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The Influence of Kecombrang Flower (Nicolaia speciosa, Horan) Extract on Physicochemical Properties of Hard Candy

Rina Yenrina[*], Alfi Asben[*], Rahmatika[*], Herriyenni[**]
[*]*Faculty of Agricultural Technology, Andalas University, Limau Manis-Padang. 25163 Indonesia.*
[**]*Department of Nutrition. Poltekkes KemenKes RI Padang. 25146 Indonesia.*

ABSTRACT
Hard candy is very popular.To make it a functional food, kecombrang flower extract can be added. Kecombrang flower contains components that are beneficial to health. The purpose of this research was to know the effect of kecombrang flower extract on physicochemical properties of hard candy.The design of the research was a completely randomized design (CRD) that consists of 5 treatments and 3 replications. Data were analyzed statistically by using ANOVA and with Duncan's new multiple range test (DNMRT) at a 5% significance level. The treatment in this research was adding kecombrang flower extract at 0%, 4%, 6%, 8% and 10% of the total sucrose and glucose. The results showed that the addition of kecombrang flower extract had a significant effect on water content, pH, antioxidant activity, hardness, reducing sugar, and sucrose; no significant effect was seen for ash content.
Keywords: hard candy, kecombrang flower (*Nicolaia speciosa*, Horan) extract, physicochemical properties.

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I. INTRODUCTION

Candy is divided into two classes, crystal candies (creams, fondant, and fudge) and non-crystal candies(caramel, taffy, brittles, and hard candy). Hard candy is a type of candy that is widely produced and very commonly consumed; therefore, it can be a profitable business opportunity. However, consumers rarely pay attention to the nutritional content in candy.

Hard candy is widely available in various shapes, flavors and colors. One additional ingredient that can add, a functional value to hard candy is extract of the kecombrang flower. The selection of kecombrang flower extract as an additional material in the making of hard candy is due to various advantages of the kecombrang flower, such as a removal of body odor and bad breath (Hidayat and Hutapea,1991)[1].

According to Habsah et al.,(2005)[2] the kecombrang plant can be used to treat severe diseases, such as cancers and tumors. The kecombrang flower contains many bioactive compounds, such as polyphenols, alkaloids, flavonoids, steroids, saponins and essential oils, that have the potential use as antioxidants.

The results of research by Naufalin (2005)[3] has also proved that the components of kecombrang flowers when extracted with ethanol and ethyl acetate have active compounds that are functional as anti-bacterial substances. The bacteria that have been identified can be inhibited by the active ingredients of kecombrang flower extracted with ethanol and ethyl acetate are *B. cereus, P. aeruginosa, S. typhimurium, E. coli*, and *A. hydrophila.*

Kecombrang flower is commonly used as flavoring in cuisine, and there is an opportunity to increase the utilization of kecombrang flower, for example, adding it in into hard candy. In the making of hard candy, the kecombrang flower has the potential of fighting bad breath, providing antioxidants for the body, giving color, natural aroma, and flavor enhancers, so the kecombrang flower can be used as a functional food extract in candy products.

From the preliminary research that has been done, it is known that the hard candy ratio should be at 10% kecombrang flower extract maximum for making candy. The results obtained from that ratio yield a level of hardness that panelists accept. Hard candy with a concentration of kecombrang flower extract of more than 10% prevented the product from properly hardening or resulted in a mushy product.

II. METHODOLOGY

This research had been conducted in many locations, including the Laboratory of Technology and Engineering Process of Agricultural Products, Laboratory of Chemistry, Biochemistry of Agricultural Products, Laboratory of Microbiology and Biotechnology of Agricultural Products, Department of Agricultural Product Technology, and Instrumentation Laboratory Center of Faculty of

Agricultural Technology, Andalas University, Padang.

III. MATERIALS AND TOOLS

The materials used in this study were blooming red kecombrang flowers obtained from the Bandar Buat market, Padang; sugar; glucose syrup; water; ethanol 96%; aquades; Pb-acetate; NaOH; $(NH_4)_2HPO_4$; Luff-Schoorl solution; KI; H_2SO_4; starch indicator; HCl; KOH; phenolphthalein indicator; ethanol; DPPH 1 mM; and methanol.

The tools used to make hard candy were the analytical scales, stove, pot, stirring spoon, goblet, and thermometer. Tools used for analysis include an oven, desiccator, furnace, Erlenmeyer flask, measuring cup, glass cup, pipette, measuring flask, filter paper, burette, funnel, porcelain cup, stopwatch, hot plate, vacuum rotary evaporator, magnetic stirrer, texture analyzer, spectrophotometer, and water bath.

Research Design

This research was designed using completely randomized design (CDR) with 5 treatments and 3 replications. The data obtained were analyzed statistically by using ANOVA test if results were significantly different, then Duncan's new multiple range test (DNMRT) test was used at the 5% real level.

Based on preliminary research that has been done, the treatment in this research were:

A = Addition of kecombrang flower extract 0%
B = Addition of kecombrang flower extract 4%
C = Addition of kecombrang flower extract 6%
D = Addition of kecombrang flower extract 8%
E = Addition of kecombrang flower extract 10%

Implementation of Research

Determination of Formulation

The formulation of hard candy based on a formula made by Ramadhan (2012)[4] methods with modifications. The formula in making hard candy shown in Table 1.

Table 1. Formulation of Materials in Making Hard Candy

No	Materials	Treatments				
		A	**B**	**C**	**D**	**E**
1	Sucrose (g)	70	70	70	70	70
2	Glucose Syrup (g)	30	30	30	30	30
3	Water (g)	20	20	20	20	20
4	Kecombrang Flower Extract (%)*	10/0	10/4	10/6	10/8	10/10
5	Total Material (g)	130	130	130	130	130

Note: The percentage of kecombrang flower extract counted from the total weight of sucrose and glucose. Total amount of sucrose and glucose was 100 grams. *The addition of flower extract is included in 10 grams of water.

Making of kecombrang flower extract (Nugraheni, 2013)[5] methods with modification

- Blooming red kecombrang flowers were washed with clean water
- Kecombrang flowers were washed and then reduced in size to facilitate the destruction of kecombrang flowers
- Ethanol 96% was added with an ethanol and kecombrang flower ratio of 4:1
- The mixture was then blended
- After blending and extraction, maceration was performed by stirrer for 60 minutes at 30°C
- The solution was centrifuged for 15 minutes at 400 rpm to separate the filtrate from the residue
- The resulting extract was then filtered through a vacuum filter
- Then, the extract was thickened with a vacuum rotary evaporator at a temperature of 40°C until the solvent separated from the sample, characterized by a non-dripping solvent from the distillate tube
- Kecombrang flower extract was then obtained

Making of Hard Candy (Ramadhan, 2012)[4] methods with modification

The first step was to weigh out the material: 70 g of sugar (sucrose), 30 g of glucose syrup, 30 g of water, and then the material was heated to a temperature of 150°C (if inserted in water,the material wouldturn into a sheet of yarn and could be broken). It was then lifted up, and the flower extract was added according to the treatment level while being stirred until fully blended, care is taken to remove the air bubbles. The candy was then printed and allowed to harden. Once hardened, it could be removed from the mold and stored at room temperature.

Observation

Observations were done on kecombrang flower extract and hard candy products. The observation of kecombrang flower extract included antioxidant activity (Huang, et.al., 2005)[6], pH value (Yenrina, et al., 2011)[7], while observations of the hard candy with kecombrang flower extract also included pH value[7], water content (Sudarmadji, 1997)[8], ash content[8], sucrose content[8], reducing sugar content[8], antioxidant activity[6], and hardness (Brookfield Texture Analyzer).

IIII. RESULTS AND DISCUSSION

Kecombrang Flower Extract

Observations performed on the raw materials of kecombrang flower extract were color, pH value and antioxidant activity. The results of chemical analysis of raw materials can be seen in Table 2.

Table 2. Analysis Result of Kecombrang Flower Extract

Variable	Result
Color	Red
pH Value	3.2
Antioxidant Activity	47.42%

The kecombrang flower extractwas observed to have a pH value of 3.2. The pH value of kecombrang flower extract was not much different from that of previous research. According to Rukmini and Naufalin (2010)[9] the pH value of the kecombrang flower extract of 3.89. According to Koswara (2009)[10], the pH value affects the candy crystallization, if the pH too high, it causes a crystal that feels rough in the mouth, if the pH too low, it causes stickiness. Stickiness is a problem that occurs in the process of making of hard candy, due to water content that is too high.

The color obtained in this flower extract was red. This was in accordance with the findings of Naufalin (2005)[3], in which the flavonoid compound in the flowers is a cloudy anthocyanin in the form of red pigment. In the residual solvent test, thesolvent obtained in this flower extract was 10%. In the process of making hard candy using temperature at 150°C, the ethanol will be burned off because of the lower boiling point of 78°C for ethanol.

The result of antioxidant activity analysis of kecombrang flower extract that obtained was 47.42% at concentration of 100 ppm. The value of this antioxidant activity is relative high. According to Winarsi (2007)[11]antioxidants are substances that can slow or prevent the oxidation process.

Physical Properties Analysis of Hard Candy
Hardness

Based on the hardness test, hard candy with the kecombrang flower extract was found to be between 128.45 N / cm^2 to 185.71 N / cm^2. The results of the test can be seen in Table 3. The results of the analysis of variance indicated that the addition of kecombrang flower extract gave asignificant effect at level of $\alpha = 5\%$ to the hardness of hard candy. The lowest hardness test was found in treatment E (addition of kecombrang flower extract 10%) of 128.45 N / cm^2 while the highest hardness test was found in treatment A (addition of kecombrang flower extract 0%) of 185.71 N / cm^2.

Hardness is the applied force, which is measured when testing a candy product. Hardness is one of the important requirements of hard candy. The hardness of hard candy is influenced by its components such as water and sugar that help form its texture. As seen in Table 8. the higher the sucrose content in hard candy, the higher the hardness level.

Table 3. Hardness of Hard Candy

Treatments	Hardness (N/cm^2) (Average ± SD)
E (KFE 10%)	128.45 ±0.79 a
D(KFE 8%)	154.67 ± 1.30 b
C(KFE 6%)	177.25 ± 0.43 c
B(KFE 4%)	185.58 ± 0.29 d
A(KFE 0%)	185.71 ± 0.15 d
CV = 0.14%	

Table 4. Water Content of Hard Candy

Treatments	Water Content (%) (Average ± SD)
A (KFE 0%)	0.62± 0.01 a
B (KFE 4%)	1.22±0.93 ab
C (KFE 6%)	1.73±0.08 bc
D (KFE 8%)	1.94±0.54 bc
E (KFE 10%)	2.31±0.25 c
CV = 3.21%	

Table 5. pH Value of Hard Candy

Treatments	pH Value (Average ± SD)
A(KFE 0%)	6.15±0.10 a
B (KFE 4%)	5.7± 0.04 b
C (KFE 6%)	4.97± 0.04 c
D (KFE 8%)	4.56± 0.11 d
E (KFE 10%	4.29± 0.30 d
CV= 0.98%	

Table 6. Ash Content of Hard Candy

Treatments	Ash Content (%) (Average ± SD)
C(KFE 6%)	2.05± 0.14
A (KFE 0%)	2.26± 0.34
D (KFE 8%)	2.39± 0.07
B (KFE 4%)	2.49± 0.36
E (KFE 10%)	2.50± 0.76
CV = 5.90%	

Table 7. Reducing Sugar Content of Hard Candy

Treatments	Reducing Sugar Content (%) (Average ± SD)
A(KFE 0%)	10.73 ±.0.19 a
B (KFE 4%)	11.19 ± 0.98 ab
C (KFE 6%)	11.80 ± 0.08 b
D (KFE 8%)	12.76 ± 0.09 c
E (KFE 10%)	15.38 ± 0.02 d
CV = 1.22%	

Table 8. Sucrose Content of Hard Candy

Treatments	Sucrose Content (%) (Average ± SD
E (KFE 10%)	48.30 ±0.83 a
D (KFE 8%)	48.77 ± 0.66 a
C (KFE 6%)	50.68 ± 1.03 b
B (KFE 4%)	50.91 ± 0.77 b
A (KFE 0%)	51.43 ± 0.91 b
CV = 9.44%	

Table 9. Antioxidant Activity of Hard Candy

Treatments	Antioxidant Activity (%) (Average ± SD)
A(KFE 0%)	0.00 ±0.00 a
B(KFE 4%)	6.14 ±1.33 a
C (KFE 6%)	24.14 ±4.89 b
D (KFE 8%)	40.82 ±7.90 c
E (KFE 10%	43.19 ±4.52 c
CV = 6.8%	

KFE = Kecombrang Flower Extract
The numbers on the same lane followed by unequal small letters are significantly different at the 5% level of Duncan's new multiple range test (DNMRT).

Chemical Properties Analysis of Hard Candy
Water Content

The water content in the hard candy was measured between 0.62% - 2.31%. The results can be seen in Table 4. The variance analysis showed that the extract gave a significant effect at level of $\alpha = 5\%$ to the water content of hard candy. Based on Table 4. it can be seen that the lowest water content in hard candy with the addition of kecombrang flower extract was seen in treatment A (addition of kecombrang flower extract 0%) and the highest water content was seen in treatment E (addition of kecombrang flower extract 10%). The increased of water content in hard candywas due to the increased levels of kecombrang flower extract added, so that the more the extract added to the hard candy, the more the water content increased.

Water content is a very influential on the overall quality of hard candy because the shelf life of hard candy is influenced by water content. According to SNI 01-3547-2008[12]the maximum water content in hard candy is 3.5%. The results obtained in this studyindicate that the hard candy containing the extract meets this quality threshold.

According to Purnomo and Adiono (1985)[13], the art of making candy with satisfactory shelf life lies in the making of the products with minimum water content. Sugar solution used as the main ingredient for making hard candy with heating at high temperature will harden and decrease the water content. This is in accordance with Winarno (2004)[14], when the sucrose solution is evaporated the concentration will increase, as well as the boiling point. This situation will continue so that all the water evaporates and the whole solution is a melted liquid sucrose.

pH

Based on the test results of pH in hard candywith the addition of kecombrang flower extract, the values ranged between 4.29 - 6.15. The results of the test can be seen in Table 5. The degree of acidity is an important parameter in determining the quality of a product, namely, the addition of freshness, and the desired pH value. Based on the results of analysis variance showed that the addition of kecombrang flower extract gave a significant effect on pH value. In Table 5. it can be seen that the highest pH value found in treatment A (addition of kecombrang flower extract 0%) and the lowest pH value found in treatment E (addition of kecombrang flower extract 10%).

The pH value of hard candy with addition of kecombrang flower extract decreased along with the addition of kecombrang flower extract. This was due to pH analysis on raw materials noted that the extract of kecombrang flower had a pH value of 3.2. The more the kecombrang flower extract was added, the overall pH value of the hard candy decreased, and the acidity level increased. At low pH levels, the sucrose will be converted into inverted sugar[13].

Ash Content

The hard candy was found to contain an ash content that ranged between 2.05% - 2.50%. The result of ash content analysis of hard candy with addition of kecombrang flower extract can be seen in Table 6. From Table 6. it can be seen that the addition of kecombrang flower extract to hard candy was not found to have a significant effect at a level of $\alpha = 5\%$. Treatments with addition of kecombrang flower extract did not affect the ash content in hard candy due to the concentration levels of the extract.

Ash content is one of the quality requirements of hard candy, because the lower the ash content of a candy, the better the candy will be. According to Bernard (1989)[15], sugars with high purity and low level of ash will produce candies with a high degree of clarity. Based on[12] maximum ash content in hard candy should be 2.0%.

Reducing Sugar Content

Based on the results of reducing sugar content of hard candy ranged between 10.73% - 15.38%. The result of analysis of reducing sugar content of hard candy can be seen in Table 7. The result of the analysis of variance indicated that the addition of kecombrang flower extract gave a significant effect at level of $\alpha = 5\%$ to reducing sugar content. Based on SNI 01-3547-2008[12] the reducing sugar level of hard candy is a maximum of 24%. In the research that has been done, the value of reducing sugar ranged from 10.73% -15.38%, which is within this standard.

Reducing sugars are sugars that are capable of acting as a reducing agent. This ability is due to the aldehyde or ketone free group (Fennema,1985)[16]. Sucrose is a non-reducing because it does not have a reactive free OH group, but during the heating with the presence of acid, it can be hydrolyzed into glucose and fructose, which is a reducing sugar.

Reducing sugar content is affected by cooking temperature. According to Winarno (2004)[14], the higher the heating temperature, the higher percentage of inverted sugar is formed. According to Jackson (1995)[17] sucrose is converted into reducing sugars influenced by acid concentration, heating temperature and heating time. The lower the pH of the hard candy, the higher the reducing sugar content of hard candy.

Sucrose Content

The results of sucrose content of hard candy ranged between 48.30% - 51.43%. The sucrose content of hard candy can be seen in Table 8. The result of variance analysis was significantly different at the level of $\alpha = 5\%$ to the total of sucrose content in hard candy produced. Sucrose content is one of the quality parameters used in hard candy. According to SNI 01-3547-2008[12], the sucrose content in hard candy should be at least 35%. From the results of sucrose content in hard candy, the lowest sucrose content was found in treatment E (addition of kecombrang flower extract 10%) and the highest sucrose content was found in treatment A (addition of kecombrang flower extract 0%).

According to Jackson (1995)[17], granulated sugar is sucrose that undergoes purification. In addition to glucose syrup, making hard candy is also uses granulated sugar. In this case, the sugar serves as a sweetener, texture builder, preservative and taste former. In this study,it can be seen that the higher the level of kecombrang flower extract is, the lower the sucrose content will be. This is in accordance with the acidity of hard candy, the higher the acidity of hard candy lowers the sucrose content, as many of the sugar are reduced in high acidity levels.

Antioxidant Activity

The results of antioxidant activity of hard candy ranged between 00.00% - 43.19%. The results of antioxidant activity can be seen in Table 9. The result of the analysis of variance indicated that the addition of kecombrang flower extract had a significant effect on antioxidant activity at a level of $\alpha = 5\%$. Based on Table 9. it can be seen that the lowest antioxidant activity of hard candy was found in treatment A (addition of kecombrang flower extract 0%), and the highest antioxidant activity was found in treatment E (addition of kecombrang flower extract 10%) with the concentration of 10.000 ppm. Antioxidant activity of hard candy increased with the increasing concentrations of extract. This was thought to be due to kecombrang flower extracts containing alkaloids, flavonoids, polyphenols, steroids, saponins, and essential oils that have antioxidant properties.[3]

Antioxidant activity of hard candy came from antioxidant content of kecombrang flower extract. Antioxidant activity obtained from hard candy with extract was still quite low when compared with the antioxidant activity in kecombrang flower extract alone. This due to the blanching and heating process, which resulted in degradation of compounds that act as antioxidants. Antioxidant activity decreased due to heating process.[18]

IV. CONCLUSION

Addition of kecombrang flower extract gives significant effect on water content, pH, antioxidant activity, reducing sugar, sucrose and hardness and gave no significant effect on ash content of hard candy. Kecombrang flower extract is a viable ingredient that can be added to the production of hard candy.

Significance Statements

This research reveals that the addition of kecombrang flower extract provide functional properties on hard candy, and it can increase the economic value of kecombrang flowers. Further research needs to focus on the anti-microbial ability of the resulting hard candy

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