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Evaluation of the proximate quality of the combination of Tuna *(Thunnus albacares)* and white oyster mushroom *(Pleurotus ostreatus)* nuggets

H S Yufidasari, A A Prihanto, R Nurdiani and A A Jaziri

Department of Fishery Product Technology, Faculty of Fisheries and Marine Science, Brawijaya University, Jl. Veteran Malang 65145, Indonesia

E-mail: heftisalis@gmail.com

Abstract. Nugget is a processed meat product which has great market demand but need variations to increase its nutritional content. Tuna is rich in omega-3 protein, vitamins, and minerals. White oyster mushrooms have high nutritional content which are about 23-33% protein, 36-68 % carbohydrates and 12-22 % amino acids. The purpose of this research is to evaluate the chemical quality of Tuna nugget (*Thunnus albacores*) with combination of white oyster mushroom (*Pleurotus ostreatus*). Complete Randomized Design (RAL) with parameters of Tuna and white oyster mushroom formulation, TJ1 (70 % Tuna: 30 % white oyster mushroom), TJ2 (50 % Tuna: 50 % white oyster mushroom), TJ3 (30 % Tuna: 70 % white oyster mushroom), and Control or K Treatment (100 % Tuna) is used. Results of Tuna nuggets with white oyster mushroom combination showed the highest value of water content in TJ3 50.14 %, protein K 19.6 %, fat TJ3 22.98 %, ash K 3.99 % and 2.47 % crude fiber. From these results, there is a need for further research on fat, ash and coarse fiber content that is used in the manufacture of fish nuggets combined with oyster mushrooms because it failed to meet Indonesian National Standard (SNI).

1. Introduction

Fish nugget is an alternative for fish processing with the aim to extend the durability of fish, it also increases the added value in fish marketing. There are many processed fish products.Nuggets isa type of product which is processed by crushing meat-based materials, steamed and then fried. Nuggets can be stored in the form of frozen food [1]. Tuna *(Tunnus albacores*) is a marine fish that has a high protein content at approximately 22 gr / 100 gr of meat. Tuna is also rich in omega 3, vitamins and minerals [2].

The processing of meat into nuggets needsother ingredients. White oyster mushroom (*Pleurotus ostreatus*), can be used as a filler in the manufacturing of the nuggets. The white oyster mushroom is a type of wood mushroom that can be consumed or falls into the category of edible mushroom. White oyster mushrooms contain high protein, fat, fiber, amino acids, and minerals. Based on dry weight, it contains 23-33 % protein, 36-68 % carbohydrates, 12- 22 % amino acids and 3.3-4.7 % fats, which is lower than beef [3].

Chicken nuggets that were substituted up to 50 % with oyster mushrooms have met the standards of protein and water content [4]. Other results explained that the best treatment of white oyster mushroom nuggets was obtained from 100 gr white oyster mushrooms, 25 gr fish, and 15 gr fluor. The

making of nuggets with Tuna formulations (*Tunnus albacores*) and different white oyster mushrooms are new innovations in the manufacture of foodstuffs. The formulation of Tuna and white oyster mushrooms is expected to increase the quality of nuggets produced, including the texture, taste, aroma and nutrition of the nugget. The high nutrient content and texture of the fish meat is dense and soft in texture, while the texture of white oyster mushrooms is good with a similar texture to chicken meat. This is the main reason in the selection of these materials.

2. Methodology

This research used the experimental method with Complete Randomized Design (CRD), one factor, 4 treatments and 3 replications.The formulation of the Tuna and white oyster mushroom were: TJ1 (70 % Tuna: 30 % of white oyster mushroom), TJ2 (50 % Tuna: 50 % of white oyster mushroom), TJ3 (30 % Tuna: 70 % of white oyster mushroom), and Control or K Treatment (100 % Tuna).

2.1. Procedure of research

The process of making oyster mushroom nuggetsbegan with the washing of the white oyster mushrooms to clean them and then steaming them with bay leaves to remove any unpleasant flavors, then mashed. The Tuna meat was washed and milled. Two pieces of white bread were soaked in milk, then stirred until smooth. One tablespoon of margarine was melted to sauté 25 grams of onion and 2 cloves of garlic that werefinely blended.

Minced Tuna meat, mashed white oyster mushrooms, sautéed onion, ½ teaspoon pepper, ½ teaspoon salt, 20 g carrot, and one egg were mixed until homogeneous. The dough was poured into a pan that was smeared with margarine and steamed for 15-20 minutes. After cooling down, the dough was cut to 5 cm x 3 cm x 1 cm in size and then was proceeded with the coating process. The cut dough was covered with whiteegg and breadcrumbs and then fried.

2.2. Parameters of test

The test parameters used in this study were proximate quality (water content, protein, fat, ash and crude fiber tests) following the standard method.

3. Result and Discussion

This study aims to determine the proximate quality of the Tunanugget formulation with the white oyster mushroom substitution by testing its moisture, protein, fat, ash and fiber. The main raw materials in this study were Tuna *(Tunnus albacores)* and white oyster mushroom *(Pleurotus ostreatus)* which can be seen in figure 1.

Figure 1. Tuna (A) and white oyster mushroom (B)

Figure 2. Nugget Tuna Substitute with White Oyster Mushroom (TJ1 = Tuna 70 %, Oyster Mushroom 30 %; TJ2= 50 % Tuna, 50 % Oyster Mushroom; TJ3 = 30 % Tuna, 70 % Oyster Mushroom and K = Control, 100 % Tuna fish).

Figure 2 showed that there is no difference in the physical appearance of the four treatments, because the coating and the frying processeswere the same. The coating of the nugget product is to attract the attention of the consumer [1], which describes that the sensory nugget characteristic depends on the coating technique.

3.1. Water content

Water in food acts as a solvent of some components in addition to acting as a reagent, while water forms can be found as free water and bound water. Free water can easily disappear such as in the case of evaporation or drying, whereas bound water is difficult to be liberated in such a manner. The result of water analysis depicted in table 1.

Table 1. Results of test water content of Tuna nugget with white oyster mushroom substitutions.

Treatments	Repetition (%)			Total(%)	Average(%)
	1	2	3		
TJ1	51.29	48.19	49.74	149.22	49.740*
TJ2	49.54	50.05	49.79	149.38	49.793
TJ3	49.95	50.33	50.14	150.42	50.140**
K	46.19	53.16	49.68	149.03	49.677
				598.05	

*Note: * lowest water content,** the highest water content*

From the water content test, it was found that the highest water content was in the TJ3 treatment (30 % Tuna meat and 70 % g of white oyster mushroom) at 50.14 %. The lowest water content was showedin the control treatment (100 % Tuna meat) at 49.68 %.

3.2. Protein content

The result of protein content can be seen in table 2.

Table 2. Results of protein content of Tuna nugget with white oyster mushroom substitution.

Treatments	Repetition (%)			Total (%)	Average (%)
	1	2	3		
TJ1	17.45	18.46	17.96	53.87	17.96**
TJ2	16.4	17.27	16.84	50.51	16.84
TJ3	15.44	16.2	15.82	47.46	15.82*
K	19.12	20.08	19.6	58.8	19.6
				210.64	

*Note: * lowest protein content,** the highest protein content*

From the test of protein content, it was found that the highest protein content was in the K treatment (100 % Tuna meat and 0 % white oyster mushroom) at 19.6 %. The lowest protein content was found in the TJ3 treatment (30 % Tuna meat and 70 % white oyster mushroom) at 15.82 %.

3.3. Fat content

The fat content test results can be seen in table 3.

Table 3. Results of fat content of Tuna nugget with white oyster mushroom substitution.

Treatment	Repetition (%)			Total (%)	Average (%)
	1	2	3		
TJ1	21.45	23.26	22.36	67.07	22.36*
TJ2	22.04	23.75	22.9	68.69	22.90
TJ3	22.18	23.77	22.98	68.93	22.98**
K	20.64	22.18	21.41	64.23	21.41
				268.92	

*Note: *lowest fat content, **highest fat content*

From the fat content test, we found that the highest fat content was in the TJ3 treatment (30 % Tuna meat and 70 % white oyster mushroom) at 22.98 %. The lowest fat content was found in the K treatment (100 % Tuna meat and 0 % white oyster mushroom) at 21.41 %.

3.4. Ash content

The ash content test results can be seen in table 4.

Table 4. Results of ash content of Tuna nugget with white oyster mushroom substitution.

Treatment	Repetition (%)			Total (%)	Average (%)
	1	2	3		
TJ1	3.52	3.72	3.62	10.86	3.62**
TJ2	3.37	3.54	3.46	10.37	3.46
TJ3	3.1	3.27	3.19	9.56	3.19*
K	3.9	4.09	3.99	11.98	3.99
				42.77	

*Note: *lowest ash content, **highest ash content*

The ash content test found that the highest ash content was in the K treatment (100 % Tuna meat and 0 % white oyster mushroom) at 3.99 %. The lowest fat content was found in the TJ3 treatment (30 % Tuna meat and 70 % white oyster mushroom) at 3.19 %.

3.5. Crude fiber content

The crude fiber content test results can be seen in table 5.

Table 5. Results of crude fiber content of Tuna nugget with white oyster mushroom substitution.

Treatment	Repetition (%)			Total (%)	Average (%)
	1	2	3		
TJ1	0.9	0.95	0.93	2.78	0.93
TJ2	0.53	0.56	0.55	1.64	0.55
TJ3	0.83	0.87	0.85	2.55	0.85
K	2.41	2.53	2.47	7.41	2.47
				14.38	

From the crude fiber content test we found that the highest crude fiber content was in the K treatment (100 % Tuna meat and 0 % white oyster mushroom) at 2.47 %. The lowest protein content was found in the TJ2 treatment (50 % Tuna meat and 50 % white oyster mushroom) at 0.55 %.

3.6. Discussion

The results of the variation analysis on the nugget water content showed thattheTuna nugget with white oyster mushroom combinationslightly affecting ($P < 0.05$) to all treatments. However, the water content value when compared with the standard in SNI 7758: 2013 still shows a decent range of production, where the SNI standard of maximum water content for nuggets is 60 %. The value of water content will increase along with the addition of the oyster mushroom substitution. Oyster mushrooms have a higher amount of water content in a fresh state which is 90.97 % [5].

The results of the variation analysis of the nugget protein content showed that the Tuna with white oyster mushroom combinationnugget gave a very real effect ($P > 0.01$) to all treatments. The percentage of Tuna use in the nuggets manufacturedwas decreased until 30 % in line with the increase rate of the mushroom mixture to 70 %. This can affect the value of protein content in the nuggets because Tunais the ingredient that is thesource of protein, while the added oyster mushroom has a lower protein content than chicken meat protein, thus reducing the protein content in the nuggets.

Tuna protein content is 22-24 % per 100 grams of meat [3]. Oyster mushrooms have lower amounts in fresh state at 2.67 % per 100 grams [5]. This is in line with the results of the study [4], which stated that the results of the chicken nugget protein content showed decreased levels whensubstituted with white oyster mushrooms; the higher the amount of oyster mushrooms in the chicken nuggets,the lower the protein content. However, the value of protein content when compared with the standard level of protein of nuggets in SNI 7758: 2013 still shows a decent range of production, where the SNI standard level of protein for nuggets is at least 12 %.

The results of the variation analysis of fat content showed that Tuna with combined white oyster mushroom nuggets did not give a significant difference of influence ($P < 0,05$). The addition of oyster mushroom in the nugget will decrease the fat content of the Tuna until 30 % in line with the increase of mushroom mixture to 70 %. Thus, the fat content in the fish meat and oyster mushrooms will affect the fat content of the fish - mushroom nugget. The fat content of Tuna meat is 2.7 % per 100 grams [2], in fresh state the oyster mushroom have a lower amount of fat content at 0.33 grams per 100 grams [5]; hence the higher the percentage of mushrooms mixed into thedough, the lower the fat content of the chicken nuggets will be. Moreover, the fat content results compared to the SNI 7758: 2013 has still not shown a decent range of production, where the SNI standard of protein for nuggets is maximum 15 %. The high fat content of the nugget is caused by the process of frying it using the deep frying method where the material is immersed in cooking oil, which will increase fat content.

The results of the variation analysis on ash content of the nuggets showed that the Tuna with white oyster mushroomnugget combination gave a very real effect ($P > 0.01$) to all treatments. The value of ash content will decrease as the oyster mushroom composition is substituted. This is suitable with the statement of Well yalina *et.al* [6] that the use of more Tuna meat will increase the ash content in nuggets, because meat contains minerals such as phosphorus and iron;additionally,it is also affected by the result of the burning residue of added ingredients in the making of the nuggets including spices [7]. Compared to the standard ash content of nuggets in SNI 7758: 2013, it still does not show a proper production range, where the SNI standard of maximum ash contentfor nuggets is 2.5 %.

The results of the variation analysis on crude fiber content of the nuggets show that the Tuna nugget with the white oyster mushroom combination gives a very real effect ($P > 0.01$) to all treatments. The value of crude fiber content will decrease as the oyster mushroom composition is substituted. When compared to the study Warsino *et.al* [8], the crude fiber content of fresh oyster mushrooms was 3.5 % in 100 grams. Meanwhile, according to Suharjo [9], the fiber in white oyster mushrooms is 1.56 %, but its ability to bind water to white oyster mushroom is not as good as chicken meat so that its substitution on chicken meat is limited.

4. Conclusion

The results of the quality evaluation of Tuna nuggets substituted with white oyster mushroom showed that the highest water content was found in the TJ3 treatment (30 % Tuna meat and 70 % white oyster mushroom) which measured at 50.14 %, while the lowest was found in the control treatment (100 % Tuna meat) at 49.68 %. The protein content test results showed that the highest level was found in the treatment of K (100 % Tuna) at 19.6 % and the lowest in the TJ3 treatment (30 % Tuna meat and 70 % white oyster mushroom) at 15.82 %. The highest level of fat content was found in the TJ3 treatment (30 % Tuna meat and 70 % white oyster mushroom) at 22.98 %,while the lowest was found in the K treatment (100 % Tuna) at 21.41 %. The highest ash content result was obtained in the treatment of K (100 % Tuna) measured at 3.99 % and the lowest was in the TJ3 treatment (30 % Tuna meat and 70 % white oyster mushroom) at 3.19 %. From the test of crude fiber content, the highest results were measuredin the K treatment (100 % Tuna) which was 2.47 %. The lowest crude fiber content was in the TJ2 treatment (50 % Tuna meat and 50 % white oyster mushroom) at 0.55 %. Therefore, the best quality nugget formulation of Tuna and white oyster mushroom was found in the TJ2 treatment (50 % Tuna: 50 % white oyster mushroom).

5. References

[1]. Chen S D, Chen, Chao and Lin 2009 *J.Food Eng*. **95** 59–364.
[2]. Departement of Health, education and walfare 1972 Food composition for use in east Asia. USA.
[3]. Suriawiria U 2002 *Oyster mushroom cultivation* (Jogjakarta:Yayasan kanisius) (In Indonesia)
[4]. Laksono MA 2012 *Anim. Agri. J.***1** 692
[5]. Muchtadi T R 1990 *Preservative technology of earl mushrooms* (*Pleuratus ostreatus*) (Bogor : Bogor Agricultural Institute) (In Indonesia)
[6]. Wellyalina F, Azima and Aisman 2013 *J. Food Tech. Appl.* **1** (In Indonesia)
[7]. Afrianti L H 2013 *Food preservation technology* (Jakarta : Penerbit Alfabeta) p 260 (In Indonesia)
[8]. Warisno and Dahana 2010 *Oyster, sowing mushrooms, reap rupiah* (Jakarta : Gramedia) (In Indonesia)
[9]. Suharjo E 2008 *Mushroom cultivation with cardboard media* (Jakarta : Agro Media Pustaka) (In Indonesia)