



Fortification Of Soybean Flour On Catfish Nugget Preference Level

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ABSTRACT

This research aims to determine the percentage of soybean flour as a source of vegetable protein in catfish nuggets preferred by panelists. The method used was experimental method with the comparison of soybean and tapioca by 0%: 100%, 10%: 90%, 15%: 85%, 20%: 80% and 25%: 75% based on the amount of flour used. The parameters observed were made to the preferences level (the appearance, aroma, texture and taste characteristics performed by semi-trained panelists), folding test, moisture content, ash content, protein content and fat content in catfish nuggets. The results showed that 15% : 85% comparison of soybean and tapioca flour was the most preferred treatment by panelists compared to other treatments with 8.0 mean value of appearance, 7.6 aroma value, 8.1 texture value, 8.0 taste value, and proximate test results for moisture content is 67.50%, 1.93% ash content, 15.78% protein content and 7.57% fat content.

Introduction

Fish have high nutritional value as a fulfillment of daily nutritional needs. The level of fish consumption in Indonesia in 2015 reached 41.11 kg / capita (KKP 2016). Catfish is one type of freshwater fish that often consumed by various groups of people. The level of catfish production is growing, in 2017 catfish production reached 1.8 million tons (Director General of Aquaculture 2017). This fish has a high nutritional protein value of 17.7% (Astawan 2008). Catfish can be processed into various kinds of food preparations, such as daily food dishes, leather crackers, shredded, sticks, meatballs and nuggets.

Fish nuggets are fishery products using a minimum 30% fish and / or surimi meat, mixed with flour and other ingredients coated with predust flour, put in batter mix mixture and then coated with bread and through the cooking stage (BSN 2013) The purpose of diversifying nugget products is to increase the value of fish consumption in the community because of its practical form so that it can facilitate the community in consuming fish.

Nugget generally has nutrients that are good enough to fulfill people's nutritional needs, especially protein. Fish nuggets already contain animal protein, but the amount of each amino acid contained in them needs to be added. Therefore, one of the foodstuffs addition that contain larger amino acids is from plant foods. The ingredients contain vegetable protein and can be used in processing nuggets is soy flour. Adding soy flour will also complement the amino acids found in catfish nuggets. The addition of soy flour will enrich the nutritional nuggets with a high vegetable protein content ie 34.39% (Widodo 2001). In addition, soybeans also contain fiber which is good for smoothing the body's digestion. This fiber which needed by humans can be also added soy flour into processed food consumed. According to Aparicio et al (2008) in Winarsi (2010) in 100 g of food, soy beans contain soluble fiber of 10 g and insoluble fiber of 7 g.

Fortification of soybean flour as a source of vegetable protein into catfish nuggets was carried out to improve the characteristics of nugget products and enrich the amino acids and fibers contained in them. The addition of soy flour will cause an influence on the panelist preference level which includes appearance, aroma, texture and taste which aims to determine the level of acceptance of panelists to the product being tested. Therefore, research needs to be done on the fortification of soybean flour as a source of vegetable protein to the preference level of catfish nuggets. This research aims to determine the percentage of soybean flour compared with tapioca as a source of vegetable protein to the preference level of catfish nuggets.

Materials And Methods

Time and Place of Research

Research about soybean and tapioca flour formulations influence on the level of catfish nugget preference was carried out in April 2018 at the Fisheries Product Processing Laboratory, Fisheries Study Program, Faculty of Fisheries and Marine Sciences.

Tools and Materials

The tools used in this research are 0.1 g precision digital scales, food processor, basin, knife, spoon, plate, calico cloth, stove, check, cob, skillet, baking pan, styrofoam plate and assessment sheet for hedonic test assessment.

The ingredients used in this research are catfish, fine salt, garlic, onion, pepper, steamed ice, soy flour, tapioca, flour pan, egg white, aluminum foil and label paper.

Research Methods

The method used in this research is an experimental method, using four treatments with 20 semi-trained panelists as repetition. The panelists in this research are Faculty of Fisheries and Marine Sciences students who have experience in organoleptic assessment. Five treatments for the formulation of soy flour and tapioca from fish meat are:

- Treatment A (0%: 100%)
- Treatment B (10%: 90%)
- Treatment C (15%: 85%)
- Treatment D (20%: 80%)
- Treatment E (25%: 75%)

Surimi Making

Making catfish surimi using the Suzuki (1981) method in Primary and Rostini (2018). Catfish are washed and weighed, then the fish are weeded by remove the head, fins, scales, tail and stomach contents, then the fish being filet use a filet knife to take the meat out while skin attached to the fish meat are removed. Fish filet is crushed using a food processor. Pulverized meat was collected in a basin and carried out the first washing using ice water with 4: 1 ratio of an ice and fish meat and temperature of 1-50C. Fish meat and ice water are stirred periodically for 10 minutes using a wooden stirrer. Fish meat is then squeezed using a blancu cloth to remove the water. Then the second washing with the same temperature and time as the first washing is done and then added kitchen salt 0.3% by weight of the pulverized meat which is washed and then filtered again with a blancu cloth to remove the water. Surimi that has been made then packed and freeze in contact freezer with a temperature below -350C or use blast freezer water with a temperature of -250C to -300C for 3 hours.

Nugget Making

Making nuggets according to Nafiah (2011) which has been modified is that surimi that has been given salt is then ground using a food processor. The milled Surimi was given spices, soy flour and tapioca according to the treatment evenly, then added curai ice. The mixed dough is then printed on a rectangular pan. The dough has been printed and then steamed using a steamed pan at 850C for 30-40 minutes to ripen the mixture. The steamed dough is cooled for 10-15 minutes, then removed from the baking sheet and cut into 4 × 3 cm sizes. The nuggets that have been cut into pieces are then dipped in egg white and covered with pan flour. Nugget is stored in the freezer with the aim to suppress microbial growth. Fried nuggets use hot cooking oil at 800C for 3-4 minutes.

Data Analysis

Data from the measurement of chemical testing and physical testing were analyzed descriptively comparatively. The comparative descriptive method, the results of the research and its analysis are described in a scientific writing in the form of a narrative, then a conclusion is drawn from the analysis.

The hedonic test results will be analyzed using non-parametric statistics using a two-way variant analysis to determine the effect of the ratio of soybean and tapioca flour to the preference level of catfish nuggets. Furthermore, if the results have a significant influence, the results of further tests will uses multiple follow-up tests, while to determine the best treatment, Bayes method is used.

The statistics used in the Friedman test are defined by the following formula:

$$X_r^2 = \left[\frac{12}{(n \times k)(k + 1)} \times \sum_{j=1}^k (R_j)^2 \right] - [(3n)(k + 1)]$$

Description:

X_r^2 = Friedman test statistics

n = Repetition

k = Treatment

R_j^2 = The total ranking of each treatments

According to Siregar et al (2014) the equation of the Bayes method is as follows:

$$P(A_i|B) = \frac{P(B|A_i)}{\sum_{i=1}^k P(B|A_i)P(A_i)}$$

Description:

$P(A_i | B)$ = Opportunity A_i with conditions event B occurs first

$P(B | A_i)$ = Opportunity B with conditions event A_i occurs first

$P(A_i)$ = Opportunity event A_i

Results And Discussion

Appearance

Appearance is one of the characteristics in the assessment of preference test, besides that appearance is very important in a product because it is the sensory trait that was first seen by consumers.

Table 1. Average Appearance of Catfish Nuggets

Comparison of Soy and Tapioca Flour (%)	Median	Average
0: 100	7.00	6.5 ^a
10: 90	7.00	7.4 ^{ab}
15: 85	9.00	8.0 ^b
20: 80	7.00	6.8 ^{ab}
25: 75	7.00	7.4 ^{ab}

Description : Numbers followed by different letters show significantly difference according to multiple comparison tests at the 5% level

Based on the Friedman test on the treatment ratio of 0% soybean and tapioca flour: 100% significantly different from the treatment ratio of 15%: 85%, it shows that the addition of soy flour affects the appearance of catfish nuggets. Based on the nugget appearance which shows that the ratio of soybean and tapioca flour above 15%: 85% results in a more yellow and quite hollow nugget appearance caused by the higher percentage of soybean flour added.

The higher addition of soy flour will affect the panelist's assessment about characteristics of the product appearance. This is due to the protein content derived from catfish and soy flour plays a role in the Maillard reaction and the heating process will cause browning reactions when the nugget is fried (Ofrianti and Wati 2012).

Furthermore, Winarno (2008) explained that the Maillard reaction is a reaction between carbohydrates, especially production sugars and amino acid groups of proteins forming hydroxymethylfurfural compounds then the compound continues to become furfural. Furfural formed will form melanoidin which causes the brownish color of the nugget.

The surface of the catfish nugget produced in each treatment has almost all cavities. Cavities that arise can be caused from the process during processing, including steaming. The steaming process can cause the development of starch granules called gelatinization. According to Winarno (1997) gelatinization is an event of the development of starch granules so that the granules cannot return to their original state. The mechanism of the gelatinization process is that the starch granules will absorb water which breaks down the amylose crystals and breaks the bonds of the helical structure of the molecule. Addition of water and heating will cause amylose to diffuse out of the granule, so that the granule contains only a portion of amylopectin and will rupture form matrix with amylose called gel (Winarno 1997).

Soy flour added also acts as a binder, according to Pietrasik (2003) high water holding capacity (WHC) due to the addition of binder will increase the strength of the gel matrix and reduce cavity structure in beef meatballs. This is also corroborated by the opinion of Eni et al (2017) that the less and the absence of cavities formed shows that the nugget quality is increasing, this is due to the addition of binder causing a reduction in hollow structures so as to improve the texture of white snapper nuggets.

Aroma

Aroma is an organoleptic parameter that gives rise to the special attraction possessed by consumers in determining a food product.

Table 2. Average Aroma of Catfish Nuggets

Comparison of Soy and Tapioca Flour (%)	Median	Average
0: 100	7.00	7.7 ^b
10: 90	6.00	7.6 ^{ab}
15: 85	7.00	7.6 ^{ab}
20: 80	7.00	6.6 ^{ab}
25: 75	7.00	6.2 ^a

Description : Numbers followed by different letters show significantly difference according to multiple comparison tests at the 5% level

Based on the results of the Friedman test above shows that the ratio of soybean and tapioca flour 0%: 100% with an average value of 7.7 is significantly different from the treatment of 25%: 75% which has an average value of 6.2. This shows that the addition of soy flour influences the panelist's assessment of the nugget aroma.

The comparison treatment of 10% soybean and tapioca flour: 90% - 25%: 75% did not have a significant difference in the assessment of aroma nuggets by the panelists. This is caused by the addition of soy flour on catfish nuggets. However, based on the average value obtained, the ratio of 10% soybean and tapioca flour: 90% - 15%: 85% which is 7.6 can still be accepted by the panelists because it is close to the average value of 0% soybean flour addition treatment with an average value of 7.6.

The higher the amount of soy flour added, it will affect the aroma assessment on nuggets because of the content of vegetable protein contained therein. This is in accordance with the opinion of Santoso (2005) in Parinduri et al (2016), that the more germination soybean flour used is, the more the value of the aroma score decreases. Soybeans have an off flavor that results in deviations from the taste and aroma of the product, which affects the assessment when consuming processed products. The off flavor compounds found in soybeans are glucosides and saponins, these compounds must be deactivated or eliminated so that products with soybean ingredients produced are of good quality (Koswara 1992). However saponin compounds can function as antioxidants and efficacious as a drug. Soybeans contain isoflavones (genistein and daidzein), phytosterols, phytic acid, fatty acids, saponins, phenolic acids, lecithin and protease inhibitors which are antioxidants and efficacious as drugs (Anderson 2002 in Kurniasari and Fithri 2010).

According to Yamaguchi et al (1988) in Pratama (2011) the amino acid content that plays a role in aroma is phenylalanine, tyrosine, and tryptophan, but those contained in catfish are only amino acids phenylalanine and tryptophan. Catfish surimi which is used as the main ingredient in making catfish nuggets also affects the aroma assessment. According to Caharley (1992) in Machmud (2012) surimi contains fatty acids and essential amino acids which are volatile so that if the component is mixed it will give a savory aroma.

Texture

Texture is a typical parameter in fish jelly products. Adding soy flour to fish jelly products will certainly have an effect on the texture of the product.

Table 3. Average Textur of Catfish Nuggets

Comparison of Soy and Tapioca Flour (%)	Median	Average
0: 100	7.00	6.4 ^a
10: 90	7.00	6.7 ^{ab}
15: 85	9.00	8.1 ^b
20: 80	7.00	7.6 ^{ab}
25: 75	7.00	6.8 ^{ab}

Description : Numbers followed by different letters show significantly difference according to multiple comparison tests at the 5% level

Based on the panelists' assessment of catfish nuggets texture, it was found that the addition of soybean flour to catfish nuggets had a textures average range of 6.4 to 8.1. Texture of catfish nuggets with a ratio of 15% soybean and tapioca flour: 85% has the highest average value of 8.1 (preferred), with a soft and dense nugget texture. Nugget texture with 0% treatment: 100% has the lowest average value of 6.4 with less soft and denser texture.

The higher the tapioca flour used, the lower the amount of soy flour used, and vice versa. According to Eni et al (2017) this is due to the high concentration of tapioca which is given and the addition of soy flour only ranges from 15% - 35%, causing the nugget texture to become chewy.

Tapioca containing carbohydrates is quite high at 86.9 g (DIY Province BKPP 2012). The presence of amylose and amylopectin in the starch of the filling material causes a tendency to absorb water and good gelatinization properties (Komansilan 2015). In addition, soy flour can function as a binder because it includes foods that contain high protein. According to Soeparno (2005), the binding material has a purpose to increase the binding capacity of meat, reduce shrinkage during cooking, increase the stability of the emulsion, improve flavor and improve the characteristics of sliced products.

The raw material used is catfish which is processed into surimi also has an effect on the texture produced on catfish nuggets, where surimi has a strong gel that can produce a chewy characteristic of the product. This happens due to the addition of salt in the process of making surimi or in making nuggets themselves. In accordance with the opinion of Primary and Rostini (2018) where when salt is added as much as 2-3% and milled together with meat will cause the meat to become a thick paste.

Taste

Taste is a parameter that is very influential in the assessment of a fish jelly product. Taste is one of the organoleptic characteristics that play a role in the assessment of a product that aims to determine the level of product acceptance.

Table 4. Aaverage Taste of Catfish Nuggets

Comparison of Soy and Tapioca Flour (%)	Median	Average
0: 100	7.00	7.1 ^{ab}
10: 90	7.00	7.1 ^{ab}
15: 85	9.00	8.0 ^b
20: 80	7.00	6.6 ^{ab}
25: 75	7.00	6.4 ^a

Description : Numbers followed by different letters show significantly difference according to multiple comparison tests at the 5% level

Based on the panelists' taste assessment of catfish nuggets, found that the addition of soy flour to catfish nuggets had an average range of 6.4 to 8.0. Flavor of catfish nuggets with a ratio of 15% soybean and tapioca flour: 85% has the highest average value of 8.0 (preferred), with a taste of savory nuggets and a slight taste of soy flour. While the taste of catfish nuggets in the treatment of 25%: 75% had the lowest average value of 6.4 with a rather savory taste and the taste of soy flour was quite dominant but still favored by the panelists.

Based on the research of Ofrianti and Wati (2012), the organoleptic quality (taste) of cork fish nuggets was influenced by the addition of variations in the soy flour concentration. This is because the cork nugget with the addition of soy flour contains a lot of protein that can affect the taste of the cork fish nugget where the type of amino acid that is influential here is glutamic acid. According to Winarno (2008), proteins containing several amino acids include glutamic acid. Glutamic acid is very important role in food processing, because it can cause good taste. In addition, based on organoleptic quality research the taste of white snapper nuggets is influenced by soy flour which has flavor, water and fat binding properties (Eni 2017).

However, soy flour also has a taste that can reduce the product taste itself. This taste is bitter taste and lime flavor caused by glycoside compounds in soybean seeds. Soyasaponin and sapogenol are the main causes of bitter taste in soybeans and nonfermented products (Santoso 2005 in Jayadi et al 2012). So that, 15%: 85% ratio of soybean and tapioca flour is the most favored treatment by panelists. While the treatment ratio of soybean and when tapioca flour more than 15%: 85% it has a lower score than another treatments because it is accompanied by the increasing amount of soy flour added.

Decision Making by *Bayes Method*

Bayes method is one technique that can be used to perform the analysis in the making decision the best of a number of alternatives with the aim of producing an optimal acquisition. To generate the optimal decision to consider a variety of criteria (Marimin 2004). The results of the criteria calculations are presented in Table 5.

Table 5. Criteria Weight Value of Catfish Nuggets

Criteria	Weights Criteria
Appearance	0.15
Aroma	0.17
Textur	0.30
Taste	0.38
Total	1

Based on calculations on the parameters of appearance, aroma, textur and taste showed that the highest weight value criteria on the parameters of taste with a value of 0.38. It shows that the parameters of taste is the most important criterion for catfish nuggets products fortified soy flour. The decision on the value of the relative weights of the criteria of appearance, aroma, textur and taste in catfish nuggets were calculated using pairwise comparisons (Pairwise comparison). The pairwise comparison result data against the criteria of appearance, aroma, textur and taste of catfish nuggets of all 20 semi-trained panelists to level A catfish nuggets fortified soy flour can be seen in Table 6.

Table 6. Catfish Nugget Rate Decision Matrix Using Bayes Method

Treatment (%)	Criteria				Alternative value	Priority Values
	Appearance	Aroma	Textur	Taste		
0: 100	7	7	7	7	7,000	.190
10: 90	7	8	7	7	7.168	0.195
15: 85	9	7	9	9	8.664	0.235
20: 80	7	7	7	7	7,000	.190
25: 75	7	7	7	7	7,000	.190
Weight	0.15	0.17	0.30	0.38	36.832	1,000

Based on calculations by Bayes methods obtained results show that the catfish nuggets with soy and tapioca flour ratio 15% : 85% scored the highest of 8.66 alternatives then followed with a ratio of 10% : 90% have an alternative value is 7.16 and followed with a ratio of 0% : 100%, the ratio of 20% : 80% and 25% : 75% with alternative value is 7.00. Based on the overall results which includes assessing the appearance, aroma, texture and taste, it can be concluded that soy and tapioca flour ratio of 15% : 85% is the most preferred treatment by panelists compared with other treatments. It is based on the opinions of Marimin (2004) that the highest alternative value by considering the criteria can be used to analyze the best decision.

Folding Test

The folding test is included in the physical testing carried out on catfish nugget products in order to determine the level of elasticity.

Table 7. Folding Test Value of Catfish Nugget

Comparison of Soy and Tapioca Flour (%)	Median	Average
0: 100	> 5	Very Chewy
10: 90	> 5	Very Chewy
15: 85	> 5	Very Chewy
20: 80	> 5	Very Chewy
25: 75	> 5	Very Chewy

Based on the assessment results of the folding test on catfish nuggets with the addition of soy flour obtained quality that is > 5 of the treatment ratio of soybean and tapioca flour as follows, 0%: 100%, 10%: 90%, 15%: 85%, 20%: 80% and 25% : 75%. This shows that the addition of soy flour in all treatments is included in the criteria of very chewy with a quality > 5 and is included in the AA rank

The use of tapioca flour in the dough serves to unify the meat with water so that it can be easily formed into a mixture and can also bind water. Tapioca flour contains amylose which functions in water absorption and can improve the product gelatinization process. In addition to the effect of tapioca flour, the addition of soy flour can also affect the elasticity of catfish nuggets. Soy flour contains lecithin which is a natural emulsifier and is able to work with gluten to strengthen the structure of the dough (Arlene et al 2009).

This is inseparable from the influence of raw materials used in catfish nuggets making in the form of catfish surimi, because in the surimi making process itself through the stages of dozing, washing and salt giving. Surimi washing process will eliminate sarcoplasmic protein and dissolve myofibril protein, especially myosin and actin. Myofibril protein will form a gel during heating due to denaturation, interaction and aggregation processes (Primary and Rostini 2018). The use of surimi is one of the causes where from the five treatments have a high elasticity score.

Chemical Analysis Results

The parameters tested were water content, ash content, protein content and fat content.

Table 8. Results of Chemical Analysis of Catfish Nuggets with Comparison of Soy and Tapioca Flour

Parameters tested	Comparison of Soy and Tapioca Flour (%)		SNI 7758: 2013 of Fish Nuggets (%)
	0: 100	15: 85	
Water content	69.74	67.50	Max. 60
Abu Kadar	1.85	1.93	Max. 2.5
Protein levels	14.67	15.78	Min. 5
Fat level	6.87	7.57	Max. 15

Water Content Test

Water content is the amount of water in a material which is determined by the weight reduction of a material which is heated at the test temperature.

Based on the test results, the water content of catfish nuggets with a ratio of 0% soybean and tapioca flour: 100% has a water content value of 69.74%, while in the treatment ratio of 15%: 85% the addition of soy flour has a water content value of

67.50%. This shows that the water content of catfish nuggets with the addition of soy flour is lower than the one without the addition of soy flour.

This is in accordance with the opinion of Ofrianti and Wati (2012) that the decrease in the concentration level of soy flour causes an increase in the water content of cork fish nugget. Increased water content is caused by tapioca raw materials used with the starch content in it which can absorb water. According to Winarno (1988) in Eni (2017), this condition can occur because the amount of hydroxyl groups in the starch molecule is very large so the ability to absorb water becomes large too.

Ash Content Test

Ash content is the amount of inorganic residue resulting from the ignition or annealing of a product (BSN 2006). Based on the test results, the ash content of catfish nugget with a 0%: 100% ratio of soybean and tapioca flour is 1.85%, while the catfish nugget ash content with a ratio of 15%: 85% is 1.93. This shows that the ash content of catfish nuggets with the addition of soy flour is greater than without the addition of soy flour.

Soy flour contains 8 mg iron, 195 mg calcium and 554 mg phosphorus, while other minerals are found in very small amounts (0.003% smaller) namely boron, magnesium, benilium and zinc. Ash content is also influenced by minerals from additional ingredients used such as fish, salt and spices used where each ingredient has a different mineral content so that it can affect the ash content of a product.

Protein Content Test

Protein is a macronutrient that has an important role in the formation of biomolecules in the body. Based on the results of the test, the protein content of catfish nugget in the treatment ratio of 0% soybean and tapioca flour: yield was 14.67%, while in the treatment with 15%: 85% ratio of soybean and tapioca flour obtained a protein content value of 15.78 %. This shows that the addition of soy flour to catfish nuggets has an effect in increasing the value of protein content, where the need for protein consumption in adults (more than 18 years old) is 0.8 g / kg body weight (Muchtadi 2008).

According to Widodo (2001) soy flour has a fairly high protein content of 34.49%. While the protein content of tapioca is 0.5 g in 100 g of food ingredients (DIY Provincial BKPP 2012).

Adding soy flour to catfish nugget can enrich the value of amino acids in it by adding vegetable protein derived from soy flour. The amino acid composition of catfish meat and amino acid composition of soy flour showed that almost all levels of amino acids in catfish flesh were smaller than the amino acid levels of soy flour. In addition, there is a difference. Catfish meat does not have the type of amino acid cystine while soy flour has the amino acid type (Wijayanti et al 2014, Sitompul 2004). Therefore, the addition of soy flour in the 15%: 85% ratio of soybean and tapioca flour has increased the protein value of 1.11% from the ratio of soybean and tapioca flour by 0%: 100%.

Fat Content Test

Fats and oils are effective energy sources and also one of the important food substances that play a role in human health (Winarno 2008). Based on the results of the test, the fat content of catfish nugget in the treatment ratio of 0% soybean and tapioca flour: 100% obtained results that is 6.87%, while the 15% comparison treatment: 85% obtained the result is 7.57%. This shows that the addition of soy flour can affect fat levels in catfish nuggets. According to Widodo (2001) that soy flour has a fairly high fat content of 25.53%. While the fat content in tapioca is 0.3 g per 100 g of food ingredients (BKPP DIY Province 2012).

In addition, other factors that play a role are changes in the value of water content. Fat does not dissolve in water, so the more water that comes out causes the tendency of fat levels to increase. According to Warris et al (2000) fat content has a negative relation with water content, meaning that if the water content has decreased, there will be an increase in fat content.

Conclusion

Based on the results of research on soybean flour fortification on the preference level of catfish nuggets, it can be concluded that the addition of soy flour to all treatments is favored by the panelists, but the treatment with 15%: 85% ratio of soybean and tapioca flour produces the catfish nuggets that are most preferred by the panelists compared to the other treatment. The addition of soybean flour by 15% has a median value of 9, aroma of 7, texture of 9 and taste of 9. Then produces an alternative value of 8.66, water content of 67.50%, ash content of 1.93%, protein content of 15.78 % and 7.57% fat content.

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