

Effect of black sticky rice tape and purple sweet potato formulation on organoleptic properties and anthocyanin content of sweet purple mochi as a high anthocyanin snack to prevent cancer

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Abstract

Cancer is one of the second leading causes of death worldwide. It is estimated that by 2030, cancer incidence could reach 26 million people, and 17 million of them will die because of cancer. Free radicals in the body can cause cancer, so it is very important to consume foods rich in antioxidants, such as black glutinous rice

tape and purple sweet potato, because the human body cannot naturally make antioxidants. The study aimed to determine the effect of black sticky rice and purple sweet potato formulations on organoleptic properties (color, aroma, taste, texture, and overall) and the anthocyanin content in sweet purple mochi. The method used a hedonic test to determine the level of liking and UV-VIS spectrophotometry combined with differential pH to determine anthocyanin levels. Thirty participants were students from Nutrition Department, Politeknik Kesehatan Kemenkes Bandung. The results showed significant aroma, taste, and overall $p < 0.05$ differences. F3 was the most preferred formulation, containing 11.2 mg of anthocyanins per 70 gram. There were significant effects and differences in the formulation of black sticky rice tape and purple sweet potato on organoleptic properties (aroma, taste, and overall). The anthocyanin content in the product can fulfill the adequacy of anthocyanins in a day, so this product can be used as a snack to prevent cancer.

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Introduction

Cancer is one of the second leading causes of death worldwide, characterized by abnormal cells that develop uncontrollably and can attack cells or tissues in the body.^{1,2} In 2019, it was estimated that 10 million people died due to cancer worldwide;³ it is estimated that by 2030, cancer incidence could reach 26 million people, and 17 million of them will die because of cancer.⁴ Cancer ranks as the second most prevalent cause of mortality among children aged 1 to 14 years.⁵ In 2020, as reported by the Global Cancer Observatory, an estimated 396,914 individuals in Indonesia were diagnosed with cancer, resulting in a death toll of 234,511.⁶ The most common cancers are breast, lung, colon, rectum, and prostate cancers.^{7,8} Breast and lung cancers contributed 12.5% and 12.2% of new cases diagnosed in 2020. Meanwhile, colorectal cancer contributed to 10.7% of new cases.^{9,10} Cancer and its treatments cause significant stress.^{11,12} A variety of risk factors contribute to the high burden of non-communicable diseases.¹³ The etiology of cancer is still unknown, but according to Ling *et al.* (2018) cause of cancer is related to smoking, alcohol consumption, and viral infection (Human Papilloma Virus).¹⁴ One factor causing cancer is an increase in free radical levels exceeding the ability of antioxidants in the body.^{15,16} Free radicals have a very high reactivity level, so they can damage tissue and continue to cause cancer cells.^{17,18} Based on Riskesdas, cancer prevalence in Indonesia increased from 1.4 per 1000 population in 2013 to 1.79 per 1000 population in 2018. The highest cancer prevalence in 2018 was found in the age group of 55-64 years, which was 4.62%.^{19,20}

One prevention of free radical formation is to use nutrients that act as antioxidants. Antioxidants are essential nutrients that can protect the body by fighting free radicals.²¹ Substances classi-

fied as antioxidants are anthocyanins. Research by Yi *et al.* (2010) states that anthocyanins can capture free radicals and reduce cell damage due to oxidative stress.²² This is in line with the study of Shi (2021), anthocyanins in colorectal cancer prevention review with high use of fruits and vegetable anthocyanins showing antitumor effects on colon cancer.²³ Each type of cancer requires a different approach of therapy, and a precise cancer diagnosis is crucial for proper and successful care. Surgery, radiation, systemic therapies, such as chemotherapy, hormonal medicines, and targeted biological therapies, are frequently used in treatment.²⁴

Utilization of high-anthocyanin food sources can be done as an effort to prevent cancer. One of the food sources high in anthocyanins is black sticky rice tape and purple sweet potatoes. The black sticky rice tape contains 257 ppm/100 g anthocyanins with an antioxidant activity of 70.2% grams.²⁵ Purple sweet potato contains anthocyanins of 61.85 mg/100 g with antioxidant activity of 59.25%.²⁶ Several studies use black sticky rice tape as one of the raw materials for making products high in anthocyanins. Research by Moviana *et al.* (2022) made cookies from black sticky rice tape, which contained anthocyanin levels of 5.72mg/100 grams of cookies.²⁷ Research by Sukowati *et al.* (2023) made eggroll with black glutinous rice tape as the main ingredient. The eggroll contains anthocyanin levels of 22.64 mg/100 grams of eggroll.²⁸ In addition, research by Sari *et al.* (2019) made purple blacksoy layered pancakes from purple sweet potatoes as an alternative food source of anthocyanins to prevent cancer. The pancake contains 17.85 mg of anthocyanins.²⁹

Seeing the high content of anthocyanins in purple sweet potatoes and black sticky rice tape, the author is interested in diversifying food to obtain a new product, mochi, which has high levels of anthocyanins as a functional food to prevent cancer. For this reason, it is necessary to research the manufacture of black sticky rice tape rice and purple sweet potato mochi to determine the effect of sticky rice and purple sweet potato formulations on organoleptic properties (color, aroma, taste, texture, and overall) and the anthocyanin content in sweet purple mochi as a high anthocyanin snack to prevent cancer. The study aimed to determine the effect of black sticky rice and purple sweet potato formulations on organoleptic properties (color, aroma, taste, texture, and overall) and the anthocyanin content in sweet purple mochi.

Materials and Methods

Research design

This study used an experimental research design with a complete randomized (RAL) consisting of independent and dependent variables.

Sample

The panel acts as an instrument or tool in analyzing the organoleptic properties of a product. This panel consists of people or groups in charge of assessing the organoleptic properties of the product called panelists. Moderately trained panelists for organoleptic test generally number 30 people who have been previously trained for organoleptic properties.³⁰ The sample for organoleptic test are 30 moderately trained panelists who are a student of the Nutrition Department, Politeknik Kesehatan Kemenkes Bandung level 3 and 4 who has met the inclusion criteria. The inclusion criteria namely healthy and having received organoleptic test material.³⁰ The exclusion criteria namely in a state of illness, hunger, fullness, not having a cold, not having allergies to the

ingredients tested, not having mouth ulcers. All participants in this study signed a written informed consent form for participating in this study before doing organoleptic test.

Variables

The independent variable in this study is the comparison of black sticky rice tape with purple sweet potato, divided into three balances, namely 20%:80%, 30%:70%, and 40%:60%. In contrast, the dependent variable in this study is product quality, which includes organoleptic properties consisting of color, aroma, taste, texture, overalls, and anthocyanins.

Data collection process

This research consists of several stages, namely the first stage in preliminary research, which aims to obtain the appropriate balance. The second stage in the form of primary research, namely the implementation of organoleptic tests and anthocyanin analysis carried out in October 2021-March 2022, including data collection in the form of organoleptic test results in the Taste Test Laboratory, and anthocyanin-level testing at SIG Laboratory PT. Saraswanti Genetech, Indonesia

Instruments

This research instrument is a hedonic test form with 7 rating scales, namely very dislike being given a grade of 1, dislike being given a grade of 2, quite do not like being given a grade of 3, neutral is given a grade of 4, quite like being given a value of 5, likes to be given a grade of 6, and really likes to be given a grade of 7. The organoleptic test of sweet purple mochi was carried out with hedonic tests on color, aroma, taste, texture, and overalls. Anthocyanin content testing using UV-VIS spectrophotometry method with Differential PH.

Data analysis

The analysis was used to determine the effect of different balances of black sticky rice tape and purple sweet potato on organoleptic properties and anthocyanin levels of sweet purple mochi, each of which was tested for normality with a confidence degree of 95% ($\alpha=0.05$). If the data is normally distributed, the One-Way ANOVA test is carried out, if meaningful ($p \leq \alpha$), followed by a post-hoc test, namely the Tukey test. Conversely, if the data is abnormally distributed, the Kruskal-Wallis test is used if meaningful ($p < \alpha$), followed by the Mann-Whitney test. This study use non-parametric tests (Kruskal-Wallis test and Mann-Whitney test) because the results of the data normality test show abnormally distributed.^{31,32}

Results

The organoleptic test results of sweet purple mochi can be seen in Table 1.

Table 1 shows, the highest percentage of 33.3% of panelists stated that they very liked the color of Formula 3, 40% of panelists very liked the aroma and taste of Formula 3, and 26.7% of panelists very liked the overall texture of formula 3. In comparison, 43.3% of panelists liked the texture of Formula 2. Thus, it is known that the balance of F3 with the percentage of black glutinous rice tape and purple sweet potato 40%: 60% is superior in color, aroma, taste, and overall compared to other balances.

Table 2 shows the result of the Kruskal Wallis test; p-value of color $0.605 > \alpha$ (0.05) and p-value of texture $0.153 > \alpha$ (0.05) were obtained, which means that there were no significant differences in

the color and texture aspect of the three balances. Meanwhile, the Kruskal Wallis test of aroma, taste, and overall shows a significant difference between the three balances.

To find out the location of the difference in each formula, then the Mann-Whitney test can be found that there were significant differences in the aroma aspect of the product on the balance of F1 and F3 with $p\text{-value } 0.003 < \alpha (0.05)$, there were significant differences in taste aspects in F1 and F2 balances with $p\text{-value } 0.001 < \alpha (0.05)$ and F1 and F3 balances with $p\text{-value } 0.00 < \alpha (0.05)$, and there were significant differences in the overall aspects of the product with a $p\text{-value } 0.029 < \alpha (0.05)$, F1 and F3 balance with a $p\text{-value } (0.001) < \alpha (0.05)$.

Anthocyanin content analysis was carried out on the formulation most preferred by the panelists, namely formula F3 with a ratio of black sticky rice tape and purple sweet potato 40%:60%. The results of the anthocyanin level analysis are then compared with the need to determine the level of achievement of anthocyanin levels in this product. Table 3 shows anthocyanin levels in F3 amounted to 11.2 mg per 70 grams of product. Sweet purple mochi products can fulfill 112% of anthocyanin adequacy daily.

Discussion

Color of sweet purple mochi

All three mochi formulas have met the desired mochi criteria: purple. It is because black sticky rice tape and purple sweet potatoes, the essential ingredients for making mochi, have anthocyanin pigments that function as natural purple dyes, so panelists find it challenging to distinguish the color of the mochi produced.

Black sticky rice tape is made from black sticky rice with an anthocyanin pigment content of 257 ppm. In comparison, purple sweet potatoes contain anthocyanin pigments of 61.85 mg/100g. Black sticky rice tape with a purple-black color causes a change in the color of the cake to darker. The black sticky rice tape is used, the more concentrated the color of the mochi produced.³³ It is in line with Puspawati *et al.* (2020) research on making black sticky rice tape ice cream mochi, which states that adding 75% black sticky rice tape causes a deep purple color in the mochi ice cream produced.³⁴

Table 1. Distribution, frequency, likeness, rating to color, aroma, taste, texture, and overall.

Formula (%)	Liked Level	Color		Aroma		Taste		Texture		Overall	
		n	%	n	%	n	%	n	%	n	%
Formula 1 (20%:80%)	Very dislike	0	0	0	0	1	3.3	0	0	0	0
	Dislike	0	0	0	0	0	0	2	6.7	1	3.3
	Quite do not Like	1	3.3	1	3.3	4	13.3	1	3.3	1	3.3
	Neutral	5	16.7	6	20	6	20	6	20	8	26.7
	Quite like	7	23.3	7	23.3	11	36.7	10	33.3	9	30
	Like	11	36.7	14	46.7	7	23.3	4	13.3	9	30
F2 (30%:70%)	Very Like	6	20	2	6.7	1	3.3	7	23.3	2	6.7
	Very dislike	0	0	0	0	0	0	0	0	0	0
	Dislike	0	0	0	0	0	0	0	0	0	0
	Quite do not Like	0	0	0	0	1	3.3	0	0	1	3.3
	Neutral	4	13.3	5	16.7	2	6.7	2	6.7	4	13.3
	Quite like	6	20	6	20	7	23.3	10	33.3	6	20
F3 (40%:60%)	Like	16	53.5	11	36.7	14	46.7	13	43.3	13	43.3
	Very Like	4	13.3	8	26.7	6	20	5	16.7	6	20
	Very dislike	0	0	0	0	0	0	0	0	0	0
	Dislike	0	0	0	0	0	0	0	0	0	0
	Quite do not Like	0	0	0	0	1	1.3	3	10	0	0
	Neutral	5	16.7	3	10	0	0	6	20	0	0
Quite like	6	20	3	10	6	20	8	26.7	9	30	
Like	9	30	12	40	12	40	9	30	13	43.3	
Very Like	10	33.3	12	40	12	40	4	13.3	8	26.7	

n, the number of panelists.

Table 2. The result of differences test organoleptic properties of three balances.

Organoleptic properties	n	Kruskall Wallis Test (p-value)
Color	30	0.065
Aroma	30	0.0125
Taste	30	0.002
Texture	30	0.153
Overall	30	0.003

n, the number of panelists.

Table 3. Comparison of anthocyanin content of sweet purple mochi with nutritional adequacy.

Bioactive substances	Nutritional value per serving (70 grams)	Nutritional adequacy	% daily value
Anthocyanins (mg)	11.2	10	112%

Aroma of sweet purple mochi

The aroma produced from the three product formulas of sweet purple mochi has a distinctive aroma of black sticky rice tape and purple sweet potato with different levels because in the fermentation process of black sticky rice tape, glucose hydrolysis, and alcohol oxidation occur, giving rise to aroma compounds, namely the aroma of alcohol that is characteristic of tape.³⁵ At the same time, the distinctive fragrant aroma of purple sweet potatoes comes from the degraded starch content.³⁶

Panelists preferred the aroma of adding black sticky rice tape and purple sweet potato by 40% and 60% to the F3 formula because the aroma produced from the black sticky rice tape balance was more dominant. The higher the addition of the balance of black sticky rice tape, the more intense the distinctive aroma of black sticky rice tape. The research is in line with Fauziyah's research on making Cracker formula BMC black sticky rice tape, mung bean flour, and peanut flour that the addition of 40% black sticky rice tape produces a more dominant distinctive aroma of black sticky rice tape.³⁷ Similarly, Wardani *et al.*'s (2020) research stated that panelists liked the aroma of cakes made with black sticky rice tape, the aroma of cakes without adding black sticky rice tape was not liked and was less attractive to panelists.³³

Taste of sweet purple mochi

The sweetness from the three sweet purple mochi products formulas has a sweet taste with different sweetness levels. It is caused by the fermentation process of black sticky rice tape, where during the ripening process, the starch content turns into reducing sugars that will cause a sweet taste. The sugar content in black sticky rice tape is 18.39%.³⁸ The sweetness is obtained from the enzyme amylase, converting the starch in sticky rice into simple sugars. *Aspergillus* is one of the microorganisms that play a role in making tape. *Aspergillus* microbes in tape-making function to hydrolyze starch in raw materials into simple sugars. Oligosaccharide sugars, such as stamiosa, raffinose, and verbascosa, the sugar content in purple sweet potatoes is 5.64%.³⁹

Panelists preferred the taste of adding black sticky rice tape and purple sweet potato by 40% and 60% to the F3 formula because of the sweetness resulting from the balance of black sticky rice tape, which is more dominant. The higher the addition of black sticky rice tape balance, the sweeter the taste is obtained. The research is in line with Fajriyanti's study in 2018 on making Black Tapai Berry Ice Sherbet, that the addition of 75% black sticky rice tape produces a sweeter taste in Black Tape Berry Ice Sherbet.²⁵

The texture of sweet purple mochi

The texture of sweet purple mochi is influenced by the many balances used. The more purple sweet potato is used, the chewier the mochi. It is due to the amylopectin content in purple sweet potato. Amylopectin affects the gelatinization ability so that the resulting cake is chewy.⁴⁰

The study is in line with research conducted by Attati (2019) on the effect of cassava substitution on the level of mochi liking, which states that the more the number of sweet potatoes, the higher the chewiness of mochi is.⁴¹ Based on the addition of black sticky rice tape used more dominantly, and a little purple sweet potato, the mochi produced tends to be rather soft and slightly chewy. Due to the fermentation effect, black sticky rice tape has a soft and watery texture.

Overall sweet purple mochi

Overall, the F3 formula with a balance of black sticky rice tape and purple sweet potato 40%:60% is the most preferred compared to other formulas based on a rating scale superior to every organoleptic aspect. In Formula 3, the black sticky rice tape formulation is used more than other formulas. The study is in line with research by Wardani *et al.* (2020), which states that the addition of black sticky rice tape affects the physical properties of the product, both in terms of taste, aroma, texture, and taste preferred by panelists compared to products without the addition of black sticky rice tape.³³

Anthocyanin content of sweet purple mochi

Based on the anthocyanin level testing results, anthocyanin levels were obtained in black sticky rice tape and purple sweet potato mochi of 11.2 mg/70 grams of the product. This product has a higher anthocyanin content than cookies from black sticky rice, but in the research of Moviana *et al.* (2022), it contained anthocyanin levels of 5.72 mg/100 grams of cookies. It can occur due to different ways of processing the product so that it can produce different anthocyanin content as well.²⁷ Anthocyanins are generally unstable at high temperatures, so, during processing or storage, they may cause discoloration or a decrease in antioxidant activity.⁴²

Compared with the adequacy of anthocyanins a day, based on research conducted by Pojar (2013) obtained a percentage of 112%.⁴³ The percentage shows that this sweet purple mochi product has met the adequacy of anthocyanin levels.⁴⁴ It is because the product contains black sticky rice tape and purple sweet potatoes with high anthocyanin content. The anthocyanins found in purple sweet potatoes and black sticky rice tape are a class of water-soluble flavonoids that may aid in cardiovascular disease prevention, obesity control, and antitumor activity. Potential antitumor effects are based on a wide range of biological activities, including antioxidant, anti-inflammatory, anti-mutagenesis, inducing cell termination, stimulating apoptosis or autophagy of cancer cells, anti-invasion, anti-metastasis, reverse drug resistance in cancer cells, and enhancing sensitivity to chemotherapy.⁴⁵

This research implies that the sweet purple mochi product formula 3 with a ratio of black sticky rice tape and purple sweet potato 40%:60% is a product that is accepted and liked by panelists. The use of black sticky rice tape and purple sweet potato aims to make a product by utilizing local food ingredients that have functional value, namely anthocyanins, so that in addition to tasting good, this product can also be an alternative snack for the community to prevent cancer.

The strength of this study is that in making mochi, ingredients are used that are functional foods that can be beneficial for health. The presence of anthocyanins in sticky rice tape and purple sweet potato can make the product more attractive and have a functional value that can be used as a reference and idea for the community and food industry to develop other products from these ingredients.

The limitation of this study is the influence of product shipment, product storage, and equipment conditions on the analysis of anthocyanin levels for laboratory tests through expeditions is beyond the control of researcher's analysis of anthocyanin levels for laboratory tests through expeditions is beyond the control of researchers. Sweet purple mochi has not been applied as an alternative to prevent cancer in the community because it was only studied from the aspect of liking (hedonic) and nutrient content (anthocyanin). In addition, the shelf life of sweet purple mochi was not studied, so the durability of the product is unknown.

Conclusions

Formula 3 with a balance of black sticky rice tape and purple sweet potato 40%:60% is preferred and superior in color, aroma, taste, and overalls. There were significant effects and differences in the formulation of black sticky rice tape and purple sweet potato on organoleptic properties (aroma, taste, and overall). The anthocyanin content in black sticky rice tape and purple sweet potato mochi is high and fulfills anthocyanins' adequacy daily, so this product can be a snack to prevent cancer. In this study, sweet purple mochi has not been applied as an alternative to prevent cancer in the community. Therefore, further research needs to be done on the effect of giving sweet purple mochi products for cancer prevention. In addition, it is necessary to make safe and attractive packaging for the product and conduct research on product shelf life to obtain information about the durability of sweet purple mochi.

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