PENGARUH PENAMBAHAN EKSTRAK KULIT PISANG (*Musa* sp.) SEBAGAI SUMBER ANTIOKSIDAN PADA PRODUKSI TAHU PUTIH

(*The Effect of Addition of Banana Peel (Musa sp.) Extract to the Production of White Tofu as a Source of Antioxidant*)

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ABSTRACT

High antioxidant content of banana peel can be utilized as a source of antioxidant for other foodstuffs so it will be more economically valuable. One of foodstuffs that can be added by banana peel extract is tofu. However, adding banana peel extract as a source of antioxidant to the production of tofu need to be studied further related to the shelf life of tofu base on total microbes. This study aims to find out the effect of adding banana peel extract as a source of antioxidant to the production of white tofu. Stages of research: 1) The making of banana peel extract, 2) Antioxidant test of banana peel extract, 3) Phytochemical test of extract, 4) Production of tofu with the combination of banana peel extract with variations in concentration namely 5%, 10%, and 15%, 5) The extraction of fortification tofu, 6) Test of tofu antioxidant activity, and 7) Test with TPC test. The result show that banana peel extract contains alkaloid, tannins, flavonoid, steroids and triterpenoid. Banana peel extract shows the antioxidant activity as much as 58,02%. The addition of banana peel extract in the production of tofu is the most optimum at the concentration of 15% with a shelf life of 1 day at room temperature that show antioxidant activity as much as 51,87%. The best TPC value on tofu with banana peel extract is produced at concentration of 15% with a shelf life of 1 day at room temperature.

Keywords: *Banana peel extract, Source of Antioxidant, Tofu production, TPC*.

ABSTRAK

Kandungan antioksidan yang tinggi pada kulit pisang dapat dimanfaatkan sebagai sumber antioksidan bagi bahan pangan lain sehingga kulit pisang akan lebih bernilai secara ekonomi. Salah satu bahan pangan yang dapat ditambahkan ekstrak kulit pisang sebagai sumber antioksidan adalah tahu. Akan tetapi, penambahan ekstrak kulit pisang sebagai sumber antioksidan pada produksi tahu perlu dikaji lebih lanjut. Penelitian ini bertujuan untuk mengetahui pengaruh penambahan ekstrak kulit pisang sebagai sumber antioksidan terhadap produksi tahu putih. Tahap-tahap penelitian: 1) Pembuatan ekstrak kulit pisang, 2) Uji Antioksidan Ekstrak Kulit Pisang 3) Uji fitokimia ekstrak kulit pisang 4) Produksi tahu dengan kombinasi ekstrak kulit pisang dengan variasi konsentrasi yakni 5%, 10%, dan 15%, 5) Ekstraksi tahu hasil fortifikasi, 6) Uji aktivitas antioksidan tahu 7) Uji TPC. Hasil penelitian menunjukkan bahwa ekstrak kulit pisang mengandung alkaloid, tannin, flavonoid, steroid, dan triterpenoid. Aktivitas antioksidan ekstrak kulit pisang tersebut sebesar 58,02%. Nilai aktivitas antioksidan tahu terfortifikasi paling optimum ditunjukkan pada penambahan ekstrak kulit pisang konsentrasi 15% dengan masa simpan 1 hari pada suhu ruang yakni sebesar 51,87%. Nilai TPC terbaikpun terlihat pada tahu dengan variasi penambahan ekstrak kulit pisang sebesar 15% dengan masa simpan 1 hari pada suhu ruang.

Kata kunci: Ekstrak kulit pisang, Produksi Tahu, Sumber Antioksidan, TPC

INTRODUCTION

Banana becomes the most popular fruit among Indonesian because it is frequently consumed without knowing the social strata. Indonesia also becomes the largest producer of bananas in Asia and its production continues to increase every year. Indonesian like to consume bananas directly or processed into various products. However, on the other hand, many producers have not processed the banana peel optimally, resulting in high organic waste. Banana peel waste is usually processed into animal feed only, whereas banana peel has a complete nutrient content such as fat, protein, calcium, phosphorus, iron, vitamin B, vitamin C, and water. Banana peel also contains higher antioxidant than any other parts of banana in vitro. The activity of antioxidant in banana peel reaches 94,25% at a concentration of 125µg/ml while in banana section is only about 70% at a concentration of 50 mg/ml (Andini, 2014). Some antioxidant compounds found in banana peel are catechin, gallocatechin and epicatechin which belong to flavonoid group. Based on this, banana peel has good potential to be used as antioxidant source for food.

Antioxidant is known as substance that can protect cells from the danger of reactive oxygen free radicals because it can slow or prevent the oxidation process. The high content of antioxidant in food product is believed to reduce various degenerative diseases (Junita et.al, 2017) such as cancer, heart disease and stroke. Antioxidant naturally found in various kinds of fruits, vegetables and nuts. However, an unhealthy diet sometimes makes the body lack of antioxidant intake. Therefore, the addition of antioxidant to food commonly consumed by the people becomes an alternative provision of antioxidant intake for the body. One of the most frequently consumed food by the people is tofu.

Tofu is not a brand new food for Indonesian. High vegetable protein content in tofu makes it a high quality food. Tofu has better vegetable protein content than animal protein sourced from meat, milk, and eggs. Moreover, tofu contains protein that is almost equivalent to meat. The addition of antioxidant in the production of tofu that is called combination tofu in this study, is expected to be able to improve the quality value of tofu and extend its shelf life by pressing the number of microbes in tofu. The study of banana peel extract addition in tofu production has been previously conducted by Supriyanti et al., in 2015 but have not seen the antioxidant activity of combination tofu at a certain shelf life and its relation to the number of microbes in the combination tofu (tofu with the addition of variations in the concentration of banana peel extract).

Based on the reasons previously stated, the purpose of this study was to determine the effect of adding banana peel extract with variations in the concentrations of 5%, 10% and 15% in tofu production with a shelf life of 1, 3 and 6 days on antioxidant activity and its relation to the total number of microbes in combination tofu production (tofu with the addition of variations in the concentration of banana peel extract). The application of adding banana peel extract formula that contains antioxidant in the production of tofu is expected to be able to decrease banana peel waste by enhancing its economic value and utilize the potential of Indonesia's natural resources as a nutrient-rich food and affordable for the people.

RESEARCH METHOD

Materials and Tools

This study used tools namely beaker, blander, filter, basin, analytic balance, rotary vacuum evaporator and UV-Vis spectrophotometer. Ingredients used in this study are soybean as raw material in making tofu, vinegar acid as a clot in the production of tofu and banana peel as additional antioxidant extract source. In phytochemical testing, antioxidant testing of banana peel and combination tofu, required ingredients include aquadest, methanol, 2M chloride acid, 2M NaOH, mg powder, concentrated chloride acid, Iron (III) chloride

($FeCl_3$) 1%, glacial CH_3COOH, concentrated sulfuric acid, chloroform, wagner, reagent, DPPH (2,2– *Diphenyl-l-picrylhdrazyl*) while for TPC testing requires nutrient agar media.

Research Procedure

Preparation and the Production of Banana Peel Extract

Banana peels are cleaned and blended until smooth. 100 gram of banana peel then macerated with 300 ml of water for 1 x 24 hours. The extract obtained was filtered with a Buchner funnel using vacuum and the filtrate obtained was evaporated using rotary vacuum evaporator until thick extract were obtained. This process is repeated until banana peel extract was obtained in sufficient quantities (Supriyanti, 2015).

Phytochemical Test

Phytochemical test was carried out by using Sangi method. Banana peel extract was identified by its chemical component with a color reagent method in order to determine the metabolite compounds contained in the sample. Tests carried out include terpenoids and steroids test, flavonoid test, alkaloid test, saponin test, tannin test and anthocyanin test (Supriyanti, 2015).

The Production of Tofu

First step in the production of tofu is by making soymilk first. Heated soymilk is then added to the concentration of banana peel extract as much as 5%, 10%, and 15%. After the addition of banana peel extract, soymilk is given vinegar to the separation between whey and curd. The curd formed is separated by whey and moulded into tofu (Supriyanti, 2015).

The Extraction of Tofu

50 gram of tofu macerated with methanol as much as 100 ml for 1 x 24 hours. The extract obtained then filtered with cortheexong Buchner using vacuum and the filtrate obtained evaporated with rotary vacuum evaporator until thick extract was obtained (Supriyanti, 2015).

Antioxidant Activity Test

The determination of antioxidant activity was carried out by DPPH method with modification. DPPH solution: 4,9 mg of DPPH is dissolved in 25 ml of methanol. Antioxidant activity test of banana peel and tofu was carried out by making dissolved sample, blank and control. The making of dissolved sample was done by taking a sample of 0,5 ml added 3 ml of methanol and 0,3 ml of DPPH 0,5 Mm. Blank: a mixture of 3,3 ml methanol with 0,5 ml sample. Control: mixing 3,5 ml DPPH 0,5 Mm. Making dissolved sample placed on vial bottles that have been coated with aluminum foil. The solution is shaken and incubated for 100 minutes. The absorbance measurement was then carried out using a UV-Vis spectrophotometric at a wavelength of 517 nm (Supriyanti, 2015)..

Antioxidant activity can be determined by the following equation:

$$\% \text{ Antioxidant Activity} = \frac{100 - (Abssample - Absblank)x\ 100}{Abscontrol}$$

Total Plate Count (TPC) Test

This experiment emphasizes the testing of Total Plate Number carried out at the Laboratory of Food Technology, Faculty of Engineering, Pasundan University with the stages of making media, isolation and observation. In the making of media, agar nutrient media was made dissolving in aquadest, which is then sterilized in autoclave. The isolation stage carried out by using pouring method and isolated at 30^oC temperature for 72 hours according to procedure in SNI 7388-2009. The growth of microbial colonies was observed by using *colony counter*.

Data Processing and Analysis

The phytochemical analysis data of banana peel extract were processed and

analyzed based on observations, while the antioxidant activity value was calculated based on the percent antioxidant activity. Data were processed and analyzed using Mocrosoft Excel 2010 to see the relationship between variations in concentration with antioxidant levels and the number of microbes on days 1,3, and 6.

RESULT AND DISCUSSION

This study was started by extracting banana peel with maceration method and the solvent used is water. Maceration method was selected due to extraction of chemical content will not damage secondary metabolite extracted and the extracts can be used as antioxidant because in the maceration process does not involve heating. Water chosen as solvent because the extract will be mixed with food ingredient, namely tofu.

Banana peel extract was then tested for phytochemical to determine the secondary metabolite compound contained in it using the principle of discoloration by chemical reagent used for each tests of alkaloid, tannin, flavonoid, steroid, triterpenoid and anthocyanin. Positive saponin test was indicated by the appearance of foam and was stable for 30 minutes and did not disappear when in drops of HCl 2 N. The result of phytochemical test can be seen in Table 1.

Table 1. The Result of Phytochemical Test

Test	Result
Alkaloid	+
Tannin	+
Flavonoids	+
Saponin	-
Steroids	+
Triterpenoid	+
Anthocyanin	-

Notes: (+) detected on sample
(-) not detected on sample

Based on Table 1, it shows that banana peel extract contains alkaloid, tannins, flavonoid, steroids and triterpenoid. From the result of phytochemical test on banana peel, it shows that the extract of banana peel contains secondary metabolites compound that has the potential as antioxidant.

Antioxidant activity test of banana peel extract used DPPH method because it is most common used method with relatively simple, short and the number of samples used was small. Measurement of antioxidant activity of banana peel extract was carried out at a maximum wavelength of DPPH of 517 nm. To find out the presence or absence of antioxidants in banana peel extract, which is characterized by changes in color in DPPH solution in methanol which is reacted with extract solution. The DPPH solution which was originally purple (violet) turned pale yellow. Changes occur due to reduced DPPH when reacting with antioxidant compounds (Rizkayanti et al, 2017).

The result of antioxidant activity in banana peel extract shows the antioxidant activity of banana peel extract as much as 58,020%. Based on the study conducted by Nuramanah, et al. (2013), antioxidant activity in banana peel extract was 97,85%. Supriyanti's research in 2015 also showed that kapok banana peel extract can withstand DPPH of 95.14%. The difference of antioxidant activity content between study result and literary journal is thought to be caused by type of solvent (polarity of the solvent) used during extraction by maceration method. Ethanol solvent during extraction by maceration will produce high antioxidant activity, while water solvent will produce weak antioxidant activity. This is in line with research conducted by Rizkayanti et al in 2017. In addition, number of things such as stirring during maceration which is not maximal and not at the same time so that the macerate obtained is less. Another factor that is suspected to be one of the causes of differences in the level of antioxidant activity is the temperature at evaporation, the temperature used is too high at 70-80 ^{o}C. According to (Margaretta et al., 2013) the solubility of the extracted active substance will increase with increasing temperature.

Table 2. Antioxidant Activity (%)fortification tofu with various concentrations of 0% (control), 5%, 10%, and 15% on day 1, 3, and 6 at room temperature.

	Antioxidant Acitvity			
	Concentration 0%	Concentration 5%	Concentration 10%	Concentration 15%
Day-1	34,98 ± 0,01[a]	46,88 ± 0,03[b]	50,42 ± 0,04[c]	51,87 ± 0,04[d]
Day-3	34,94 ± 0,01[e]	43,03 ± 0,03[f]	48,60 ± 0,03[g]	49,80 ± 0,04[h]
Day-6	34,90 ± 0,01[i]	41,32 ± 0,03[j]	45,70 ± 0,03[k]	47,52 ± 0,04[l]

Data are expressed in mean ± SD, different letters show significant differences between treatments

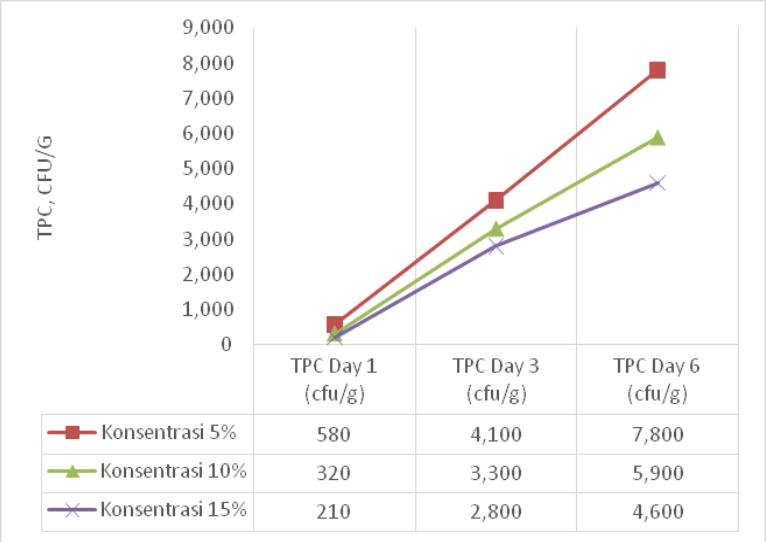

Figure 1. Total plate number for tofu mixed with banana peel extract with various concentrations of 5%, 10%, and 15% on day 1, 3, and 6 at room temperature

However, if the temperature is too high it can cause damage to the material being processed. Bioactive and phenol components are damaged at temperatures above 500C because they can undergo structural changes and produce low extracts (Handayani and Sriherfyna, 2015). The time at extraction needs to be maximized because according to (Rahmi, Siti, Chairunnisa and Satibi, 2014) the right extraction time will produce optimal compounds. If the extraction time is too long it can cause hydrolyzed extracts and vice versa if it is too short it can cause the active compounds contained in the material not to be extracted completely. If the temperature and extraction time are determined precisely, the antioxidant activity produced by the extract will be high.

Banana peel extract then added at the time of tofu production. Making tofu begins with washing 500 grams of soybeans and then mashed and filtered to produce soy milk. Soy milk heated to a temperature of 70 C-90 C. The addition of banana peel extract with a concentration variation of 5%, 10%, and 15% to soy milk when soy milk at cooling stage after heating. The next stage is adding vinegar to the fortified soy milk consists of whey and curd. The curd is then printed into tofu. Tofu after the fortification is then stored at room temperature for 1-6 days. Antioxidant activity test and microbial test of tofu on days 1,3, and 6. The result of antioxidant activity in banana peel extract in various concentrations of 5%, 10% and 15% were added to the production of tofu and stored at room temperature for 1,3 and 6 days shown in the following Table 2.

The result of antioxidant activity determination in Table 2 shows that antioxidant activity in tofu with banana peel extract is higher than antioxidant activity in the tofu without banana peel extract. Based

on the data, tofu with higher concentration of banana peel will produce higher antioxidant activity. Although this antioxidant activity will decrease along with the addition of days and shelf life. This is due to the antioxidant compound damage at a certain time. Based on the data result, it can be concluded that the addition of banana peel extract in the production of tofu is the most optimum at the concentration of 15% with a shelf life of 1 day at room temperature of 51,87%.

The relation between antioxidant concentration and shelf life connected to TPC test result that show total microbes as a main factor of food damage. TPC test result in tofu with banana peel extract at various concentration of 5%, 10%, and 15% and various shelf life for 1,3, and 6 days shown in Figure 1.

In the previous experiment stage, qualitative test of phytochemical compound has been carried out presented in Table 1. Asih, Ida Ayu Raka et al. 2018 explained that the content of phytochemicals in banana peel has an antioxidant and antibacterial effect. These phytochemical compounds include tannins which deposit protein and inhibit the growth of microbes by damaging cell walls and forming microbial functional protein bonds (Ningsih, 2016; Sudira, 2011). Another phytochemicals compound in banana peel is Alkaloid. Alkaloid functions to inhibit microbes by damaging the constituent components of cells so that the cell wall is not fully formed, and this can result in cell death (Pangestu et al, 2017). The next phytochemical is steroid, which is indeed abundant as a lipid fraction in plants and animals. This substance functions as antimicrobial and antioxidant by forming a layer like wax to reject the present of microbes (Ningsih, 2016). Flavonoid in banana peel also has antimicrobial and antioxidant effects. The mechanism of action is by inhibiting the synthesis of nucleic acid and the function of cytoplasmic membrane, resulting the chaos in energy metabolism and changes in cell permeability, which resulted in microbial cell death. Terpenoid compounds inhibit bacterial growth by inhibiting the mechanism of protein synthesis so that it causes changes in the components of the bacterial cell itself (Sarfina et al.,2017).

In this regard, it is true that banana peel has antioxidant properties that can inhibit microbial growth due to presence of phytochemical compounds. However, this TPC value continues to increase along with the length of storage time. This is because the activity of phytochemical compounds has a saturation period, which at the moment cannot maintain the mechanism of resistance to microbes. Therefore, the concentration of banana peel extract will be linear with the phytochemical compounds contained and will be linear with the performance of inhibition to microbes. Hence, in this experiment the best TPC value is produced at concentration of 15% and in 1 day (Figure 1). If the concentration curve of 15% in Figure 1 is extrapolated, it will obtain saturated value from antioxidant bioactive compounds, in this case phytochemical compounds. The saturation value is assumed when the acquisition of TPC value reach maximum limit required by SNI beforehand, which is $4{,}76\times10^{4}$cfu/gram, at 77 days. If roughly viewed from TPC parameters alone, it can be stated that by soaking using banana peel extract of 15% can increase shelf life of tofu until 77 days.

SUMMARY

Banana peel extract was tested for phytochemical to determine the secondary metabolite compound shows that banana peel extract contains alkaloid, tannins, flavonoid, steroids and triterpenoid. From the result of phytochemical test on banana peel, it shows that the extract of banana peel contains secondary metabolites compound that has the potential as antioxidant. Antioxidant activity test of banana peel extract used DPPH method because it is most common used method. The result of antioxidant activity in banana peel extract shows the antioxidant activity of banana peel extract as much as 58,02%.

Antioxidant activity in tofu with banana peel extract is higher than antioxidant

activity in the tofu without banana peel extract. The addition of banana peel extract in the production of tofu is the most optimum at the concentration of 15% with a shelf life of 1 day at room temperature of 51,87%.

Banana peel has antioxidant properties that can inhibit microbial growth due to presence of phytochemical compounds. However, this TPC value continues to increase along with the length of storage time. The best TPC value is produced at concentration of 15% with a shelf life of 1 day at room temperature.

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