Food ScienTech Journal Vol. 1 (1) 2019 ISSN : 2685-4279 DOI: 10.33512/fsj.v1i1.6194

ANALOGUE SAUSAGE FORMULATION OF TEMPEH-WHITE OYSTER MUSHROOMS *(Pleurotus ostreatus)* WITH THE ADDITION OF CARRAGEENAN

Septi Rohmawati, Akhmad Mustofa*, Yannie Asrie Widanti

Department of Agricultural Product Technology, Faculty of Food Technology and Industry, Universitas Slamet Riyadi
Jalan Sumpah Pemuda 18 Kadipiro, Surakarta 57136
*E-mail: garadaiva@gmail.com

ABSTRACT

Sausage is a food product that is processed as a variety of food. Tempeh and white oyster mushroom (*Pleurotus ostreatus*) contain many nutrients needed by the body. In addition, carrageenan also contributes to the nutritional content of the product. This research was conducted to determine the chemical and sensory characteristics of sausage that are rich in fiber and received by consumers. This study used completely randomized design method (CRD) which consists of two factors. The first factor was the substitution of tempeh and white oyster mushroom with a ratio of 50:100; 75:75; 100:50. The second factor was the addition of carrageenan, including 4, 6 and 8 g. The chosen ratio was the treatment of a comparison of 75 g of tempeh and 75 g of white oyster mushroom with the addition 6 g of carrageenan. The chemical properties of the analogue sausage was: 14% protein, 11.22% fat, 44.24% moisture, 6.02% crude fiber, 2.37% ash and 27.29% total carbohydrate. While for sensory test color was 2.96 (light brown), flavor of tempeh 2.45 (enough flavor), flavor of mushroom 1.74 (enough flavor), texture 2.55 (chewy enough) and overall preference 2.45 (most preferred).

Keywords: Carrageenan, sausage, tempeh, white oyster mushroom

INTRODUCTION

Sausages have been created from both meat and fish, as the main ingredients. But behind the delicacy, it turns out that sausages can have a negative impact on health like high cholesterol. According to Sabudi (2016), meat sausage is not good if consumed in excess, as it has much fat in the process of making that it can accumulate cholesterol in the body which is able to cause various kinds of diseases. Therefore sausages are developed with the main non-animal ingredients so that it has enough nutrients to consume which is good for consumers as it does not has bad impact for highly consuming it.

Tempeh is a food that has a fairly good nutritional content. Tempeh has a high protein and isoflavone that good for health. Tempeh is a soy-based food that has a high protein as one of the content, which is good for body. Tempeh is easily obtained at a relatively cheap price. Some of the important components in tempeh that are beneficial to health are amino acid, unsaturated fatty acids, and isoflavones (Haron *et al*., 2009). Some of the benefits of tempeh are low in fat, so it is good for diet, fiber content that is good for digestion, and lowers blood lipids.

Oyster mushrooms have a delicious taste, good nutritional value, and beneficial to health. White oyster mushrooms have high protein content, according to Djarijah and Djarijah (2001), white oyster mushrooms have a protein content of 10.5-30.4%. The results of the Schneider *et al*., (2011) study shows that consuming 30 grams of oyster mushrooms for 21 days would have a positive effect on blood lipid profiles.

Carrageenan is a seaweed resin extracted with water or an alkaline solution of certain species from the class of Rhodophyceae (red algae). It is known that the content of seaweed fiber is around 33.50% dry weight (Hernawati *et al*., 2013). The substitution of oyster mushroom-tempeh will affect the level of food fiber in sausage analogues of oyster mushroom-tempeh. The application of adding carrageenan in making tempeh sausages is to be an emulsifier and also expected to contribute as a source of fiber. This study is conducted to examine the effect of carrageenan concentration and substitution of oyster mushroom-tempeh on food fiber content so that the analogue sausage of oyster mushroom-tempeh can produce the best characteristic. Test parameters include protein content, fat content, moisture content, ash content, crude fiber content, total carbohydrate content and sensory include color, tempeh flavor, oyster mushroom flavor, texture, and overall preference.

MATERIALS AND METHODS

Tools and Materials

Supporting cooking utensils, mortars, spatulas, Shimadzu AUX 320 digital scales, crucibles, hypertherm muffins, memmert oven, laboratory fume hoods, desiccators, electric stove, distillation flask, condenser, electrothermal, kjeldahl pumpkin, pipette measuring, erlenmeyer, waterbath, soxhlet tube, clamp, filter paper.

Tempeh, oyster mushroom from farmer in Sragen middle of Java, carrageenan, seasoning, sulfuric acid, aquadest, sodium hydroxide, hydrochloric acid, petroleum ether, xylene, anti-froth, asbestos, potassium sulfate, and alcohol 95%.

Methods

Experimental Design

This study uses factorial completely randomized design with two factors: Ratio of tempeh with white oyster mushrooms (50:100; 75:75; 100:50 g) and the addition of carrageenan (4; 6; 8 g), it is obtained 9 combination treatment of each treatment with duplicates. The data obtained are analyzed by variance test at a significant level of 0.05. If there is a significant difference continued by the Tukey Test to find out the significant difference between treatments at a significance level of 5%.

Sausage Production

Tempeh was diced and weighed according to treatment (50; 75; 100 g). The mushrooms were sorted and weighed according to treatment (100; 75; 50 g) and then blanched it for 5 minutes. Tempeh and white oyster mushrooms were mashed using food processor. White tempeh and oyster mushrooms then mixed with 1.5 g sugar, 1.5 g salt, 1.5 g pepper powder, 0.5 g coriander powder, 2 g garlic, 0.5 g nutmeg powder, 5 g vegetable oil, and ice water 7 g. Mixed ingredients were added with carrageenan according to the treatment (4, 6, and 8 g). Materials were put into the sausage sleeve and steamed it for 30 minutes. Sausages were ready to be served.

Data Analysis

The analysis consisted of chemical and organoleptic analysis. Chemical analysis were protein content (Sudarmadji *et al*., 1997), fat content (AOAC, 1995), water content (Baedhowie and Pranggonowati, 1982), crude fiber level (Apriyantono *et al*., 1989), ash content (Sudarmadji *et al*., 1997), and total carbohydrate levels by difference (Kartika *et al*., 1988). Organoleptic analysis of the scoring test method (Kartika *et al*., (1988) consisted of color, tempeh and mushroom flavor, texture, and overall preference.

RESULTS AND DISCUSSION

Chemical Analysis

Chemical analysis results are shown in Table 1. It consists of protein, fat, water, crude fiber and ash content.

a. Protein Content

The lowest protein content was found in the treatment of the ratio of 100 grams tempeh and 50 grams white oyster mushroom with the addition of 4 grams of carrageenan which was 13.138%. The highest protein content was found in the treatment of 50 grams of tempeh and 100 grams of white oyster mushroom with 8 grams of carrageenan addition that is 16.161%. The sausage formulation containing much of white oyster mushrooms had higher protein content than the sausage formulation which contain a little white oyster mushroom. This is because the oyster mushroom protein is higher than the protein in tempeh. The

ingredients for making sausages also affect the sausage protein content.

According to Hudaya (2008), carrageenan protein content is 1.26% and according to Witanto (2013) carrageenan protein content is 2.27%, more than the tapioca flour protein content of 0.5-0.7%. This research of tempeh-oyster mushroom sausage had lower protein content than the Ambari study (2013) which stated that tempeh sausage made with the addition of 20% oyster mushrooms had a protein content of 14.67%. It is also known from the study that the more mushroom added, the higher the protein content. This is in accordance with the results of oyster mushrooms study in the treatment of making sausage in which the higher ratio of mushroom, the more the protein content will be. This protein content of tempeh – white oyster mushroom sausage meet national Indonesian standard (SNI) 01-3820-1995 which was over 13%.

b. Fat Content

The lowest fat content is found in the treatment of 50 gram tempeh and 100 gram oyster mushroom with the addition of 8 gram carrageenan of 9,642%, the highest fat content is found in the treatment of 100 gram tempeh and 50 gram white oyster mushroom with the addition of 4 grams carrageenan 14,971%. According to Suryati (2010) the fat content in oyster mushroom ranged from 1.08-9.4%, whereas according to Cahyana *et al.,* (1999) the fat contained in tempeh is 8.8 grams. The ingredients of sausage making that contribute to the fat content of sausages are carrageenan and the addition of vegetable oils. Fat content in oil is 15%.

According to Karyani (2013), carrageenan contains 1.60% fat content. Hudaya (2008), stated that the fat content of carrageenan is 0.13%, less than the fat content of tapioca flour which is 0.2%. The results of the study are smaller than Simanjuntak *et al*. (2016) which stated that in the treatment of mushroom:tempeh as much as 75:25, the fat content is 15.283%, and it is stated that the more tempeh added, the fat content would increase.

c. Water Content

Water in food will effect the damage to the food. Tabrani (1997) said that food damage is caused by chemical, microbiological, enzymatic processes or a combination of them. All three processes require water. The lowest water content is found in the treatment of 100 grams tempeh and 50 grams of white oyster mushroom with the addition of 8 grams carrageenan which is 38.768%, the most water content is in the treatment of 50 grams of tempeh and 100 grams of white oyster mushroom with the addition of carrageenan 61.099%. The more oyster mushrooms, the higher the sausage water content. According to the analysis of Agro Industry Center / BBIA (2014) the oyster mushroom water content is 91.8%, and the tempeh water content is 43.30% (Bastian *et al*., 2013).

d. Crude Fiber Content

The lowest crude fiber content is in the treatment of 100 grams of tempeh and 50 grams of white oyster mushroom with the addition of 4 grams of carrageenan which is as much as 5.435%, while the highest content of fiber content is in the treatment of 50 gram tempeh and 100 gram white oyster mushroom with the addition of carrageenan 8 gram which is as much as 6.787%. The more mushrooms will increase the fiber content. In addition, carrageenan also contributes to increase the fiber content in sausage. Hernawati *et al*., (2013) also stated that the addition of carrageenan could increase the fiber content of a product. Larasati *et al*., (2017), said that the addition of carrageenan had no significant effect ($\alpha > 0.05$) on sausage fiber content. carrageenan fortification of 0% is 0.06%, carrageenan fortification of 2% is 0.12%. The fiber content obtained from the analysis of white oyster mushrooms sausage was in accordance with Ambari's *et al*. (2014) which stated that the Independent sample t-test result showed that the crude fiber content of selected sausage formula was significantly different ($\alpha < 0.05$) with fiber content. This indicates that the addition of oyster mushrooms can significantly increase crude fiber levels in the final sausage product.

e. Ash Content

The ash content in a food product shows the amount of mineral content. The ash content of a food can reflect the quality of a food related to the presence of certain metal contaminants (Faridah *et al*., 2006). The lowest ash content is in the treatment of 100 grams of tempeh and 50 grams of white mushroom with

the addition of 4 grams of carrageenan which is equal to 1.778%. While the largest ash content is found in the treatment of 50 grams of tempeh and 100 grams of white oyster mushroom with the addition of 8 grams of carrageenan which is equal to 3.175%. Besides, carrageenan also contains ash content, so the addition of carrageenan will affect the results of sausage ash content analysis. Karyani (2013) stated that the results of the average carrageenan ash content are 0.06%.

Table 1. Chemical properties of sausage

Ratio of Tempeh - Oyster Mushroom	Carrageenan	Chemical Test				
		Protein Content	Fat Content	Water Content	Crude Fiber Level	Ash Content
(gram)		(%)				
50:100	4	16,161^{g}	9,985^{a}	61,099^{c}	6,296^{cd}	2,624^{abc}
	6	16,187^{g}	9,860^{a}	60,312^{c}	6,414^{d}	2,835^{bc}
	8	17,707^{h}	9,642^{a}	57,476^{bc}	6,787^{e}	3,175^{c}
75:75	4	14,662^{d}	11,841^{b}	46,841^{ab}	5,769^{b}	2,316^{abc}
	6	14,877^{e}	11,223^{ab}	44,242^{a}	6,068^{c}	2,370^{abc}
	8	15,489^{f}	10,578^{ab}	44,118^{a}	6,210^{cd}	2,393^{abc}
100:50	4	13,138^{a}	14,971^{c}	40,322^{a}	5,435^{a}	1,778^{a}
	6	13,291^{b}	14,536^{c}	38,832^{a}	5,574^{ab}	1,956^{ab}
	8	13,524^{c}	13,714^{c}	38,,768^{a}	5,620^{ab}	2,158^{abc}

Note: Value with different notation in the same column has a significant differences at 5% (Tukey test)

Organoleptic Test

The most preferred sausage for consumers is the treatment of 75 grams of tempeh and oyster mushrooms of 75 grams with the addition of carrageenan 6 grams. The results of organoleptic sausage test is shown in Table 2.

Table 2. Organoleptic test results of sausage

M (gram)	R	Sensory test				
		Color	Tempeh Flavor	Mushroom Flavor	Texture	Total Preference
100:50	4	2,620	2,127^{a}	2,153	1,107^{a}	1,903
	6	2,647	2,243^{a}	1,863	1,500a	1,833
	8	2,743	2,377^{ab}	1,857	1,643^{ab}	1,580
75:75	4	2,833	2,443^{ab}	1,743	2,333^{bc}	2,057
	6	2,957	2,453^{ab}	1,743	2,553^{c}	2,453
	8	3,047	2,513^{ab}	1,657	2,707^{cd}	2,417
50:100	4	3,293	2,847^{ab}	1,517	2,910^{cd}	1,913
	6	3,507	3,097^{ab}	1,343	3,273^{de}	1,880
	8	3,560	3,467^{b}	1,223	3,853^{e}	1,823

Note:
M (Substitution of tempeh - white oyster mushroom)
R (Carrageenan)
1. Color: If the value is higher, the color is getting darker
2. Tempeh Flavor: If the value is higher, the flavor of tempeh is getting stronger
3. Mushroom Flavor: If the value is higher, the flavor of the mushroom is getting stronger
4. Texture: If the value is higher, the texture is getting thicker
5. Total Preference: If the score is higher, the panelists will like it more
Value with different notation in the same column has a significant differences at 5% (Tukey test)

a. Color

The darkest brownish color which is 3,560 is found in the treatment of 100 grams of tempeh and 50 grams of white oyster mushroom with the addition of 8 grams of

carrageenan. For the assessment of the brightest light brown color sausage of 2,620 is found in the treatment of the comparison of 50 grams of tempeh and 100 grams of white oyster mushroom with the addition of 2 grams of carrageenan. The difference in the ratio of tempeh and mushroom produces different color levels. The color formation of tempeh and white oyster mushrooms is caused by the process of caramelization and maillard reaction. Brownish color that appears is the reaction between carbohydrates and amino acids. During heating, the carboxyl group will react with amino group or peptide so that glycosylamine is formed. These components are polymerized to form dark colored components "melanoidin" which cause discoloration in the product, ie the product will become brownish (Larasati *et al*., 2017). The addition of carrageenan is also one of the factors that causes the changing color to become brownish, so that if the addition of carrageenan increases, the color of the sausage will be darker.

b. Tempeh Flavor

The panelists' assessment of tempeh flavor ranged from 2.127 to 3.467. The sausage formulation which has a very strong tempeh flavor is the formulation with a comparison of 100 gram tempeh and 50 gram of white oyster mushroom which is 3.46 while the lowest tempeh flavor is at a comparison of 50 grams of tempeh and 100 grams of white oyster mushroom which is 2.217. The more tempeh added, the tempeh flavor will be stronger. Astuti (2009) stated that the typical aroma formation in tempeh is caused by the degradation of components in tempeh during the fermentation process.

c. Oyster Mushroom Flavor

The panelist's assessment of white oyster mushroom flavor ranged from 1.57-2.153. The lowest value of white oyster mushroom flavor is found in the treatment of 100 grams tempeh and 100 grams white oyster mushroom which is 1.57, the highest rating of white oyster mushroom flavor is found in the treatment of 50 grams of tempeh and 100 grams of white oyster mushroom which is as much as 2,153. The more oyster mushrooms added, the stronger the oyster mushroom flavor. The substitution of tempeh makes the flavor of the white oyster mushroom in making sausage formulations diminish.

d. Elasticity

The texture value (elasticity) of the sausage ranges from 1,107-3,853. The lowest elasticity value is found in the treatment of 50 grams tempeh and white oyster mushroom 100 grams with the amount of carrageenan 2 grams which is as much as 1,107, while the most elastic sausage texture value is found in the sausage formulation by treating the comparison of 100 grams of tempeh and 50 grams white oyster mushroom with carrageenan 8 grams which is 3,853. The more carrageenan added, the thicker the sausage will be. The addition of tempeh will make the product solid, so that the formulation of more tempeh and a lot of carrageenan, will tend to make the sausage dense. The addition of carrageenan in large quantities results in the texture of the sausage being too hard and less liked by the panelists.

e. Total Preference

The level of panelist's preference ranged from 1,580-2,453. In Table 2, the lowest level of consumer preference is found in the treatment of a comparison of 50 grams of tempeh and 100 grams of white oyster mushroom with the addition of 8 grams of carrageenan which is 1.580, while the highest level of panelists preference for sausages is in the treatment of 75 grams of tempeh and 75 grams white oyster mushrooms with the addition of carrageenan 6 grams which is 2,453. Tempeh-white oyster mushroom Sausage formulation with the addition of carrageenan for the most preferred by panelists is the treatment of 75 grams of tempeh and oyster mushrooms of 75 grams with the addition of carrageenan 6 grams which is 2,453. On the addition 4 grams of carrageenan the preferred level is 2,057 and at the addition of 8 grams is as much as 2,417.

Panelists do not like the sausage formulation that contained too much mushroom. It may be because the white oyster mushroom has a distinctive and pungent odor. The smell of mildly fishy mushrooms is also a factor for panelists to dislike. However, in many tempeh substitutions, panelists also dislike. This is probably due to the smell and the texture of tempeh which become harder.

The difference in the addition of carrageenan gives a different level of preference, since the addition of carrageenan which slightly causes the texture of the sausage to be soft and the addition of too much carrageenan will make the sausage texture harder.

CONCLUSION

In accordance with the objectives of the study, which is to know the chemical characteristics, sensory properties, fiber-rich sausage formulations and preference by consumers, the best formulation is used in the treatment. The best result of Analogue sausage formulation of tempeh-white oyster mushrooms with the addition of carrageenan research is obtained from a combination of 75 grams of tempeh and 75 grams of white oyster mushroom and the addition of 6 grams of carrageenan. In these treatment, chemical characteristics are known; protein content 14.877%; fat content 11.223%; moisture content 44,242%; crude fiber content 6.068%; ash content 2,370%; total carbohydrate content 27.288%, while organoleptic analysis is known to be 2,957; flavor tempeh 2,453; mushroom flavor 1,743; texture (elasticity) 2,553; total preference is 2,453.

REFERENCES

AOAC, 1995. Official Methods of Analysis of The Assiciation of Official Agriculture Chemist 16th. Arlington, Virginia, USA: The Association of Official Analytical Chemist, Inc.

Apriyantono A, Fardiaz D, Puspitasari NL, Sedarnawati Y, dan Budianto S, 1989. Petunjuk Laboratorium Analisis Pangan. Bogor: Pusat Antar Universitas, Institut Pertanian Bogor.

Astuti, NP. 2009. Sifat Organolaptik Tempe Kedelai yang Dibungkus Plastik, Daun Pisang dan Daun Jati [Karya Tulis Ilmiah]. Surakarta: Fakultas Ilmu Kesehatan, Universitas Muhammadiyah Surakarta.

Baedhowie M, dan Pranggonowati. 1982. Petunjuk Praktek Pengawasan Mutu Hasil Pertanian. Departemen Pendidikan dan Kebudayaan, Jakarta.

Bastian FE, Ishak AB, Tawali M, dan Bilang. 2013. Daya Terima Dan Kandungan Zat Gizi Formula Tepung Tempe Dengan Penambahan Semi Refined Carrageenan (SRC) Dan Bubuk Kakao. *Jurnal Aplikasi Teknologi Pangan* 2(1): 5-9.

BBIA. 2014. Hasil Analisa Jamur Tiram Segar. No. 3358/ LHU/Bd/ABICAL.1/IV/2014.

Cahyadi. 2006. Kedelai Khasiat dan Teknologi. Bumi Aksara, Bandung.

Cahyana YA, Muchrodji, dan Bakrun M. 1999. Jamur Tiram: Pembibitan, Pembudidayaan, Analisis Usaha. Pustaka Grafikatama, Jakarta.

Djarijah NM, dan Djarijah AS. 2001. Budidaya Jamur Tiram (Pembibitan Pemeliharaan dan Pengendalian Hama Penyakit). Kanisius, Yogyakarta.

Faridah DN, Kusumaningrum HD, Wulandari N, dan Indrasti D. 2006. Analisa Laboratorium. Bogor: Departemen Ilmu dan Teknologi Pangan: IPB.

Haron H, Ismail A, Azlan A, Shahar S, dan Peng LS. 2009. Daidzein and Genestein Contents in Tempeh and Selected Soy Producs. *Food Chemistry* 115 (4): 1350-1356.

Hernawati W, Manalu A, Suprayogi dan Astuti DA. 2013. Suplementasi Serat Pangan Karagenan dalam Diet untuk Memperbaiki Parameter Lipid Darah Mencit Hiperkolesterolemia. *Makara Seri Kesehatan* 1 (17): 1-9.

Hudaya RN. 2008. Pengaruh Penambahan Tepung Rumput Laut Untuk Peningkatan Kadar Iodium dan Serat Pangan Pada Tahu Sumedang. [Skripsi]. Bogor: Fakultas Perikanan dan Ilmu Kelautan, IPB.

Kartika B, Hastuti P, dan Supratno W. 1988. Pedoman Uji Inderawi Bahan Pangan. Yogyakarta: Pusat Antar Universitas Pangan dan Gizi UGM.

Karyani S. 2013. Analisis Kandungan Foodgrade Pada Karagenan dari Ekstraksi Rumput Laut Hasil Budidaya Nelayan Sram Bagian Barat. *Bimafika* 4: 499-506.

Larasati K, Patang, Lahming. 2017. Analisis Kandungan Kadar serat dan Karakteristik Sosis Tempe dengan Fortifikasi Karagenan Serta penggunaan Tepung Terigu Sebagai Bahan Pengikat. *Jurnal Pendidikan Teknologi Pertanian* 3 (1): 67-77.

Sabudi S. 2016. Sosis Berbahan Dasar Tempe Kedelai. *Jurnal Gastronomi Indonesia* 4

(1). Bali : Sekolah Tinggi Pariwisata Nusa Dua Bali.

Schneider I, Kressel G, Meyer A, Krings U, Berger RG, and Hahn A. 2011. Lipid Lowering Effect of Oyster Mushroom (Pleorotus ostreatus) in Humans. *Journal of Functional Food* 3 (1): 17-24.

Sudarmadji S, Haryono B, dan Suhardi. 1997. *Prosedur Analisa untuk Bahan Makanan dan Pertanian*. Liberty, Yogyakarta.

Suryati I. 2010. Desain Proses Pengolahan Keripik Jamur Tiram Putih (Pleurotus ostreatus) dengan Menggunakan Vacuum Frying. [Skripsi]. Bogor: Fakultas Teknologi Pertanian, Institut Pertanian Bogor.

Widyastuti N, dan Istiani S. 2004. Optimasi Proses Pengeringan Tepung Jamur Tiram Putih (Pleurotus ostreatus). *Jurnal Ilmu Kefarmasian Indonesia* 2 (1): 1-4.

Winarno FG. 1997. Pangan Gizi Teknologi Dan Konsumen. Gramedia Pustaka Utama, Jakarta.

Witanto B. 2013. Pembuatan Sosis Jamur Tiram Putih (Pleurotus ostreatus Jacq.) Dan Tepung Rebung Dengan Kombinasi Tepung Tapioka dan Karagenan (Eucheuma cottonii Doty). [Skripsi]. Yogyakarta: Fakultas Teknobiologi, UAJY.