FORTIFICATION OF GEMBILI FLOUR (*Dioscorea esculenta*) IN THE COB-SPEED LOAD NUGGETS KNOW AS INULIN SOURCE

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Abstract

Gembili (Dioscorea esculenta) is a plant that contains high inulin. Inulin is a type of carbohydrate that contains fiber and is classified as a prebiotic. Inulin will still undergo fermentation even by the good microbes present in the large intestine so that it has positive implications for the diets of people with diabetes. This study aims to determine the effect of fortification of gembili flour (Dioscorea esculenta) on the physical, chemical, and organoleptic characteristics of tongkol-dregs tofu pindang nuggets. The method used in this research is the experimental method. The experimental design in the main study was a simple completely randomized design (CRD) using 4 replications. The independent variable used in this study is the difference in the concentration of gembili flour in the manufacture of tuna-tofu tuna pindang nuggets. While the dependent variable in this study is the content of food fiber nuggets of tuna-tofu. The results of this study indicate that the substitution of gembili flour with different concentrations has a significant effect on the inulin content of tongkol-tofu tuna nuggets. However, there is no significant effect on the physical characteristics, namely texture and organoleptics, which include the appearance, aroma, taste and texture of the tuna-tofu tuna nuggets.

Keyword: Fortification, Gembili, Nuggets, Inulin, Diabetes

Introduction

The preparation of processed nuggets starts with ground meat and added spices, then coated with flour adhesive, re-coating using bread flour (breading) and fried half-cooked followed by freezing to keep the quality of the nuggets good during storage (Wulandari et al. 2016). The nugget product can become a nutritious product by adding tofu pulp which is high in dietary fiber and other nutritional components.

The processing of gembili tubers into flour is one way to extend the shelf life of gembili tubers. In the form of flour, gembili tubers are easier to use and formulated with other ingredients (Widowati, 2010). The nutritional content of gembili flour varies greatly, such as protein, water, crude fiber, ash, fat and starch. Gembili flour has the potential to be a very high source of carbohydrates at 86.84%, as well as other components such as 8.39% water, 0.72% ash, 0.15% fat, 3.92% protein (Saskiawan and Nafi 'ah, 2014) as well as high inulin, namely 14.77% (Sari, et al. 2015). Added by Rimbawan and Nurbayani, (2013) states that inulin is one of the carbohydrates, where inulin in gembili flour has a function as a prebiotic, a component of soluble, indigestible dietary fiber and can stimulate the activity of good bacteria in the digestive tract. conducted by Pratiwi et al. (2016), stated that the substitution of gembili flour had an effect on increasing inulin levels in tuna fish nuggets by 0.15%. In addition to fish nuggets, substitution of gembili flour has an effect on increasing inulin levels in other products such as tuna fish balls. The results of research by Aziza et al. (2015), stated that the substitution of gembili flour in making tuna fish balls increases the inulin levels in tuna fish balls, which is 0.12%. So that by making tofu tongkol-dregs pindang fish nuggets with the substitution of gembili flour it is expected to increase the inulin content of the tofu tuna-dregs pindang fish nugget product.

Materials and Methods

Making Tofu Dregs and Gembili Flour Making

In this research, the first thing to do is to make tofu dregs and gembili flour. The diagram for making tofu dregs and gembili flour based on the published modification method (Hardoko, et al. 2017)

Production of Tongkol-Dregs Tofu Pindang Nugget

The process of making tongkol-tofu pindang nuggets can be seen in Figure 4.The formulation of the preliminary research on making tongkol tofu pindang nuggets with the substitution of gembili flour can be seen in Table 3. Procedure for making tuna pindang-tofu nuggets (Modification Hardoko, et al. 2017)

Table 3 Nugget Formulation

Ingredient	Formula A (g)	Formula B (%)	Formula C (%)
Fish meat	100		
Tofu Dregs	100		
Tapioca flour	60		
Gembili flour	0	10	20
Garlics	7		
Sugar	3		
Salt	6		
Skimmed milk	7		
Pepper	1		
Coriander	1		
Ice water	15		
Eggs	2		

Fortification of Gembili Nugget Pindang Fish Tongkol-Dregs Flour

The concentration of adding the best gembili flour obtained from preliminary research is then used as the basis for the main research. Based on the preliminary research, it was found that the best gembili flour concentration was a concentration of 10%. Thus, the main research procedure was carried out to obtain the best gembili flour concentration based on physical, chemical and organoleptic parameters. The physical parameter is texture. Chemical parameters are inulin content, while protein content, water content, fat content, ash and carbohydrate content in the best treatment. Meanwhile, the organoleptic parameters using the hedonic method include appearance, aroma, taste and texture. Hedonic testing was carried out with a panel of 30 people with a rating scale of 1 - 4. The main research formulation of making pindang fish nugget tofu tuna with the substitution of gembili flour can be seen in Table 4.

Tabel 1. Main Research Formulation

Ingredient	Composition F1 (g)	Composition F2 (%)	Composition F3 (%)	Composition F4 (%)
Fish meat	100			
Tofu dregs	100			
Tapioka Flour	60			
Gembili Flour	0	5	10	15
Garlics	7			
Sugar	3			
Salt	6			
Skimmed milk	7			
Pepper	1			
Coriander	1			
Iced water	15			
Eggs	2			

Information :
F1 = 0%, F2 = 5%, F3 = 10% and F4 = 15% The substitution of gembili flour comes from the weight of tuna fish and tofu dregs by reducing the amount of tapioca

Test Parameter Analysis Procedure

The test parameters used in this study were physical, chemical and organoleptic analysis. Physical analysis is texture. Then the chemical analysis is the inulin content, while the protein content, water content, fat content, ash content and carbohydrate content in the best treatment. Meanwhile, the organoleptic analysis of appearance, aroma, taste and texture used the hedonic test method.

Physical Parameters

The physical parameter being tested is texture. Texture was measured using a texture analyzer. First the sample is placed under a probe with a diameter of

1.5 cm. The upper limit of the probe is set at a distance of 2.5 mm, then the bottom at 1.0 mm. Then set the pressing speed is 10 mm / minute. Recorded data, read by excel. The result of texture measurement is the maximum power (Newton) that the sample can withstand, as an illustration of the hardness of the sample (Souripet, 2015).

Chemical Parameters

The chemical parameters in this study were inulin content, while protein content, water content, fat content, ash and carbohydrate content in the best treatment.

Results and Discussion

Chemical Characteristics of Tongkol-tofu Pindang Nugget With Gembili Flour Substitution

The physical characteristics of the tofu tuna-dregs nuggets with the substitution of gembili flour are texture. The physical characteristics of tongkol tofu with the substitution of gembili flour can be seen in Table 5.

Table 5 Physical characteristics of tongkang-dregs tofu nuggets with the substitution of gembili flour

Treatment	Texture (N)*
F1	9.16±0.61
F2	8.70±1.04
F3	7.92±1.69
F4	7.74±1.91

Based on the ANOVA results, it can be analyzed that the substitution treatment of gembili flour has no significant effect ($p > 0.05$) on the texture of the tuna-tofu tongkang pindang nuggets, indicating that the F1, F2, F3 and F4 treatments were not significantly different from each other. The highest texture value was found in F1 treatment (0% substitution of gembili flour) of (9.16N ± 0.61) and the lowest value of texture was in treatment F4 (15% substitution of gembili flour) which was (7.74N ± 1.91). The texture value of mackerel tofu nuggets in each treatment of the difference in the concentration of gembili flour decreased. This is in accordance with the research of Pratiwi, et al. (2016) which states that the lower the maximum compressive power of the nuggets is due to the greater substitution of gembili flour that is added, so that the level of nugget hardness also decreases.

Chemical Characteristics of Tongkol-tofu Pindang Nugget With Gembili Flour Substitution

The chemical characteristics of tongkol tofu with the substitution of gembili flour were inulin content. The chemical characteristics of mackerel tofu with substitution of gembili flour can be seen in Table 6.

Table 6 Chemical characteristics of tongkang tofu tuna pindang with substitution of gembili flour

Treatment	Inulin (%)*
F1	0.70 ± 0.03^{a}
F2	2.42 ± 0.01^{b}
F3	2.74 ± 0.07^{c}
F4	3.06 ± 0.02^{d}

*Supersript alphabet show significantly difference

Based on the ANOVA results, it can be analyzed that the substitution treatment of gembili flour has a significant effect ($p < 0.05$) on the levels of inulin pindang tongkol tofu. Then continued with Duncan's further test. The highest inulin levels were obtained in the F4 treatment (15% substitution of gembili flour) which was (3.06% ± 0.02), while the lowest inulin levels were in F1 treatment (0% substitution of gembili flour), namely (0.70% ± 0.03).

The inulin content of tongkol-dregs tofu nuggets in each treatment showed an increase in the concentration of gembili flour. This is due to the increasing percentage of the substitution concentration of gembili flour to tapioca flour in the tofu tuna-dregs pindang fish nugget. According to Pratiwi, et al. (2016) which states that the inulin content of a product is influenced by the concentration of substituted gembili tuber flour. The greater the amount of tuber flour that is substituted in the product, the higher the inulin content in the product will be.

Organoleptic Characteristics of Tofu Tongkol Pindang Nugget With Gembili Flour Substitution

Organoleptic testing with the hedonic method was carried out to determine the level of acceptance of tuna-tofu tuna pindang nuggets with the substitution of gembili flour. The parameters

observed were appearance, aroma, taste and texture. Organoleptic characteristics of pindang pindang fish, tofu dregs tuna with the substitution of gembili flour can be seen in the table 7.

Table 7 Organoleptic characteristics of pindang pindang fish, tofu dregs tuna with substitution of gembili flour

Treatment	Appearance	Aroma	Flavor	Texture
F1	3.40±0.50[a]	3.27±0.64[a]	3.30±0.60[a]	3.27±0.03[a]
F2	3.40±0.56[b]	3.40±0.50[b]	3.23±0.77[b]	3.33±0.01[b]
F3	3.63±0.49[c]	3.37±0.56[c]	3.33±0.61[c]	3.40±0.07[c]
F4	3.57±0.50[d]	3.23±0.63[d]	3.07±0.60[d]	3.23±0.02[d]

Informations: F1: 0%; F2: 5%; F3: 10% and F4: 15% The substitution of gembili flour comes from the weight of tuna fish and tofu dregs by reducing the amount of tapioca

Appearance

Based on the results of the Kruskal-Wallis test, the highest average appearance value was in the F3 treatment (10% substitution of gembili flour) of (3.63 ± 0.49), while the lowest average appearance was in the F1 treatment (0% substitution of gembili flour) and F2 (5% substitution of gembili flour), namely (3.40 ± 0.50 and 3.40 ± 0.56), respectively. So that the appearance favored by the panelists is the F3 treatment (10% substitution of gembili flour). Treatment F3 has the appearance of a golden yellow color leading to brown. The appearance is influenced by the frying process so that the color turns brown (Sumantri, et al. 2015).

Aroma

Based on the results of the Kruskal-Wallis test, the highest average aroma value was found in treatment F2 (5% substitution of gembili flour) of (3.40 ± 0.50), while the lowest average value of aroma parameters was in treatment F4 (15% substitution of gembili flour).) which is equal to (3.23 ± 0.63). So that the aroma that the panelists like is the F2 treatment (5% substitution of gembili flour). This is because the nuggets have an aroma that matches the ingredients used, where the aroma of the tofu tuna-tofu nuggets is typical of fish and a little flavorful of flour.

Taste

Based on the results of the Kruskal-Wallis test, the highest average taste parameter value was in the F3 treatment (10% substitution of gembili flour) of (3.33 ± 0.61), while the lowest average value of taste parameters was in the F4 treatment (15% substitution of flour). gembili) which is equal to (3.07 ± 0.60). So that the taste that the panelists like is the F3 treatment (10% substitution of gembili flour). The taste that appears is due to the protein content when the steaming process is carried out, the protein will undergo amino acid hydrolysis, one of which is glutamic acid which will cause a delicious taste (Sartika and Syarif, 2016).

Texture

Based on the results of the Kruskal-Wallis test, the highest average texture parameter value was found in the F3 treatment (10% substitution of gembili flour) of (3.40 ± 0.50), while the lowest average value of texture parameters was in the F4 treatment (15% substitution of flour). gembili) which is equal to (3.23 ± 0.43). So that the preferred texture of the panelists is the F3 treatment (10% substitution of gembili flour). During the frying process water evaporation occurs. An increase in frying temperature will result in the release of water content in foodstuffs which will determine the texture of the product (Pratiwi, et al. 2016).

Determination of the Best Treatment for Tofu Tongkol Pindang Nugget with Gembili flour substitution

From the calculation results of determining the best treatment, it can be concluded that the best treatment in all parameters is found in F3 treatment (10% substitution of gembili flour) with a texture value of 7.92 N, inulin content of 2.74%, hedonic appearance of 3.63. , aroma hedonic is 3.37, taste hedonic is 3.33 and texture hedonic is 3.40. Then from the results of determining the best treatment in the F3 treatment (substitution of 10% gembili flour) followed by proximate testing which aims to determine the nutritional composition contained in the best treatment which includes protein content, moisture content, fat content, ash content and carbohydrate content. The results obtained in the proximate test

were protein content of 15.21%, water content of 31.29%, fat content of 9.87%, ash content of 3.74% and carbohydrate content of 38.89%. The quality requirements for fish nuggets based on SNI 7758: 2013 are a minimum protein content of 5%, a maximum water content of 60%, a maximum fat content of 15% and a maximum ash content of 2.5%.

Conclusion

Based on the above discussion, it can be concluded that the substitution of gembili flour with different concentrations has a significant effect on the inulin content of tongkol-dregs tofu. However, there is no significant effect on the physical characteristics, namely texture and organoleptics, which include the appearance, aroma, taste and texture of the tuna-tofu tuna nuggets. The best percentage of gembili flour substitution is in F3 treatment (10% substitution of gembili flour) with a texture value of 7.92 N, inulin content of 2.74%, hedonic appearance of 3.63, hedonic aroma of 3.37. , the taste hedonic is 3.33 and the texture hedonic is 3.40. As well as the nutritional composition of the best treatment, namely protein content of 15.21%, water content of 31.29%, fat content of 9.87%, ash content of 3.74% and carbohydrate content of 38.89%.

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