

The Effect of Substitution Lesser Yam (*Dioscorea esculenta*) Flour on Texture and Inulin Levels of Boiled Tuna Nugget-Okara

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Abstract- The lesser yam flour is made from the lesser yam through the drying, refining and sifting process. Lesser yam flour contains high inulin which can be used as a prebiotic and healthy for the digestive tract. The substitution of yam lesser flour using concentrations of 0%, 5%, 10% and 15%. Texture analysis using a texture analyzer and inulin using spectrophotometry. The highest texture value at F1 treatment is 9,16N and the highest inulin level is at F4 treatment is 3,06%

Index Terms- Lesser Yam Flour, Texture, Inulin, Nugget.

I. INTRODUCTION

Nugget is a type of food that is popular among everyone. Nugget is made from small and irregularly cut meat, then processed again into a relatively larger size.¹ Preparation of processed nuggets starts with ground meat and added spices, then coated with flour adhesive, re-coating using breading and half-cooked frying followed by freezing to maintain good quality nugget during storage.² Nugget products can be nutritious products with the addition of okara containing high dietary fiber and other nutritional components.³

Lesser yam flour is flour obtained from tuber species of *Dioscorea esculenta* through the process of drying, refining and sifting. Lesser yam flour has the potential to be a very high carbohydrate source of 86.84%, and other components such as water by 8.39%, ash by 0.72%, fat by 0.15%, protein at 3.92%.⁴ and also high inulin in the amount of 14.77%.⁵

Inulin is a polymer of a combination of fructose monomers. Inulin generally covers all linear fructose with glycosidic beta (2-1) fructosyl-fructose bonds. This specific type of glycosidic bond gives different inulin structural and physiological properties. Because of the beta configuration of the bonds between fructose monomers, the inulin type cannot be enzymatically hydrolyzed by human saliva and small intestinal digestive enzymes, especially in its alpha-glycosidic bonds. So that inulin cannot be digested and fermented in the large intestine.⁶ the high and low texture values and inulin levels are influenced by the number of percentages of substitution of lesser yam flour used.

II. MATERIALS AND METHOD

Materials

The materials used in this study were pindang tuna which was obtained from Blimbing Market, okara from tunggulwulung tofu factory, lesser yam tuber obtained from Pasar Besar Malang, tapioca flour, garlic, sugar, salt, skim milk, pepper, coriander, ice water. Breading material is panir flour. The materials used for the analysis were cysteine 1.5%, H₂SO₄, carbazole 0.12%, buffer sodium phosphate 0.1M, standard inulin solution.

Method

The method used an experimental method. The treatments are used in this study is variation of the concentration of the lesser yam flour. The experimental design was used as a completely randomized design with 4 treatments and 5 replications. the lesser yam flour concentration used were 0%, 5%, 10% and 15%.

Preparation of okara

The okara preparation process, first thing to do is the fresh okara obtained from the tofu factory. Then the okara is squeezed with a blurry cloth so that the water in the okara does not drip. Then the okara is steamed for 30 minutes. After that, it is cooled at room temperature.³

Processing of lesser yam flour

The process of making lesser yam flour. First, the lesser yam tubers are washed with running water to clean the dirt and soil attached. Then the blanching process was carried out at 80°C for 1 minute. Continuing to do the stripping of lesser yam tuber skin with a knife. Then thinly sliced 1-2 mm thick, then immersed in a 5% (b / v) salt solution and 0.3% (b / v) metabisulfite for 2 hours. Then wash with running water to remove the mucus that comes out from the slices of the yam tuber. Then the oven was drained at 80°C for 24 hours. Then mashed with a blender and carried out sieving with a size of 80 mesh.⁷

Processing of Nugget

First, boiled tuna obtained from Blimbing Market, was washed with water to clean the dirt, then the flesh was taken without skin, thorns and head. Furthermore, the meat obtained is crushed with a chopper. Then the pulverized meat and spices are mixed into the mixer and added with okara, tapioca flour, lesser yam flour (according to treatment), skim milk, and 2 eggs until the mixture is evenly mixed. Then the mixture is added to the baking sheet and steamed for 30 minutes then cooled to room temperature. While the dough is cooled to room temperature, butter mixture (eggs and tapioca) is made. The cooked and cold dough is folded with a rectangular rectangle with a size of 2x1x1 cm. Then dip it into the dough (butter) and continue breading with panir flour, and get raw nuggets that are ready to be stored or fried.³

Texture Analysis

Texture is measured using a texture analyzer. The first, sample must be placed under a probe 1.5 cm in diameter. The upper limit of the probe is set at a distance of 2.5 mm, then the bottom is 1.0 mm. Then set the pressing speed is 10 mm / minute. Recorded data, read with excel. The result of texture measurement is the maximum power (Newton) that is able to be held by the sample, as an illustration of the hardness level of the sample.⁸

Analysis of Inulin Levels

Analysis of inulin levels by spectrophotometric methods. First the samples are cut into smaller sizes and weighed according to the provisions. Then blended accompanied by the addition of water 1: 2 (b / v). Then heated at 80°C for 1 hour with constant stirring. Then it is cooled, filtered and the filtrate is taken.⁹ Next, take 1 ml of filtrate and add 0.2 ml 1.5% cysteine and 6 ml 70% H₂SO₄. Then homogenized, then 0.2 ml of 0.12% carbazole in ethanol solution was added. Then heated at 60°C for 10 minutes. Then the absorbance is cooled and measured at a wavelength of 560 nm. And then standard curve is made using samples containing inulin more than 20 µg / ml.¹⁰ Calculate the percentage of inulin in the sample using a standard curve.

$$\text{Kadar inulin} = \frac{\text{konsentrasi inulin} \left(\frac{\mu\text{g}}{\text{ml}} \right) \times \text{faktor pengenceran (ml)} \times \Sigma \text{filtrat (ml)}}{\text{jumlah bahan} \times \text{total padatan terlarut}}$$

Statistic Analysis

Data were analyzed using SPSS 22 computer program. The study design used one way ANOVA with 5 replications and if the results were obtained significantly different DMRT follow-up tests (5%).

III. RESULT

The results showed that the substitution concentration of the lesser yam flour on a higher nugget would reduce the level of hardness (texture). however, it will increase inulin levels in nuggets.

The highest texture on the 0% substitution lesser yam flour substitution treatment was 9.16±0.61 N and the lowest was on the 15% substitution treatment of yam lesser flour of 7.74±1.91N. while the highest inulin content of 0% substitution of lesser yam flour was 3.06% and the lowest was at 0% substitution lesser yam flour treatment of 0.70%.

Table 1 : Texture (Hardness)

Treatment	Unit	Result*
0%	N	9.16±0.61 ^{tb}
5%	N	8.70±1.04 ^{tb}
10%	N	7.92±1.69 ^{tb}
15%	N	7.74±1.91 ^{tb}

*superscript notation tb states no real difference between treatments

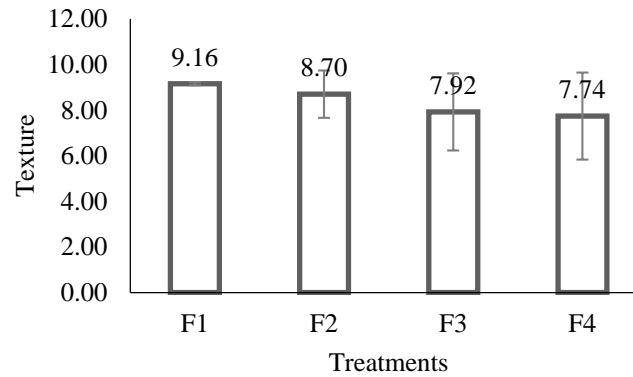


Figure 1: Diagram of Texture

Table 2. Inulin Levels

Treatment	Unit	Result*
0%	%	0.70±0.03 ^a
5%	%	2.42±0.01 ^b
10%	%	2.74±0.07 ^c
15%	%	3.06±0.02 ^d

*superscript letter notation states the real difference between treatments

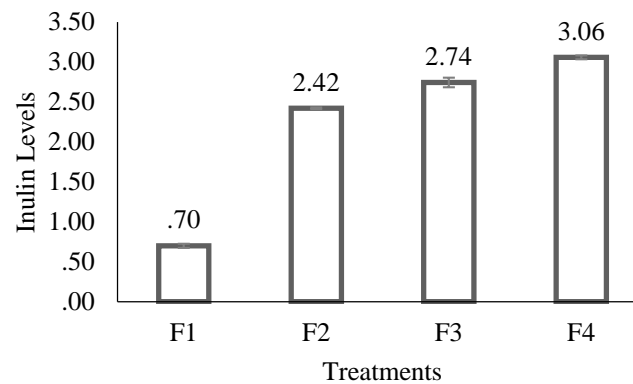


Figure 2. Diagram of Inulin Levels

IV. DISCUSSION

Based on the ANOVA results can be analyzed which proves the substitution of lesser yam flour does not significant difference ($p > 0.05$) on texture of tuna-okara nuggets. In the Table. 1 shows that between treatments F1, F2, F3 and F4 are not significantly different from each other. The highest texture value in F1 treatment (0% substitution of lesser yam flour) was (9.16 ± 0.61) and the lowest texture value was in treatment F4 (15% substitution of lesser yam flour) of (7.74 ± 1.91).

The texture value of boiled tuna nugget-okara in each concentration treatment decreased. This shows that the lower the compressive power on the nugget is due to the greater substitution of added lesser yam flour, so the level of hardness of the nugget decreases.¹¹ The decrease in the level of hardness is due to differences in the starch content found in the adhesives and fillers used. The high amount of starch content results in the texture of nuggets becoming more dense and harder.¹² Starch has a role in determining the texture of a food. Starch granules and mixed and heated water will form a gel that has irreversible properties, where starch molecules will glue together to form clots and increase the hard texture of the food.¹³ Tapioca flour has a high starch content of 81.40%,¹⁴ whereas in lesser yam flour has a lower amount of starch content, which is 42.16%.¹⁵ So that the substitution of lesser yam flour will reduce the level of hardness of boiled tuna nuggets.

Based on the ANOVA results, it can be analyzed that the substitution treatment of lesser yam flour has a different significance ($p < 0.05$) on the levels of inulin boiled tuna nugget-okara. Then proceed with Duncan's further test. In the Table. 2 shows the results of Duncan's further test that between treatments were significantly different. The highest inulin content was obtained in treatment F4 (15% substitution of lesser yam flour) in the amount of $(3.06\% \pm 0.02)$ while the lowest inulin content was in the treatment of F1 (0% substitution of lesser yam flour) of $(0.70\% \pm 0.03)$.

The levels of inulin from boiled tuna nugget-okara in each treatment increased the concentration of lesser yam flour. This is because the greater the percentage substitution concentration of lesser yam flour on tapioca flour on boiled tuna nugget-okara. Lesser yam tuber has a high inulin content of 14.63%,¹⁶ while cassava as tapioca raw material contains lower inulin levels of 1.38%.¹⁷ Furthermore, in the formulation of making boiled tuna nugget-okara, garlic was added with 2.32%. Garlic in addition to providing flavor and aroma to boiled tuna nugget-okara is also an ingredient that can increase inulin levels. Garlic has an inulin content of 9-16%.¹⁸ This makes the levels of inulin on boiled tuna nugget-okara increase with the percentage of substitution concentration of lesser yam flour. The inulin content of a product is influenced by the concentration of the lesser yam flour substituted. The greater the amount of lesser yam flour substituted on the product, the higher the inulin content in the product.¹¹

V. CONCLUSION

From the results it can be concluded that the higher the substitution of lesser yam flour is used it will reduce the level of texture, but it will increase the level of inulin on boiled tuna nuggets.

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