

The Effect of Angkung (*Basella alba* L.) Fruit Addition on Physicochemical Properties of Noodles

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ABSTRACT

This study aims to determine the physicochemical properties of red violet noodles (RVN), noodles which are added with angkung fruit juice as a natural dye. RVN is believed has potential effect as healthy food because it contains antioxidant compounds from angkung fruit. The treatment in the study was the addition of angkung juice, at various concentrations of 0% (Control), 2% (RVN1), 4% (RVN2), and 6% (RVN3). Physicochemical analysis such as water content, water absorption index (WAI) and water-soluble index (WSI), color, and texture profile. Data were analyzed using a completely randomized design (CRD). Significant differences between data were analyzed using ANOVA followed by Duncan's multiple distance test (DMRT) at $\alpha = 5\%$. The water content of RVN samples ranged from 11.2 to 11.8% with Control (0% angkung juice) having the highest value, swelling index value is ranged from 51.05 to 51.09%, the WAI of RVN samples ranged from 4.90 to 4.97 g/g with Control having the highest value, while the WSI value of RVN is ranged from 2.36 to 4.86%, the value of L is ranged from 60.82 to 66.78 while the value of a is ranged from 2.05 to 9.08 and the value of b with the addition of angkung juice is ranged from 19.81 to 25.01. The lowest value of hardness is controlled 6.91 mJ, the range value of adhesiveness is 0.12-0.13 mJ, and the lowest value of chewiness is controlled 4.81 mJ. In this research, red violet noodles have similarity physicochemical properties with control, which means that with the addition of angkung juice, it has the same good quality as noodles in general but has a more attractive red violet color. Red-violet noodles with the addition of angkung fruit juice will be continued in the future by conducting sensory tests and testing health benefits in vitro and in vivo. It is expected that red-violet noodles can be consumed by everyone as a healthy food.

Keywords: Angkung; Basell; Healthy food; Noodles

INTRODUCTION

One item that is especially well-liked in the neighborhood is noodles. Noodles are being used as substitute for rice in food (Nurjannah et al., 2019). Noodles are a popular food in Indonesia which can be served as fried noodles, boiled noodles, and also served with meatballs. Various innovations to promote new noodles have been developed by adding other food sources such as cassava flour, tempeh, corn flour, breadfruit, *Pleurotus* powder, Curcuma longa powder, onion juice, and betel leaf extract (Parlindungan & Purnawan Candra, 2021). Making noodles are currently added a lot of vegetables that are rich in color and antioxidant content. The addition of vegetables is expected to provide additional nutritional value that is not found in common noodles. In addition, vegetables added to the noodle dough can later be used as healthy natural dyes and flavors. Some vegetable products that are commonly used in noodles making are carrot, green spinach, mustard, pumpkin, corn, and tomato. The addition/substitution of other food sources also aims to improve physicochemical properties such as chemical composition, texture, color, increase antioxidant activity, or extend the shelf life of the noodles (Irmayanti, 2020).

Angkung fruit (*Basella alba* L.) is generally cultivated for its leaves as a green vegetable which is rich in vitamins, minerals, and antioxidants. However, many angkung fruits, estimated

at 2 kg/plant, are discarded by farmers after the harvest leave. In fact, ripe angkung fruit that has a deep red-purple skin and flesh color is a source of natural pigments. The main red pigment in ripe angkung fruit has been identified as gomphrenin I (GPI), a betacyanin pigment, and was shown to exhibit strong antioxidant and anti-inflammatory activities. Other betacyanin derivatives such as betanidine-dihexose and isobetanidine-dihexose have also been isolated from ripe angkung fruit (Huang et al., 2016). Therefore, intensive research is needed to use fruits that are treated as agricultural waste in development of value-added products, such as natural dyes. *Basella alba* L. (*Basellaceae*), commonly known as Malabar Spinach is a coiled, branched, smooth vine that can reach several meters. The stems of *Basella alba* are green. The fruit is fleshy, stemless, globose, 5 to 6 mm long, and purple when ripe; they contain betacyanin as the main pigment (Adhikari et al., 2012).

This study aims to determine the physicochemical properties of noodles added with angkung fruit juice as a natural dye. RVN products are expected to attract consumers because the psychochemical properties are quite attractive.

METHODS

Materials

Ingredient used in these experiments are wheat flour, water, salt, eggs, and fryingoil which obtained from traditional market at Gresik, sodium alginate (CV. Makmur Sejati, Malang), and angkung fruits (CV. RAJ, Malang).

Tools

Tools used in these experiments are beaker glass, desiccator, extraction tube, test tube, measuring pipette, and magnetic stirrer.

Preparation of Angkung Fruit Juice

Briefly, 1 kg of angkung fruit (*Basella alba* L.) was placed in a manual juice press (VZ-1, China) and then filtered using filter paper to separate impurities after which the angkung juice was obtained.

Preparation of Red Violet Noodles

Briefly, weighed 500 grams of high-protein wheat flour, 3 eggs, 5 grams of alginate, 1 tablespoon of oil, half a tablespoon of salt, 100 ml of water, and angkung fruit juice according to the treatment in the study, namely the addition of 0% (Control), 2% (RVN1), 4% (RVN2), and 6% (RVN3) were added to the dough mixer (DMIX-002, Maksindo Malang, Indonesia). Then the dough was mixed until smooth. Then the dough is placed in a container covered with a wet cloth for 30 minutes. The dough that has been rested for 30 minutes is then taken and placed in a noodle marker (MKS-220, Maksindo Malang, Indonesia), and after that wet red-violet noodle is obtained. Then, immediately place the wet red violet noodles into an oven at 70 °C for 3 hours to get dry red violet noodles.

Water Content

Analysis for water content was modified using a method of Baur & Ensminger (1977), The sample was weighed as many as 2 grams and then put in a cup (a) and dried in an oven at 105 °C for 3 hours, then cooled in a desiccator and weighed (b). Water content can be determined by the following formula:

$$\text{Water content (\%)} = \frac{a-b}{a} \times 100\% \quad (1)$$

Swelling Index

Swelling index was modified using a method of Kamble et al. (2018), briefly sample was weighed 2 grams, then boiled for 4 minutes and weighed of cooked RVN (a). After that it was dried in an oven at 115 °C for 3 hours and weighed (b). Swelling index can be determined by the following formula:

$$\text{Swelling index (\%)} = \frac{a-b}{b} \times 100\% \quad (2)$$

Water Absorption Index and Water Soluble Index (WSI)

Analysis of water absorption index (WAI) and water soluble index (WSI) was modified using a method of Patria et al. (2020). Briefly, the sample flour (2 g) was diluted in 20 mL of distilled water in 50 mL centrifuge tubes then mixed for 10 mins and centrifuged at 3000 rpm for 20 mins. After that, the supernatant was placed in an aluminum dish then dried the supernatant in an oven at 105 °C for 24 hours. Then the weight of the gel and dried supernatant is recorded. WAI and WSI can be determined by the following formula:

$$\text{WAI (g/g)} = \frac{\text{weight of sample gel (g)}}{\text{weight of sample flour (g)}} \quad (3)$$

$$\text{WSI (g/g)} = \frac{\text{weight of dried supernatant (g)}}{\text{weight of sample flour (g)}} \times 100\% \quad (4)$$

Color Analysis

Color analysis was modified using a method of Patria et al. (2021). The color of RVN was determined using a colorimeter. Measurements were made at random locations on the surface of RVN, Lightness (L), redness (a) and blueness (b) values were noted.

Texture Profile Analysis

Texture profile analysis of RVN was modified based on Patria et al. (2021) using the Texture Profile Analyzer (TexturePro CT V1.4 Build 17). Sample was compressed to 50% deformation. The plunger was withdrawn to the original height, and the sample was stopped for 5 s, followed by the compression with draw cycle at 50% deformation. The speed of the compression head was adjusted to 2 mm/sec and the diameter probe was TA11/1000.

Research Design

The treatment in the study was the addition of angkung juice, at various concentrations of 0% (Control), 2% (RVN1), 4% (RVN2), and 6% (RVN3)

Data Analysis

Data were analyzed using a completely randomized design (CRD). Significant differences between data were analyzed using ANOVA followed by Duncan's multiple distance test (DMRT) at 5%.

RESULTS AND DISCUSSION

Water Content

The results of the water content of the red-violet noodle (RVN) samples were shown in Table 1. The water content of RVN samples ranged from 11.2 to 11.8% with Control (0% angkung juice) having the highest value. However, from all treatments given, there were no significant ($p > 0,05$) difference because the addition of angkung juice did not affect the water content of RVN and also angkung does not contain starch, so it cannot bind water. Although the angkung of the fruit is used in the form of juice, the drying conditions used are the same to obtained dry RVN, namely at a temperature of 70 °C for 3 hours. Water content is an important parameter of food products because the water content in food determines the acceptability and freshness of food. The water present in the ingredients can affect the appearance, texture, taste, shelf life, as well as the quality and durability of the ingredients (Winarno, 1997). Patria et al., (2021) reported that the level of water content influenced by material formula, extrusion temperature, and the drying process performed after the extrusion process.

Swelling Index

Based on the results, the swelling index of the RVN samples have been proven in Table 1.

Table 1. Physicochemical properties (water content, swelling index, wai, and wsi) of red violet noodles

Sample	Water Content (%)	Swelling Index (%)	WAI (g/g)	WSI (%)
Control	11.8 ± 0.9 ^a	51.09 ± 0.4 ^a	4.97 ± 0.1 ^a	2.36 ± 0.2 ^a
RVN ₁	11.2 ± 0.4 ^a	51.05 ± 0.9 ^a	4.96 ± 0.1 ^a	3.99 ± 0.2 ^b
RVN ₂	11.5 ± 0.9 ^a	51.06 ± 0.4 ^a	4.96 ± 0.1 ^a	4.31 ± 0.1 ^c
RVN ₃	11.6 ± 0.9 ^a	51.06 ± 0.6 ^a	4.90 ± 0.1 ^a	4.86 ± 0.2 ^d

Different notations on the same column are significantly different based on the DMRT test ($P < 0.05$)

RVN₁: Addition angkung juice 2%

RVN₂: Addition angkung juice 4%

RVN₃: Addition angkung juice 6%

The swelling index of RVN samples ranged from 51.05 to 51.09% with Control (0% angkung juice) having the best value. However, from all remedies given, there has been no significant ($p > 0.05$) distinction due to the fact the addition of angkung juice did now no longer have an effect on the swelling index of RVN. Angkung does not contain starch or protein, so it

does not have a swelling effect on RVN. Angkung (*B. alba*) juice contains pigments and flavonoid compounds such as a rich source of betalains and has the potential for added value to be used in herbal medicine development of food coloring and nutraceuticals (Lin et al., 2010). According to research conducted by Gull et al. (2018) that the swelling index of the developed functional pasta increased with respect to the control. This may be because the carboxyl and hydroxyl groups in the starch allow them to bind with available water resulting in an increase in the swelling index. The texture characteristics of pasta are recognized as more important for consumers.

Water Absorption Index (WAI)

The results of the water absorption index (WAI) were not a significant ($p > 0.05$) difference. The WAI of RVN samples ranged from 4.90 to 4.97 g/g with Control (0% angkung juice) having the highest value (Table 1). In the WAI parameter, noodles with the addition of angkung juice and control there were no significant changes because the basic ingredients used were the same, namely high protein wheat flour and angkung did not contain starch or protein so it did not change the water absorption ability. *Basella* spp fruit was found to be rich in biochemical content, such as phenolics and flavonoids. Both aqueous methanol and aqueous extracts of the fruits exhibited high antioxidant activity and scavenging potential along with anticancer activity against human cervical cancer cells. The high content of betalains, especially betacyanin and various bioactive compounds contained in the extract, shows the efficacy of fruits (Kumar et al., 2015).

Water Soluble Index (WSI)

Based on the results, WSI of RVN was significantly ($p < 0.05$) difference. The WSI of RVN samples ranged from 2.36 to 4.86% with RVN₃ sample (6% angkung juice) have the highest value (Table 1). The higher the addition of angkung juice, the higher the WSI value. This is because the pigment compounds found in angkung are easily soluble in water. A high WSI value is an indicator of not good noodle quality. Research conducted by Pratama et al. (2015), namely the manufacture of tuber and legumes noodles with the addition of xanthan gum has a WSI value of 5-10%. Also, research conducted by Filho et al. (2021) that the making of red pasta with the addition of beets has a WSI value from 2.57% to 3.25%. Betalain is a water-soluble nitrogen-containing pigment. Synthesized from the amino acid tyrosine into two structural groups: red-purple betacyanin and yellow-orange betaxanthins. Betacyanin give red, blue, or purple to certain flowers and fruits (Reshmi et al., 2012). Betacyanin is a water-soluble betalain pigment derived from glycosylation of betanidines, which can be considered as a condensation product of cyclodopa with betalamic acid (Strack et al., 2003).

Color

Based on the results, The value of L and a of RVN was significantly ($p < 0.05$) difference. However, on b value was no significantly ($p > 0.05$) difference with addition angkung juice, but control was significantly ($p < 0.05$) difference. The addition of angkung juice, the value of L is lower ranged from 60.82 to 66.78 while the value of a is higher ranged from 2.05 to 9.08 and the value of b with the addition of angkung juice is also lower 19.81 to 25.01, which means that with the addition of angkung juice, the color of the noodles becomes darker and the color

changes to more purple and there is little red (Figure 1).Huang et al. (2016) reported that ripe fruit of *B. alba* with dark red-violet skin and flesh is a valuable source of natural pigment. The main red pigment in the ripe fruit of *B. alba* has been identified as gomphrenin I (GPI), a betacyanin pigment, and was shown to exhibit strong antioxidant and anti-inflammatory activities. Mitraa & Dasb (2015) reported that the original color of *Basella alba* is violet. But a sharp color change can be observed with a change in pH. At pH 5.1 it remains violet but at pH 4.45 the color changes to dark violet and at pH 8.14 the color becomes pink.

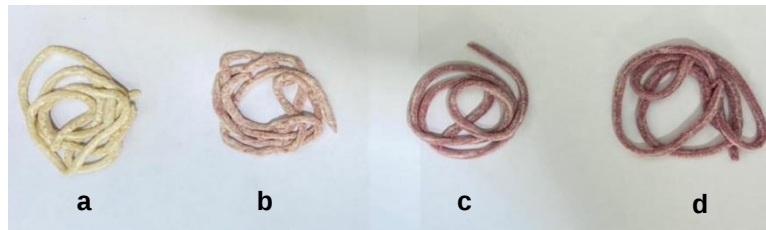


Figure 1. Red violet noodles (a) control, (b) RVN₁, (c) RVN₂,(d) RVN₃

Table 2. Color of red violet noodles

Sample	L	a	b	Description
Control	66.78 ± 1.03 ^a	2.05 ± 0.15 ^a	25.01 ± 0.12 ^a	Yellow
RVN ₁	65.29 ± 1.01 ^b	5.94 ± 0.53 ^b	19.92 ± 0.82 ^b	Red Violet
RVN ₂	64.47 ± 1.10 ^c	7.92 ± 0.18 ^c	19.86 ± 0.52 ^b	Red Violet
RVN ₃	60.82 ± 1.05 ^d	9.08 ± 0.61 ^d	19.81 ± 0.99 ^b	Red Violet

Different notations on the same column are significantly different based on the DMRT test ($P < 0.05$)

RVN₁: Addition angkung juice 2%

RVN₂: Addition angkung juice 4%

RVN₃: Addition angkung juice 6%

Texture Profile

The results of the texture profile of the red-violet noodle (RVN) samples were shown in Figure 1, The hardness of RVN no significantly ($p > 0.05$) difference with addition angkung juice, but control was significantly ($p < 0.05$) difference. The chewiness of RVN no significantly ($p > 0.05$) difference with addition angkung juice. The various treatments not lowered the adhesiveness levels. The chewiness of RVN no significantly ($p > 0.05$) difference with addition angkung juice, but control was significantly ($p < 0.05$) difference. This is due to the addition of angkung juice can cause some of the thickening compounds to also dissolve when cooked so that it can reduce the chewiness value. According to Aisya et al. (2020),the level of adhesiveness of wet noodles is inversely proportional to the level of chewiness. Adhesiveness is a rheological property that occurs when there is an attractive force between the surface of the food material and the surface of other materials when in contact. The stickiness of wet noodles can be affected by the water content. The higher the water content, the more capable the starch hydroxyl group is to absorb water, but higher water content will cause a stickier texture.

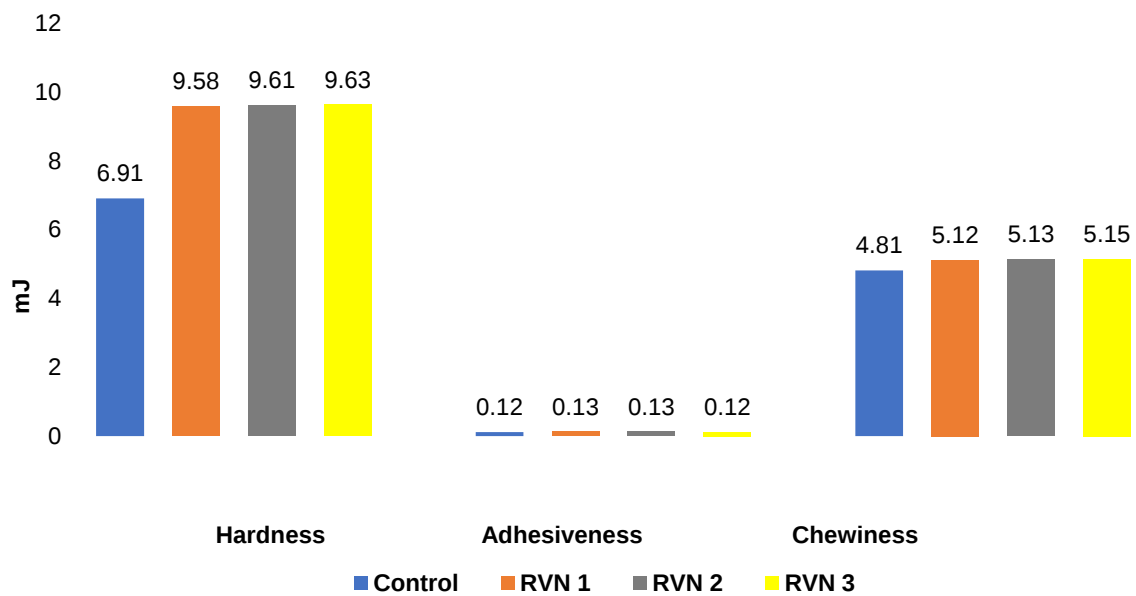


Figure 1. The results of texture profile of the red-violet noodle (RVN)

CONCLUSION

The water content, WAI, and swelling index of RVN samples with Control has the highest value, while the WSI of RVN having highest value is RVN₃, the value of L was lower ranged from 60.82 to 66.78 while the value of a is ranged from 2.05 to 9.08 and the value of b with the addition of angkung juice is ranged from 19.81 to 25.01. The lowest value of hardness is control 6.91 mJ, ranged value of adhesiveness is 0.12-0.13 mJ, and lowest value of chewiness is control 4.81 mJ. In this research, red violet noodles have similarity physicochemical properties with control, which means that with the addition of angkung juice, it has the same good quality as noodles in general but has a more attractive red violet color. Noodles with the addition of angkung fruit juice will be continued in the future by conducting sensory tests and testing health benefits in vitro and in vivo. It is expected that RVN can be consumed by everyone as a healthy food.

ACKNOWLEDGEMENT

Thank you to LPPM Muhammadiyah University of Gresik for providing financial support for this research activity.

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