PAPER • OPEN ACCESS

The Potential of Lindur Fruit Flour (*Bruguiera Gymnorrhiza*) in Reducing Oil Absorption of Milkfish Nugget during the Deep Frying Process

View the article online for updates and enhancements.

The Potential of Lindur Fruit Flour (*Bruguiera Gymnorrhiza)* in Reducing Oil Absorption of Milkfish Nugget during the Deep Frying Process

A Widyastuti, AA Abdillah and Laksmi Sulmartiwi[*]

Faculty of Fisheries and Marine, Universitas Airlangga

laksmi-s@fpk.unair.ac.id

Abstract. Milkfish Nugget is a processed fish product using minced milkfish. The ingredients of making *nuggets* milkfish are flour and spices. However, flour tends to absorb a lot of oil during the frying process. Lindur fruit flour is a semi-finished material which contains hydroxyl and amylopectin groups that can possibly be used as a solution to the problem. The concentration of lindur flour added to each treatment are 0%, 15%, 20%, and 25%. The tests were carried out by testing the fat content of milkfish nuggets and organoleptic. The results revealed that the addition of lindur flour significantly affect the fat content (p <0.05). The treatment of adding 0% lindur flour has a mean fat content of 6.75%, while the highest addition of lindur flour was at 25% which produced a mean fat content of 3.72. Organoleptic test consisted of 5 aspects, namely appearance, odor, taste, and texture. The results indicated that the most preferred product was with the addition of 15% lindur fruit flour.
Keywords: Lindur fruit flour, milkfish nugget, fat content.

1. Introduction

Milkfish nuggets are processed products made from minced milkfish. The process of making milkfish nuggets are by mincing the meat, followed by adding spices then mixing, steaming, and molding into a certain shape and finally frying (Hapsari, 2002). The main ingredients of the dough in making milkfish nuggets are wheat flour, water, eggs, and spices. Milkfish nuggets have a crunchy texture on the outside and chewy on the inside (Amalia, 2012). Milkfish nuggets are popular because the savory taste of milkfish in addition to the fried panir flour coating which adds a crisper texture. However, milkfish nuggets have disadvantages, such as its tendency to absorb excessive oil (Kim *et al*., 2015).

Wheat flour tends to absorb a lot of oil during the frying process (Shih *et al.,* 2001). The amount of oil absorbed is caused by the high water content in wheat flour. Several studies have reported that in deep frying process, oil penetrates the product to replace evaporated water (Thanaturkson *et al*., 2005). Therefore, the high water content in wheat flour will evaporate and leave gaps to be filled by oil. Thus, the cooking oil absorbed by milkfish nuggets tends to be high (Nurani et al., 2013).

Consumption of products that contain excessive oil may cause serious health risks such as cardiovascular disease, hypertension, diabetes, cancer and obesity (Saguy and Dana, 2003). Therefore, low-fat processing products are needed to reduce excessive oil consumption.

Bruguiera gymnorrhiza can be processed into semi-finished products which is the flour. Lindur fruit flour is a semi-finished fishery product. Lindur flour can be processed into a variety of products, one of which is *nuggets* milkfish. The addition of lindur fruit flour in this study was hoped to reduce excessive oil absorption in milkfish nuggets during deep frying process.

The less water contained in the product, the less oil will be absorbed during deep frying process. This is because the evaporation of water during the deep frying process leaves less space compared to products that contain a lot of water. The water content in lindur flour is less than 5.83%, while the water content in wheat flour is 14% (Fitasari, 2009). In addition, starch in lindur fruit flour has a hydroxyl group that is able to bind water during the deep frying process. Therefore, some of the water are bound or partially evaporates so that it leaves even smaller space for oil (Ladamay and Yuwono, 2014). The purpose of this study was to produce milkfish nuggets by adding lindur flour to reduce oil absorption during the deep frying process.

2. Methodology

2.1. Research equipments

The Equipment used were fryer with 2 liter capacity, basin, measuring cup, analytic scale brand Sartorius BS 124 S, spoon, oil tissue, plastic *polyethylene* (PE) with clips, soxhlet tube, filter paper, nylon rope, water bath brand ThermolyneHH-6 Memmert UN 55, desiccator brand Duran, porcelain saucer, and *crus* clamp.

2.2. Research ingredients

The ingredients used were milkfish obtained from the Pabean market in Surabaya, wheat flour, panir flour, spices, palm cooking oil obtained from supermarkets in Surabaya, lindur flour and n-hexana solvents.

2.3. Research design

This research was an experimental research. The experimental research was done to test the relationship between a cause and a result. This study aimed to determine the possible causal relationship by giving one or more treatments to one or more studies and comparing them to control variable that is not given treatment (Silalahi, 2010). This study employed a completely randomized design (CRD) with 4 treatments, which are the addition of 0%, 15%, 20% and 25%, each with 5 replications.

2.4. Work procedure

2.4.1. The production of lindur fruit flour

The production of lindur flour began with sorting the lindur fruit. The brownish or mature lindur fruits were chosen to be used in this research. Then, the lindur fruit was washed to remove the impurities contained in the lindur fruit.

The next step was boiling lindur fruit for 30 minutes. After the lindur was boiled and drained, it was peeled by separating the skin from the fruit. The peeled fruit was then soaked in water for 24 hours in which soaking water will be changed every 6 hours. Soaking was done to reduce the levels of tannins found in lindur. After soaking, lindur fruit was then cut into small pieces or chopped in order to reduce the surface so that it can dry evenly during the drying process.

The pieces were then dried in the sun for ± 3 days. Drying was done to reduce water content in lindur fruit (Seknun, 2012). After drying, the lindur was grinded with a grinder to obtain a smoother result. After grinding sieve was used obtain an even smooth texture.

2.4.2 Milkfish nugget production

The production milkfish nuggets began with sorting. This was done in order to get the best quality milkfish. After that, fresh milkfish was washed and weeded to clean and facilitate processing. After washing and weeding, the flesh of milkfish was separated from the skin in filleting process. This was

done because only the flesh or meat is used to make the nugget. After fillets and skin off process, the bones were separated from the meat using a meatbone separator. Milkfish meat was minced and then 100 gr of it was mixed with flour, lindur flour, eggs, garlic, onion, pepper, salt, and sugar. After that, the mixture was steamed in 80° temperature for 30 minutes. After the mixture was steamed, then it was cut or molded and then coated using panir flour with a layer of white egg. The final step was frying the milkfish nuggets at 100° using deep frying method for 3 minutes.

2.5. Test of fat content

Testing of fat content was done after the nuggets were fried. Fat content testing employed the soxhlet method (AOAC, 2005). The fat content test was carried out by weighing about 2 grams of nuggets which was spread over cotton on a filter paper and rolled into the thimble then put into soxhlet flask. Extraction process was carried out for 6 hours with 150 ml of fat solvent in the form of hexane. The results of fat extraction were dried in an oven for 1 hour at a temperature of 100ºC. Calculation of fat content followed the formula:

$$\% \text{ fat} = \frac{⬚⬚}{⬚} \text{ x } 100\% \tag{1}$$

Description:
A: Weight of empty flask (g)
B: Sample weight (g)
C: Weight of the flask and extracted fat (g)

2.6. Organoleptic test organoleptic

Observation is a way of determining the quality of nugget products by using the five senses. Organoleptic tests include four parameters, color, aroma, taste and texture. This is due to the level of consumer preference that is assessed by taste, smell, color, and mouth stimulation. According to SNI 7758: 2013 concerning fish nugget, there are 4 parameters, which are appearance, smell, taste, and texture. The appearance parameters consist of value 9 (dry bread flour layer, product-specific brilliance), 7 (dry product, less brilliant in specific for the product), 5 (breadcrumbs slightly wet, slightly dull), and 3 (wet, dull bread flour layer). Odor parameters consist of a value of 9 (less product specific), 7 (less product specific strength), 5 (musty), and 3 (sour and rancid). Taste parameters consist of 9 (product specific strength), 7 (less product specific strength), 5 (slightly sour), 3 (sour), texture parameters consisting of 9 (solid, compact), 7 (rather dense, rather compact), 5 (slightly soft), 3 (soft),

The organoleptic testing has an important role as an initial detection in assessing quality to find out deviations and changes in products (National Standardization Agency, 2006). Organoleptic tests in this study used assessment sheets based on SNI 7758: 2013. The number of panelists included in this study were 30 TIHP majors that have not been trained. The nature of this test is very subjective because it only relies on the senses and the sensitivity of the panelists (Adawyah, 2011).

2.7. Data analysis

The data from the research results were analyzed using statistical calculation methods. The data were analyzed using variance or Analysis of Variance to determine the effect of each treatment on the fat content of milkfish nuggets. Follow-up test with Duncan's multiple distance test was done to find out the best treatment.

Data analysis for organoleptic test used the descriptive method. Descriptive method was a method used to describe or analyze a research result but is not used to make broader conclusions (Sugiyono, 2005).

3. Results and discussion
3.1 Results
3.1.1. Fat content

The average data on fat content of milkfish nuggets product can be seen in Table 1.

Table 1. Average product fat content of milkfish nuggets.

Treatment	Average(%) ± SD
0%	$6.75^d \pm 0, 15$
15%	$5.65^c \pm 0.16$
20%	$4.98^b \pm 0.06$
25%	$3.72^a \pm 0.11$

Description: P0 (0% Lindur Fruit Flour), P1 (15% Lindur Fruit Flour) , P2 (20% Lindur Fruit Flour), P3 (25% Lindur Fruit Flour).letter notations *superscript* Differentin the same column show a comparison between treatments with very significant differences (p <0.05).

Based on Table 1, it can be seen that the average texture value for each treatment was different. From the results of statistical analysis it was found that P0 (0% lindur fruit flour), P1 (15% lindur fruit flour), P2 (20% lindur fruit flour), and P3 (25% lindur fruit flour) were significantly different (P <0.05). The follow up test using the Duncan test was done to find out how much difference is there in the treatments. The notation d at P0 is different from the notation on P3, P2, and P1 which indicated that the addition of lindur flour affects the fat content. Likewise, the different notation in treatment P3 is a, treatment P2 b, and treatment P1 c, indicated that the concentration of flour lindur fruit has an effect on the value of fat content milkfish nuggets.

3.1.2. Organoleptic test

The average data of organoleptic test values of milkfish nuggets can be seen in Figure 1.
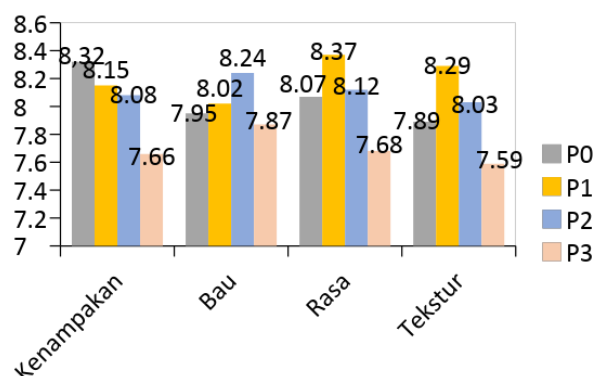

Figure 1. The graph of the average organoleptic score in appearance, smell, taste, and texture of milkfish nuggets.

The taste and texture parameters with the addition of 15% (P1) lindur flour had the highest values of 8.37 and 8.29 respectively. The value of 8.37 in the taste parameter was included in the product-specific strong category, while the value of 8.37 in the texture parameter was in the dense and compact category. This shows that the majority of panelists like the taste and texture of *nuggets* milkfish with the addition of 15% lindur fruit flour (P1). The appearance parameters with 0% (P0) lindur flour concentration had the highest value of 8.32. The value of 8.32 in the appearance parameters is in the category of dry bread flour layer, brilliantly specific products. This showed that the majority of panelists like the appearance of milkfish nuggets with the concentration of 0% (P0) lindur flour. Meanwhile the lowest value was obtained by the treatment of adding 25% lindur flour (P3) which is 7.66 which is in the category of dry bread flour, less brilliant product specifics. The odor parameter with the addition of 20% lindur flour (P2) is the treatment with the highest value of 8.24. The value of 8.24 on odor parameters is included in the product-specific strong category. While the lowest value in

the odor parameter is obtained by the treatment of adding 20% lindur flour (P3), which is 7.87 which is included in the product less specific category. This shows that the majority of the panelists favor the smell on the products *nugget* milkfish with the addition of 20% lindur flour (P2).

3.2. Discussion

Milkfish nuggets have disadvantages. During the frying process, milkfish nuggets tend to absorb a lot of oil. This is because the main ingredient in milkfish nuggets is wheat flour which contains a lot of water that tends to absorb a lot of oil during the deep frying process. Meanwhile lindur flour does not absorb much oil. This is because lindur flour contains less water than wheat flour. The results water content test of lindur flour is equal to 11.26%. It is supported by the research conducted by Sulistyawati et al. (2010) which found that lindur flour contains 8.46% water, while wheat flour contains 14% water (Fitasari, 2009). In addition, the hydroxyl group that can bind water to dough can hold some of the water that may evaporate during deep frying process so that the space left by the water gets smaller. Oil gets into the product to fill these small spaces.

Lindur fruit flour contains amylose and amylopectin. According to Bunga (2017), the amylose content found in lindur flour is 7.92% and amylopectin is 78.14%. The more amylopectin contained in a starch, the more is its ability to reduce the solubility of starch so that it absorbs a less water (Setiani, 2013). During the process of deep frying milkfish nuggets, there will be a process of water evaporation water. Milkfish nuggets containing lindur flour will absorb a little oil as a substitute for the water in evaporation process. Therefore, it can be concluded that lindur flour contains less water so it can reduce oil absorption in milkfish nugget products during the deep frying process.

Fat is specifically used to name animal oil at the temperature of the free space in either its solid and liquid form. The oil absorbed in milkfish nuggets will become fat if the nugget is at room temperature. Therefore, a fat content test is needed to determine the amount of fat content of milkfish nuggets. The more addition of lindur fruit flour, the less fat content is. When compared with the fat content of commercial milkfish nuggets which is at 19%, milkfish nuggets with the addition of lindur fruit flour contains less fat content, which is 5.65%. According to SNI 7758: 2013 concerning fish nuggets, the recommended maximum fat content is 15%. Thus it can be concluded that the addition of lindur flour can be accepted in the processing of milkfish nuggets.

The treatment without the addition of 0% (P0) lindur flour has good physical appearance, brilliant, and the color of milkfish nuggets is similar to the commercial products. This is because there is no addition of lindur flour so that the appearance of milkfish nugget is same as the nugget commercial nuggets. P0 treatment is a treatment with 100% flour concentration. According to Fitiasari (2009), proteins in wheat flour form a network that binds to each other in dough and is responsible as a component that forms viscoelastic. This makes the dough with a concentration of 100% flour more compact and good.

The color of the appearance of milkfish nugget with the addition of 25% (P3) lindur flour is more brown. This tannin content in lindur fruit flour causes lindur flour to contain a natural brown color (Baderan and Rahim, 2017). The brown color of the lindur flour affect the color of the dough milkfish nugget. The greater the content of lindur flour on a dough, the darker the color of the dough is.

Odor parameters in all treatments showed no significant differences. The scores obtained on average are at the value of 8 with product-specific strength categories. The highest score is found in P2 treatment which is equal to 8.09. While the lowest score was found in the P3 treatment, namely 8.01. Lindur flour does not have a large effect on odor. Lindur has a distinctive aroma but when processed into a product, the aroma is no longer noticeable. This is because after the processing process, especially during the heating process using high temperatures makes the lindur smell in the nugget disappear. Therefore, products with addition or without the addition of lindur flour have a aroma that is not significantly different.

Lindur flour contains 25.25 mg of tannin. Tannin gives a bitter taste in lindur (Sofro et al., 1992). But this content is volatile so it is easy to evaporate when soaked in a polar solution such as water. Hence, the bitter taste disappears along in the processing of lindur flour. Milkfish nugget with the

addition of 15% (P1) lindur flour does not have a bitter taste so that the taste of this treatment is the most acceptable treatment according to the panelists.

Based on the results of organoleptic test, the highest texture value was obtained by treatment P1 with a score of 8.05. While the lowest value was obtained in treatment P3 which was 7.97. It can be concluded that the level of hardness in P1 was well received by the panelists. Lindur fruit flour contains high amylopectin. The more amylopectin content contained in a starch, the less is the solubility of starch so that it absorbs a little water (Setiani, 2013). It can be concluded that the more lindur fruit flour added, the harder the product will be. Therefore, the product in treatment P1 is the most acceptable treatment for panelists.

4. Conclusion
Based on the results of this study it can be concluded that the addition of lindur flour in the production process of milkfish nuggets reduces oil absorption and fat content. The best treatment is products milkfish nugget with P1 treatment with fat content of 5.65%. This treatment also obtained the highest value in the organoleptic test, making it the most preferable treatment by panelists.

5. References
[1]   Adawyah, R. 2011. Processing and Preservation of Fish. Earth Literacy. Jakarta. p. 13-23.
[2]   Amalia, U. 2012. Estimation of Age Save Products of Fish Nugget with Trademark Fish Nugget "So Lite". Saintek Perikanan Journal. Faculty of Fisheries and Marine Sciences, Diponegoro University. Vol. 8. No. 1.
[3]   Anindita, ND 2017. Effect of Addition of Kappa-Carrageenan to Oil Content on *Battered-Fried Fillet Fish.* Faculty of Fisheries and Marine Affairs. Airlangga University.
[4]   Allen, JA, & Duke, NC (2006). Bruguiera gymnorrhiza (large-leafed mangrove).*Species Profiles for Pacific Island Agroforestry, Ver*,*2*.
[5]   Aprilio, I, 2010. Hazardous Cooking Articles. http: // iloaprilio. student.umm.ac.id. [Retrieved March 5, 2011]
[6]   Association of Official Analytical Chemyst (AOAC). 2005. *Official Method of Analysis of the Association of Official Analytical Chemists. Arlington: The Association of Official Analytical Chemyst, Inc.*
[7]   National Standardization Agency. 2006. Indonesian National Standards 01-2346. Fresh Fish Organoleptic Test. Jakarta: Indonesian National Standardization Agency.
[8]   National Standardization Agency. 2013. SNI 7758-2013 concerning fish nets, Jakarta.
[9]   Bouchon, P., J, M. Aguilera., And D, L. Pyle. 2003. *Structure of Oil-Absorption Relationships During Deep-Fat Frying*. Journal of Food Science Vol. 68. No. 9.
[10] Flowers, SM, Jacoeb, AM, & Nurhayati, T. (2017). Characteristics of starch from lindur and its application as edible film.*Journal of Indonesian Fisheries Research*,*20*(3), 446-455.
[11] Dhinendra, NPA, EN Dewi, and Rhomadhon. 2015. Mangrove Flour Substitution (*Bruguiera gymnorhizza*) on the Physical and Chemical Properties of Naget Kurisi Fish (*Nemipterusnematophorus*). Saintek Perikanan Journal. Vo. 11. No.1. Thing 62-71.
[12] Duke, NC, & James, AA 2006. *Bruguiera gymnorrhiza (large-leafed mangrove). Species Profi les for Pacifi c Island Agroforestry Apr.* Ver 2.I.
[13] Fitasari, E. (2009). Effect of Level of Addition of Wheat Flour to Water Content, Fat Content, Protein Levels, Microstructure, and Organoleptic Quality of Processed Gouda Cheese.*Journal of Animal Husbandry Science and Technology*,*4*(2), 17-29.
[14] Fortuna, J. 2005. Mangrove fruit was found as staple food. http://www.tempointeraktif.com (September 29, 2012).

[15] Hapsari, RD 2002. Processing of Patin Meat (*Pangasius pangasius*) Becomes Meatballs, Sausages, Nugget and Utilization of Waste to Fish Flour. Bogor: Bogor Agricultural Institute.

[16] Hoenselaar, R. 2012. *Saturated Fat and Cardiovascular Disease: The Discrepancy Between the Scientific Literature and Dietary Advice.* Institute of Medicine European Food Safety Authority Coronary Heart Disease. Vol 28. 18–123.

[17] Kim, HK, Kim, J., Lee, G., Kim, J., Choe, H., Kim, Y., Yoon and C, Kim. 2015. *Quality Evaluation of Chicken Nugget Formulated with Various Contents of Chicken Skin and Wheat Fiber Mixture.* Korean Journal of Food Science. No. 35.

[18] Ladamay, N. A & SS Yuwono. 2014. Utilization of Local Materials in Making Foodbars (Tapioca Rasio Study: Green Bean Flour and CMC Proportion). Food Journal and Agroindustry. Vol. 2 No. 1: 67-78.

[19] Mas'ud ,. F. 2011. Prevalence and Degree of Dactylogyrus sp. on Milkfish Seed Gills (Chanos chanos) in Traditional Pond, Glagah District, Lamongan Regency. Fisheries and Marine Scientific Journal Vol.3 (1); 27-39.

[20] Mellema, M. 2003. *Mechanism and reduction of fat uptake in deep-fat fried foods.* Trends in Food Science & Technology, 14: 364–373.

[21] Misra, N., Kaur, S., Tiwari, BK, Singh, N., and Cullen, P. 2015. Treatment of Wheat Flour (ACP) Treatment of Wheat Flour. *Hydrocoll Food*. 44, 115-121.

[22] Moreira, R. 1999. *Deep Fat Frying, Fundamental and Aplications.* Aspen Publishers Inc. Gaithersburg Maryland.

[23] Muntalim., F, Mas'ud. 2014. Cultivation Development and Processing Technology of Milkfish (*Chanos Chanos Forsskal*) in Lamongan Regency To Increase Added Value. Exact Journal. Vol 2. No. 1. Hal 54-68.

[24] Nurani, D., Irianto, H., & Hapsari, H. 2013. Study of the Level of Absorption of Edible Oil by Curly Peanut Flour. PATPI Journal. Indonesian Institute of Technology. Serpong.

[25] R, T. Laksmi., A, M. Legowo., And Kusrahayu. 2012. Water Strength, Ph and Organoleptic Properties of Chicken Nugget Substituted with Boiled Eggs. Animal Agriculture Journal. Vol 1. No. 1. Page 453-460.

[26] Saguy, IS, & Dana, D. 2003. *Integrated Approach to Deep Fat Frying: Engineering, Nutrition, Health and Consumer Aspects*. Journal of Food Engineering. Vol. 56. 143-152.

[27] Saparinto, C., Hidayati, D. 2006. Food Additives. Yogyakarta: Kanisius.

[28] Seknun, N. 2012. Utilization of Lindur (Fruit Flour*Bruguiera gymnorrhiza*)in Making Dodol as an Effort to Increase Value. (Essay). Bogor Agricultural Institute.

[29] Setiani, W., Sudiarti, T., & Rahmidar, L. (2013). Preparation and characterization of edible films from polybend Sukun-chitosan starch.*Journal of Chemical Valence*,*3*(2).

[30] Shih, EF, Clawson, EL and Daigle, KW 2001. *Development of Low Oil-Uptake Donuts*. Journal of Food Science. Vol. 66. Page 141-145.

[31] Sofro, ASM, Lestariana, W., Haryadi, 1992. Proteins, Vitamins and Food Additives. The Inter-University Center (PAU) of Gajah Mada University, Yogyakarta.

[32] Sugiyono. 2005. Business Research Methods. Bandung: Alfabeta.

[33] Thanatuksorn, P., Pradistsuwana, C., Jantawat, P., & Suzuki, T. 2005. *Oil and Drying in the Deep Fat Frying Process of Wheat Flour - Water Mixture, from Batter to Dough.* Japan Journal of Food Engineering. Vol. 6. No. 2. 143-14.

[34] Wanma A. 2007. Utilization of Mangrove Forests*"Bruguieragymnorrhiza* (L) Lamk asBah".an Producing Carbohydrate Wetland Conservation News. Vol. 15. No. 2: 6.