potravinárstvo®
OPEN ACCESS
Received: 13.11.2022
Revised: 17.1.2023
Accepted: 26.1.2023
Published: 27.2.2023

Slovak Journal of Food Sciences

Potravinarstvo Slovak Journal of Food Sciences
vol. 17, 2023, p. 69-81
https://doi.org/10.5219/1826
ISSN: 1337-0960 online
www.potravinarstvo.com

The quality characteristics of biscuits made with plantain and purple rice flour as substitutes for wheat flour

I Ketut Budaraga, Asnurita, Yolan Novera

ABSTRACT

Biscuits are wheat flour-based manufactured food products. Another option is to locate a flour substitute, such as plantain flour or purple rice. This study aims to establish the ideal ratio of purple rice flour and plantain flour based on the quality attributes of biscuits. This study employed a one-factor, Completely Randomized Design (CRD) with five treatment levels and three replications. The observational data were analysed using ANOVA with the DNMRT further test at a 5% significant level. The treatment in this study compared purple rice flour and plantain flour to prepare biscuits. The ratio of purple rice flour to plantain flour had a very significant ($p < 0.01$) effect on water content (3.56%), ash content (2.11%), fat content (25.18%), crude fiber content (17.85%), protein content (4.72%), and carbohydrate content (61.49%), but no significant effect ($p > 0.01$) on antioxidant activity (55.83%). Except for protein, all treatments meet the SNI's requirements for biscuit quality. Based on the organoleptic test of taste, aroma, texture, and colour preferred by panellist with score of A (90-10) 3.52%, B (80-20) 3.97%, C (70-30) 4.42%, D (60-40) 5.03%, and E (50-50) 5.52% were obtained. The best-quality biscuits were in treatment E. (comparison of purple rice flour and plantain flour 50:50).

Keywords: biscuit, flour, plantain fluor, purple rice fluor, subsitution

INTRODUCTION

Biscuits are wheat flour-based manufactured food products. According to **[1]** biscuits are items made by baking dough made from wheat flour with or without the use of approved food additives. Biscuits are a type of snack that is commonly enjoyed in society. This is a dry product with a low water content. According to **[2]**, based on industry association data, biscuit consumption is expected to rise by 55-58% in 2012, owing to an increase in domestic consumption. Biscuits are enjoyed by people of all ages, including infants and adults, although in varying forms **[3]**.

The majority of biscuits on the market are made with wheat flour as the primary ingredient. Biscuits are made with wheat flour that has a low protein level. Non-wheat flour is now being researched for usage in the production of biscuits, particularly gluten-free biscuits **[4]**. As a result, several efforts are being undertaken to replace wheat flour with flour derived from local resources, such as tubers, seeds, and fruits, including purple rice and plantains.

Rice (*Oryza sativa* L.) is a food crop grown in underdeveloped nations as a staple diet or source of carbohydrates **[5]**. Rice comes in many different kinds: white, brown, black, and purple.

Purple rice with coloured grains has long been a unique and traditional dish in many cultures for desserts and medical purposes **[6]**. Today, the benefits of pigmented rice are generally known, and it is employed in commercial food production as well as dietary supplements, cosmetics, and medications **[7]**. Coloured rice is high in phenolic compounds. Flavonoid chemicals are one type of phenolic compound that has antioxidant properties **[8]**.

Because wheat flour is used as the principal basic ingredient in many processed food products in Indonesia, the country's reliance on wheat flour imports is growing. This can be decreased by using locally grown foods

such as plantains. One of the wild plantains is the plantain (*Musa balbisiana*), which is diploid **[9]**. While the plantain plant (*Musa balbisiana*) has numerous advantages, one is that its sap contains antioxidant chemicals, one of which can lessen the incidence of Alzheimer's **[10]**. Plantains have a rather high starch content, over 90% **[11]**. Plantain is suited for processing flour due to its high starch content. Plantain can be used as flour when the fruit is not mature, and the skin colour is still green due to the high starch and non-starch polysaccharides **[12]**. The benefit of processing into flour is that it has a longer shelf life and is more practical when used to produce other food products. Plantains and seeds have a relatively high mineral content (in ppm), including calcium, magnesium, potassium, sodium, manganese, and phosphorus **[13]**.

Figure 1 and 2 represents the plantain flour and purple rice powder used in our research. The final product of the biscuit is present in Figure 3.

Figure 1 Plantain flour.

Figure 2 Purple rice powder.

Scientific hypothesis

This research investigated the effect of utilizing plantain flour as an alternative raw material to wheat flour in the production of biscuits. The addition of plantain flour will greatly reduce reliance on wheat flour while also enhancing the economic worth of plantains. It can also determine the influence of the ratio of purple rice flour to plantain flour on the quality of biscuits and comparing purple rice flour and plantain flour in manufacturing biscuits that consumers enjoy. This hypothesis is supported by research conducted by **[9]** on the ratio of wheat flour (30% plantain flour) which is the most preferred by the panelists, and it is also known that the resistant starch content of plantain flour is higher (39.35%) than other types of bananas, implying that plantain has a great opportunity to be processed into functional products, one of which is the production of biscuits.

MATERIAL AND METHODOLOGY

Samples

This study was conducted at Ekasakti University's Agricultural Product Technology Laboratory in Padang. The study was carried out during March and April of 2021. Purple rice from Kenagarian Kasang, Padang Pariaman City, and Pasar Raya Padang City plantains were the main raw materials used in this study. The researchers developed purple rice flour and plantain flour.

Chemicals

ROFA Laboratorium Centre provided all reagents, which were of analytical grade (Indonesia):
1. Protein analysis, 1.25% concentrated sulfuric acid (H_2SO_4), and Aquades, 30% d NaOH, Methyl Indicator, Methyl red 0.2%, Methyl blue 0.2%, selenium mix, H_3BO_3%, HCl 0.1N are the materials for chemical analysis.
2. Fat content analysis using n-hexane.
3. Crude fiber content, ethanol, sulfuric acid (H_2SO_4), 1.25% NaOH, and 10% potassium sulfate analysis (K_2SO_4).
4. DPPH 45 ppm antioxidant test in methanol. Scales, stoves, cauldrons, basins, trays, spoons, sieves, mixers, knives, blenders, sieves, ovens, mixers, cake pans, and moulds are all needed to make biscuits. Margarine, eggs, honey, skim milk, salt, and vanilla are also included.

Animals and Biological Material

Animal and special biological materials were not used in this research.

Instruments

All tools were of analytical grade and were purchased from ROFA Laboratorium Centre (Indonesia). The tools for chemical analysis are:
1. Protein analysis, 500 ml Kjeldahl flask, distillation apparatus, 50 ml burette, 5 ml measuring pipette, 50 ml Erlenmeyer, dropper pipette, 250 ml beaker, and fume hood.
2. Antioxidant test, UV-VIS spectrophotometer.
3. Organoleptic test by 30 untrained panellists after being chosen through discrimination, descriptive and affective tests.

Laboratory Methods

In this investigation, the treatments were the following ratios of purple rice flour to plantain flour (%): A = 90:10; B = 80:20; C = 70:30; D = 60:40; E = 50:50. The recipe for purple rice flour and plantain flour biscuits refers to [14] in [15].

Description of the Experiment

Sample preparation: The sample preparation for biscuits can be seen in the following Table 1. Table 2 shows the ingredient formulation for the production of biscuits.

Table 1 Standard formulations for making biscuits.

No	Material type	Percentage (%)
1	Flour	50
2	Egg Yolk	20
3	Honey	10
4	Margarine	10
5	Skimmed Milk	10
6	Baking soda	0.2
7	Salt	0.2

Note: Source: **[14]** in **[15]**.

Table 2 Biscuit formulation in 200 g of ingredients.

No	Material type	Unit	Treatment				
			A	B	C	D	E
1	Purple rice flour	g	90	80	70	60	50
2	Plantain flour	g	10	20	30	40	50
3	Egg yolk	g	40	40	40	40	40
4	Honey	g	20	20	20	20	20
5	Margarine	g	20	20	20	20	20
6	Skimmed Milk	g	20	20	20	20	20
7	Baking soda	g	0.4	0.4	0.4	0.4	0.4
8	Salt	g	0.4	0.4	0.4	0.4	0.4

Note: Source: **[14]** in **[16]**.

Number of samples analyzed: We analyzed Purple rice flour 350 g, Plantain flour 150 g, Egg yolk 200 g, Honey 100 g, Margarine 100 g, Skimmed Milk 100 g, Baking soda 2 g, and Salt 2 g samples.

Number of repeated analyses: All measurements of instrument readings were performed five times.

Number of experiment replication: The number of repetitions of each experiment to determine one value was three times.

Design of the experiment: The researcher made the biscuits themselves:

a. Production of modified rice flour **[17]**

- Purple rice washed with running water
- Drain and dry in the sun for 8 hours
- Smoothing with a blender and then sifting 60 mesh
- Get purple rice flour

b. Production of modified plantain flour **[16]**

- Plantains
- Peeling the plantain skin and then soaking it in citric acid for 5 minutes
- Washing with clean water
- Slicing plantains and then drying in the sun for 7 hours for 3 days
- Smoothing with a blender and then sifting 60 mesh
- Get plantain flour

c. Biscuit making **[14]** in **[15]**

- Mixing I
- Margarine, egg yolks, and honey, mixing with a hand mixer for ± 10 minutes
- Mixing II
- Purple rice flour and plantain flour, according to the treatment, baking soda, skim milk, and salt was mixed using a high-speed mixer for 2 minutes
- Thin dough with a thickness of 2 cm
- Printing with a diameter of 3 cm
- Baking in the oven (150°C, ± 10 minutes)
- Biscuits

We have used the following methods for physicochemical analysis: water content **[18]**, protein content **[18]**, ash content **[18]**, crude fiber content **[18]**, fat content **[18]**, an antioxidant with DPPH method **[19]** and organoleptic test **[20]**.

Statistical Analysis

Microsoft Excel and SPSS Version 34 produced the statistical data analysis. The design used in this study was a one-factor Simple Completely Randomized Design (CRD) with 5 treatment levels and 3 replications. Observational data were analyzed using Analysis of Variance (ANOVA) and Duncan's New Multiple Range Test (DNMRT) advanced test at a 5% significance level. The data from this research were entered into SPSS 26.0. (SPSS Analytics Partner) and then the data were evaluated using ANOVA (Analysis of Variance) and the Tukey–Kramer test to determine the significant differences.

RESULTS AND DISCUSSION

Water Content

The study of diversity revealed that the water level of the produced biscuits differed considerably (p >0.01) depending on the ratio of purple rice flour to plantain flour. Based on the further DNMRT test at the level of = 0.01, all treatments demonstrated a very substantial difference in the water content of the biscuits. Table 3 shows the average water content of biscuits. The biscuits' water content ranged from 3.56 to 5.01%. The water content of the biscuits revealed a decrease in yield while increasing the amount of plantain flour. Plantain flour has a low water content since biscuits are baked at 150 °C, allowing the baking process to evaporate and limiting the quantity of water in the biscuit dough **[21]**. Treatment A (90:10 comparison of purple rice flour and plantain flour) had the highest water content of 5.01%. Treatment E (50:50 comparison of purple rice flour and plantain flour) had the lowest water level of 3.56%. The water content will decrease if less purple rice flour is used and more plantain flour is used, and vice versa.

According to **[22]**, rice flour has a water content of 13%, while plantain flour has a water content of 7.46% **[9]**. According to the research, the more plantain flour used in making biscuits, the lower the water content of the biscuits. Except for treatment A, which did not meet the Indonesian National Standard **[23]** for biscuits, the water level of the biscuits produced was a maximum of 5%.

Each treatment's water content varies because the water's relationship with food ingredients varies; the water content in food can be divided into bound water and free water **[24]**. The amylose concentration and soaking temperature of rice seeds alter water absorption **[25]**. Rice (non-waxy rice) is classified into three types based on its amylose content: low amylose (20%), medium amylose (20-25%), and high amylose (> 25%). (Arraullo, et al 1976). If the amylose concentration is low, water absorption and swelling will rise at temperatures exceeding 65°C **[26]**.

Table 3 Average water content of biscuits.

Comparison of purple rice flour with plantain flour (%)	Water Content (%)		Standard Deviation
A = 90:10	5.01	a	0.05
B = 80:20	4.70	b	0.02
C = 70:30	4.35	c	0.01
D = 60:40	3.82	d	0.02
E = 50:50	3.56	e	0.04
KK: 3.86%			

Note: The numbers in the same column followed by different lowercase letters show a significant difference in the DNMRT follow-up test at the level of α = 0.01. KK is the coefficient of diversity.

Ash Content

The diversity analysis revealed that the ratio of purple rice flour to plantain flour had a significant (p0.01) effect on the ash content of the final biscuits. Based on the DNMRT additional test, all treatments revealed a very significant difference in the ash content of the biscuits at the level of = 0.01. Table 4 shows the average ash content of biscuits.

Table 4 Average ash content of biscuits.

Comparison of purple rice flour with plantain flour (%)	Ash content (%)		Standard Deviation
A = 90:10	1.70	a	0.01
B = 80:20	1.83	b	0.04
C = 70:30	1.95	c	0.01
D = 60:40	2.04	d	0.02
E = 50:50	2.11	e	0.05
KK: 3.93%			

Note: The numbers in the same column followed by different lowercase letters show a very significant difference in the DNMRT follow-up test at the level of α = 0.05. KK is the coefficient of diversity.

The ash content of biscuits ranged from 1.70 to 2.11%. The higher the ash content of the biscuits, the more plantain flour is used, and the less purple rice flour is used. This is due to the high mineral concentration of plantain flour, which causes the ash content to rise. Ash is classified as a mineral element or an organic compound **[27]**.

The maximum ash level of biscuits was discovered in treatment E (50:50 comparison of purple rice flour with plantain flour), which was 2.11%, while the lowest ash content was observed in treatment A (90:10 comparison of purple rice flour with plantain flour), which was 1.70%. The ash content rises as less purple rice flour is used and more plantain flour is used, and vice versa.

All treatments had at least 1.6% biscuit ash content, which met the Indonesian National Standard **[28]**. This is because plantain flour has more ash than purple rice flour. Plantain flour has an ash content of 5.3% **[9]**, whereas rice flour has an ash content of 1.0 **[22]**.

Food has ash as one of its constituents. This component comprises minerals such as potassium, phosphorus, sodium, and copper. Mineral elements in the body combine with organic molecules or free ions; mineral elements operate as building blocks and regulators. The body's mineral content must be within ideal ranges **[29]**. The higher the ash content of the biscuits, the more plantain flour is used. As a result, biscuits made with a lot of plantain flour have more minerals.

Fat Content

The diversity analysis revealed that the ratio of purple rice flour to plantain flour was very significant (p <0.01) in the fat content of the manufactured biscuits. Based on the DNMRT additional test, all treatments revealed a very significant difference in the fat content of the biscuits at the level of = 0.01. Table 5 shows the average ash content of biscuits.

Table 5 Average fat content of biscuits.

Comparison of purple rice flour with plantain flour (%)	Fat level (%)		Standard Deviation
A = 90:10	16.66	a	0.10
B = 80:20	19.19	b	0.03
C = 70:30	21.18	c	0.00
D = 60:40	23.10	d	0.00
E = 50:50	25.18	e	0.48
KK: 1.24%			

Note: The numbers in the same column followed by different lowercase letters show a very significant difference in the DNMRT follow-up test at the level of α = 0.01. KK is the coefficient of diversity.

The fat content of biscuits ranged from 16.66% to 25.18%. The more plantain flour used in the production of biscuits, the higher the fat content. This is because plantain flour has a larger fat content than purple rice flour. Treatment E (50:50 comparison of purple rice flour and plantain flour) had the highest fat content (25.18%). Treatment A (comparison of purple rice flour with plantain flour 90:10) had the lowest fat content value of 16.66%. The less purple rice flour used and the more plantain flour used, the lower the fat level, and vice versa.

The fat content of all treatments biscuits exceeded the maximum fat content limit in the Indonesian National Standard **[23]**, which is a minimum of 9.5%. This is because the fat in biscuits is obtained by adding butter, eggs, and cream milk to the biscuit dough formulation **[30]**, and plantain flour has a larger fat content than purple rice flour. Plantain flour has a fat content of 0.6% **[9]**. On the other hand, rice flour has a fat content of 0.5%. This statement follows the findings that increasing the use of purple rice flour in the production of biscuits reduces the fat level of the product.

Crude Fiber Content

The diversity analysis revealed that the ratio of purple rice flour to plantain flour had a highly significant (p <0.01) variation in the crude fiber content of the biscuits prepared. Based on the DNMRT additional test, all treatments revealed a very significant difference in the crude fiber content of the biscuits at the level of = 0.01. Table 6 shows the average crude fiber content of biscuits.

Table 6 Average content of crude fiber of biscuits.

Comparison of purple rice flour with plantain flour (%)	Crude Fiber Content (%)		Standard Deviation
A = 90:10	8.38	a	0.17
B = 80:20	10.08	b	0.03
C = 70:30	12.74	c	0.00
D = 60:40	14.50	d	0.00
E = 50:50	17.85	e	0.01
KK: 4.91%			

Note: The numbers in the same column followed by different lowercase letters show a very significant the difference in the DNMRT follow-up test at the level of α = 0.01. KK is the coefficient of diversity.

Biscuits had a crude fiber content ranging from 8.38 to 17.85%. The more plantain flour is used to make biscuits, the higher the crude fiber content. This is because plantain flour contains more crude fiber than purple rice flour. The maximum crude fiber content of biscuits was discovered in treatment E (50:50 comparison of purple rice flour and plantain flour), which was 17.85%, while the lowest crude fiber content was identified in treatment A (90:10 comparison of purple rice flour and plantain flour), which was 8.38%. This assertion is based on the study's findings that crude fiber content is inversely related to water content; the higher the crude fiber content, the lower the water content produced; and vice versa, the higher the crude fiber content, the higher

the water content produced. The less purple rice flour and plantain flour used, the higher the crude fiber content, and vice versa.

The crude fiber content of biscuits produced for all treatments exceeded the 0.5% maximum allowed in the Indonesian National Standard **[23]**. This is because plantain flour contains more crude fiber than purple rice flour. Plantain flour has 13.71% crude fiber **[9]**. The more plantain flour is used in the production of biscuits, the higher the crude fiber content of the biscuits. Crude fiber is made up of cellulose, pentose, and other ingredients. This crude fiber component has no nutritional value but is critical in facilitating the digestion process in the body **[32]**.

Protein Content

The study of diversity revealed that the protein composition of the biscuits made differed significantly ($p < 0.01$) between purple rice flour and plantain flour. Based on a subsequent DNMRT test at the threshold of = 0.01, all treatments exhibited a significant difference in biscuit protein content. Table 7 shows the average protein content of biscuits.

Table 7 Average protein content of biscuits.

Comparison of purple rice flour with plantain flour (%)	Protein Content (%)		Standard Deviation
A = 90:10	7.78	e	0.14
B = 80:20	6.75	d	0.00
C = 70:30	5.59	c	0.14
D = 60:40	5.00	b	0.00
E = 50:50	4.72	a	0.14
KK: 5.11%			

Note: The numbers in the same column followed by different lowercase letters show a significant difference in the DNMRT follow-up test at the level of α = 0.01. KK is the coefficient of diversity.

The protein content of biscuits ranged from 4.72 to 7.78%. The more purple rice flour used to produce biscuits, the higher the protein level produced. This is due to the low protein content of plantain flour; the highest protein content of biscuits is found in treatment A (comparison of purple rice flour with plantain flour 90:10), which is 7.78%, while the lowest protein content is found in treatment E (comparison of purple rice flour with plantain flour 50:50), which is 4.72%. The less purple rice flour used and the more plantain flour used, the lower the protein contents, and vice versa.

The protein level of all treatment biscuits did not match the Indonesian National Standard **[23]**, which was 9%. This was due to the increased protein content of purple rice flour to plantain flour. Rice flour has a protein content of 7.59% **[33]**, while plantain flour has a protein content of 4.8% **[9]**. The more purple rice flour used in biscuit production, the higher the protein level of the biscuits.

Antioxidant Activity

The diversity analysis revealed no significant difference ($p > 0.01$) in the antioxidant content of the biscuits formed when purple rice flour was compared to plantain flour. Table 8 shows the average antioxidant content of biscuits.

Table 8 Average antioxidant content of biscuits.

Comparison of purple rice flour with plantain flour (%)	Antioxidant Activity	Standard Deviation
A = 90:10	85.83	10.41
B = 80:20	80.00	14.31
C = 70:30	70.66	19.50
D = 60:40	61.83	5.77
E = 50:50	55.83	0.29
KK: 9%		

Note: The numbers in the same column followed by different lowercase letters show a significant difference in the DNMRT follow-up test at the level of α = 0.01. KK is the coefficient of diversity.

Biscuit antioxidant activity levels ranged from 55.83 to 85.83%. The less plantain flour used in biscuit production, the higher the antioxidant level of the biscuits produced. The increased usage of purple rice flour in the production of biscuits raises antioxidant activity. This is due to the presence of 67.64% antioxidant chemicals in purple rice flour **[34]**. In a comparison of antioxidants studied by **[35]**, levels of antioxidant activity in brown rice flour were found. The Mandel Handayani variety brown rice flour had the highest antioxidant activity concentration of the two types, ranging from 92.286 to 92.972%, whereas the Segreng Handayani variety had a range of 79.207 to 89.870%.

Treatment A (comparison of purple rice flour with plantain flour 90:10) had the greatest antioxidant levels of biscuits, at 85.83%, while treatment E (compare of purple rice flour with plantain flour 50:50) had the lowest antioxidant levels, at 55.83%. The antioxidant activity decreases as purple rice flour is used less and plantain flour is used more, and vice versa.

It is not specified in the SNI for biscuits for antioxidant activity because antioxidants are very important to investigate to establish the antioxidant content of the blend of purple rice flour and plantain flour in biscuits. This purple rice flour contains antioxidant chemicals that are beneficial to the body. The antioxidant activity of biscuits containing more purple rice flour will be enhanced. The antioxidant activity of all biscuit treatments was 70.83%. as stated by **[34]**. Purple rice has a level of antioxidant activity of 67.64%.

Carbohydrate Content

According to the results of the diversity study, the ratio of purple rice flour to plantain flour made a very significant difference (p 0.01) in the carbohydrate content of the biscuits created. Based on the DNMRT additional test at the level of = 0.01, all treatments exhibited a very significant variation in biscuit carbohydrate content. Table 9 shows the average carbohydrate content of biscuits.

Table 9 Average carbohydrate content of biscuits.

Comparison of purple rice flour with plantain flour (%)	Carbohydrate levels (%)	Standard Deviation
A = 90:10	71.72 a	0.73
B = 80:20	69.28 b	0.08
C = 70:30	66.91 c	0.12
D = 60:40	64.27 d	0.01
E = 50:50	61.49 e	0.03
KK: 2.58%		

Note: The numbers in the same column followed by different lowercase letters show a very significant difference in the DNMRT follow-up test at the level of α = 0.01. KK is the coefficient of diversity.

Biscuit carbohydrate content ranged from 61.49 to 71.72%. The more plantain flour used in biscuit baking, the lower the carbohydrate content produced. This is because purple rice flour has more carbs than plantain flour. Treatment A (comparison of purple rice flour with plantain flour 90:10) had the highest carbohydrate amount (71.72%), whereas treatment E (comparison of purple rice flour with plantain flour 50:50) had the lowest carbohydrate content (61.49%). The carbohydrate amount will decrease as less purple rice flour is used and more plantain flour is used, and vice versa.

The findings of this study support the assertion above that biscuits made with purple rice flour contain more carbohydrates, resulting in a greater carbohydrate content. The carbohydrate content of biscuits prepared for treatment A was at least 70% of the Indonesian National Standard **[23]** for biscuits.

This figure is slightly lower than the minimum SNI standard for biscuits, which specifies a minimum carbohydrate content of 70%. Plantain flour has a reduced carbohydrate percentage, namely 47.6-49.8% [9]. Even though plantain flour biscuits did not meet the minimum carbohydrate content level in **[23]** biscuits. Humans get the majority of their calories from carbohydrates. Carbohydrates also influence the properties of food items such as flavour, colour, and texture. Furthermore, carbohydrates are beneficial in the body because they inhibit the breakdown of excess body protein, and mineral loss, and aid in fat and protein metabolism **[36]**.

Organoleptic Test

The organoleptic test was performed using sensory assessment, which included sampling the taste and aroma of the biscuit and analyzing its texture and colour. The test was conducted using biscuits prepared according to the treatment formulation. By being put to the test by 30 untrained panellists.

a. Flavour

The essential factor in consumer acceptance of a product is its taste. Taste is distinct from smell in that it involves all five tongue senses. Several elements can influence taste, including chemical substances, temperature, concentration, and interaction with other flavour components [**36**]. Table 10 displays the panellists' ratings on the flavour of the biscuits.

Table 10 Biscuit taste test value.

Comparison of purple rice flour with plantain flour (%)	Flavour value (%)	Description
A = 90 : 10	3.56	different (tasteless)
B = 80 : 20	4.88	somewhat similar (almost like banana)
C = 70 : 30	4.24	somewhat similar (almost like banana)
D = 60 : 40	5.00	similar (banana flavour)
E = 50 : 50	5.60	similar (banana flavour)

Notes: taste scores include 7 = very much similar; 6 = very similar; 5 = similar; 4 = somewhat similar; 3 = different; 2 = very different; 1 = very much different.

Table 10 demonstrates that treatment E (50:50 comparison of purple rice flour and plantain flour) received the highest rating from the panellists for biscuit taste, with 5.60%. (similar). The panellists' lowest rating of the biscuit taste was 3.56% (different) in treatment A (comparison of purple rice flour with plantain flour 90:10).

The data gathered revealed that the higher the addition of purple rice flour, the lower the panellist acceptance rate. This is due to the slightly bland flavour of purple rice flour, which affects the biscuit taste. Adding plantain flour and other ingredients can improve the taste of the biscuits. However, based on the panellists' acceptance data, it can be determined that the panellists have accepted the combination of purple rice flour with plantain flour on a scale of 5 to 5.60, indicating that the panellists already enjoy the taste of the cookies.

Food products, in general, do not have a single flavour but a blend of several integrated flavours. Taste is the sensation of salty, sweet, sour, or bitter flavours created by substances dissolved in the tongue **[37]**.

b. Aroma

According to **[36]**, the five senses of smell greatly influence scent. There are four types of aromas that the nose may detect: aromatic, sour, rancid, and burnt. The scent also influences food products' delicacy and taste, consisting of three components: smell, taste, and stimulation **[38]**. Table 11 displays the panellists' ratings on the scent of biscuits.

Table 11 Biscuit aroma test value.

Comparison of purple rice flour with plantain flour (%)	Aroma Value(%)	Description
A = 90 : 10	3.36	different (not typical banana aroma)
B = 80 : 20	3.88	different (not typical banana aroma)
C = 70 : 30	4.44	somewhat similar (almost like banana)
D = 60 : 40	4.84	somewhat similar (almost like banana)
E = 50 : 50	5.44	similar (banana aroma)

Notes: taste scores include 7 = very much similar; 6 = very similar; 5 = similar; 4 = somewhat similar; 3 = different; 2 = very different; 1 = very much different.

Table 11 demonstrates that treatment E (50:50 comparison of purple rice flour and plantain flour) received the highest rating from the panellists for biscuit scent, with 5.44%. (similar). The panellists' lowest estimate of the biscuit scent was 3.36% (different) in treatment A (comparison of purple rice flour with plantain flour 90:10).

The inclusion of purple rice flour decreased fragrance reception. This is because purple rice flour does not have a significant scent. The aroma of the biscuits is derived from raw materials and other additives used during baking.

c. Texture

The water quantity, fat content, and number of carbohydrates and proteins all influence the appearance of meals. Texture changes can be induced by water or fat content loss, emulsion breakdown, or protein hydrolysis **[39]**. Table 12 displays the panellists' ratings of biscuit texture.

Table 12 shows that treatment E (comparison of purple rice flour and plantain flour 50:50) had the greatest rating for biscuit texture, 5.52% (similar), whereas treatment A received the lowest rating for biscuit texture (comparison of purple rice flour and plantain flour). The panellists' acceptance rating is 3.52% (dislike) on a scale of dislike to like (90:10).

Table 12 Value of biscuit texture test.

Comparison of purple rice flour with plantain flour (%)	Texture Value(%)	Description
A = 90 : 10	3.52	different (rough)
B = 80 : 20	3.96	different (rough)
C = 70 : 30	4.48	somewhat similar (rather rough)
D = 60 : 40	5.20	similar (soft)
E = 50 : 50	5.52	similar (soft)

Notes: taste scores include 7 = very much similar; 6 = very similar; 5 = similar; 4 = somewhat similar; 3 = different; 2 = very different; 1 = very much different.

The more plantain flour used, the softer the finished product and the greater the panellist acceptance rate. Adding purple rice flour was responsible for the low level of panellist acceptance of treatment A (comparison of purple rice flour and plantain flour 90:10). The biscuits would harden or solidify. Food's water, fat, protein, and carbohydrate content heavily influence its texture. The texture is a pressure sensation that can be felt with the mouth (when biting, chewing, and swallowing). Texture sensing can detect wetness, dryness, hardness, smoothness, roughness, and oiliness **[40]**.

d. Colour

Colour is vital in fulfilling human tastes, according to **[41]**. Colour assessment is done by examining the product firsthand using each panellist's sense of sight. Table 13 shows the panellists' ratings of the hue of the biscuits.

Tabel 13 Nilai uji warna biskuit.

Comparison of purple rice flour with plantain flour (%)	Colour Value (%)	Description
A = 90 : 10	3.64	do not like (light yellow)
B = 80 : 20	4.16	kinda like (yellow)
C = 70 : 30	4.52	kinda like (yellow)
D = 60 : 40	5.08	like (dark yellow)
E = 50 : 50	5.52	like (dark yellow)

Notes: taste scores include 7 = very much similar; 6 = very similar; 5 = similar; 4 = somewhat similar; 3 = different; 2 = very different; 1 = very much different.

Table 13 demonstrates that treatment E (comparison of purple rice flour and 50:50 plantain flour) received the highest colour assessment of 5.52%. (similar). Because the panellists find the dark yellow colour more appealing. Treatment A (comparison of purple rice flour and plantain flour 90:10) received the lowest rating of 3.64% (different). Because panellists find light skin to be less appealing.

Colour evaluation is accomplished through direct visual inspection of the product with each panellist's sense of sight. Many elements influence a product's quality, but before other factors are examined and assessed, the colour component visually emerges first in deciding panellists' product acceptability **[36]**.

Figure 3 Final product of biscuit.

CONCLUSION

A comparison of purple rice flour and plantain flour on the quality of antioxidant-rich biscuits revealed that purple rice flour had a significant effect on water, ash, crude fibre, fat, protein, and carbohydrate content but had no effect on antioxidant activity. Treatment E has 3.56% water content, 2.11% ash content, 25% fat content, 17.5% crude fiber content, 4.72% protein content, 55.83% antioxidant activity, and 61.49% carbohydrate content (comparison of purple rice flour and plantain flour 50:50). To limit the consumption of wheat flour, it is suggested that the community and biscuit entrepreneurs develop antioxidant-rich biscuit goods using purple rice flour and plantain flour.

REFERENCES

1. Wijaya, H. (2010). Kajian Teknisi Standar Nasional Indonesia Biskuit. SNI 01-2973-1992.
2. Saksono. (2013). Pasar Biskuit Diproyeksi Tumbuh 8% Didorong Konsumsi. In Indonesia Finance Today. Retrieved from http://www. indonesiafinancetoday.com.
3. Sari, O. F. (2013). Formula Biskuit Kaya Protein Berbasis Spirulina Dan Kerusakan Mikrobiologis Selama Penyimpanan. In Skripsi Program Studi Teknologi Hasil Perairan Fakultas Perikanan dan Ilmu Kelautan IPB. Bogor
4. Anonymous. (2021). Green Education Centre. In Budidaya Sorgum. Retrieved from http://budidaya-sorgum.html.
5. Bhattacharjee, P., Singhal, R. S., & Kulkarni, P. R. (2002). Basmati rice: a review. In International Journal of Food Science and Technology (Vol. 37, Issue 1, pp. 1–12). Wiley. https://doi.org/10.1046/j.1365-2621.2002.00541.x
6. Rerkasem, B., Sangruan, P., & Prom-u-thai, C. T. (2015). Effect of Polishing Time on Distribution of Monomeric Anthocyanin, Iron and Zinc Content in Different Grain Layers of Four Thai Purple Rice Varieties. In International Journal of Agriculture and Biology (Vol. 17, Issue 4, pp. 828–832). Friends Science Publishers. https://doi.org/10.17957/ijab/14.0012
7. Sukhonthara, S., Theerakulkait, C., & Miyazawa, M. (2009). Characterization of Volatile Aroma Compounds from Red and Black Rice Bran. In Journal of Oleo Science (Vol. 58, Issue 3, pp. 155–161). Japan Oil Chemists' Society. https://doi.org/10.5650/jos.58.155
8. Pietta, P.-G. (2000). Flavonoids as Antioxidants. In Journal of Natural Products (Vol. 63, Issue 7, pp. 1035–1042). American Chemical Society (ACS). https://doi.org/10.1021/np9904509
9. Musita, N. (2014). Pemanfaatan Tepung Pisang Batu (*Musa Balbisiana Colla*) Pada Pembuatan Kue Brownies The Utilization Of Musa Balbisiana Banana Flour In Brownies. In Jurnal Riset Industri (Vol. 8, Issue 3, pp. 171–178). Badan Penelitian dan Pengembangan Industri.
10. Pothavorn, P., Kitdamrongsont, K., Swangpol, S., Wongniam, S., Atawongsa, K., Svasti, J., & Somana, J. (2010). Sap Phytochemical Compositions of Some Bananas in Thailand. In Journal of Agricultural and Food Chemistry (Vol. 58, Issue 15, pp. 8782–8787). American Chemical Society (ACS). https://doi.org/10.1021/jf101220k
11. Gutierrez, E. (2007). Delivering pro-poor water and sanitation services: The technical and political challenges in Malawi and Zambia. In Geoforum (Vol. 38, Issue 5, pp. 886–900). Elsevier BV. https://doi.org/10.1016/j.geoforum.2005.09.010
12. Sánchez-Rivera, M. M., García-Suárez, F. J. L., Velázquez del Valle, M., Gutierrez-Meraz, F., & Bello-Pérez, L. A. (2005). Partial characterization of banana starches oxidized by different levels of sodium

hypochlorite. In Carbohydrate Polymers (Vol. 62, Issue 1, pp. 50–56). Elsevier BV. https://doi.org/10.1016/j.carbpol.2005.07.005
13. Endra. (2006). Analisis Proksimat dan Komposisi Asam amino Buah Pisang Batu (Musa Balbisiana Colla). Fakultas Matematika dan Ilmu Pengetahuan Alam. Institut Pertanian Bogor.
14. Manley, D. (2000). Technology of Biscuits, Crackers, and Cookies, Third Edition. CRC Press. https://doi.org/10.1201/noe0849308956
15. Marwah. (2018). Kualitas fisiko kimia biskuit pada berbagai komposisi tepung terigu, tepung dengke dan tepung sagu. Universitas Hasanuddin.
16. Welly. (2012). Kajian formulasi tepung pisang batu (Musa balbisiana Colla) dan tepung terigu dalam pembuatan biskuit coklat. Universitas Lampung.
17. Mahmud, Y. (2018). Keragaman Agronomi Tanaman Padi (Oryza sativa L.) Varietas Pandan Putri pada Beberapa Sistem Tanam di Kecamatan Mundak Jaya Kabupaten Indramayu. In Agro Wiralodra (Vol. 1, Issue 2, pp. 1–7). Universitas Wiralodra. https://doi.org/10.31943/agrowiralodra.v1i2.527
18. Ligarnasari, I. P., Anam, C., & Sanjaya, A. P. (2018). Physical, chemical and sensory properties of brownies substituted with sweet potato flour (Ipomoea batatasL.) with addition of black cumin oil (Nigella sativaL.). In IOP Conference Series: Earth and Environmental Science (Vol. 102, p. 012084). IOP Publishing. https://doi.org/10.1088/1755-1315/102/1/012084
19. Taylor, S., & Todd, P. A. (1995). Understanding Information Technology Usage: A Test of Competing Models. In Information Systems Research (Vol. 6, Issue 2, pp. 144–176). Institute for Operations Research and the Management Sciences (INFORMS). https://doi.org/10.1287/isre.6.2.144
20. Azima, N. F., & Ropanti. (2014). The Addition of Broccoli (Brassica oleracea var italica) to Increase the Functional Properties of Ice Cream. In Pakistan Journal of Nutrition (Vol. 13, Issue 4, pp. 196–203). Science Alert. https://doi.org/10.3923/pjn.2014.196.203
21. Nurdjanah. (2011). Karakteristik Coklat Dari Campuran Tepung Pisang Batu (Musa Balbisiana) Dan Tepung Terigu Pada Berbagai Tingkat Subsitusi. In Jurnal Teknologi dan Industri Hasil Pertanian (Vol. 16, Issue 1). Universitas Lampung.
22. Badan Standarisasi Nasional. (2009). SNI (Standar Nasional Indonesia) 3549-2009 tentang Tepung Beras.
23. Badan Standarisasi Nasional. (2011). SNI 01-2973-2011. Kajian teknis standar nasional indonesia biskuit.
24. Yuliana, Y., & Novitasari, R. (2014). Pengaruh substitusi tepung terigu dengan tepung pisang kepok (Musa paradisiacal formatypica) terhadap karakteristik mie kering yang dihasilkan. In Jurnal Teknologi Pertanian (Vol. 3, Issue 1, pp. 1–14). Universitas Islam Indragiri. https://doi.org/10.32520/jtp.v3i1.57
25. Lee. (1995). Physicochemical properties of Calcium-Fortified Rice. In Cereal Chemistry (Vol. 72, Issue 1, pp. 352–355). Wiley.
26. Arraullo. (1976). Rice postharvest technology. International Development Research Centre.
27. Lii. (1996). Effect of Amylose Content on the Rheological Property of Rice Starch Cereal. In Chemistry (Vol. 73, Issue 1, pp. 415–420). MDPI AG.
28. Badan Standarisasi Nasional. (2009). SNI 01-3751-2009. Tepung Terigu Sebagai Bahan Makanan.
29. Nurhayati. (2014). Teknologi Mutu Pisang Dengan Sistem Spray Drying Untuk Biskuit. In Jurnal dinamika penelitian indusrti (Vol. 25, Issue 1). Indonesian Ministry of Industry.
30. Zaddana. (2018). Aktivitas Antioksidan Dan Kandungan Serat Pangan Biskuit Campuran Bekatul Beras Merah (Oriza Glaberrima) Dan Ubi Jalar Ungu (Ipomoea Batatas). In Fitofarmaka jurnal farmasi (Vol. 8, Issue 2, pp. 60–70). Universitas Pakuan. https://doi.org/10.33751/jf.v8i2.1574
31. Riganakos, K.A. & Kontominas, M.G. (1995). Effect Of Heat Treatment On Water Sorption Behavior of Wheat Flours Using A Hygrometric Technique. In Dev Food Sci (Vol. 37, Issue C, pp. 995–1005). Elsevier. https://doi.org/10.1016/S0167-4501(06)80212-8
32. Hermayanti. Y. & Gusti, E. (2006). Modul Analisa Proksimat. SMAK 3 Padang.
33. Tuankotta. (2015). Perbandingan Kadar Protein Pada Tepung Beras Putih (Oryza Sativa L.), Tepung Beras Ketan (Oryza Sativa L Glutinosa), Dan Tepung Sagu (Mestroxylon Sagu Rottb.) Dengan Menggunakan Metode Kjeldahl. Universitas Islam Bandung.
34. Budaraga, I.K, & Salihat, R.A. (2020). Antioxidant Activity Of 'Broken Skin' Purple Rice, 'Skinned' Purple Rice, And Purple Rice Stem Organically Cultivated In Indonesia. In Int J Adv Sci Eng Inf Technol (Vol. 10, Issue 5, pp. 2132–2137). Insight Society. https://doi.org/10.18517/ijaseit.10.5.9634
35. Indriyani. (2013). Karakteristik Fisik, Kimia Dan Sifat Organoleptik Tepung Beras Merah Berdasarkan Variasi Lama Pengeringan. In Jurnal Pangan dan Gizi (Vol. 4, Issue 8). Food and Nutrition Society of Indonesia.
36. Winarno, F.G. (2004). Kimia Pangan Dan Gizi. Gramedia Pustaka Utama.
37. Setyaningsih. (2010). Analisis Sensori Untuk Industri Pangan Dan Agro. Penerbit IPB Press.

38. Winarno, F.G. (2008). Kimia Pangan dan Gizi. PT Gramedia Pustaka Utama.
39. Fellow. (1990). Food Processing Technology. Wood head publishing Ltd.
40. Noviyanti. (2016). Analisis Penilaian Organoleptik Cake Brownies Subtitusi Tepung Wikau Maombo. In Jurnal Sains dan Teknologi Pangan (Vol. 1, Issue 1, pp. 58–66). Halu Oleo University.
41. Abdullah, M. Z., Mohamad-Saleh, J., Fathinul-Syahir, A. S., & Mohd-Azemi, B. M. N. (2006). Discrimination and classification of fresh-cut starfruits (Averrhoa carambola L.) using automated machine vision system. In Journal of Food Engineering (Vol. 76, Issue 4, pp. 506–523). Elsevier BV. https://doi.org/10.1016/j.jfoodeng.2005.05.053

Funds:

This research received no external funding.

Acknowledgments:

We are grateful to the Directorate of Research and Community Service (DRPM), Ministry of Education and Culture, Indonesia. We also would like to thank the Chancellor of Universitas Ekasakti, Chair of the Institute for Research and Service to the Community of Universitas Ekasakti, Dean of the Faculty of Agriculture, Universitas Ekasakti, team, and students who contributed to this research.

Conflict of Interest:

The authors declare no conflict of interest.

Ethical Statement:

This article does not contain any studies that would require an ethical statement.

Contact Address:

*__I Ketut Budaraga__, Ekasakti University, Faculty of Agriculture, Agricultural Product Technology Department, Veterans Dalam, 26B, 25115, Padang, Indonesia,
Tel.: +62 81283837468
E-mail: iketutbudaraga@unespadang.ac.id
ORCID: https://orcid.org/0000-0002-3920-2879

Asnurita, Ekasakti University, Faculty of Agriculture, Agricultural Product Technology Department, Veterans Dalam, 26B, 25115, Padang, Indonesia,
Tel.: + 62 85274876633
E-mail: asnuritaita2017@gmail.com
ORCID: https://orcid.org/0000-0001-8682-7938

Yolan Novera, Ekasakti University, Faculty of Agriculture, Agricultural Product Technology Department, Veterans Dalam, 26B, 25115, Padang, Indonesia,
Tel.: +62 81364455877
E-mail: yolannovera96@mail.com
ORCID: https://orcid.org/0000-0002-4832-3189

Corresponding author: *