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Chemical Composition and Antioxidative Potential of Chicken Sausage with Substitution of Tempe

Jamhari[1], Yuny Erwanto[1], Listia Kusumasari Nurhanifah[1]

[1]Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia
Corresponding email: jam_hari@ugm.ac.id

ABSTRACT: The experiment was conducted to investigate the chemical composition and antioxidative potential of chicken sausage with substitution of *tempe*. The experiment used five levels of *tempe* substitution, namely 0, 5, 10, 15 and 20%, with three replications. The data observed were chemical composition, including moisture, protein and fat contents, and antioxidative potential of the chicken sausage expressing by 2,2-diphenyl-1-picrylhydrazyl (DPPH). The data were analyzed by analysis of variance of one way classification, and mean differences were tested by Duncan `s New Multiple Ranges Test. The results of the study showed that substitution of *tempe* did not affect on moisture and protein contents, but it affected on fat content ($P<0.05$). The fat content increased as increasing of substitution of *tempe*. The substitution of *tempe* also did not affect on DPPH of chicken sausage. Chicken sausage with the substitution of *tempe* up to 20% had an antioxidative potential with the DPPH range values of 20.60 to 26.81%.

Keywords: Chicken Sausages, *Tempe*, Chemical Composition, Antioxidative Potential.

INTRODUCTION

The sausage is one processed meat products are growing rapidly and popular in Indonesian society. The processed meat products have a high nutritional value. The term of sausage comes from the Latin, salsus which means salt. This refers to the terms of pieces or crushed meats preserved by salting. Along with the development of the food industry, are now starting to develop research on the making of sausages with meat combine with other foodstuffs to improve the nutritional quality of the sausages as diversification of food. Soy protein products are generally used as ingredients in the sausage product because of its functional properties that can improve the quality of sausages (Hin *et al.,* 2000).

Tempe is a fermented soybean with *Rhizopus oligosporus*. Protease enzyme produced by molds during the fermentation process of soybeans into *tempe* will degrade proteins (polypeptides) into peptides that are shorter and free amino acids. *Tempe* as traditional foods likely as potential antioxidants fights free radicals, which can slow aging and prevent degenerative diseases (atherosclerosis, coronary heart disease, diabetes mellitus, and cancer). In addition, *tempe* also has been known to contain antibacterial substances that cause diarrhea, lowering blood cholesterol, preventing heart disease, hypertension, and others.

Binding peptides between myofibrilar meat protein and soy protein with the aid of heating can improve the functional properties of foodstuffs (Feng and Xiong, 2002), including the antioxidant potential. Based on this phenomenon, research on sausage products with a combination of broiler meat and soybean is expected to be a new breakthrough for food products in Indonesia and is able to give a plus for health benefits. This study aims to determine the effect of substitution of soybean in broiler chicken meat sausage on chemical characteristics and antioxidant potential of broiler chicken meat sausage.

MATERIALS AND METHODS

Materials used in the manufacture of sausages are chicken, 36-hours fermentation *tempe*, skim milk powder, garlic, pepper, coriander, salt, water ice, sugar, starch, and the plastic casing. Materials used in the chemical composition test is distilled water, chloroform, methanol, 1M NaCl, Tris-HCl 2M, and a solution of biuret.

Tempe manufacture

Soy beans are soaked in a just boil water, then cooled until the water is warm and the skin discarded until clean. Soy beans boiled until the water frothing or soft, then discarded cooking water, then drained soybeans. After drying, soybeans transferred into the concave container or bowl. *Tempe* yeast and Sago flour were added and mixed until well blended. Mix was put into plastic and sealed. Plastic wrap pierced with the tip of a knife in both sides to get some air. *Tempe* was put into a warm place for about 36 hours.

Sausage manufacture

Manufacture of sausage was done based on the percentage of soybean are used for substitution of chicken meat. Broiler chicken meat is ground. Basic ingredients, such as meat broiler chicken sausage and *tempe* were tested on water and fat content. Analysis of water content and fat sausage formulation designed to determine the method by Morrison *et al.* (1971).

Manufacture of sausages made by substitution level of *tempe* into sausage meat chicken. 0% substitution level *tempe* into the meat used as a control. Substitution of *tempe* in this study were 5, 10, 15, and 20%. Broiler chicken meat and 36-hours fermentation *tempe* were milled, mixed with all the other ingredients, salt, garlic, pepper, skim milk powder, coriander, sugar, water ice, and tapioca flour, then chopped (crushing) during 30 minutes. Furthermore, dough was put into a plastic casing and boiled in water bath with a temperature of 80°C for 30 minutes.

Chemical composition tests

Water content was determined by the method according to graphymetrically method by AOAC (AOAC, 1970). Determination of fat content was carried by soxhlet method, by extracting the samples with chloroform:methanol solution of 2:1 (Atkinson *et al.*, 1972). The protein content was determined spectrophotometrically by Biuret method with a wavelength of 540 nm. Absorbace of samples will be compared to the absorbance of standard bovine serum albumin (Owusu-Apenten, 2002).

Antioxidant activity test

The antioxidant activity was tested on the 1,1-diphenil-2-picrylhydrazyl (DPPH) value. The DPPH value was tested spectrophotometrically with a wavelength of 517 nm (Soler-Rivas, *et al.*, 2000, cit. Rodriguez-Ambriz, 2007).

Data analysis

Chemical composition data were analyzed by variance analysis of completely randomized design (CRD). The mean treatment differences were tested by Duncan's New Multiple Ranges Test (DMRT).

RESULTS AND DISCUSSION

Cemical composition

The mean chemical composition of broiler chicken meat sausage with *tempe* substitution can be seen in Table 1.

Table 1. Mean values of chemical composition of broiler chicken sausage subtituted by *tempe*)

Variables	Substitution level of *tempe* (%)				
	0	5	10	15	20
Moisture (%)[ns]	71.2	70.94	72.33	70.24	63.17
Protein (%)[ns]	9.23	12.38	15.71	15.93	13.97
Fat (%)	3.12[ab]	2.48[a]	3.67[ab]	5.82[c]	4.88[bc]

[ns]Not significant
[abc]Different superscripts in the same row showed significant difference (P<0.05).

Moisture. The water content of broiler chicken meat sausage with *tempe* substitution was showed in Table 1. The results of statistical analyzes showed that the water content of broiler chicken meat sausage was not significantly different with different levels of substitution *tempe*. Water content in the control chicken sausage or sausage meat broiler without substitution *tempe* was 71.2% and the water content of broiler chicken meat sausage with substitution *tempe* 5, 10, 15, and 20% was 70.94, 72.33, 70.24, and 63.17%, respectively

Judge *et al.* (1989) stated that the water content of chicken broiler is approximately 73.7% and according to the SNI (1992) *tempe* had a maximum water content of 65%. In theory, increasing the level of *tempe* will reduce the water content of chicken meat sausage. However, the increasing the level of *tempe* did not decrease the water content of the sausage. This is because the meat as the main ingredient in manufacturing of sausages has a relatively high water content so that the substitution of soybean up to 10% has no contribution to lowering the water content of the sausage meat broiler meat substituted *tempe*.

Protein content. The mean protein content of broiler chicken meat sausage by *tempe* substitution was showed in Table 1. The results of the statistical analysis showed that the protein content of broiler chicken meat sausage was not significantly different with different levels of *tempe* substitution. This is because the protein content of meat and *tempe* is relatively the same. Broiler chicken meat protein was 22% (Judge *et al.*, 1989), while *tempe* contained a minimum of 20% protein (SNI, 1992). Therefore, the increase of the level of *tempe* on the sausage will have no effect on the protein content of sausage meat.

According to SNI (1995) sausage has a minimum protein content of 13%, while the research that has been conducted shows that the data on the protein content of the broiler chicken meat sausage substitute *tempe* level 0 and 5% were under the SNI, which amounted to 9.23 and 12.38%. This is because the protein content according to SNI is total protein, whereas in this study the protein content meaned is soluble protein.

Fat content. The result of the fat content of broiler chicken meat sausage with *tempe* substitution was showed in Table 1. The results of the statistical analysis showed that the fat level of broiler chicken meat sausage was significantly different with different level of *tempe* substitution. This is due to the fat content of meat and fat content of *tempe*. Increase of the *tempe* level in broiler chicken meat sausage caused increase of fat level. Data from this study showed differences in the levels of fat in each level *tempe* substitution in chicken meat sausage. Fat content in the control

sausage or sausage meat broiler without *tempe* substitution or *tempe* substitution levels 0% and 5% level of substitution *tempe* is highly significant with sausage meat broiler chicken with *tempe* 15% substitution level. The highest fat content found in broiler chicken meat sausage with *tempe* substitution level of 15% with a content of 5.82%.

Antioxidant activity

The antioxidant activity of broiler chicken meat sausage with *tempe* substitution was showed in Table 2. Broiler chicken meat sausage with *tempe* substitution levels of 0 to 20% had a number of 1,1-diphenil-2-picrylhydrazyl (DPPH) of 20 to 37%. The results showed no difference in the numbers radical scavenging activity at each level of *tempe* substitution in broiler chicken meat sausage.

Table 2. 1,1-Diphenil-2-picrylhydrazyl (DPPH) values of broiler chicken sausage subtituted by *tempe*)

Substitution level of *tempe* (%)	DPPH value (%)
0	21.42
5	20.60
10	24.19
15	36.02
20	26.81

At *tempe* are antioxidant factor II (6,7,4 trihydroxy isoflavone). These antioxidants are synthesized during the fermentation process of soybeans into *tempe* by bacteria *Micrococcus luteus* and *Coreyne bacterium*. Increased levels of substitution of soybean on broiler chicken meat sausages will increase the antioxidant activity. However, in this study increased levels of substitution of soybean on broiler chicken meat sausage did not increase antioxidant activity. This is due to increased levels of substitution of soybean on broiler chicken meat sausage did not increase antioxidants, because antioxidants in broiler chicken meat sausage substituted *tempe* not only from *tempe*, but also from the results of the digestion of meat protein peptide or protein *tempe*.

Some research suggests that protein digestion in meat and soybean will produce amino acids and peptides simple functional capabilities, ie to inhibit hypertension and as an antioxidant. Antioxidant derived from soybean *tempe* active peptides which are broken down by protease enzymes during fermentation 24 hours. During the fermentation process the protein to be broken down by protease enzymes to produce active peptides that can capture free radicals DPPH in total antioxidant activity test (Rahayu, 2009).

CONCLUSIONS

Based on the study it can be concluded that the substitution of *tempe* into sausage meat broiler slightly affects the water content and protein, but many affect the fat content. Broiler chicken meat sausage with substitution *tempe* has potential as an antioxidant, but increased levels of *tempe* not always increase antioxidant activity.

REFERENCES

AOAC. 1990. Official Methods of Analysis of the Association of Official Analytical Chemists. 15th ed., AOAC Inc., Arlington, Virginia.

Atkinson, T., V.R. Fowler, G.A. Garton, and A. Lough. 1972. A rapid method for the determination of lipid in animal tissues. Analysts, London, 97: 562-568.

Feng, J. and Y.L. Xiong. 2002. Interaction of myofibrillar and preheated soy proteins. J. Food Sci. 67: 2851-2856.

Hin, K.B.C., J.T.K. Eeton, R.K. Iller, N.T.L. Ongenker, and J.W.L. Amkery. 2000. Evalution of konjac blenz and soy-potein isolates as fat replacamant in fow fat Bologna. J. Food Sci. 65: 756-763

Judge, M.D., E.D. Aberle, J.C. Forrest, H.B. Hedrick and R.A. Merkel. 1989. Principles of Meat Scince. 2nd ed. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Morrison, G., N.B. Swebb, T.M. Blummer, and F. Jing. 1971. Relationship between composition and stability of sausage type emulsion. J. Food Sci. 36: 426.

Owusu-Apenten, R.K. 2002. Food Protein Analysis. Quantitative Effects on Processing. Marcel-Dekker Inc., New York.

Rahayu, A.. 2009. *Evaluasi pengaruh pasteurisasi dan aktivitas antioksidan tempe ampas tahu dengan penambahan bekatul.* Fakultas Teknologi Pertanian, UGM, Yogyakarta.

Rodriguez-Ambriz, S.L., J.J. Islas-Hernandez, E. Agama-Acevedo, J. Tovar, L.A. Bello-Perez, 2007. Characterization of a fibre-rich powder preparation by liquefaction of unripe banana flour. Food Chemistry, 107: 1515-1521.

SNI, 1992. *Tempe* Kedele. Standar Nasional Indonesia. SNI 01-3144-1992. Badan Standarisasi Nasional, Indonesia.

SNI, 1995. *Sosis Daging*. Standar Nasional Indonesia. SNI 01-3820-1995. Badan Standarisasi Nasional, Indonesia.