from snakehead fish and kelakai, can provide albumin, especially for those experiencing hypoalbuminemia. If the body's albumin is low, it will result in the appearance of protein deficiency and affect the decrease in albumin levels in the blood (Syamsiatun & Siswati, 2015). Implications of the observed variations in protein, fiber, and albumin content for the nutritional quality and health benefits of Bingka cake. Bingka cake is a high-protein traditional food that needs to be promoted as a good and healthy food.

CONCLUSION

The best protein content test results were 5.10%, the best fiber content was 2.33%, and the best albumin content of 17.13%. There is an effect of the formulation of snakehead fish flour and kelakai flour on protein content, fiber content, and albumin content in bingka. Albumin levels in bingka. The best formulation obtained in the formulation of flour snakehead fish flour and kelakai flour is in P2. There are underlying mechanisms behind protein denaturation, fiber enhancement, and albumin degradation during the baking process.

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