Development and texture profile of wood-ear mushroom (Auricularia auricula) sausage formulated with carrageenan

Natasya Hermawan, Andreas Romulo, Ata Aditya Wardana*

Food Technology Department, Faculty of Engineering, Bina Nusantara University, Jakarta, Indonesia 11480

* Corresponding author: ata.wardana@binus.edu, ataaditya@gmail.com

Abstract. As a food with low content of saturated fats, wood-ear mushroom can be utilized to be meat replacer of conventional sausages. The product, however, probably characterize differently compared to meat-based sausages. This research was aimed to evaluate the effect of carrageenan on texture and organoleptic properties of wood-ear mushroom sausage. Five different concentrations of carrageenan (2, 4, 6, 8 and 10%) were preliminary assessed by using hedonic test to determine three of the most preferred samples which were sausage formulated with carrageenan 2, 6 and 8%. The results showed that different concentration of carrageenan altered texture attributes and overall liking of wood-ear mushroom sausage, with 2% carrageenan formulation as the most accepted sample. The proximate composition determination resulted 8.85% moisture, 12.27% ash, 8.58% protein, 11.03% fat, and 59.27% carbohydrate. Furthermore, it was characterized by texture attributes including hardness, springiness, cohesiveness, gumminess, chewiness respectively.

1. Introduction

Sausage is one of the most famous food products in Indonesia which is based on beef or chicken and commonly packed in a casing. This protein-rich food could be differentiated into five categories; fresh, fermented sausages, smoked precooked, emulsion-type, and cooked sausages [1]. Recently, both non-meat and vegetable-substituted sausages containing lower contents of saturated fats have gained great attentions as an alternative of conventional meat sausages. Previous studies developed the various non-meat, vegetable-based and vegetable-substituted sausages such as carrot, beet, tomato, and vegetable protein [2, 3].

Edible fungi of Auricularia genus were considered as a major food source in the past. Furthermore, Auricularia species can be used as medicinal resources of various human diseases, including potential for cancer treatment [4]. Wood-ear mushroom (Auricularia auricula) is considered as a nutritious food due to its valuable nutrition as well as high fiber content (7.4 - 27.6%), high unsaturated fat (72%), and comprehensive essential amino acid [5]. It could be utilized as a sausage product diversification in term of meat replacement. Nevertheless, that may result the different characteristics compared to meat-based sausage including texture and organoleptic.

Texture is one of the main attributes of food products that can be assessed objectively by texture analyzer. For sausage products, springiness is an attribute associated with consumer’s acceptability [6]. Carrageenan, a carbohydrate complex extracted from certain red algae, is an alternative to improve
non-meat sausage texture due to its ability to form gel and increase viscosity [7]. The aim of this work was to evaluate the effect of carrageenan on texture profile and organoleptic properties of wood-ear mushroom sausage.

2. Materials and Methods

2.1. Sausage preparation

The sausages are made by mixing wood-ear mushrooms and other ingredients such as corn starch (47 ± 2%), white eggs (12 ± 1%), seasonings (20 ± 1%), and carrageenan (2, 4, 6, 8 and 10%) in food processor. The dough was then filled into plastic casings. Subsequently, the sausages were boiled for 20 minutes and cooled down before stored inside the freezer. Prior to use for analysis, the sausages were thawed for 20 minutes and were boiled for 10 minutes before served or analyzed.

2.2. Organoleptic analysis

In the preliminary test, an organoleptic hedonic analysis was done on wood-ear mushroom sausages with five different carrageenan concentration (2, 4, 6, 8 and 10%). After three of the most preferred samples were obtained, simple ranking test was then conducted on the colour, aroma, taste, texture, after taste and overall liking of sausages. The 27 untrained panelists scored the products according to 1-9 level scale and 1-3 degree of likeness for hedonic and simple ranking test respectively.

2.3. Texture profile analysis

Texture characteristics were analyzed using Stable Micro Systems TA-XT Plus texture analyzer to determine the hardness, springiness, cohesiveness, gumminess and chewiness of samples. A Software Exponent Lite with compression probe of 75 mm diameter, pre-test speed of 2 mm/s, test speed of 0.5 mm/s, post-test speed of 10 mm/s, strain of 25%, trigger force of 5 g was employed in this analysis.

2.4. Proximate analysis

The proximate analysis of the sausages including moisture, ash, protein, and fat contents were determined referring to National Standardization Agency of Indonesia (BSN) (1992) [8]. Briefly, moisture content was measured by calculating lost water of samples dried at 105°C until a constant weight. Ash content was determined by counting the remaining non-organic compounds after the samples were burned to ash. Kjeldahl procedure was used to estimate the crude protein content of the samples. Fat content was calculated by extraction method using Soxhlet with n-hexane as the solvent. Lastly, carbohydrate determination was done using by difference method.

2.5. Statistical analysis

The results were statistically analyzed by using analysis of variance (ANOVA) and Tukey as the post-hoc test with 5% significance level. Moreover, the results of ranking test were evaluated statistically using Friedman and Wilcoxon Signed-Rank as the post-hoc test with 1.7% significance level employed in SPSS software version 16.0.

3. Results and Discussion

3.1. Texture characteristics

Among five samples in preliminary test, only three samples with the best acceptable texture, which were 2, 6 and 8%, were further characterized for the texture profile. Hardness, springiness,
Cohesiveness, gumminess and chewiness of the samples were assessed using texture analyzer. In general, the results showed significant differences in texture profile analysis. These differences could be associated to the hydrocolloid addition which affect their binding ability and water holding capacity.

The hardness, gumminess, and chewiness of the samples increased along with the higher level of carrageenan (Figure 1 and Figure 2). Hardness is the force needed to pierce the sample into certain depth, where the hardness force could change variably depending on the contact of the sample and the probe, along with the pressure given by the instrument [10]. The increase of hardness is probably due to carrageenan’s functions as a gelling and thickening agent, which indicated that more addition of carrageenan in a product increased the solidity of the product. Previous work revealed that hardness could be increased by improving gel strength of protein when increasing carrageenan [11, 12]. Also, the larger amount of carrageenan produces more solid sample, and thus more force is needed to break the samples representing its gumminess and chewiness properties [5]. Sample with 6% carrageenan resulted the greatest value for springiness and cohesiveness parameters. This can be due to the inconsistent waiting time of the two strokes, as springiness represents the time needed by a pressed sample to its original shape, while cohesiveness is known as gel strength, represents the intermolecular energy of the samples [9,10]. Similar result also showed that the addition of κ-carrageenan could increase the cohesiveness and chewiness of low-fat frankfurters [13].

Figure 1. Force-time curves on sausages formulated with carrageenan (a) 2%, (b) 6%, (c) 8%.
Figure 2. Texture profile of wood-ear mushroom sausage. Data entries followed by different letters differ significantly.

3.2. Simple ranking test

The simple ranking test was done to select the best treatment referring to the consumer’s preferences. Six organoleptic parameters were evaluated including colour, aroma, taste, tenderness, after taste, and acceptability. Table 1 exhibited that there was no significant difference among the products for their colour, aroma, taste, tenderness and after taste. Acceptability parameter, however, showed that sausages with 2% carrageenan were the most acceptable, followed by products containing 8% and 6% carrageenan.

| Parameters   | 2%  | 6%  | 8%  |
|--------------|-----|-----|-----|
| Colour       | 2.12±0.84<sup>a</sup> | 2.23±0.76<sup>a</sup> | 1.65±0.76<sup>a</sup> |
| Aroma        | 2.00±0.74<sup>a</sup> | 2.00±0.89<sup>a</sup> | 2.00±0.84<sup>a</sup> |
| Taste        | 1.54±0.77<sup>a</sup> | 2.19±0.76<sup>a</sup> | 2.27±0.75<sup>a</sup> |
| Tenderness   | 1.77±0.82<sup>a</sup> | 1.96±0.86<sup>a</sup> | 2.27±0.72<sup>a</sup> |
| After taste  | 1.92±0.81<sup>a</sup> | 1.96±0.79<sup>a</sup> | 2.12±0.87<sup>a</sup> |
| Acceptability| 1.46±0.76<sup>b</sup> | 2.32±0.70<sup>c</sup> | 2.23±0.73<sup>bc</sup> |

Data entries of the same row followed by different letters differ significantly.
3.3. Proximate composition

The most preferred and acceptable sample was further analyzed for its proximate content representing in Table 2. The selected product contained water of 8.85% which was probably free water, unbonded with carrageenan. As for the protein content, it is considered lower than a normal meat-based sausage. This is because of the main ingredient for the product, wood-ear mushroom, has a lower protein compared to meat. Moreover, the highest of the proximate content of wood-ear mushroom sausage was carbohydrate (59.27%).

Table 2. Proximate content of wood-ear mushroom sausage with 2% carrageenan

| Parameter       | Content (%) |
|-----------------|-------------|
| Water           | 8.85        |
| Ash             | 12.27       |
| Protein         | 8.58        |
| Fat             | 11.03       |
| Carbohydrate    | 59.27       |

4. Conclusion

The new product development namely wood-ear mushroom sausage was successfully prepared by formulating with various carrageenan concentration (2, 6 and 8%). The results of this study revealed that the addition of carrageenan affected some texture characteristics in which the higher level of carrageenan, the greater value of the hardness, gumminess, and chewiness of the samples become. Furthermore, addition of 6% carrageenan exhibited the highest springiness and cohesiveness value. According to the ranking test, it was selected that sausage with 2% carrageenan was the most preferred by panelist containing 8.85% moisture, 12.27% ash, 8.58% protein, 11.03% fat, and 59.27% carbohydrate.

References

[1] Abdolghafour B and Saghir A 2014 Development in Sausage Production and Practices-A review Sausage Production : Ingredients and Raw J. Meat Sci. Technol. 2 40–50
[2] Burri S, Tato I, Nunes M L and Morais R 2011 Functional Vegetable-Based Sausages for Consumption by Children Food Nutr. Sci. 2 494–501
[3] Hidayat B T, Wea A and Andriati N 2018 Sausage Substituted with Texturized Vegetable Protein Food Res. Int. 2 20–31
[4] Wu F, Yuan Y, Malysheva V F, Du P and Dai Y C 2014 Species Clarification of the Most Important and Cultivated Auricularia mushroom “Heimuer”: Evidence from Morphological and Molecular Data Phytotaxa 186 241–253
[5] Kadnikova I A, Costa R, Tatiana K K, Guruleva O N and Yanguo S 2015 Chemical Composition and Nutritional Value of the Mushroom Auricularia auricula-judae J. Food Nutr. Res. 3 478–82
[6] Paula A M and Conti-Silvia A C 2014 Development in Sausage Production and Practices – A Review J. Food Eng. 121 9–14
[7] Necas J and Bartosikova L 2013 Carrageenan: A review Vet. Med. (Praha). 58 187–205
[8] National Standardization Agency of Indonesia 1992 Indonesia National Standard 01-2891-1992 Test Methods for Foods and Drinks. Jakarta: National Standardization Agency of Indonesia
[9] Gupta R K, Sharma A and Sharma R 2007 Instrumental Texture Profile Analysis (TPA) of Shelled Sunflower Caramel Snack Using Response Surface Methodology Food Sci. Tech. Int. 13 455–460
[10] Nishinari K, Kohyama K, Kumagai H, Funami T and Bourne M C 2013 Parameters of Texture Profile Analysis Food Sci. Technol. Res. 19 519–521

[11] Foegeding E A and Ramsey S R 1987 Rheological and Water Holding Properties of Gelled Meat Batters Containing Iota Carrageenan, Kappa Carrageenan or Xanthan Gum J. Food Sci. 52 549–553

[12] Defreitas Z, Sebranek J G, Olson D G and Carr J M 1997 Carrageenan Effects on Salt-Soluble Meat Proteins in Model Systems J. Food Sci. 62 539–543

[13] Mittal G S and Barbut S 1994 Effects of Carrageenans and Xanthan Gum on The Texture and Acceptability of Low Fat Frankfurters J. Food Process. Pres. 18 201–216