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Physicochemical and organoleptic characteristics of instant rice with the addition of moringa leaf (Moringa Oleifera l) and butterfly pea (Clitoria Ternatea) extract produce of cabinet dryer

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Abstract

Instant rice is a processed rice product that has been cooked and then dried so that the product can be stored for a long period of time, but can be served in a shorter period of time. This research was conducted to determine the difference between instant rice with moringa extract and instant rice with butterfly pea flower extract. The tests carried out in this research were physicochemical characteristics and organoleptic tests. The highest treatment for instant rice with the addition of Moringa extract yield analysis was obtained in the A3B3 treatment 78.88 ± 4.07b, the highest rehydration time was obtained in the A3B1 treatment 5.74 ± 0.47c, the highest kamba density was obtained inthe A2B1 treatment 0.65 ± 0, 06c, the highest water content was obtained by the A1B1 treatment 8.03 ± 1.16d, the highest ash content was obtained by the A1B3 treatment 0.98 ± 0.01a, the highest antioxidant content was obtained by the A1B1 treatment 111.42 ± 0.87a, the highest protein content was obtained by the A3B1 treatment 9.40±0.24c. The results of the organoleptic test that are widely preferred are the A1B1 treatment (10% Moringa extract; 50ºC drying temperature). Then, the research results for instant rice using butterfly pea flower extract were obtained, namely the highest kamba density was obtained in the P1W1 treatment (0.66 ± 0.01d), the highest yield was obtained in the P3W2 treatment (81.00 ± 2.12e), the fastest rehydration time was obtained in the P3W3 treatment (4.35 ± 1.08a), then the results of the chemical analysis of the highest water content were obtained in the P2W1 treatment (7.02 ± 0.04g), the highest ash content was obtained in the P3W1 treatment (1.10 ± 0, 07ab), the highest antioxidant levels were obtained in the P1W1 treatment (319.58 ± 0.64g). The results of the organoleptic test for the most preferred formulation are the P2W2 treatment (20% butterfly pea flower extract and 60ºC drying temperature).

Keywords: Butterfly flower extract, Instant rice, Moringa extract.

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1. Introduction

Rice is the main food of the Indonesian people, which comes fromrice plants (oryza sativa) which are included in the type of cereal plants, after becoming rice, it can then be processed into rice that can be consumed [1]. According to Central Bureau of Statistics (BPS) [2] in 2022, the rice consumed by Indonesians was 81.044 kilograms per capita per year. Divided by 365 days a year, the average person in Indonesia consumes 0.222 kg of rice a day. Rice is also an energy source food that has a high carbohydrate content but low protein. Rice contains a variety of nutrients, including proteins, lipids, and carbohydrates. Rice has 360 kcal of energy, 6.6 grams of protein, 0.58 grams of fat, and 79.34 grams of carbohydrates per 100 grams [3].

At this time, the rapid advancement of technology makes people want all jobs or activities to be fast or practical ranging from heavy to light work, for example making food when traveling, when climbing mountains or when in an emergency. People want to make it easier to store instant food that is quick to serve in order to reduce meal time. Ready-to-eat or instant food is also the food of choicebecause it is fast and does not waste a lot of time. Therefore, instant rice is the right solution to make rice faster and more practical [1]. According to Pamungkas, et al. [4] the requirements for instant rice are that the rice must be prepared in a fast time, which is between 5-10 minutes and can be prepared easily.

Another study explained that the composition of the ratio of water and weight used in the instant rice making process contributes to the properties of the resulting parboiled rice. In addition, instant rice processing is one way to determine and increase the selling price of rice.

In this instant rice research, the rice used is ciherang and sarinah rice varieties, then the ciherang variety rice is added with moringa leaf extract and for sarinah variety rice, telang flowerextract is added. Moringa leaves are added because they are high in fiber as well as protein, as stated by Gopalakrishnan, et al. [5] if in 100g of moringa leaves there are 27.1 g of protein and 19.2 g of fiber. Moringa leaves also have a fairly large mineral content, the macro minerals identified are calcium, potassium and phosphorus. The highest mineral found in moringa leaves is calcium with a content of 603.77 milligrams/100 grams [6]. Meanwhile, telang flowers contain anthocyanin compounds, flavonoids, flavonol glycosides, kaempferol glycosides, quersetin glycosides and mirisetin glycosides. Then to improve the quality of instant rice, in this study a cabinet dryer was used. Cabinet dryer is a mechanical dryer that utilizes heat energy evaporation.

2. Materials and Methods

2.1. Time and Place

This research was conducted from April to November 2023 and took place at the Post-Harvest Laboratory and Integrated Laboratory of the Faculty of Agriculture, University of Garut, Pasundan University and BRIN (National Research and InnovationAgency) Bandung.

2.2. Tools and Materials

The tools used in making instant rice include rice cooker, freezer, heater, cabinet drying, digital scales, 100 ml measuring cup, 60 mesh sieve, aluminum container, plastic container. The tools used for analysis are goblet, watch glass, desiccator, porcelain cup, thermometer, beaker, oven, UV-vis Lambda 25 spectrophotometer, soxhlet tube, kjeldahl tube, vortex, electric heater, electric stove, furnace and erlenmeyer.

The materials used to make this instant rice use raw materials in the form of local Garut rice (Ciherang and sarinah), Moringa leaves, telang flowers, clean water and distilled water. While the materials used for analysis are distilled water, methanol, DPPH, CuSO4, H2SO4, K2SO4, NaOH, H3BO3, HCl.

2.3. Instant Rice Making Procedure

The working procedure carriedout in this study is that the rice is washed twice with clean water to clean the rice from dirt or unwanted substances. Then the washed rice is mixed with water and moringa leaf extract or telang flower extract in a ratioof 2 grams of rice per 3 mL of solution (b/v) or as much as 300 mL. Moringa or telang extract was added according to the treatment, namely 10%, 20%, and 30% of the total volume of solution used for cooking. After that, the rice was cooked in a rice cooker at 60-65ºC for 15 minutes. After cooking, the rice was allowed to cool for 10 minutes. Then the half-cooked rice was put into the freezer and frozen for 2 hours. The freezing process aims to form a rice texture that is suitable for instant rice. Finally, to make the instant rice dry, the frozen rice is dried for 16 hours using a cabinet drying device. Drying is carried out at various temperatures, namely 50°C, 60°C and 70°C Rewthong, et al. [7] in Rahmadi, et al. [8].

2.4. Experiment Design

This research design uses a 2- factor Randomized Group Design (RAK) method, factor A (moringa extract/telang flower extract) which consists of 3 treatment levels (A1: 10% moringa extract/telang flower extract, A2: 20% moringa extract/ telang flower extract and A3: 30% moringa extract/ telang flower extract) and factor B (drying temperature) with 3 treatmentlevels (B1: temperature 50ºC, B2: temperature 60ºC and B3: temperature 70ºC). The tests carried out in this study were physicochemical characteristics and organoleptic tests. The addition of extract concentration refers to the modification of research Rewthong, et al. [7] in Rahmadi, et al. [8] and for drying temperature refers to research [9].

3. Results and Discussion

3.1. Moringa Leaf Extract Instant Rice

3.1.1. Physical Characteristics of Moringa Leaf Extract Instant Rice

Testing the physical properties of instant rice with the addition of moringa extract includes physical tests of yield, rehydration time and cambadensity, the results can be seen in Table 1 to Table 3.

3.1.1.1. Yield

Table 1.
Instant Rice Yield Analysis.

Treatment	Rendemen/*Yield* (%)
A1B1	56.50 ± 2.83^{a}
A1B2	65.60 ± 8.34^{ab}
A1B3	70.43 ± 11.42^{ab}
A2B1	69.50 ± 2.12^{ab}
A2B2	63.75 ± 8.13^{ab}
A2B3	76.68 ± 8.94^{b}
A3B1	63.00 ± 7.07^{ab}
A3B2	63.25 ± 3.89^{ab}
A3B3	78.88 ± 4.07^{b}

Note: a= similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

Based on the average results, the highest yield was shown by the A3B3 formulation (30% moringa extract with a temperature of 70ºC) which amounted to 78.88%. Meanwhile, the lowest yield was in sample A1B1 (10% moringa extract with a temperature of 50ºC) which amounted to 56.50%. In the context of making instant sorghum rice, it can be seen that the longer the freezing, the higher the yield of instant sorghum rice. This is influenced by changes in the composition of the final product due to processing conditions. In addition to the freezing stage, a decrease in the nutritional content of the material also occurs at the drying stage [10]. According to McCabe, et al. [11] drying means reducing the amount of water or liquid from solid materials, so that the remaining water or liquid in the solid material has a low and acceptable content.

3.1.1.2. Rehydration Time

Table 2.
Rehydration Time Analysisof Instant Rice.

Treatment	Rehydration Time
A1B1	5.17 ± 0.13^{abc}
A1B2	5.58 ± 0.67^{bc}
A1B3	4.27 ± 0.34^{a}
A2B1	5.39 ± 0.25^{bc}
A2B2	4.33 ± 0.09^{a}
A2B3	4.25 ± 0.03^{a}
A3B1	5.74 ± 0.47^{c}
A3B2	4.63 ± 0.59^{ab}
A3B3	4.97 ± 0.64^{abc}

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

Based on the average results, the fastest rehydration time is shown by the A2B3 formulation (20% moringa extract with a drying temperature of 70ºC), which is 4.25 minutes. Meanwhile, the slowest rehydration time was shown in the A3B1 formulation (30% moringa extract with a drying temperature of 50ºC), which was 5.74 minutes. According to Kumalasari, et al. [12] good rehydration in instant products is with a high level of rehydration and fast time. According to Widowati, et al. [13] that the drying stage in making instant rice is critical and plays an important role in determining the final quality of the product. The quality of the instant rice produced is greatly influenced by the drying method used. Several negative impacts, such as deformation, breakage and unsatisfactory results during the rehydration process, can occur if the drying procedure is not appropriate. There are several key concepts emphasized in the statement including drying speed, porous structure and rehydration quality.

3.1.1.3. Custard Density

Table 3.
Density Analysis of InstantRice Custard.

Treatment	Cage Density (g/ml)
A1B1	0.53 ± 0.01^{a}
A1B2	0.63 ± 0.01^{c}
A1B3	0.60 ± 0.01^{bc}
A2B1	0.65 ± 0.06^{c}
A2B2	0.60 ± 0.01^{bc}
A2B3	0.60 ± 0.02^{bc}
A3B1	0.62 ± 0.02^{bc}
A3B2	0.64 ± 0.03^{c}
A3B3	0.56 ± 0.02^{ab}

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

Based on the average results, thehighest cube density is shown by the A2B1 formulation (20% moringa extract with a temperature of 50ºC) which is 0.65 g/ml. Meanwhile, the lowest cage density was shown in the A1B1 formulation (10% moringa extract with a temperature of 50ºC) which amounted to 0.53 g/ml. Cage density is the weight of a material in a certain volume, including the volume of air in the space between materials. Honestin [14] in research conducted by Damayanti and Suwita [15]. The highest camba density is caused by moringa extract and by the length of drying time, moringa leaf powder is composed of amino acids that are hydrogen linked to each other. The hydrogen bond is able to bind water when there is an interaction between theprotein content in moringa and water so that the fluffiness of the rice changes Trisnawati [16] in Astutik, et al. [17]. Then the freezing temperature and time cause the structure of the instant rice to become hollow so that thecamba density decreases. Custard density correlates with rehydration time, water absorption, and development volume. The smaller the cubage density value, the more hollow the instant rice structure will be so that the rehydration time is shorter, the water absorption capacity is higher, and the development volume is greater [18].

3.1.2. Chemical Characteristics of Moringa Leaf Extract Instant Rice

Testing the chemical properties of instant rice with the addition of moringa extract includes physical tests of water content, ash content, antioxidant content and protein content, the results can be seen in Table 4 to Table 7.

3.1.2.1. Water Content

Table 4.
Moisture Content Analysis ofInstant Rice.

Treatment	Moisture Content (%db)
A1B1	8.03 ± 1.16^{d}
A1B2	5.72 ± 0.03^{bc}
A1B3	4.15 ± 0.85^{ab}
A2B1	7.08 ± 0.53^{cd}
A2B2	4.63 ± 0.74^{ab}
A2B3	3.38 ± 0.25^{a}
A3B1	6.65 ± 0.64^{cd}
A3B2	4.65 ± 0.92^{ab}
A3B3	3.85 ± 0.71^{a}

Note: a= similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

Based on the average results, thehighest water content was shown by the A1B1 formulation (10% moringa extract with a temperature of 50ºC) which amounted to 8.03%. Meanwhile, the lowest water content is in the A2B3 sample (20% moringa extract with a temperature of 70ºC) which is 3.375%. This is caused by the temperature at the time of drying the instant rice, the higher the drying temperature, the lower the moisture content of the instant rice. According to Damayanti and Suwita [15] sweet potato flour treatment witha drying temperature of 70ºC produces lower water content. According to Winarno [19] low drying temperatures tend to evaporate only a small portion of the water on the surfaceof the material. In contrast, high temperatures not only evaporate the water on the surface but also the water bound within the material. This explains why high drying temperatures can result in a more significant reduction in moisture content. Drying temperature is also a significant parameter in the food production and processing process, and choosing the right temperature can affect the physical and chemical properties of the food produced.

3.1.2.2. Ash Content

Table 5.
Ash Content Analysis ofInstant Rice.

Treatment	Ash Content (%db)
A1B1	0.97 ± 0.04^{a}
A1B2	0.98 ± 0.02^{a}
A1B3	0.98 ± 0.01^{a}
A2B1	0.97 ± 0.02^{a}
A2B2	0.98 ± 0.02^{a}
A2B3	0.97 ± 0.004^{a}
A3B1	0.98 ± 0.02^{a}
A3B2	0.96 ± 0.004^{a}
A3B3	0.98 ± 0.01^{a}

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

Based on the average results, thehighest ash content was shown by the A1B3 formulation (10% moringa extract with 70ºC temperature), which amounted to 0.9840%. Meanwhile, the lowest water content was in the A3B2 sample (30% moringa extract with a temperature of 60ºC), which amounted to 0.9635%. According to research conducted by Sudarmaji, et al. [20] the lower the ash content in a material, the higher the purity. The working principle of determining ash content is by oxidizing (burning) all organic substances at high temperatures, which is around 500-600°C and then weighing the substances left behind after the combustion process [21]. Ash is an inorganic residue that remains after the combustion of an organic material. Ash content and composition vary depending on the type of material and combustion method. Ash content reflects the mineral content in a material, both organic and inorganic [22].

3.1.2.3. Antioxidant Content

Table 6.
Antioxidant Analysis of Instant Rice.

Treatment	IC_{50} (ppm)
A1B1	111.42 ± 0.87^{a}
A1B2	182.52 ± 3.51^{b}
A1B3	205.59 ± 6.29^{c}
A2B1	183.19 ± 3.87^{b}
A2B2	205.28 ± 6.98^{c}
A2B3	229.76 ± 1.41^{d}
A3B1	208.15 ± 5.90^{c}
A3B2	242.76 ± 4.40^{e}
A3B3	262.65 ± 3.66^{f}

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

Based on the average results, the highest antioxidant was shown by formulation A1B1 (10% moringa extract with 50ºC temperature) which amounted to 111.42 µg/ml and was declared in the weak category (100- 250). Meanwhile, the lowest antioxidant was shown by formulation A3B3 (30% moringa extract with 70ºC temperature) which amounted to 262.65 µg/ml and was declared in the inactive category because it was more than 200 µg/ml. According to Riskianto Kamal and Aris [23] A compound is said to have very strong antioxidant activity if the IC50 value is <10 µg/mL, strong if the IC50 value is 10-50 µg/mL, moderate if the IC50 value is 50-100 µg/mL, weak if the IC50 value is 100-250 µg/mL and inactive if the IC50 value is >250 µg/mL.

3.1.2.4. Protein Content

Table 7.
Protein Analysis of Instant Rice.

Treatment	Protein (%db)
A1B1	8.09 ± 0.08^{a}
A1B2	8.18 ± 0.09^{ab}
A1B3	9.25 ± 0.03^{c}
A2B1	8.73 ± 0.28^{abc}
A2B2	8.96 ± 0.60^{bc}
A2B3	8.10 ± 0.29^{a}
A3B1	9.40 ± 0.24^{c}
A3B2	8.96 ± 0.50^{bc}
A3B3	9.20 ± 0.39^{c}

Note: a= similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

Based on the test results, the protein content is obtained with an average of 8.09 - 9.25 higher than the protein content of delangu rice which is 3.3563% [24]. The highest protein content was found in the A1B3 treatment (10% moringa extract with a drying temperature of 70ºC) while the lowest protein content was found in the A1B1 treatment (10% moringa extract with a drying temperature of 50ºC). This is due to the effect of the addition of moringa extract, the more the addition of moringa extract, the protein content will increase. This is because moringa leaves have a protein content of 6.7 grams per 100 grams of material Bey, et al. [25] in Faras, et al. [26]. In line with researchconducted by Zakaria, et al. [27] on wet noodle research adding moringa leaf flour, which states that the proteincontent of wet noodles with the addition of moringa leaf flour tends to increase along with the increasing concentration of moringa leaf flour. Then according to Yulianti [28] states that the potential contained in moringa leaves includes high protein, beta-carotene, vitamin C, minerals, especially iron and calcium. The protein content of moringa leaves is equivalent to twice the protein found in milk.

3.1.3. Organoleptic Analysis of Moringa Leaf Extract Instant Rice

The results of organoleptic analysis on instant rice research with the addition of moringa extract can be seen in Table 8.

Table 8.
Organoleptic Analysis of Moringa Leaf Extract Instant Rice.

Treatment	Sensory Attributes				
	Color	Aroma	Taste	Texture	Overall
A1B1	1.60 ± 0.32^{a}	1.92 ± 0.31^{ab}	1.94 ± 0.29^{a}	2.06 ± 0.33^{cd}	1.94 ± 0.31^{ab}
A1B2	1.64 ± 0.28^{ab}	1.91 ± 0.26^{ab}	1.90 ± 0.27^{a}	2.01 ± 0.21^{bcd}	1.90 ± 0.26^{ab}
A1B3	1.75 ± 0.28^{abc}	1.79 ± 0.28^{a}	1.85 ± 0.27^{a}	1.92 ± 0.23^{abc}	1.84 ± 0.25^{ab}
A2B1	1.75 ± 0.26^{abc}	1.94 ± 0.26^{ab}	1.88 ± 0.29^{a}	1.92 ± 0.30^{abc}	1.92 ± 0.25^{abc}
A2B2	1.76 ± 0.22^{abc}	1.88 ± 0.26^{ab}	1.91 ± 0.27^{a}	1.86 ± 0.20^{ab}	1.88 ± 0.22^{ab}
A2B3	1.79 ± 0.26^{bc}	1.74 ± 0.29^{a}	1.79 ± 0.29^{a}	1.90 ± 0.25^{abc}	1.80 ± 0.29^{a}
A3B1	1.83 ± 0.30^{cd}	2.08 ± 0.34^{bc}	1.97 ± 0.27^{a}	1.82 ± 0.30^{a}	2.00 ± 0.31^{bc}
A3B2	1.98 ± 0.29^{d}	2.03 ± 0.40^{bc}	2.18 ± 0.30^{b}	2.07 ± 0.28^{cd}	2.12 ± 0.28^{cd}
A3B3	2.21 ± 0.36^{e}	2.14 ± 0.46^{c}	2.22 ± 0.34^{b}	2.18 ± 0.35^{d}	2.20 ± 0.34^{d}

Note: a= Similar letter notation means there is no significant difference atthe Duncan test level has a value of 5%.

3.1.3.1. Color

Based on the research on the higher the concentration of moringaextract, the more intense the color of color test, it shows that the average value of liking for the color of instant rice from all treatments is in the rangeof 1.60-2.21. The highest average color value was shown in the A1B1 treatment, which was 1.60. While the lowest average value of liking for the color of instant rice is shown in the A3B3 treatment, which is 2.21. Color is the first impression that appears and is assessed by panelists. Judging from the results, the more the addition of moringa leaf extract, the more the average panelist decreases the level of liking of instant rice. The color of moringa leaves is green while if taken the extract will turn into a brownish yellow color, so it is clear that the instant rice [29].

3.1.3.2. Aroma

Based on the research on the aroma test, it shows that the average value of liking for the aroma of instant rice from all treatments is in the range of 1.74-2.14. The highest average value of color is shown in the A2B3 treatment, which is 1.74. While the lowest average value of liking for the color of instant rice is shown in the A3B3 treatment, which is 2.14.

3.1.3.3. Taste

Based on research on the aroma test, it shows that the average value of liking for the taste of instant rice from all treatments is in the range of 1.79- 2.22. The results of the assessment of the taste of instant rice showed that the panelists preferred the A2B3 treatment, namely with (20% moringa extract with 70ºC drying temperature). Panelists preferred the taste of A2B3 instant rice with an average value

3.1.3.4. Texture

Based on the research on the aroma test, it shows that the average value of liking for the texture of instant rice from all treatments is in the range of 1.82-2.18. The results of the assessment of the texture of the instant rice showed that the panelists preferred the A3B1 treatment, namely with (30% moringa extract with drying temperature of 50ºC). Panelists preferred the texture of A3B1 instant rice with an average value of 1.82 (very like) and the lowest in the A3B3 treatment (30% moringa extract with 70ºC drying temperature) with an average value of 2.18 (like). Based on the results of the analysis, it can be seen that the more the addition of moringa extract, the level of liking for the texture of instant rice decreases, but seen from the table the level of liking for the texture on average likes the of 1.79 (Like) and the lowest in the A3B3 treatment (30% moringa extract with 70ºC drying temperature) with an average value of 2.22 (Somewhat like). According to Wahidah [30] in Lamusu [31] the complexity of a flavor is produced by the diversity of natural perceptions. Taste is influenced by three factors, namely odor, taste, and oral stimuli (hot and cold). The first factor can be detected by the sense of smell and the last two mentioned factors can be detected by sensory cells on the tongue.A3B1 sample which adds 30% moringaextract.

3.1.3.5. Overall

The overall measurement is a combination of all the previous organoleptic parameters. Overallassessment is taken by assessing generalliking. Assessment of the overallsensory of instant rice was carried out by 25 panelists, from the results of the assessment it can be seen that instant rice with the addition of moringa extract and variations in drying temperature as a whole both in terms of color, aroma, taste and texture seen from the most preferred average is instant rice treatment A2B3 (20% moringa extract with drying temperature 70ºC) with an average of 1.80 (very like) and the lowest level of liking is in treatment A3B3 (30% moringa extract with drying temperature 70ºC) with an average value of 2.20 (like).

3.2. Telang Flower Extract Instant Rice

3.2.1. Physical Characteristics of Telang Flower Instant Rice

Testing the physical properties of instant rice with the addition of telang flower extract includes physical tests of yield, rehydration time and camba density, the results can be seen in Table 9 to Table 11.

3.2.1.1. Yield

Table 9.
Instant Rice Yield Analysis.

Treatment	Rendement (%)
P1W1	65.00 ± 2.83^{cd}
P1W2	69.00 ± 1.06^{d}
P1W3	62.00 ± 2.12^{bc}
P2W1	63.00 ± 0.71^{b}
P2W2	54.00 ± 0.71^{a}
P2W3	65.00 ± 1.41bc
P3W1	63.00 ± 1.41bc
P3W2	81.00 ± 2.12e
P3W3	65.00 ± 0.71bc

Note: a= similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

The lowest yield was shown by P2W2 formulation (20% telang flower extract with 60ºC temperature) which amounted to 54 g/ml. Meanwhile, thehighest yield was shown in the P3W2formulation (30% telang flower extractwith 60ºC temperature) whichamounted to 81 g/ml. As reported by Tomás-Barberán, et al. [32] in Lamadjido, et al. [33] that the high active compoundscontained in a sample are indicated bythe high amount of yield produced. According to Rahmawati [34] thesmaller the water content produced willcause a decrease in the weight of thematerial, because water in foodingredients is the main component, ifwater is removed, the material will bemore compressed and lighter so that itwill affect the yield of the final product.

3.2.1.2. Rehydration Time

Table 10.
Analysis of Instant RiceRehydration Time.

Treatment	Rehydration Time
P1W1	6.96 ± 2.18[a]
P1W2	6.62 ± 1.97[a]
P1W3	4.95 ± 0.74[a]
P2W1	7.05 ± 2.83[a]
P2W2	5.80 ± 3.25[a]
P2W3	4.64 ± 0.63[a]
P3W1	4.85 ± 0.50[a]
P3W2	4.69 ± 0.62[a]
P3W3	4.35 ± 1.08[a]

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

The lowest rehydration time was shown by formulation P2W3 (20% telang flower extract with 70ºC drying temperature) which amounted to 5.09 minutes. Meanwhile, the highest yield was shown in the P2W1 formulation (20% telang flower extract with a drying temperature of 50ºC) which amounted to 9.05 minutes. According to Luna, et al. [35] the treatment of instant rice processing affects the rehydration time. Differences in rehydration time in rice varieties may be caused by amylose levels in the type of rice and the length of time immersion with hot temperatures. The rehydration time test was conducted to determine the optimal brewing and rehydration time for instant yellow rice products.

3.2.1.3. Custard Density

Table 11.
Density Analysis of InstantRice Custard.

Treatment	Custard Density
P1W1	0.66 ± 0.01[d]
P1W2	0.58 ± 0.02[a]
P1W3	0.66 ± 0.03[cd]
P2W1	0.66 ± 0.01[d]
P2W2	0.61 ± 0.01[abc]
P2W3	0.61 ± 0.01[ab]
P3W1	0.62 ± 0.01[bcd]
P3W2	0.63 ± 0.01[bcd]
P3W3	0.63 ± 0.01[bcd]

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

The lowest camba density was shown by formulation P1W2 (10% telang flower extract: 60ºC drying temperature) which amounted to 0.58 g/ml. Meanwhile, the highest density was shown in formulations P1W1, P1W3 and P2W1 which amounted to 0.66 g/ml. The higher the slurry density value, the denser the product. A material is declared slurry if the slurry density value is small, meaning that for a large volume the weight of the material is light. Then, the liquid density is also related to the degree of cereal development, where the degree ofdevelopment is high, the liquid density is smaller. The smaller the cubage density value, the more hollow the instant rice structure will be so that the rehydration time becomes shorter, thewater absorption capacity is higher, and the development volume is greater.

3.2.2. Chemical Characteristics of Telang Flower Extract Instant Rice

Testing the chemical properties of instant rice with the addition of telang flower extract includes physical tests of water content, ash content and antioxidant content, the results can be seen in Table 12 to Table 14.

3.2.2.1. Water Content

Table 12.
Moisture content analysis of instant rice.

Treatment	Moisture Content (%db)
P1W1	6.54 ± 0.14^{f}
P1W2	4.25 ± 0.07^{cd}
P1W3	4.09 ± 0.01^{c}
P2W1	7.02 ± 0.04^{g}
P2W2	5.51 ± 0.09^{e}
P2W3	3.75 ± 0.28^{b}
P3W1	3.15 ± 0.07^{a}
P3W2	4.42 ± 0.04d
P3W3	3.32 ± 0.03a

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

The highest water content value is found in the P2W1 treatment (20% telang flower extract with a temperature of 50ºC) with an average value of 7.02 ± 0.04%, while for the lowest water content in the P3W1 treatment (30% telang flower extract with a temperature of 50ºC) has an average value of 3.15 ± 0.07%. This is due to the temperature at the time of drying the instant rice, the higher the drying temperature, the lower the moisture content of the instant rice.

Moisture content is one of the physical properties of the material that shows the amount of water contained in the material. In the boiling process, water will be absorbed by the rice so that the moisture content increases. This occurs due to the process of osmosis (osmotic pressure) which causes the absorption of water into the submerged material during the boiling process. In the boiling process, water entering an ingredient is faster than water vapor entering an ingredient [36]. The difference in moisture content is caused by the different water content in the ingredients as a result of the cooking process. The treatment of cooking variations and the length of heating result in a gelatinization process, where starch granules swell as water enters the cells and affects the moisture content of the ingredients [37].

3.2.2.2. Ash Content

Table 13.
Ash content analysis of instant rice.

Treatment	Ash Content (%db)
P1W1	0.52 ± 0.04^{bcd}
P1W2	0.65 ± 0.07^{d}
P1W3	0.62 ± 0.04^{cd}
P2W1	0.45 ± 0.07^{abc}
P2W2	0.60 ± 0.07^{cd}
P2W3	0.70 ± 0.14^{d}
P3W1	1.10 ± 0.07^{e}
P3W2	0.35 ± 0.07^{ab}
P3W3	0.27 ± 0.11^{a}

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

The highest ash content value was found in the P3W1 treatment with an average value of 1.10 ± 0.07% while the lowest ash content value was found in the P3W3 treatment with an average value of 0.27 ± 0.11%. This shows that the factors affecting the ash content of rice are the method of drying, type of food, temperature and time during drying. In the drying process, the longer the time and the higher the temperature used, the ash content will increase [21]. The ash content of the instant rice of telang flower extract has met the quality requirements of SNI 2973-1992, which is max 1.60%.

3.2.2.3. Antioxidant Content

Table 14.
Antioxidant Analysis of Instant Rice.

Treatment	IC_{50} (ppm)
P1W1	155.54 ± 6.60^{a}
P1W2	186.63 ± 4.51^{b}
P1W3	249.68 ± 1.22^{d}
P2W1	185.54 ± 2.10^{b}
P2W2	238.62 ± 2.26^{c}
P2W3	275.31 ± 6.75^{e}
P3W1	248.06 ± 3.13^{cd}
P3W2	293.89 ± 5.83^{f}
P3W3	319.58 ± 0.64^{g}

Note: a= Similar letter notation meansthere is no significant difference at the Duncan test level has a value of 5%.

The results of antioxidant concentration analysis in Table 13 show that the instant rice with telang flower extract has a low concentration. The instant rice formulation P1W1 had the lowest concentration among P1W2, P1W3, P2W1, P2W3, P3W1, P3W2 and P3W3 at 155.54 µg/ml. Because of the decrease in anthocyanin concentration,it is thought to be caused by the heating process. Anthocyanins are unstable due to processing, storage conditions and the influence of several factors such as temperature, light, pH, and oxygen.Telang flowers contain anthocyanins with fairly good stability but are easily damaged by heat. The optimum temperature for processing these flowers is 50˚C.

3.2.3. Organoleptic Analysis

The results of organoleptic analysis on instant rice research with the addition of moringa extract can be seen in Table 15.

Table 15.
Organoleptic Analysis of Telang Flower Extract Instant Rice

Treatment			Sensory Attributes		
	Color	Aroma	Taste	Texture	Overall
P1W1	3.00 ± 1.88^{a}	2.95 ± 1.85^{a}	3.00 ± 1.90^{b}	3.88 ± 2.07^{d}	3.36 ± 1.94^{cd}
P1W2	3.00 ± 1.79^{a}	4.00 ± 2.10^{b}	3.00 ± 1.88^{b}	3.84 ± 2.06^{cd}	3.76 ± 2.04^{d}
P1W3	3.00 ± 1.78^{a}	3.20 ± 1.89^{a}	3.00 ± 1.85^{b}	3.56 ± 1.98^{bcd}	3.00 ± 1.84^{abc}
P2W1	3.00 ± 1.87^{a}	3.04 ± 1.86^{a}	3.00 ± 1.75^{ab}	2.92 ± 1.79^{a}	2.68 ± 1.76^{ab}
P2W2	3.00 ± 1.80^{a}	2.96 ± 1.83^{a}	2.00 ± 1.65^{a}	3.04 ± 1.85^{ab}	2.72 ± 1.77^{ab}
P2W3	2.68 ± 1.75^{a}	3.08 ± 1.86^{a}	3.00 ± 1.78^{ab}	2.92 ± 1.82^{a}	3.52 ± 1.71^{a}
P3W1	3.00 ± 1.79^{a}	3.00 ± 1.86^{a}	3.00 ± 1.78^{ab}	3.20 ± 1.90^{ab}	3.04 ± 1.87^{bc}
P3W2	3.00 ± 1.83^{a}	3.00 ± 1.85^{a}	3.00 ± 1.77^{ab}	3.28 ± 1.92^{abc}	2.80 ± 1.79^{ab}
P3W3	3.00 ± 1.85^{a}	3.12 ± 1.87^{a}	3.00 ± 1.82^{b}	3.16 ± 1.88^{ab}	2.84 ± 1.80^{ab}

Note: a= Similar letter notation means there is no significant differenceat the Duncan test level has a value of 5%.

3.2.3.1. Color

The average value of panelists' flower extract instant rice is in theP1W2 treatment with an average value liking for the color of instant rice from telang flower extract ranged from 3.00 to 2.68 or was in the category of somewhat like. The highest average score of instant rice color of telang flower extract is in the P1W1 treatment with an average value of 3.00 ± 1.88 (rather like and like), the lowest score ofinstant rice color of telang flower extract is in the P2W3 treatment with anaverage value of 2.68 ± 1.75a (like). The color of the instant rice produced is light blue for low concentration and dark blue for higher concentration and slightly dull. When "Sarinah Rice" Instant rice is processed into rice the color turns dull. The effect of the blue color is due to the presence of color pigments in telang flowers.

3.2.3.2. Aroma

The average score of panelists' liking for the aroma of instant rice with telang flower extract ranged from 4.00 to 2.95 or was in the category of ordinary to somewhat like. The highest average score of the aroma of telang of 4.00 ± 2.10 (normal), the lowest aroma score of telang flower extract instant rice is in the P1W1 treatment with an average value of 2.95 ± 1.85 (somewhat like).

3.2.3.3. Taste

The average score of panelists'liking for the taste of telang flower extract instant rice ranged from 3.00-2.00 or was in the category of somewhatlike and like. The highest average score of instant rice flavor of telang flower extract was in the P1W1 treatment (10%telang flower extract with dryingtemperature of 50ºC) with an average value of 3.00 ± 1.90 (rather

like), the lowest score of instant rice flavor of telang flower extract was in the P2W2 treatment with an average value of 2.00 ± 1.65 (like).

The taste produced in instant rice is influenced by different temperatures and lengths of time so that it will affect the level of liking of panelists with different tastes and products rich in anthocyanins, polyphenolic components of the type of alcoholic flavonoids and flavanols greatly affect the taste of instant rice on the tongue. Flavonoid alcohols and flavanols are anthocyanin components that shift equilibrium toproanthocyanidins in the mouth. Anthocyanins are reported to have a mild tart and astringent taste on the tongue. Malvidin 3-O-glucosidase is reported to be the one that most affects the taste of anthocyanins on the tongue. A study mentioned that anthocyanins have a slightly sweet taste derived from the glycoside component.

3.2.3.4. Texture

The average score of panelists' liking for the texture of instant rice of telang flower extract ranged from 3.88 to 2.92 or was in the category of somewhat like. The highest average score of instant rice texture of telang flower extract is in the P1W1 treatment with an average value of 3.88 ± 2.07 (rather like), the lowest score of instant rice texture of telang flower extract is in the P2W1 treatment with an average value of 2.92 ± 1.79 (like). The texture produced on instant rice is influenced by the addition of telang flower extract. The higher the concentration of telang flower extract composition given, the more the texture of the instant rice will increase.

3.2.3.5. Overall

The average value of panelists' overall liking of telang flower extract instant rice ranged from 3.76 to 2.52 or was in the category of mildly liked. The highest overall average score of telang flower extract instant rice is in the P1W2 treatment with an average value of 3.76 ± 2.04 (somewhat like), the lowest overall score of telang flower extract instant rice is in the P2W2 treatment with an average value of 2.52 ± 1.71 (like). The overall score of the instant rice was influenced by the different temperature levels which caused a great influence on the panelists who had different tastes and sensitivityto the overall score.

4. Conclusions

Based on the results of the physicochemical analysis andorganoleptic test of instant rice of moringa leaf extract and instant rice of telang flower extract, it can be concluded that the physicalcharacteristics of moringa leaf extractinstant rice produce the highest yield value indicated by formulation A3B3 with a value of 78.88%, the fastest rehydration time value indicated by formulation A2B3 with a value of 4.25 minutes, the highest camba density indicated by formulation A2B1 with a value of 0.65 g/ml. Then for the chemical characteristics, the highest water content value was shown by formulation A1B1 with a value of 8.03%, the highest ash content value was shown by formulation A1B3 with a value of 0.98%, the highest antioxidant content value was shown by formulation A1B1 with a value of 111.42 µg/ml, the highest protein content value was shown by formulation A1B3 with a value of 9.25%. Then for the highest color organoleptic value shown in the A1B1 treatment which is 1.60, the highest aroma value is shown in the A2B3 treatment which is 1.74, the highest taste value is shown in the A2B3 treatment which is 1.79, the highest texture value is shown in the A3B1 treatment which is 1.82 and the highest overall value is shown in the A2B3 treatment which is 1.80. As for the physical characteristics of buna telangextract instant rice, the highest yield value is shown by the P3W2 formulation with a value of 81%, the fastest rehydration time value is shown by the P3W3 formulation with a value of 4.35 minutes, the highest camba density is shown by the P1W1, P1W3 and P2W1 formulations with a value of 0.66 g/ml. Then for the chemical characteristics, the highest water content value is shown by the P2W1 formulation with a value of 7.02%, the highest ash content value is shown by the P3W1 formulation with a value of 1.10%, the highest antioxidant content value is shown by the P1W1 formulation with a value of 155.54 µg/ml. Then for the highest color organoleptic value shown in the P2W3 treatment which is 1.75, the highest aroma value is shown in the P2W2 treatment which is 1.83, the highest taste value is shown in the P2W2 treatment which is 1.65, the highest texture value is shown in the P2W1 treatment which is 1.79 and the highest overall value is shown in the P2W3 treatment which is 1.71.

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