Nutrition of wet noodles with mangrove fruit flour during the shelf life by adding catechins as a source of antioxidants

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Abstract. Wet noodles are foods that are very popular with the public, but basically, noodles do not contain many important nutrients. Catechins are a class of antioxidant compounds that can be extracted from various plant sources. The goal of this research is making of noodles from mangrove fruit flour with the addition of catechins is carried out to increase the nutritional and nutritional value and improve the quality of wet noodles during the shelf life. The research method used an experimental design with a factorial Completely Randomized Design (CRD) with three factors (K = Control, S = T. Mangrove fruit S. caseolaris). A (T. Mangrove fruit A.marina) and 3 test levels, namely storage time (0.3 and 5 days). The results were processed using SPSS version 22 software with one-way ANOVA. The results showed the value of water content in the range of 46.33-56.82%, protein content 3.88-6.83%, fat content 1.76-2.82%, ash content 0.04-0.18%, levels of carbohydrates 39.08-48.79%, fiber content 3.09-8.81%, antioxidant activity 5.11-47.74%. The results showed that seaweed fruit flour wet noodles with catechins as a source of antioxidants were able to improve the quality and nutrition of wet noodles during the shelf life. The results showed that the manufacture of wet noodles from mangrove fruit flour with the addition of 7% catechins as a source of antioxidants was able to significantly improve the nutritional quality and nutrition of wet noodles during the shelf life compared to control (K) wet noodles with wheat flour as raw material without 7% catechins as a source of antioxidants

Keywords: antioxidant; catechin; mangrove fruit; shelf life; wet noodle

1. Introduction

The number of noodle consumption is getting higher every year. Data show this condition that the consumption rate of instant noodles in Indonesia is the second largest after China [1]. In addition, the volume of noodle exports in Indonesia has also increased in the last five years, namely from 2014-2019 [1]. Noodles are flour-based foods, besides that noodles found in Indonesia can be made using alternative variations of raw materials such as corn flour noodles (vermicelli), tapioca flour noodles (rice flour noodles or kwetiau), and many other variations. However, variations of noodles already on the market, on average, lack particular nutrients that impact health. Some even contain several preservatives, artificial coloring, and monosodium glutamate (MSG), which will negatively impact health. According to, Monosodium glutamate when consumed beyond the maximum limit and constantly in the long term of course will cause various side effects without realizing it [2]. The community is wet noodles, and besides being delicious, wet noodles can also be used as dishes with many variations, such as fried noodles or soup noodles. Consumers often face constraints when buying wet noodles, one of which is a decrease in durability and quality during the shelf life or if the noodles are wet not cooked right away. Wet noodles are fresher, have stronger cooking power, stronger gluten, better taste and aroma. However, the high humidity of fresh, moist noodles can cause spoilage, browning, rancidity, and spoilage, which can impair the appearance, quality, and taste[3]. Mangrove fruit as an alternative food that can be used as a cake ingredient includes mangrove fruit flour (Avicennia sp) and lindur/tancang (Bruguiera sp) types. In addition, A. marina, B. gymnorrhiza, and S. caseolaris
are edible mangrove fruits used as raw materials of mangrove fruit flour [4]. It is said that the material from the mangrove fruit also has a relatively high nutritional value. The seeds of the Api-api plant contain 10.8% protein and 21.4% carbohydrates so that the seeds of the plant can be used as an alternative as food ingredients [5]. Mangrove fruit has many benefits because of its nutritional composition and nutritional substances, which are quite complete. Some researchers have used pedada fruit in processed foods such as making syrup, jam, cake, lunkhead, and analog rice. *Sonneratia* has several advantages compared to other mangrove plants; namely, the nature of the fruit is non-toxic and can be eaten directly without being processed first [6]. *Sonneratia* also contains fiber and minerals [7]. The proximate content of pedada fruit includes water content of 84.76%, ash content of 8.40%, fat content of 4.82%, protein content of 9.21%, carbohydrate content of 77.57%, while the vitamins contained in the mangrove pedada *S. caseolaris*, Vitamin B1 5.04 mg/100g, Vitamin B2 7.65 mg/100g, vitamin C 56.74 mg/100g, and vitamin A 11.21 RE [8].

Several studies on wet noodles have investigated the addition of specific natural antioxidant agents or modified wet noodle raw materials from materials that are rich in nutrients and can improve the sensory and durability of wet noodles, one of which is the study, which utilizes Lindur type of mangrove fruit flour (*Bruguiera gymnorrhiza*) to improve the quality of wet noodles [9] and research to improving the quality of wet noodles with the addition of antioxidants from api-api leaves as a source of antioxidants [10]. Chemical and bioactive compounds of mangrove plants can act as antimicrobials [11], antioxidants [12], anti-inflammatory [13]. Based on the above background, to improve the nutritional quality of wet noodles during the shelf life, it is necessary to research the making of wet noodles from mangrove fruit flour which is rich in nutrients with the addition of catechins as a source of antioxidants using *A. marina* (Api api) fruit as raw material. and *S. caseolaris* (Pedada).

2. Material and methods
This study used high protein wheat flour ingredients, 97% *Bruguiera gymnorrhiza* mangrove leaf extract (catechins), mangrove fruit flour, and distilled water. The tools used are noodle printers, analytical balances, basins, trays, pans, rollers, and knives.

2.1. Noodle production
The research was started by making control noodle dough (K) using wheat flour as the raw material. Wheat flour is added with hot water and then kneaded to have a ductile texture and can be formed into noodles. Then the sample is made by adding catechin powder to the kneading process. Making cooked wet noodles consists of mixing, stirring, sheet forming, resting, thinning, cutting, boiling or steaming, washing with clean water, cooling, and adding cooking oil. The level of catechins used is 7% so that in 1 sample of noodles from wheat flour weighing 50 grams, there are 3.5 grams of catechins. The samples were then treated with a shelf life of 0 days, three days, and five days with room temperature conditions. The resulting samples contained 7% catechins stored for 0 days, three days, and five days. [14] modified.

Test Analysis of water content, fat content, protein content, ash content, carbohydrate content, and fiber content [15] As for the antioxidant testing using the DPPH method. Antioxidants were determined using spectrophotometric methods. A decrease in absorbance was observed at a wavelength of 517 nm after 30 minutes of reaction. The levels were analyzed by calculating the percentage of DPPH absorption inhibition using the formula. The tools needed are a spectrophotometer, cuvette, stopwatch, measuring pipette, and centrifuge. In contrast, the materials required are a solution of DPPH (*1,1-diphenyl-2-picrilhydrazyl*), methanol, acetone, and a sample of noodles.

2.2. Research methods
The research method used is an experimental design with a completely randomized design with a factorial pattern with three factors (*S. caseolaris* mangrove fruit flour noodles; *A. marina* mangrove fruit flour noodles and control and 3 test levels (storage time 0.3 and 5 days). They were processed using SPSS Version 22 software using ANOVA (Analysis of Diversity Prints). Significantly different data (P<0.05) was further tested using Duncan’s test.
2.2.1. Moisture content. The measurement of water content was carried out by the thermogravimetric method. The cup used in the measurement is dried in an oven at a temperature of 100-105°C until a constant weight is obtained, then cooled in a desiccator and weighed. The sample was weighed as much as 5 grams in a cup, then dried in an oven at a temperature of 100-105°C until a constant weight was obtained. The sample is cooled in a desiccator and then weighed. The principle of the water content analysis method is based on the evaporation of water contained in the sample. Weight reduction occurs due to the evaporation of water contained in the sample [13-16].

2.2.2. Protein content. The method of measuring protein content was carried out using the Kjeldahl method. The principle of analysis of this method includes destruction, distillation, and titration. The principle of protein content analysis using the Kjeldahl method is to determine protein from carbon-containing materials and convert nitrogen into ammonia. Ammonia reacts with an acid to form ammonium sulfate, and then ammonia is absorbed in boric acid solution (Merck). The HCl titration step can determine the amount of nitrogen contained in the sample [15].

2.2.3. Fat content. Fat content analysis was carried out using the Soxhlet method. The principle of this analysis is to extract fat using hexane solvent. When heated, the hexane solvent will evaporate so that the fat content can be calculated. Measurement of fat content begins with drying the fat flask using an oven at 105°C for 30 minutes, then cooled in a desiccator for 15 minutes and weighed. A total of 5 grams of the sample was wrapped in filter paper and then put into a fat sleeve, then covered with fat-free cotton and doused with hexane solvent. The following procedure is distillation until the hexane solvent evaporates. The extracted flask was then heated in an oven at 105°C until the weight was constant. The dried sample was then cooled in a desiccator and weighed.[15]

2.2.4. Carbohydrate content. Calculation of carbohydrate content in the proximate analysis was calculated using the by difference method. Calculation of carbohydrate analysis is 100%-(water content + ash content + fat content + protein content). Carbohydrates are obtained by subtracting the number 100 with the water content, ash content, fat content, and protein.[15]

2.2.5. Ash content. Measurement of ash content was carried out using a furnace with a temperature of about 550 C with the dry ashing method. Determination of ash content was carried out by heating at a temperature of 550 C by oxidizing organic matter, then weighing the remaining substances.[15]

2.2.6. Crude fiber content. Analysis of dietary fiber was carried out by the enzymatic method. This measurement was carried out by reacting the sample with the enzyme alpha amylase and pepsin. The residue from the enzyme reaction was then washed with ethanol and acetone. The residue is insoluble when washed with ethanol and acetone and then dried. The filtrate, which is soluble fiber, is precipitated using ethanol then filtered and dried. Determination of dietary fiber content is divided into three stages: sample preparation, insoluble dietary fibre measurement, and soluble dietary fibre measurement.[15]

2.2.7. Antioxidant activity. Prepare a sample of wet noodles. Then make a mother liquor of each sample of 100 ppm by dissolving 10 mg of extract in 100 ml of methanol PA. Furthermore, dilution using methanol PA solvent by varying the concentration of 5 ppm, 6 ppm, 7 ppm, 8 ppm and 9 ppm for each sample. Prepare 50 ppm DPPH stock solution. DPPH stock solution is prepared by dissolving 5 mg of DPPH solids into 100 ml of methanol PA. Then a comparison solution was designed, namely a control solution containing 2 ml of methanol PA and 1 ml of 50 ppm DPPH solution. Every 2 ml of sample solution and 2 ml of DPPH solution were prepared for the test sample. Then, they were incubated for 30 minutes at a temperature of 27°C until a color change from DPPH activity occurred. All samples were made triple. All samples, namely extract samples that have been incubated, are tested for absorbance values using a UV-vis spectrophotometer at a wavelength of 517 nm [17].
3. Results and discussion

3.1. Moisture content

The moisture content of wet noodles greatly determines their durability. The higher the water content of wet noodles, the lower the shelf life. Figure 1 shows that the water content of wet noodles made from mangrove fruit flour is lower than the control. This condition may be related to the starch and fiber content in mangrove fruit which is higher than wheat flour. Fibers and starches have great hydrocolloid or water-holding abilities. Hydrocolloids are polymer components derived from vegetables, animals, microbes, or synthetic ingredients which generally contain hydroxyl groups. This polymer component is soluble in water, can form colloids, and can thicken or form a gel from a solution [18].

Figure 1 shows a significant difference (P<0.05). This means that the water content has a considerable effect on the treatment of the long shelf life of wet noodles, where the longer the storage, the lower the water content value. Control wet noodles showed a higher water content value than wet noodles from mangrove fruit flour. The high water content in mangrove fruit flour is also caused by the high carbohydrate and fiber content. Fiber is also composed of walls such as cellulose, where cellulose has a hydroxyl group that protrudes from the chain and forms hydrogen bonds easily [19,20]. This condition causes water to be more easily bound in the product as the mangrove fruit flour increases and causes the water content of wet noodles to increase.

3.2. Protein content

Protein content in making wet noodles will usually affect the swelling power, braking power, elasticity of noodles, and cooking time. In wet noodles made using high protein wheat flour in which there is gluten, it will produce noodles that have good elasticity and are not easily broken when cooked. Meanwhile, noodles produced from the raw material of mangrove fruit flour have lower protein content resulting in higher braking power. The cause of the lower protein content of mangrove fruit flour is because the raw material of wheat flour has a higher protein content (also contains gluten) when compared to mangrove fruit flour[21]. The protein content of Sonneratia mangrove fruit flour is around 8.34-8.73%, while high protein wheat flour contains approximately 12-13% protein [22].

The data in figure 2 shows that storage time has a significant effect (P<0.05) on the protein content of mangrove fruit flour wet noodles. An increase always follows the increase in protein content in the water content of the product. This condition is because the protein in food serves as a binder that can increase the water-holding capacity of the material and is hydrophobic, so it requires a large amount.
The trend of decreasing protein content during five days of storage showed that the administration of catechins could minimize protein damage that occurred during storage. These results are indicated by the data in Figure 2, which shows a drastic decrease in the moisture content of the control wet noodles (K) from 6.81% to 3.88% for five days of storage. While, the noodles with catechins showed a decrease in protein that was not too much of a decrease in value, namely from 6.83% to 4.2% in treatment S and 6.57% to 4.09% in treatment A. Catechins act as Antioxidant agents that can suppress protein breakdown and maintain nutrients in wet noodles for five days of shelf life. Antioxidants are substances that can delay, prevent, and eliminate oxidative damage to target molecules, such as fats, proteins, and DNA [23].

3.3. Fat content
Fat serves to soften the texture of a product, but the addition of excess fat can cause the product's surface to become brittle. Fat content has a significant effect on the use of flour and different storage times, where the fat content of wet noodles made from wheat flour (control) is higher than wet noodles made
from mangrove fruit flour. The low-fat content is due to the higher fat content of wheat flour (8.28%) [24] than mangrove fruit flour (1.44-1.54%) [21].

Based on Figure 3 shows that the length of the shelf life has a significant effect (P < 0.05) on the fat content produced by mangrove fruit flour noodles. The longer the shelf life, the fat content tends to decrease, but the fat content of noodles made from mangrove fruit flour has a lower value than the control. The increasing use of flour causes the fat content of wet noodles to increase, and this is because the fat content of the flour is higher than the fat content of mangrove fruit flour [19]. The addition of catechins on fat content showed that fat damage did not show a significant difference in wet noodles with mangrove fruit flour (fat content during storage tends to be more stable) than controls. During storage, there is a breakdown of fat caused by fat oxidation and rancidity. With the addition of catechins
as a source of antioxidants, it can prevent fat oxidation. The greater the antioxidant compounds contained, the greater the inhibition of the oxidation process [25].

3.4. Carbohydrate content
Carbohydrates are the main component in wet noodles and contribute the largest calories. By making wet noodles based on mangrove fruit flour, it is hoped that the noodles will be lower in fat, low in calories, but rich in fiber and antioxidants. The longer the shelf life of wet noodles, the higher the carbohydrate content. Starch components and other molecules are bound; hydrolysis or breakdown occurs into simple sugar molecules during storage. The results of this study are by research. The carbohydrate content shows that the longer the material is stored, the higher the carbohydrate content is detected [14]. It was stated that sugar is a simple carbohydrate.

Wet noodles are a product that is a source of calories. Wet noodles undergo a boiling process after cutting and before being marketed with a reasonably high water content, namely 35-60%. It has a short shelf life (ranging from 24-36 hours at room temperature). Nutrient composition of noodles per 100
grams of ingredients includes energy 86 calories, protein 0.6 g, fat 3.3 g, carbohydrates 14 g, calcium 14 mg, phosphorus 13 mg, Iron 0.8 mg [26]

3.5. Ash content
The ash content of a material is related to the minerals of a material. There is a tendency that the more mangrove fruit flour is added, the higher the ash content. The content of vitamins and other minerals in mangrove fruit flour is more than wheat flour, so that with the abundance of minerals in mangrove fruit flour it can increase the ash content. In addition, the treatment of soaking and heating fire fruit to remove tannins and HCN before being used as mangrove fruit flour will also potentially increase the ash content of the mangrove fruit flour produced.

Figure 5 shows a significant difference (P<0.05) in the value of the ash content. Ash content is closely related to the mineral content contained in a food ingredient. The ash content during the storage period showed an increase. The highest ash content was obtained by wet noodles with S. caseolaris fruit flour as the primary ingredient, while the control wet noodles showed a lower ash content than the ash content of wet noodles made from mangrove fruit flour. This condition is due to the mineral content of the raw material of mangrove fruit which is high compared to minerals in wheat as a control. Wheat flour has an ash content of around 0.49-0.56%. Meanwhile, the ash content in Mangrove fruit flour is 5.18-5.39%[27].

3.6. Crude fiber
Based on figure 6, there is a significant difference (P <0.05) in the value of fiber content of wet noodles during the shelf life. During storage, there was a decrease in the value of fiber content, but the fiber content of wet noodles made from mangrove fruit flour was higher than the control. The high fiber content in wet noodles from mangrove fruit flour is because the essential ingredients used as raw materials already have high fiber content. Pedada mangrove fruit (Sonneratia caseolaris) has high dietary fiber, 53.90%, and 9.80% of the total fiber is dietary fiber[28].

3.7. Antioxidant activity
Antioxidant activity is significant to be added to foodstuff, improve health, and increase the quality and durability of food because it avoids rancidity due to fat damage and protects proteins from denaturation and hydrolysis during the shelf life. Antioxidant activity is a parameter that can describe the percentage of a food ingredient's ability to inhibit free radicals. Antioxidants can protect the body from oxidative stress, prevent LDL from the oxidation process and slow down the process of atherosclerosis to reduce the risk of cardiovascular disease [29].

Figure 7 shows a significant difference (P<0.05) to the value of the antioxidant activity that the value of antioxidant activity during the longer shelf life will decrease. Wet noodles provided higher antioxidant activity with mangrove fruit flour as a base material than the control. The high antioxidant activity in wet noodles with the addition of catechins is because the antioxidant value of the raw material of mangrove fruit is already high. With the addition of catechins, the value of antioxidant activity will be higher.

4. Conclusion
The results showed that the manufacture of wet noodles from mangrove fruit flour with the addition of 7% catechins as a source of antioxidants was able to significantly improve the nutritional quality and nutrition of wet noodles during the shelf life compared to control (K) wet noodles with wheat flour as raw material without 7% catechins as a source of antioxidants. Based on the results of the study showed that the addition of catechins which are natural antioxidants can improve the quality of the nutritional damage of wet noodles during the shelf life.

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