SAINSTEK: JURNAL SAINS DAN TEKNOLOGI
Publisher: AMSET IAIN Batusangkar and IAIN Batusangkar Press
Website: http://ojs.iainbatusangkar.ac.id/ojs/index.php/sainstek
E-mail: sainstek@iainbatusangkar.ac.id

December 2022
Vol 14 No 2
ISSN: 2085-8019 (p)
ISSN: 2580-278X (e)
pp : 51-61

The Addition of Beetroot (*Beta Vulgaris L.*) to Dawet Ayu Sappan Wood (*Caesalpinia Sappan L.*) as a Functional Drink Containing Anthocyanins

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Article History
Received: 31 May 2022
Reviewed: 30 November 2022
Accepted: 15 December 2022
Published: 15 December 2022

Keywords
Beetroot, Sappan Wood, *Dawet Ayu*.

Abstract
Dawet Ayu is a traditional drink made from rice flour, coconut milk, and brown sugar. Natural colors derived from suji plants are often used. *We* can make Dawet ayu into a functional drink with anthocyanin content using natural colors such as sappan wood and beetroot. We can use the benefit of this research as a reference that sappan wood and beetroot contain anthocyanin which acts as an antioxidant that is beneficial for health. We conducted the study to analyze the characteristics, acceptability, and anthocyanin levels of sappan wood *dawet ayu* with the addition of beetroot. The research design used was descriptive, experimental research that compared three groups with the addition of beetroot (50 g, 100 g, and 150 g). The research design used was a randomized block design. The results of statistical tests using the Friedman test showed that there were significant differences in the indicators of color, aroma, texture, and taste. The hedonic test obtained the highest public acceptance of sample P1 (50 grams of beetroot) with a taste score of 3.30 (like very much), color was 3.77 (like very much), the aroma was 3.58 (like very much), and texture was 3.48 (really like it), with the sample P3 (150 gr beetroot) of 23.14 mg/100g as the highest anthocyanin content. Sappan wood *Dawet Ayu* products with the addition of beetroot are acceptable in the community. The more addition of beetroot and sappan wood in the *dawet ayu* product, the higher the anthocyanin content.

INTRODUCTION

Indonesia has various kinds of culinary. Food and drinks prepared from nutritious food products and simple ingredients might be traditional cuisine (Muara, 2019). Each region of Indonesia has its culinary drink, and the components are derived from plants that are commonly found in that location, and someone solely made them from ingredients that compare only used in Indonesia (Rahayu, 2019). Traditional drinks do not contain chemicals such as preservatives or synthetic colors, and instead, rely only on natural components to ensure that they do not harm the body when eaten in significant quantities regularly. In Indonesia, there are many different traditional drinks, one of which is *dawet ayu* (Nurbaeti, 2014).

Dawet Ayu is a traditional drink that has been around for a very long time. Before the Indonesian became independent, this traditional *Dawet Ayu* drink already existed. Along with the development of the era, *Dawet Ayu* became an

interesting and famous drink throughout the country (Suliati, 2019). *Dawet Ayu* is a traditional drink made from rice flour, coconut milk, palm sugar, or brown sugar water and is usually served with ice (BPOM RI, 2013). According to Hartono (2017), who observed dyes in dawet ayu in the area around Semarang and internet observations, *dawet* on the market has a bland taste with the dyes in *dawet ayu* from pandan leaves, suji plants, charcoal, and artificial food coloring. *Dawet* has the potential to be transformed into a functional drink with natural dyes that are more appealing and higher in nutrients because of its bland taste and limited addition of color.

We can find natural dyes in plant extracts (such as parts of leaves, flowers, and seeds), fruits, vegetables, wood, and others. The natural dyes used in this research were sappan wood and beetroot. Sappan wood has a natural red dye that comes from a brazilin compound. The brazilin compound has a sharp red color at neutral pH and purplish red with increasing pH (Fardhyanti & Riski, 2015). Sappan wood contains anthocyanin compounds, which are flavonoid compounds and have the ability as antioxidants (Nomer et al., 2019).

Based on its antioxidant activity, brazilin has the effect of protecting the body from poisoning caused by chemical radicals and has anticancer activity (Zhong et al., 2009 in Sugiyanto et al., 2013), while the pigment in red beetroot is betalain. Betalains are a class of antioxidants. Besides antioxidants, there are vitamins and minerals in red beets such as B vitamins and calcium, potassium, phosphorus, and iron which are more valuable than the use of red beets (Hanifan et al., 2016 in Dewi & Astriana, 2019).

The formulation was carried out by adding 50g, 100g, and 150g of beetroot extract to each formulation because it was known that if more beet extract was added it would increase the water content and cause the dawet to become sticky. In research conducted by Ann (2012), the more beet extract added, the higher the water content of the marshmallows, so the marshmallows will become sticky, while the less beet extract added, the lower the water content of the marshmallows will cause the marshmallows to become wrinkled and hard.

Previous studies used chicken feet, temulawak starch, and seaweed as raw materials for making dawet. While in this study we used beetroot and sappan wood. So with this study, we predict that the mixture of beetroot and sappan wood can produce unique characteristics of functional drinks in terms of nutrition, functional biochemical properties, and better sensory quality of drinks. I hope that it can become a new functional drink with a taste, aroma, texture, and color that is widely accepted by the public.

METHOD

Dawet Ayu Ingredients

Rice flour, tapioca flour, sappan wood, beetroot, salt, and whiting soak are the ingredients used to make sappan wood *dawet ayu*, as shown in Table 1. Pans, basins, wooden spoons, rubber spatula, stoves, strainers, bowls, and digital scales were also used.

Table 1. The Formula for Making Sappan Wood *Dawet Ayu* with the Addition of Beetroot

Ingredients	Samples Type		
	P1	P2	P3
Beet root	50 g	100 g	150 g
Sappan Wood	10 g	10 g	10 g
Water	1000 ml	1000 ml	1000 ml
Tapioca flour	60 g	60 g	60 g
Rice flour	50 g	50 g	50 g
Salt	½ tsp	½ tsp	½ tsp
Whiting Soak	2 tbs	2 tbs	2 tbs

The first process of making *dawet* is to boil 1000 ml of water with 10 grams of sappan wood. When it boils, turn it off. Then, dissolve 5 grams of whiting with 1 cup of water, and let stand until it settles. After that, mix 50 g of rice flour, 50 g tapioca flour, and 1 tsp salt. Blend the boiled water of 1000 ml of sappan wood with beetroot according to the sample (50 g, 100 g, and 150 g). Add the water mixture of sappan wood and beetroot into the flour mixture, add 1 tablespoon of whiting sediment and stir until dispersed. After that, cook the *dawet* dough on medium Heat while stirring until it boils and thickens. After that, let the dough rest until it reaches room temperature. Prepare ice cubes and boiled water, and do the printing process on the ice water by pressing until the *dawet* granules come out and fall into the ice water. Let it stand for 1 hour until the *cendol* is solid. If the *dawet* has solidified, strain and drain the *dawet*.

Antioxidant Test Material

The tools used were a set of glassware, mortar, and pestle used for pounding, UV-VIS Spectrophotometer, Mettler Toledo pH-meter, and filter paper. We distilled the materials used water or 96% ethanol which has been acidified with 1% hydrochloric acid, diethyl ether, 2M hydrochloric acid and 2M sodium hydroxide. We calculated the resulting data using the formula to get the total anthocyanin levels.

Anthocyanin Content Test Method according to Armanzah and Hendrawati (2016)

1. Wash and dry the *dawet* with a tissue, and then pound using a pestle to form a paste.
2. Extract *dawet ayu* with distilled water or 96% ethanol, which has been acidified with 1% hydrochloric acid.
3. Partition the resulting filtrate with diethyl ether and test for phytochemical anthocyanins with 2M hydrochloric acid and 2M sodium hydroxide.
4. Measure the extract using a UV-VIS spectrophotometer at a wavelength of 505nm and 700nm by adding a solution of pH 1 and pH 4.5.

We calculated the resulting data using the formula to get the total anthocyanin levels. We analyzed the absorbance measurement data using the following equation:

A = (A510-A700) pH 1,0 - (A510-A700) pH 4,5

A =Absorbance
ε =Molar Cyanidin-3-glucoside absorptivity =26900 L/(mol.cm)
L =Cuvette width = 1 cm
MW =Cyanidine-3-glucoside molecular weight =449,2/mol
DF =Dilution factor
V =Pigment extract volume (L)
Wt =initial material weight (g)

Organoleptic and Hedonic Test Materials

The material used to test organoleptic and hedonic is a questionnaire related to the human sensory test which was given to 30 untrained panelists. I asked panelists to assess the sappan wood *dawet ayu* with the addition of beetroot. The questionnaire contains an assessment of the color, texture, aroma, and taste of the product to be assessed, as well as an assessment of the preference for the product. We can see the assessment criteria in Table 2 and Table 3 (Maulina, 2015).

Table 2. The Criteria of the Organoleptic Test Scale

Score	Color	Aroma	Texture	Taste
1	Pale Red	Very Distinctive Smell of Beetroot	Mushy	Bitter
2	Slightly Pale Red	Distinctive Smell of Beetroot	Not Chewy	Bland
3	Dark red	Slightly Smell of Beetroot	Slightly chewy	Slightly Sweet
4	Bright Red	No Smell of beetroot	Chewy	Sweet

Table 3. The Criteria for the Hedonic/Like Test Scale.

Score	Color	Aroma	Texture	Taste
5	Like Very Much	Like Very Much	Like Very Much	Like Very Much
4	Like Moderately	Like Moderately	Like Moderately	Like Moderately
3	Like	Like	Like	Like
2	Dislike	Dislike	Dislike	Dislike
1	Dislike Very Much	Dislike Very Much	Dislike Very Much	Dislike Very Much

Table 4. Mean class interval and organoleptic test criteria

Aspect	Mean Score			
	$1 \leq x < 1,75$	$1,75 \leq x < 2,5$	$2,5 \leq x < 3,25$	$3,25 \leq x < 4$
Aroma	Very Distinctive Smell of Beetroot	Distinctive Smell of Beetroot	Slightly Smell of Beetroot	No Smell of beetroot
Taste	Bitter	Bland	Slightly Sweet	Sweet
Color	Pale Red	Slightly Pale Red	Dark Red	Bright Red
Texture	Mushy	Not Chewy	Slightly Chewy	Chewy

Table 5. Hedonic Test Percentage

Percentage (%)	Criteria
84-100	Like Very Much
68-83,99	Like
52-67,99	Like Moderately
36-51,99	Dislike
20-15,99	Dislike very much

Organoleptic and Hedonic Test Methods

The method of calculating the organoleptic test in this research was to convert qualitative data into quantitative data. The qualities to be analyzed were aroma, taste, and color. Based on the results of the calculation, the score interval table, and the criteria for the *dawet ayu* experimental results obtained. We can see the table of score intervals and criteria for the experimental results in Table 4.

The hedonic test calculation method in this study uses descriptive percentage analysis with the calculation of the percentage interval results with the preference test criteria for each aspect, namely (color, aroma, texture, and taste) in Table 5.

Data Analysis

The data obtained were analyzed using the Friedman test with 3 different samples. The difference test was used to determine the difference between the *dawet ayu* sappan wood, which had been added to the beetroot in a sensory aspect.

RESULTS AND DISCUSSION

Organoleptic Test

The organoleptic quality of secang *dawet ayu* products with the addition of beetroot can be measured by sensory or sensory tests. The sensory test assessed from aspects of color, aroma, taste, and texture of *dawet ayu*. Based on Table 6, shows that from each organoleptic test result in the assessment of aspects of color, aroma, taste, and texture, the sappan wood *dawet ayu* product with the addition of beetroot has the best results that P1 product with the addition of 50 grams of beetroot with a bright red color, does not have the characteristic beetroot aroma, slightly sweet taste, and chewy texture.

Table 6. The Results of the Analysis of Differences in the Mean Organoleptic Test of Sappan Wood *Dawet Ayu*

Sample	Mean Organoleptic Results							
	Color	Description	Aroma	Description	Taste	Description	Texture	Description
P1 (50 gr bit)	3,70	Bright Red	3,65	No Smell of Beetroot	2,50	Slightly Sweet	3,75	Chewy
P2 (100 gr bit)	3,58	Bright Red	3,60	No Smell of Beetroot	2,72	Slightly Sweet	3,25	Slightly Chewy
P3 (150 gr bit)	2,67	Dark Red	3,17	No Smell of Beetroot	2,75	Slightly Sweet	2,77	Slightly Chewy

Table 7. The Results of Analysis of Differences in Organoleptic Quality of Sappan Wood *Dawet Ayu*

Sample Indicator		Median	P-value	Description
Color	P1	4	0,000 < 0,05	There is a difference
	P2	4		
	P3	3		
Aroma	P1	4	0,000 < 0,05	There is a difference
	P2	4		
	P3	3		
Texture	P1	4	0,000 < 0,05	There is a difference
	P2	3		
	P3	3		
Taste	P1	2	0,012 < 0,05	There is a difference
	P2	3		
	P3	3		

Organoleptic Quality Analysis

It carried differences in organoleptic quality out using the Friedman statistical test. The purpose of Friedman's analysis is to determine whether there is a significant difference between the 3 samples. The results of the organoleptic test showed the data had a different analysis of variance, which can be seen in Table 7.

Aroma Quality

The following criteria indications are used to assess the aroma quality: Very Distinctive Smell of Beetroot (1), Distinctive Smell of Beetroot (2), Slightly Smell of Beetroot (3), and No Smell of Beetroot (4). Table 7 shows that the results of the analysis of differences in the aroma's assessment of sappan wood *dawet ayu* with the addition of beetroot had a p-value less than 0.05, namely (0.000), showing that including beetroot has a significant effect on the aroma of *dawet ayu.*

This is because the use of beetroot in the *dawet ayu* changes the fragrance qualities of the sappan wood *dawet ayu*. Volatile compounds cause aroma, which is similar to the earthy fragrance of beetroot (Alin, 2019). Geosmin and other pyrazin chemicals are responsible for beetroot's earthy aroma (Hanson & Goldman, 2019).

This can cause the more use of beetroot, the more the aroma of the beetroot on *dawet ayu* will smell. According to Ismawati et al., (2016) the results of research on yogurt with the addition of beetroot extract, along with the increase in beetroot extract added to the level of soil aroma in yogurt. We found the highest soil aroma value in the sample with the addition of the highest beetroot, which was 4% with an average value of 3.16, with the criteria of slightly smelling soil.

Taste Quality

Criteria indicators and scores, namely bitter (1), bland measure the quality of taste (2), slightly sweet (3), and sweet (4). In table 7. The results of the analysis of the difference in the taste's assessment of secang *dawet ayu* with the addition of beetroot obtained a p-value that is smaller than the value of = 0.05, namely (0.012) which indicates that the addition of beetroot has a significant effect on the taste of *dawet ayu*. This is because of the composition of beetroot, rice flour, and tapioca flour.

Taste is a crucial factor to consider when evaluating a food product. According to Bait (2012), various elements influence taste, one of which is ingredient concentration and interactions with other flavor components. The results from the three samples of the sappan wood *dawet ayu* product with beetroot were sweet in sample 3 and slightly sweet in samples 1 and 2.

Dawet ayu contains carbohydrates which are quite high compared to fat and protein. According to the Indonesian Food Composition Table in the Indonesian Nutritionist Association (2009) that 100 g of beetroot contains 9.6 g of carbohydrates, 0.1 g of fat, and 1.6 g of protein. According to the Indonesian Food Composition Table in the Indonesian Ministry of Health (2017), 100 g of tapioca flour contains 88.2 g of carbohydrates, 0.5 g of fat, and 1.1 g of protein. In 100 g of rice flour, there are 80 g of carbohydrates, 0.5 g of fat, and 7 grams of protein. Besides its function in body metabolism, carbohydrates in food determines the taste characteristics of foodstuffs, namely the sweet taste of food due to monosaccharides and disaccharides (Azrimaidaliza et al., 2020).

Color Quality

We assess the quality of color using the following criteria and scores: Pale Red (1), Slightly Pale Red (2), Dark Red (3), and Bright Red (4). The color assessment of sappan wood *dawet ayu* with the addition of beetroot received a p-value of less than 0.05, namely (0.000), showing that the addition of beetroot makes a significant difference to the color of sappan wood *dawet ayu.*

This is in line with research conducted by Chairuni et al., (2019) that the highest color organoleptic value was found in the sample with the lowest beetroot concentration of 10% and CMC concentration of 0.5%. This shows that the fewer beets, the higher the organoleptic

value for the color of the sappan wood *dawet ayu*.

Texture Quality

The quality of texture as measured by criteria indicators and scores are Mushy (1), Not chewy (2), Slightly chewy (3), and Chewy (4). Based on the results of the analysis of differences in table 7, the texture assessment of sappan wood *dawet ayu* with the addition of beetroot obtained a p-value that is smaller than the value of = 0.05, namely (0.000) which shows that the addition of beetroot has a significant effect on sappan wood *dawet ayu* texture.

This is because of the high water and fiber content of beetroot. 100 grams of beetroot contains a moisture content of 87.6 grams (United States Department of Agriculture (USDA), 2018). The more beetroot used, the mushier the texture of the *dawet ayu* would become. The amount of water affects food texture in it. The higher the water content, the lower the texture value and the soft texture (Amalia, 2011). As a result, the less the addition of beetroot to the sappan wood *dawet ayu*, the more dense and chewy the texture will be. Texture acceptance is also one of the physical properties of foodstuffs that also determines the taste of food because of the sensitivity of the senses (Arysanti et al., 2019).

Hedonic Taste

A panel of 30 people analyzed people's preferences for sappan wood *dawet ayu* with including addition. Taste, color, aroma, and texture were all assessed. Table 8 displays the results of the preference test.

Table 8. The Summary of Public Preference Test Results for Sappan Wood *Dawet Ayu.*

Sample Type	Aspect Mean				Total Percentage	Criteria
	R	W	A	T		
Sample 1 (50 gr red beetroot)	3,30	3,77	3,58	3,48	88,33	Like Very Much
Sample 2 (100 gr red beetroot)	3,01	3,52	3,47	3,00	81,20	Like
Sample 3 (150 gr red beetroot)	3,32	2,95	3,28	2,73	76,77	Like

Table 8 shows the criteria for indicating the percentage interval of people's preference for sappan wood *dawet ayu* with beetroot with different sample codes (P1, P2, P3). The calculation from the table of the community's level of preference for sappan wood *dawet ayu* with the addition of beetroot from the aspect of taste, color, aroma, and texture obtained the preferred sample, which is sappan wood *dawet ayu* with the addition of 50 grams beetroot with a percentage of 88.33%. The results indicate that a small amount of beetroot can provide a bright red color, whereas more beetroot produces a dark red color. As a result, the less beetroot added, the brighter the color of the *dawet ayu* created.

This is due to anthocyanin pigments in the beetroot. Anthocyanins are the pigments that give higher plants their colors of orange, red, purple, blue, and black (Du et al., 2015). Bright colors, according to Hawkins & Mothersbaugh (2010) (Rahardjo, 2016), can be utilized to attract attention and affect consumption.

In addition, *dawet ayu* processed with a little bit of beetroot will produce a denser and chewier texture than the use of beetroot, which produces a mushy texture. Thus, the less the addition of beetroot, the chewy, the texture of the resulting *dawet ayu* will be. There is no distinctive aroma of beetroot (earthy aroma) in this sample due to the use of small beetroot so that other ingredients can cover the

earthy aroma. The number of beetroot used in *dawet ayu* makes the beet taste even sweeter. The level of sweetness of the product affects the level of acceptance. An increase in sweetness can increase the acceptance of panelists at a certain point (Butar, 2011 Wijanarti et al., 2020).

Anthocyanin Content Test

The nutritional content test carried out is an anthocyanin content test which can be seen in Table 9.

Table 9. Anthocyanin Test Results on Sappan Wood *Dawet Ayu*

Sample Type	Anthocyanin
Sample 1 (50 g beetroot)	18,26
Sample 2 (100 g beetroot)	20,28
Sample 3 (150 g beetroot)	23,14

Total anthocyanin levels in the three samples ranged from 18.26 to 23.14 mg/100 g, with sample 3 (150 g of beets) having the highest anthocyanin content at 23.14 mg/100 g. Sappan wood and beetroot both affect anthocyanin levels. According to Nomer et al., sappan wood extract has 2.43 percent mg/100g of anthocyanin compounds, but Ramos et al., (2017) showed that raw beetroot contains 85.2 mg/100g of anthocyanins.

Factors that affect the stability of anthocyanins are structural transformation and pH, temperature, light, oxygen, and pigmentation (Fennema, 1996 in Armanzah & Hendrawati, 2016). Anthocyanins are more stable at acidic pH than in alkaline or neutral conditions. The results of the research conducted (Fardhyanti & Riski, 2015) showed that purple sweet potato tuber powder extracted with methanol-HCl pH 1 solution showed high anthocyanin stability, as evidenced by the red color that can be seen in the extract.

Temperature affects anthocyanin degradation, according to Arthey & Ashurst (2005) in Armanzah & Hendrawati (2016). This is in line with the research of Santosa et al., (2019) that boiling temperature has an effect on anthocyanin levels in nata de coco, with the maximum anthocyanin levels obtained at a boiling temperature of 30^0C. Anthocyanins are antioxidants that are not strong at temperatures above 50^0C so that the anthocyanin content in nata de coco is not damaged.

This differs from the research conducted by Hankey et al., (2012), that there was a significant increase in the total anthocyanin content in colored potatoes boiled for 15 minutes (from beginning to end) compared to fresh ones. The highest increase was observed in cultivars with low total anthocyanin content (Valfi and Congo Biru (11.1 and 10.6 times), while in cultivars with high total anthocyanin content the increase was relatively low (HB Red cultivars 3 for 44 times and Violette 3 for 20 times).

As a result, adding beetroot to creating sappan wood *dawet ayu* can change the anthocyanin content. This is consistent with Husna et al., (2013), who found that while the processing procedure diminishes the anthocyanin level of fresh purple sweet potatoes, the finished product still includes anthocyanin content as an antioxidant source.

CONCLUSION

The resulting *dawet ayu* product is bright red in color, has a sweet taste, and a chewy texture, and does not have the typical beetroot aroma. The highest anthocyanin levels in this *dawet ayu* product were discovered in sample 3 with 150 g of beetroot added, which contained 23.14 mg/100g of anthocyanin, and the lowest in sample 1 with 50 g of beetroot added, which contained 18.26 mg/100g of anthocyanin. However, depending on the level of preference,

sample 1 was the most liked, which means that the more the amount of beetroot added, the more anthocyanin it contains, but it is less favored. This anthocyanin molecule can operate as an antioxidant, protecting the body from free radicals and having anticancer action, making it suitable for public consumption.

ACKNOWLEDGEMENT

We would like to express our gratitude for the assistance and guidance in completing the research activity of making sappan wood *dawet ayu* with the addition of beetroot, especially to Mrs. Tri Marta Fadhilah S. pd., M. Gizi as the supervisor of the food innovation course. Also, to the lecturers and staff of the Mitra Keluarga College of Health, as well as all those who have assisted us in the preparation of this article which we cannot mention one by one.

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