ANTIOXIDANT ACTIVITY, SENSORY, CHEMICAL, AND MICROBIOLOGY CHARACTERISTICS OF MUNTOK WHITE PEPPER (Piper nigrum Linn) HARD CANDY

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Abstract: Muntok white pepper is the most recognized commodity of Indonesian in the world. One of the diversified products of white pepper is hard candy. This study aimed to determine the antioxidant activity, chemical, sensory, and microbiology characteristics of Muntok white pepper hard candy. The used experimental design was factorial completely randomized design, with the sucrose – glucose ratio as the first factor with two levels (50:50 and 70:30) and white pepper powder concentration as the second level with three levels (1%, 3%, and 5%). The product selection was based on the hedonic parameters. After getting the selected formulation, some tests were conducted, including antioxidant activity test by DPPH method, proximat analysis, TPC test, sensory evaluation, and energy content calculation. Selected Muntok white pepper hard candy formulation used a 50:50 sucrose – glucose ratio with 1% white pepper addition. It has a moisture content of 3.46%, ash content of 0.89%, fat of 12%, the protein content of 1.95%, reducing sugar of 11.31%, saccharose of 62.93%, TPC of 8x101 colonies/g, low antioxidant activity (IC 50) of 141208.03 mg/L, AEAC of 20.58 mg/100g vitamin C, the percent inhibition of 17.66%, the energy content of 365.44 kcal/100gr. The hedonic test result leads to be like by the panellists (5.57 -7.10 in 10 scales). Its sensory quality test results were leading to golden yellow (8.31), leading to spicy (5.58), no pepper smell (2.86), and leading to the hard texture (4.34). The selected product has confirmed the Indonesian National Standard of hard candy.
Keywords: hard candy, *Muntok* white pepper, antioxidant, IC 50.

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1. INTRODUCTION

1.1. Background

Spice's origin Indonesia is one of the most exported commodities with the best quality in the world. Among the many spice commodities produced, pepper is Indonesia's main export commodity. According to the Ministry of Agriculture (2015), pepper is one of the leading entities from the plantation, which significantly influences the country's economic growth. The form of ingredients and processed pepper products produced and traded in Indonesia are black pepper, white pepper, ground pepper, pepper oil, and oleoresin pepper. Processing materials and pepper processing are generally widely used for cooking purposes, the food industry, the pharmaceutical industry, and medicines (Laksamanahardja, 1990).

In the international market, Indonesia has a distinctive pepper brand known by the world, namely, Lampung black pepper, a black pepper produced in Lampung, and *Muntok* white pepper, a white pepper cultivated in the Bangka Belitung Islands. White pepper is a product of drying the pepper plant's fruit that is ripe and has peeled off, which is generally further processed into ground pepper (Rismunandar, 2007).

Although, the pepper commodity has been performed in Indonesia for a long time, there are still many exploitation problems in the development of white pepper, such as what happened in the Bangka Islands, among others caused by low pepper productivity, inefficient marketing systems for white pepper at the farmer level, low pepper prices and fluctuating and the underdevelopment of added value in the form of processed products also cause low income for farmers (Maryadi & Agusta, 2016). The development of pepper product diversification is a strategic step to expand market absorption and increase its economic value. One form of diversification of its product is processed into sweets using pepper white *Muntok* white pepper were imported from the islands of Bangka Belitung. The making of spices as candy has been carried out in hard candy by Yazakka & Susanto (2014); Swastihayu et al., (n.d.). One type of candy that is favored by the public is hard candy. Hard candy has a hard texture, a shiny, clear appearance, and usually consists of the essential components of sucrose and glucose syrup and other ingredients that can be added to give a better taste (Faridah et al., 2008).

In this hard candy research, the flavor was not added because the active ingredients of essential oil in white pepper will give a natural flavor that is slightly bitter, spicy, and warm, which is produced by piperine and kavisin in pepper (Rismunandar, 2007). The bioactive chemical content in white pepper can be an antioxidant that can ward off free radicals to protect the body from disease (Singletary, 2010). The essential oil in white pepper has antimicrobial activity by inhibiting the fungal mycelium growth zone Singh *et al*., (2013). White pepper will provide a relatively good nutritional value because it was reported to have various medicinal properties, including treating diseases such as asthma, respiratory tract, improving blood flow around the head, and as an aphrodisiac (Trivedi et al., 2011).

1.2. Research Purposes

The general purpose of this study was to diversify white pepper as a food ingredient. The specific aims of these research were:

a. to study the effect of sucrose - glucose ratio on the level of preference for white pepper hard candy
b. to study the effect of *Muntok* white pepper powder concentration on the preference level of white pepper hard candy
c. to study the interaction between sucrose - glucose ratio and *Muntok* white pepper powder concentration on white pepper hard candy's preference level
d. to learn sensory quality and chemical characteristics (water, ash, saccharose, reducing sugar, fat, protein), antioxidant activity, and total count plate on the selected white pepper hard candy
e. to calculate the energy value in selected white pepper hard candy products.

2. METHODS

2.1. Tools and Materials

The tools used in this research are digital scales, stoves, pans, basins, stirrers, candy molds, thermometers, PE plastics, silica gel and other chemical tools used in testing.

The materials used in this study were sugar (sucrose), water, *Muntok White Pepper* powder, glucose syrup, and the chemicals used in the test.

2.2. Time and Location

The research was conducted from August 2020 to October 2020 at the UPT Sartika Laboratory of the Faculty of Halal Food Science, Djuanda University, Bogor and the Mbrio Laboratory.

2.3. Methodology

Research on making white pepper hard candy used a ratio of sucrose: glucose with two treatment levels, namely, 50:50 and 70:30. The comparison was taken from the research of lozenges hard candy of legundi leaf extract by Alkarim *et al*. (2012). The preliminary research determined the added pepper concentrations, namely 1%, 3%, and 5%. We can see the flow chart for making *Muntok* white pepper hard candy in the Figure 1.

2.4. Product Analysis

The resulting product will be analyzed by hedonic test on all treatments to obtain the selected product. The hedonic test uses a rating test with parameters of color, taste, aroma, texture, and overall (Setyaningsih et al., 2010). Some analysis then carried out on the selected formulation, including proximate analysis (BSN (2018); AOAC (2012), total plate count analysis (BSN, 2018), antioxidant activity (AOAC, 2012), sensory quality test (Setyaningsih *et al.*, 2010), and quantification of calories value of the product (Almatsier, 2010).

2.5. Data Analysis

Analysis of the hedonic test data in this study used the SPSS 22 (Statistical Product and Service Solution) program. The statistical test used was the variance test (ANOVA) to determine whether the treatment used in the study had a significant effect or not. If the p-value <0.05, the treatment makes a significant impact on the parameter, and it will be continued with Duncan's continued test at a 95% confidence interval (significant level $\alpha = 0.05$).

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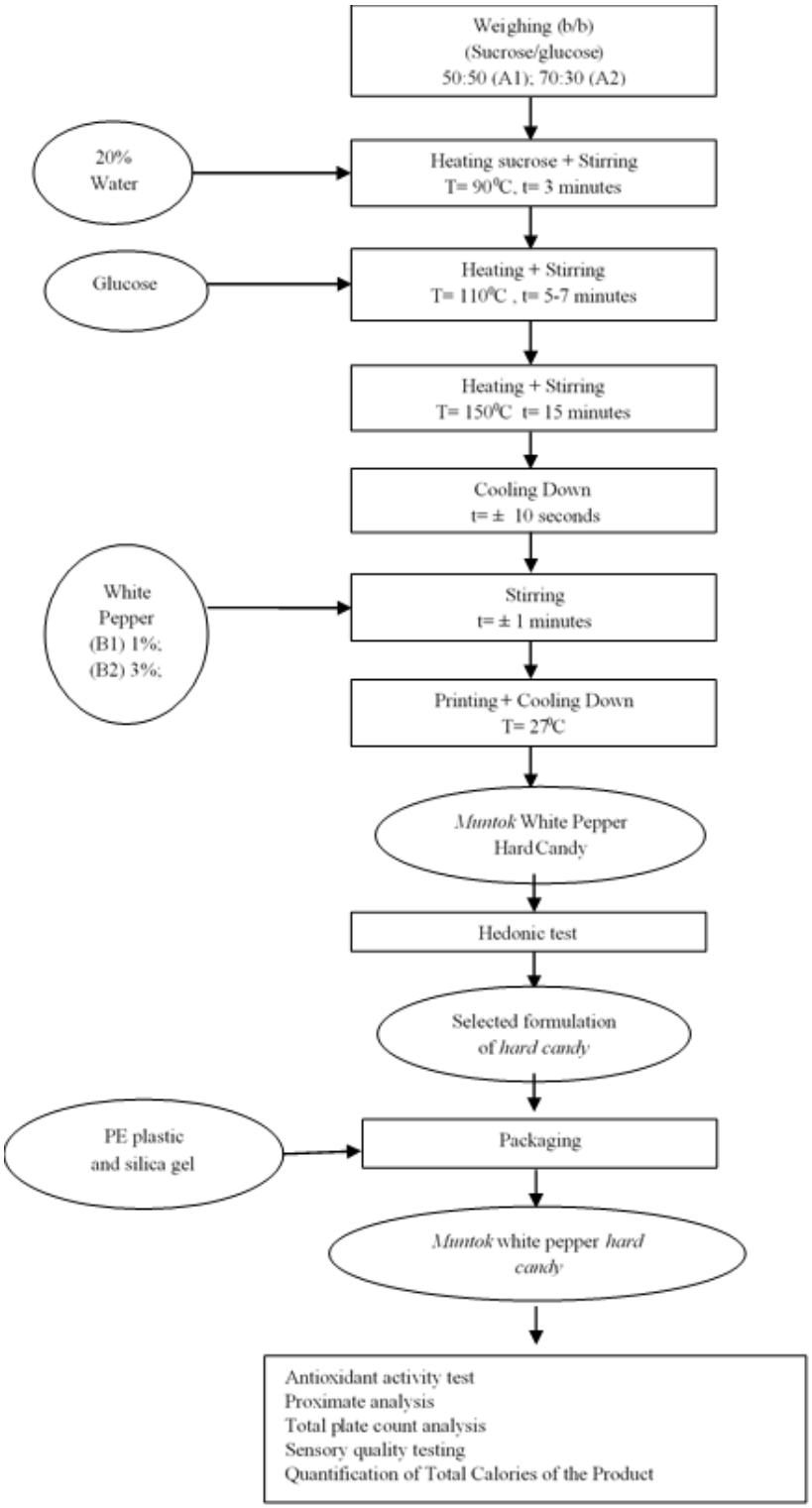

Figure 1 Flow Production Chart of *Muntok* White Pepper Hard Candy Modified Andini (2017)

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3. RESULTS AND DISCUSSION

3.1. Making *Muntok* White Pepper Hard Candy

The manufacture of *Muntok* white pepper hard candy refers to the research of Andini *et al*., (2017), which begins with heating sucrose and water until temperatures reach 90 0 C. Sucrose is a polymer of glucose and fructose molecules. Sucrose serves as the main ingredient in making hard candy, which functions as a sweetener, texture maker, preservative, flavor maker, and filler (Akib et al., 2015). When heating, some of the sucrose dissolved in water will break down into glucose and fructose known as invert sugar. Heating sucrose, which is carried out at 90 0 C will produce invert sugar with a good appearance and color. If the heating temperature is too high, it will increase the formation of invert sugar to damage the flavor and color (Lawrence, 1991). Heating with a high temperature will result in a caramelization reaction, so that the solution's color becomes darker (Wahyuni, 1998).

The addition of glucose syrup provides a soft texture because glucose syrup can inhibit crystallization. It affects viscosity, hygroscopicity, and prevents stickiness to candy (Lees, 1980). The suspension was heating until it becomes thick and smooth. *Muntok* white pepper powder was added at the cooling stage to minimize the damage of essential oil as the active compound in white pepper. Essential oils have volatile properties and are not resistant to heat (Nurjannah et al., 1990). Heating causes the evaporation and degradation of the active compounds in white pepper. Making hard candy using the heating method allows the compounds that produce aroma can be decreased (Agusta, 2000). In the final stage, the packaging of hard candy shall be done shortly to prevent water absorption from the air to the candy that can break down it quickly and become watery (Nurwati, 2011).

3.2 Hedonic Rating Test on *Muntok* White Pepper Hard Candy

This study aims to obtain the selected treatment of Bangka white pepper hard candy based on the panelists' preference level. The hedonic rating scale used is the 0-10 cm line scale. The left end shows the dislike parameter, while the right end shows the like parameter. The hedonic test panelists are semi-trained panelists consisting of 30 students from Djuanda University, Bogor.

3.2.1. *Color Parameters*

Color preference was one of the parameters evaluated in this study. The result of the scoring by the panelist in color parameters were ranging from 4.18 to 7.08 (Table 1).

Table 1 Average Hedonic Score in Color Parameters of *Muntok* White Pepper Hard Candy

Sucrose: Glucose	White pepper			Average
	B1 (1%)	B2 (3%)	B3 (5%)	
A1 (50:50)	7.04 ^{c}	5.14 ^{b}	4.33 ^{a}	5.5 ^{x}
A2 (70:30)	7.08 ^{c}	5.15 ^{b}	4.18 ^{a}	5.47 ^{x}
Average	7.06 ^{p}	5.14 ^{q}	4.26 ^{r}	

Note: Different letter notation shows significantly different at α= 0.05

Based on the test, the sucrose and glucose ratio did not significantly affect panelists' preference for the color parameters of white pepper hard candy (p> 0.05). The addition of white

pepper and the interaction between sucrose and glucose addition of white pepper significantly affected panelists' preference for the color parameters of white pepper hard candy ($p < 0.05$). The addition of white pepper affects the preferred value of white pepper's hard candy color. The lower the pepper concentration, the higher the preference of the panelists towards candy color. The higher concentration of white pepper will make the hard candy darker. A non-enzymatic reaction between reducing sugars with primary amine groups and proteins will produce melanoidin pigments that causing brown color in candy (Ketaren, 1986).

3.2.2. *Taste Parameters*

Panelists' assessment of the parameters of the taste of *Muntok* white pepper hard candy on the hedonic test resulted in values ranging from 4.11 to 7.10. The result of the scoring by the panelist in taste parameter shown in Table 2.

Table 2 Average Hedonic Score in Taste Parameters of *Muntok* White Pepper Hard Candy

Sucrose: Glucose	White pepper			Average
	B1 (1%)	B2 (3%)	B3 (5%)	
A1 (50:50)	7,10 ^{c}	5.46 ^{b}	4.14 ^{a}	5.56 ^{x}
A2 (70:30)	7.08 ^{c}	5.33 ^{b}	4.11 ^{a}	5,51 ^{x}
Average	7.09 ^{p}	5.09 ^{q}	4.12 ^{r}	

Note: Different letter notation shows significantly different at $\alpha = 0.05$

Based on the variance test, the ratio of sucrose and glucose did not significantly affect the panelists' preference for the parameters of the taste of white pepper hard candy ($p > 0.05$). The addition of white pepper and the interaction between sucrose and glucose with the addition of white pepper significantly affected panelists' preference for the parameters of the taste of white pepper hard candy ($p < 0.05$). The addition of white pepper affects the liking value of white pepper hard candy. The higher the addition of white pepper concentration, the hard candy tasted spicy and less favored by panelists. The addition of white pepper to hard candy causes a spicy taste produced by the piperine and kavisin substances in pepper fruit (Govindarajan & Stahl, 1977).

3.2.3. *Aroma Parameters*

Aroma preference was one of the parameters observed in this research. The result of the scoring by the panelist in aroma parameters were ranging from 5.03 to 6.05 (Table 3).

Table 3 Average Hedonic Score in Aroma Parameters of *Muntok* White Pepper Hard Candy

Sucrose: Glucose	White pepper			Average
	B1 (1%)	B2 (3%)	B3 (5%)	
A1 (50:50)	6.03 ^{b}	5,59 ^{ab}	5.03 ^{a}	5.55 ^{x}
A2 (70:30)	6.05 ^{b}	5,54 ^{ab}	5.06 ^{a}	5.55 ^{x}
Average	6.04 ^{p}	5.57 ^{pq}	5.04 ^{r}	

Note: Different letter notation shows significantly different at $\alpha = 0.05$

Based on the test of various sucrose and glucose comparisons, there was no significant effect on the panelists' preference for the aroma parameters of white pepper hard candy ($p > 0.05$). The addition of white pepper and the interaction between sucrose and glucose with the addition of white pepper significantly affected the panelists' preference for the aroma parameters of white pepper hard candy ($p < 0.05$). The addition of white pepper affects the

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preferred value of the aroma of white pepper hard candy. The higher the addition of white pepper concentration, the less preferred the candy aroma. The distinctive aroma produced by white pepper hard candy comes from essential oils, mostly monoterpenes, and sesquiterpenes such as a-ß-pinene, sabinen limonene, and ß-karyopylene (Parthasarathy et al., 2008).

3.2.4. *Texture Parameters*

Panelists' assessment of the parameters of the texture of *Muntok* white pepper hard candy on the hedonic test resulted in values ranging from 4.46 to 5.57. The result of the scoring by the panelist in taste parameter shown in Table 4.

Table 4 Average Hedonic Score in Texture Parameters of *Muntok* White Pepper Hard Candy

Sucrose: Glucose	White pepper			Average average
	B1 (1%)	B2 (3%)	B3 (5%)	
A1 (50:50)	5,57 ^{b}	5.55 ^{b}	5.49 ^{b}	5.53 ^{x}
A2 (70:30)	4.54 ^{a}	4.47 ^{a}	4.46 ^{a}	4.49 ^{y}
Average	5.05 ^{p}	5.01 ^{p}	4.97 ^{p}	

Note: Different letter notation shows significantly different at α= 0.05

Based on the test of various sucrose and glucose comparisons and the interaction between sucrose and glucose with the addition of white pepper, it had a significant effect on panelists' preference for the texture parameters of white pepper hard candy ($p < 0.05$). As for the addition of white pepper, there was no significant effect on the panelists' preference on the texture parameters of white pepper hard candy ($p > 0.05$). The ratio of sucrose and glucose affects the value of white pepper hard candy's texture preference value. The higher the use of sucrose, the less preferred the resulting texture. We assumed that the higher sucrose made the candy harder. According to Potter & Hotchkiss (2012) high sucrose will increase the boiling point of the solution at the time of cooking, thereby increasing hard candy's consistency and forming a hard texture.

3.2.5. *Overall Parameters*

Rate panelists against overall parameters of hard candy white pepper on the hedonic test produces a value ranging from 3.80 to 6.65. The average value of the results of the hedonic test with parameters overall preferences can be seen in Table 5.

Table 5 Average Hedonic Score in Overall Parameters of *Muntok* White Pepper Hard Candy

Sucrose: Glucose	White pepper			Average average
	B1 (1%)	B2 (3%)	B3 (5%)	
A1 (50:50)	6.64 ^{c}	5.19 ^{b}	3.80 ^{a}	5.21 ^{x}
A2 (70:30)	6.65 ^{c}	5.24 ^{b}	3.87 ^{a}	5.25 ^{x}
Average	6.64 ^{p}	5.22 ^{q}	3.83 ^{r}	

Note: Different letter notation shows significantly different at α= 0.05

Based on the variance test, the ratio of sucrose and glucose did not significantly affect the panelists' preference for the overall parameter of white pepper hard candy ($p > 0.05$). As for the addition of white pepper and the interaction between sucrose and glucose with the addition of white pepper, it had a significant effect on the panelists' preference on the overall parameters

of white pepper hard candy ($p < 0.05$). Panelists did not like white pepper hard candy with high white pepper because it will produce a stronger color, taste, and aroma. Panelists gave the lowest overall parameter score of white pepper hard candy in the 50:50 sucrose: glucose treatment with the addition of 5% white pepper with a score of 3.80 (towards dislike). Panelists gave the highest overall parameter score of white pepper hard candy in the treatment of sucrose: glucose 70:30 with 1% white pepper with a score of 6.65 (towards like).

3.3. Determination of Selected Formulation

The selected product's determination was performed by the results of the hedonic test on all parameters ranging from color, taste, aroma, texture, and overall, which are expected to lead to liking indicated by the highest hedonic value. The selected formulation was A1B1 treatment (sucrose: glucose 50:50 with the addition of 1% white pepper) with the highest hedonic value in the color parameter of 7.08 (towards like), the taste parameter of 7.01 (towards like), the aroma parameter of 6.03 (towards like), the texture parameter of 5.57 (towards like), and the overall parameter of 6.65 (towards liking).

Chemical tests were then carried out from this selected product covering moisture content, ash content, reducing sugar, saccharose, fat content, protein content, antioxidant activity, and microbiological analysis of total plate count. Then, the sensory quality test covered the parameters of color, taste, aroma, and texture. Last, we calculated the total calories contribution of the product.

3. 4. Analysis of Selected Formulation

The results of the analysis of selected white pepper hard candy formulation can be seen in Table 6.

Table 6 Results of Analysis of Selected White Pepper Hard Candy Products

Test Type	SNI (01-3547-2008)	Result
Chemical Test		
Water content (%)	max. 3.5	3.46
Ash content (%)	max. 2	0.89
Reducing Sugar Levels (%)	max. 24	11.31
Saccharose content (%)	min. 35	62.93
Fat level (%)	-	1 2
Protein Content (%)	-	1.95
Antioxidant Activity		
a. IC_{50} (mg / L)	-	141208.03
b. AEAC (mg / 100g Vit.C)	-	20.58
c. Inhibition (%)	-	17.66
Microbiological Test		
Total Plate Count (Colonies / g)	max. 5×10^2	8×10^1
Sensory Quality Test		
Color	normal	8.31
Taste	normal	5,58
Aroma	normal	2.86
Texture	normal	4.34
Energy Content		
Energy (kcal / 100gram)	-	365.44

3.4.1. *Water Content*

Selected formulation of *Muntok* white pepper hard candy has a moisture content of 3.46%, while the maximum standard of moisture content in candy is 3.5% (BSN, 2008). It can be explained that the selected white pepper hard candy's moisture content still meets the SNI requirements. Although this result was still above the moisture content of hard candy by Andini *et al.*, (2017) that has a water content of 0.92 %. Our hard candy was still quite sticky, presumably because the packaging is not tight and tight. According to Alkarim *et al*. (2012), packaging and storage will affect a hygroscopic material's stickiness. This is supported by the Engka et al., (2016), sucrose having a nature that can bind water and other components.

3.4.2. *Ash Content*

Selected white pepper hard candy has an ash content of 0.89%. Based on SNI 01-3547-2008, the maximum ash content for hard candy is 2%. The results obtained from the ash content of white pepper hard candy indicate that it has met the SNI requirements for candy. This value is relatively high compared to the results of Nurwati's research (2011), with an average ash content of 0.16% -0.10% in hard candy from pedada fruit extract. The ash content in white pepper hard candy is thought to be due to white pepper's mineral content. According to Bangka, (2018) states that pepper fruit has several minerals such as potassium, calcium, zinc, manganese, iron, and magnesium.

3.4.3. *Reducing Sugar Content*

Reducing sugar content is one of the quality parameters of candy. In making hard candy, the sucrose and water are heated, which causes the sucrose to be hydrolyzed into glucose and fructose that known as reducing sugar or invert sugar (Wahyuni, 1998). Reducing sugar testing aims to determine the sugar content that can reduce other substances in food (Winarno, 1997).

The reduced sugar content of selected white pepper hard candy was 11.31%. Meanwhile, in the study of Andini *et al*., (2017), hard candy with natural dyes phycocyanin has reduced sugar level of 16.92%. The value of reducing sugar required in SNI Hard Candy 01-3547-2008 is a maximum of 24%. The results obtained from the reducing sugar content of white pepper hard candy indicate that it has met the SNI requirements for candy. According to Wahyuni (1998), reducing sugar levels can be influenced by the ratio of sucrose and glucose syrup and the sugar inversion process during cooking.

3.4.4. *Levels of Saccharose*

The level of saccharose is one of the parameters that affects the quality of candy. Sakarosa testing or also called total sugar testing is used to indicate the amount of carbohydrates a whole contained in a food, both reductive and nonreductive compound (Wahyuni, 1998). The level of saccharose produced from selected white pepper hard candy was 62.93%. Meanwhile, based on research by Andini *et al.*, (2017) reported that hard candy with natural dyes phycocyanin had a saccharose content of 44.33%. Values levels of saccharose stipulated in Indonesian National Standard of Hard Candy number 01-3547- 2008 is at least 35%. The results of saccharose test of the white pepper hard candy showed that it had met the SNI requirements. According to Andini *et al.* (2017), the higher levels of saccharose indicates the lower of reducing sugar levels. This is because not all sucrose is converted into glucose and fructose, but there are still some matrics in the form of sucrose. So that, it affects the saccharose levels in the sample. The value of the total sugar content must be greater than the reducing sugar content, because reducing sugar is

part of the total sugar in the foodstuff, this is in accordance with the results obtained in white pepper hard candy.

3.4.5. *Fat Content*

The fat content produced from selected white pepper hard candy is 12 %. This value is relatively high compared to the research results Nurwati (2011), with an average fat content is 0.13% -0.25%. The fat content in white pepper hard candy is caused by the fat content found in white pepper. In accordance with the research of Hikmawanti et al., (2016), white pepper fruit contains alkaloids such as piperine, kavisin, and methylpyrroline, essential oils, and fats and starches. The high-fat content can affect the quality of the candy, where the fat will quickly come out of the candy surface to encourage oxidation and cause a rancid taste (Winarno 2008). However, fat is a plus for hard candies with white pepper because it adds nutritional value compared to commercial hard candies.

3.4.6. *Protein Content*

The protein content produced from selected white pepper hard candy was 1.95 % in line with Nurwati's research (2011), which made hard candy with an average protein content of 1.18% - 1.82%. The value of protein content in candy is relatively low, but it is not considered for candy products based on the Indonesian National Standard. Protein is a macromolecular nutrient that builds and maintains body cells and tissues (Almatsier (2004).

3.4.7. *An antioxidant activity*

The active compounds in white pepper such as piperine, pinene, sabinen, limonene, and ß-karyopylene can be used as a source of antioxidants (Singh et al., 2013). The method used for testing antioxidant activity in this study is the DPPH method. The principle of this antioxidant activity test method was by measuring antioxidant activity quantitatively. DPPH radical scavenging was measured by a compound that has antioxidant activity using UV-Vis spectrophotometry. This activity aimed to determine the value of free radical reduction activity, which is expressed by the value of IC 50 (Inhibitory Concentration). The IC 50 value is the amount of concentration that can inhibit free radical activity by as much as 50%. The antioxidant activity test also uses ascorbic acid (vitamin C) to express the unit of measurement as AEAC (Ascorbic Acid Equivalent Antioxidant Capacity).

Antioxidant activity of the selected white pepper hard candy consisted of IC 50 value of 141,208.03 mg/L (ppm 141,208.03), AEAC value of 20.58 mg / 100g Vitamin C, and% inhibition of 17.66%. Meanwhile, based on research by Andini *et al.*, (2017) on testing antioxidant activity, the IC 50 value was 319.06 ppm. The result of antioxidant activity in white pepper hard candy is relatively weak. According to Molyneux (2004), the antioxidant activity is very strong if the IC 50 value is less than 50 ppm and weak when the IC 50 value is more than 200 ppm. The weak antioxidant activity is thought of because of the degradation of antioxidants during the making candy's processing and heating. The degradation of antioxidants can accelerate the oxidation and reduce antioxidant activity. The antioxidant activity can also be influenced by the types of components (Salunkhe & Kadam, 1989).

3.3.8. *Total Plate Count*

According to Prasetyo et al., (2013), the microbiological quality of a food ingredient is determined by the number of microorganisms present in the food ingredient. Microbiological quality in foodstuffs can determine products' shelf life in terms of safety and damage caused by foodstuff microorganisms from microorganism contamination. The total plate count (TPC)

of selected white pepper hard candy was 8 x 10^1 colonies/g. Meanwhile, Suslawati & Dewi, (2012) produced caramel candy from goat's milk with a total microbe of 2.83 x 10^2 colonies/g. The results of the research conducted are following the quality requirements of hard candy according to SNI 3547: 2008. In the microbial contamination parameter, the total plate count (TPC) in hard candy was a maximum of 5 x 10^2 colonies/g. Based on the research of Singh *et al.*, (2013) stated that the essential oil of white pepper has antimicrobial activity by inhibiting the growth zone of fungal mycelium. Besides, the sugar used in making hard candy is used as a preservative so that microbial growth can be inhibited and can extend shelf life (Desrosier, 1988).

3.3.9. *Sensory Quality Test*

The sensory quality test on the color parameter of selected white pepper hard candy was 8.31, leading to golden yellow. During the cooking process, the sugar changes color due to browning and caramelization reactions. According to Saloko & Lalu (2009), the temperature and duration of cooking can affect the sugar color, where the higher the temperature and heating will produce the darker hard candy. The sensory quality test on selected white pepper hard candy's taste parameter was 5.58, leading to spicy. White pepper's addition causes the spicy taste. This is in line with Govindarajan's (1977) research which states that pepper has a characteristic sharp taste because it contains the alkaloid compounds piperine and kavisin which are spicy.

The sensory quality test on selected white pepper hard candy's aroma parameter was 2.86, leading to no pepper smell. According to Heath (1978) reported when flavors were added to the ingredients while the process was still hot, it can be a loss of volatile flavor, namely the essential oil component found in pepper. Most of the pepper's essential oils contain monoterpenes and sesquiterpenes such as a-ß-pinen, sabinen, limonene, and ß-karyopylene (Parthasarathy *et al*., 2008). The sensory quality test on selected white pepper hard candy's texture parameter was 4.34, leading to hard. Sucrose can be dissolved in water by a rising temperature. Higher temperatures and more prolonged cooking will cause evaporation, increase viscosity, and make hard textures (Saloko & Lalu, 2009).

3.3.10. *Energy Content*

Energy content is the amount of energy stored in predetermined food per unit volume or mass, where fat stores 9 kcal/gram, carbohydrates and protein each store 4 kcal/gram (Persatuan Ahli Gizi Indonesia, 2010). The total energy value of white pepper hard candy can be seen in Table 7.

Table 7 Total energy values of white pepper hard candy

Molecular macro	Kcal / gram
Total Sugar (carbohydrate)	251.72
Protein	5.72
Fat	108
Total Energy	365.44

The total energy content of selected white pepper hard candy was 365.44 kcal/100 gram. This result accumulates the energy value of fat, protein, and total sugar in white pepper hard candy. Almatsier (2009) states that the carbohydrate, fat, and protein content of a food ingredient can determine its energy value. According to the Regulation of the Health Ministry of the Republic of Indonesia number 28 of 2019, the Recommended Dietary Allowances

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(RDA) is a value that shows the average requirement for certain nutrients that must be met every day for almost all people with certain characteristics including age, sex, level of physical activity, and physiological conditions, to live healthy. Results of energy contribution of white pepper hard candy based on RDA was shown in Table 8.

Table 8 Results of energy contribution of white pepper hard candy based on RDA

Age (years)	RDA (Kcal / day)	% energy contribution to RDA
Child (4-6)	1400	26.10
Adult (30-49)	2550	14.33
Elderly (50-80)	2150	17

RDA is used at the consumption level which includes adequate energy, protein, fat, carbohydrates, fiber, water, vitamins and minerals (Peraturan Menteri Kesehatan Republik Indonesia, 2013.). Based on Table 8, the selected white pepper hard candy contributes 26.10% energy of RDA for children, 14.33% energy of RDA for adult, and 17.00% energy of RDA for elderly people.

CONCLUSIONS AND SUGGESTIONS

4.1. Conclusion

Based on the research that has been done, it can be concluded that:

1. The selected white pepper hard candy products from the hedonic test were sucrose: glucose 50:50 and the addition of 1% white pepper.
2. Selected white pepper hard candy has moisture content of 3.46%, ash content of 0.89%, fat content of 12%, protein content of 1.43%, reducing sugar 11.31%, saccharose 62.93%, ALT 8 x 10^{1} colonies/g, antioxidant activity (IC_{50} 141208.03 mg / L, AEAC 20.58 mg/100g vitamin C, % inhibition 17.66%), and energy content of 365.44 kcal / 100gram. This product has sensory quality test in color parameters leading to golden yellow (8.31), taste parameters leading to spicy (5.58), aroma parameters leading to no pepper smell (2.86), and texture parameters leading to hard (4.34).
3. White pepper hard candy products in accordance with SNI Hard Candy No. 3547: 2008.

4.2. Suggestions

1. Need to improve the processing technique of pepper-based product to maintain the antioxidant content of the product.
2. Further research is needed on the use of water in the formulation of white pepper hard candy in order to obtain a lower water content and obtain a better sensory quality.

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