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Organoleptic Quality of Cereal Based on Sago Flour with a Combination of Red Spinach Flour for Patients with Diabetes Mellitus

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Abstract: This study aims to determine the organoleptic quality of cereals based on sago flour with a combination of red spinach flour for diabetics. This type of research is an experiment using a completely randomized design (CRD) with 3 treatments and 6 repetitions. Observations were made by means of organoleptic quality tests. The panelists used were somewhat trained panelists of 30 people. Data were analyzed using the Kruskal Wallis test. The results showed that the red color was close to brownish red (2.3–3.67). Sago flavor (2.47–2.73) and spinach flavor (2.26–2.53). Not sweet (1.07–1.37), sago flavor (2.17–2.4), and spinach flavor (1.93–2.1). Crispy in texture close to very crunchy (2.93–3). Has a difference in color and does not have a difference in aroma, taste and texture. The conclusion is that the red color is close to brownish red. Scented sago and scented spinach. Not sweet, sago and spinach taste. Crispy in texture close to very crunchy, and the color parameters have differences.

Keywords: Cereals; Diabetes; Organoleptic Quality; Red Spinach; Sago

Introduction

Diabetes mellitus or known as diabetes among the people is a dangerous disease throughout the world (Singer, 2020). At this time, people with diabetes mellitus can attack anyone and are not limited by age, both adults, children, and the elderly, even though they do not have family members with diabetes mellitus (Balakumar et al., 2016; Zimmet et al., 2003).

The 2019 International Diabetes Federation (IDF) organization estimates that there are 463 million people aged 20-79 in the world suffering from diabetes mellitus, equivalent to a prevalence rate of 9.3% of the total population at the same age (Simatupang, 2023). The IDF has also identified 10 countries with the highest number of sufferers aged 20-79 years, Indonesia is ranked 7th with the highest number of sufferers, namely 10.7 million people and is the only country in Southeast Asia included in the list. According to the 2018 Riskesdas, the prevalence of diabetes mellitus has increased from 6.9% in 2013 to 8.5% in 2018. In West Papua, especially Sorong City, the prevalence of diabetes mellitus diagnosed by doctors in residents aged ≥15 years and over is 2.82. % and is a city that suffers from diabetes mellitus the most compared to other cities in the province of West Papua. This increase occurs associated with an unhealthy lifestyle (Balwan & Kour, 2021; Mehta et al., 2021).

One unhealthy lifestyle that can affect the occurrence of diabetes is diet (Aljulifi, 2021; Martin-Peláez et al., 2020; Zhong et al., 2023). The high number of people with diabetes mellitus in Indonesia is due to the eating habits of the Indonesian people who consume too many foods that contain carbohydrates/sugar, protein, fat and energy (Anggraini & Herlina, 2022; Williams, 2022). If this condition persists, it can lead to diabetes mellitus. This is reinforced by the results of research conducted by (Hariawan et al., 2019) regarding the relationship between diet and the incidence of diabetes. The results of his research stated that there was a relationship between diet and the incidence of diabetes mellitus.

One of the efforts to control diabetes is to consume functional food-based foods. One of the functional foods that is thought to reduce blood glucose levels is sago.

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Aside from being a functional food, sago is also one of West Papua's local foods that can be used in food diversification programs to support local and national food security. Sago is very suitable for consumption by people with diabetes mellitus because sago contains high starch and little fat and protein. In addition, sago contains a lot of undigested starch, where the content is around 34%. Several studies have also modified sago starch physically, chemically and biologically to increase undigested starch levels (Kamaruddin et al., 2020). This is reinforced by the results of Hariyanto (2020) research with tests conducted on humans which state that sago can reduce glucose levels.

Diabetes mellitus is closely related to the mechanism of normal sugar regulation. Under normal conditions, sugar levels in the body range between 70-110 mg/dL, sugar levels in the body are controlled by the action of the insulin hormone produced by the pancreas gland. A person who suffers from diabetes mellitus cannot control the sugar level in the body so that the body will always have a deficiency or excess of sugar, thus disrupting the body's overall work system. A person is said to have diabetes mellitus according to the 2010 Standards of Medical Care in Diabetes criteria when the examination results show HbA1c > 6.5%, fasting blood sugar > 126 mg/dL (7 mmol/L), non-fasting blood sugar > 200 mg/day dL (11.1 mmol/L). So for people with diabetes really need foods that have low sugar levels.

Besides being rich in sago, West Papua is also rich in vegetables, one of which is red spinach. Red spinach leaves are rich in fiber, antioxidants, flavonoid compounds, tannins and saponins which can lower blood glucose levels. Flavonoid, tannin and saponin compounds have activity in inhibiting pancreatic lipase enzymes by reducing triglyceride levels, total cholesterol and reducing body weight (Astin, 2019).

Giving red spinach extract can significantly reduce glucose (blood sugar), triglyceride, total cholesterol, LDL, and VLDL levels, but increase HDL (good cholesterol) levels (Robert et al., 2022). The results of this study show the potential of red spinach to be used as a good food for people with diabetes or high cholesterol. So that mixing sago flour with red spinach can be used as food for diabetics.

Method

This research is an experiment to make cereals based on sago flour with a combination of red spinach flour. Several treatments started from material preparation, processing, organoleptic tests (taste, color, aroma, texture). The design used in this study was a completely randomized design (CRD) with three treatments and six repetitions. The research sample was a cereal based on sago flour with a combination of red spinach flour. Variations in cereal composition are presented in Table 1.

Table 1. The composition of ingredients for making Instant Cereal based on Sago Flour with a combination of Red Spinach Flour

Material	Sample (g)		
	P1	P2	P3
Sago flour	60	75	90
Red Spinach Flour	40	25	10
Low Calorie Powdered Milk	10	10	10
Low Calorie Powdered Milk	1	1	1

Source: Modification of (Siska, 2019)

The research procedure was carried out in stages starting from the manufacture of cereals and continued with organoleptic quality tests.

Stages of making red spinach flour

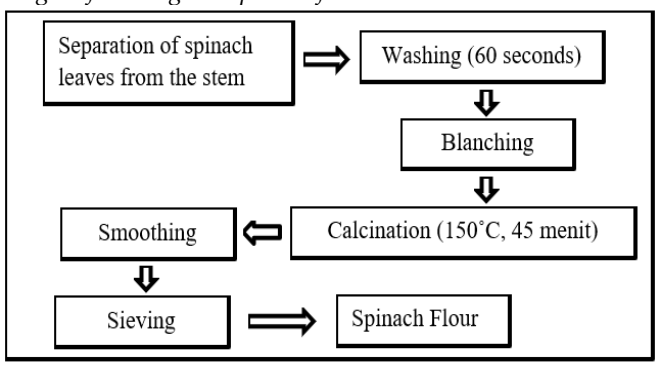

Figure 1. Spinach Flour Making Flow

The finished cereals were then subjected to organoleptic tests including color, taste, aroma, and texture of sago flour and red spinach flour cereals which were observed by organoleptic quality tests. The samples provided were 3 samples. The test was carried out by somewhat trained panelists, namely level II, III students and 30 alumni of the Nutrition Department of the Sorong Ministry of Health Polytechnic. Panelists were asked to provide their assessment of each sample based on the criteria that can be seen in the organoleptic quality test form with three and four scales (Ratnasari & Mahesty, 2022). The data collection technique in this study was by means of panelists filling out organoleptic quality form sheets.

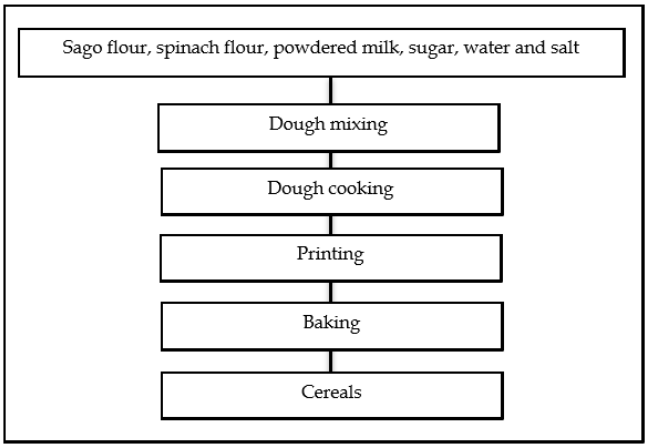

Figure 2. Cereal Manufacturing Flow

The data obtained from the organoleptic test of cereals was calculated the average value of quality assessment using Microsoft Exel 2010. The results of the average value were analyzed using Kruskul Wallis analysis because the data were not normally distributed. All tests were carried out with SPSS 20 for windows software.

Result and Discussion

The panelists in this study consisted of 30 people with details of 1 male and 29 women represented in table 1. The organoleptic tests that had been carried out included color, aroma, taste and texture.

Table 2. Characteristics of Panelists Based on Gender

Gender	n	Percentage %
Male	1	3.30
Female	29	96.70

The results of the organoleptic quality test for the color of sago flour cereal with a combination of spinach flour with the three treatments obtained the average results of the organoleptic quality test for the color of seral represented in Figure 3.

Color has an important role in the appearance of food, besides that color is also used as an indicator of the uniformity of food ingredients, whether or not the method of mixing or processing. A food ingredient served will first be assessed in terms of color. Color and appearance are the overall state of a food visually which causes panelists to be interested and like the product (Kamaruddin et al., 2022). Judging from the average treatment value between 2.3–3.67, it was found that the color of the cereal was red, close to brownish red. Concerning the Acceptability of Sago Flour-Based Cereal Combination of Red Spinach Flour for Patients with Diabetes Mellitus, the panelist's most preferred treatment was based on color parameters, namely P1, a brownish-red color close to dark or dark brown.

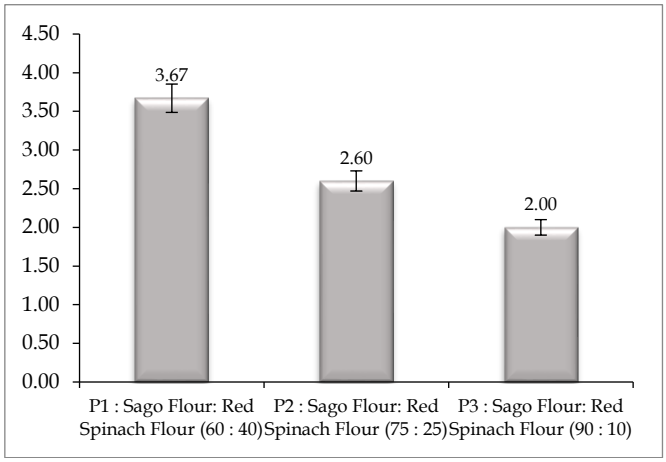

Figure 3. The organoleptic quality test for the color of seral

Of the three treatments, there were differences in color between treatments. The resulting color is red close to brownish red. At the treatment level P1 has a darker color than treatments P2 and P3. This happened because sample P1 used a higher percentage of red spinach flour than P2 and P3. It can be concluded that the more the addition of red amaranth flour the darker the color of the cereal will be. The appearance of a red color in cereals is because red spinach contains anthocyanins which are red-purplish in color (Amalia, 2021). Anthocyanins are compounds that can be used as natural dyes that can be applied to food and non-food products. Anthocyanins act as anti-diabetic by protecting pancreatic β cells from oxidative stress due to glucose induction, cardioprotectant agents by inhibiting platelet aggregation, anti-carcinogenic by reducing and delaying the onset of various types of cancer (liver, leukemia, colon, skin and breast cancer).

The results of the organoleptic quality test for the aroma of cereal sago flour combined with red spinach flour with three treatments and two aromas, the average results of the hedonic quality test for the aroma of cereals are shown in Figure 4 and 5. The results of the hedonic quality test on the taste of sago flour cereal combined with red spinach flour with three treatments and three flavors obtained the average value of the organoleptic test represented in Figures 7.

Distinctive and attractive aromas can make food more preferred by consumers so it needs to be considered in the processing of a food ingredient. From the food industry, aroma testing is considered important because it can quickly provide an assessment of the production results, whether the product is liked or not by consumers (Leech et al., 2005; Siska, 2019).

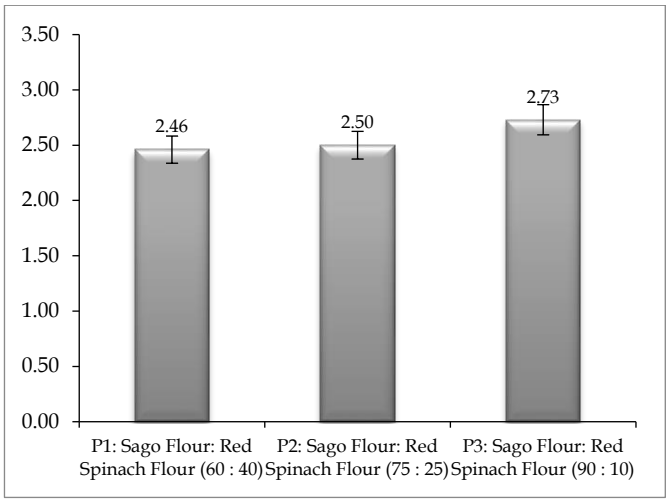

Figure 4. The hedonic quality test for the aroma of cereals

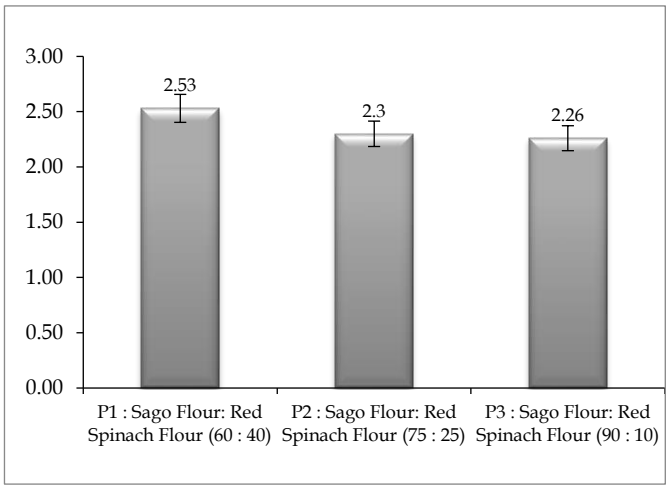

Figure 5. Average Quality Comparison of Sago Aroma in Cereals

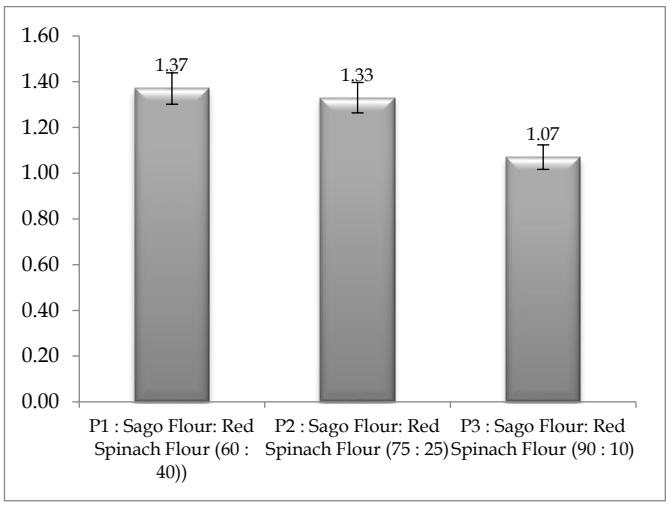

Figure 6. Average Comparison of Spinach Aroma Quality in Cereals

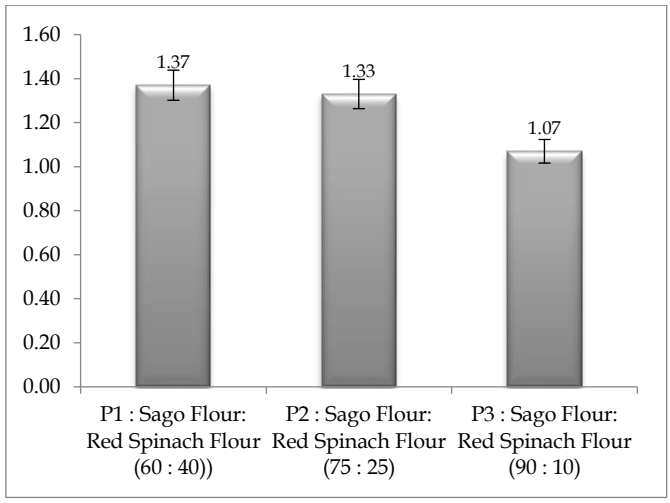

Figure 7. Average Quality Comparison of Sweetness in Cereals

Judging from the average treatment value between 2.47-2.73, it was found that all treatments had the same sago aroma, namely sago aroma, but the one with the highest value was in the P3 treatment. For the aroma of spinach, seen from the average value of the treatment between 2.26-2.53, the aroma of the cereal was obtained, namely the aroma of spinach.

The panelists preferred the most preferred treatment based on the aroma parameter, namely P3, sago aroma approaching very sago flavor and spinach flavor. There three treatments, there were differences in color between treatments. The resulting color is red close to brownish red. At the treatment level P1 has a darker color than treatments P2 and P3. This happened because sample P1 used a higher percentage of red spinach flour than P2 and P3. It can be concluded that the more the addition of red amaranth flour the darker the color of the cereal will be. The appearance of a red color in cereals is because red spinach contains anthocyanins which are red-purplish in color (Amalia, 2021). Anthocyanins are compounds that can be used as natural dyes that can be applied to food and non-food products. According to Novita et al (2013) who said that anthocyanins act as anti-diabetic by protecting pancreatic β cells from oxidative stress due to glucose induction (Fernández-Millán et al., 2014; Nizamutdinova et al., 2009), cardio protectant agents by inhibiting platelet aggregation, anti-carcinogenic by reducing and delaying the onset of various types of cancer (liver, leukemia, colon, skin and breast cancer) (Guerrero et al., 2009).

The results of the hedonic quality test on the taste of sago flour cereal combined with red spinach flour with three treatments and three flavors obtained the average value of the organoleptic test represented in Figures 8 and 9.

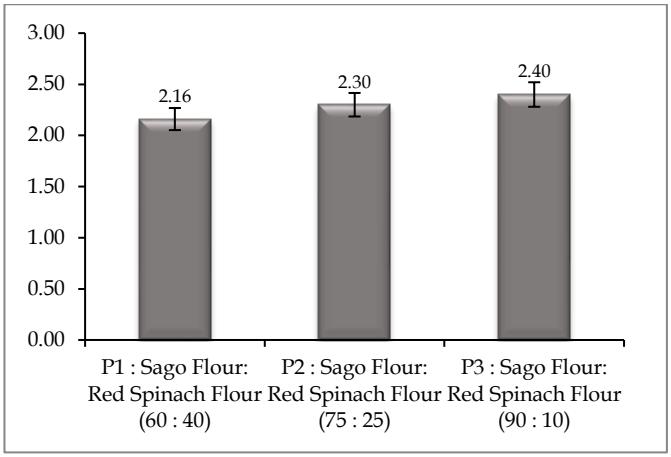

Figure 8. Average Sago Taste Quality Comparison in Cereal

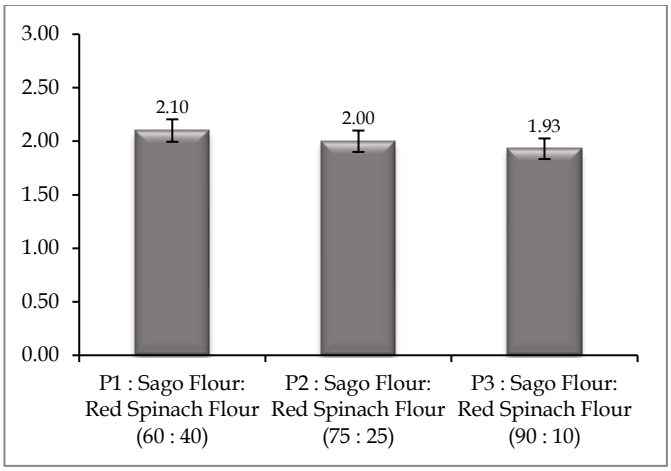

Figure 9. Average Comparison of Spinach Taste Quality in Cereals

Taste is also a very important factor in determining the level of consumer acceptance of a product, because taste determines consumer tastes before consuming a large amount of food. Taste is very difficult to understand scientifically because human tastes are very diverse (Amalia, 2021).

Judging from the average treatment between 1.07-1.37, it was found that all treatments had the same sweet taste, which was in the non-sweet range. The highest value was found in treatment P1. For the taste of sago, seen from the average treatment value of 2.17-2.4, it was found that all treatments had the same taste, which was in the sago flavor range. The highest value was found in treatment P1. For the taste of spinach, seen from the average treatment value of 1.93 - 2.1, the taste of cereal is obtained, namely spinach. Of the three treatments, there was no difference in taste. The resulting taste is not sweet, sago and spinach taste. The non-sweet taste of cereals is due to the same composition of supporting materials or additives used, both in terms of weight and type of additives, resulting in the same taste in each treatment.

The taste of sago in cereals arises because sago itself has a distinctive taste, in each treatment the use of more sago flour than spinach flour causes a distinctive sago taste to arise. This is in accordance with Soeparyo et al. (2018) that the taste of a food ingredient can come from the food itself if it is treated and processed, the taste is influenced by the ingredients added during the processing.

The taste of spinach in cereal arises because spinach tastes unpleasant, so when it is added to the product, it can affect the taste of the product. Supported by the opinion (Salim et al., 2019) which states that red spinach contains phenolase enzymes which produce a distinctive unpleasant taste, so the more red spinach flour is added the stronger the unpleasant taste of the spinach. The results of the hedonic quality test on the texture of cereal sago flour combined with red spinach flour with three treatments obtained the average results of the hedonic quality test on cereal texture as shown in the Figure 10.

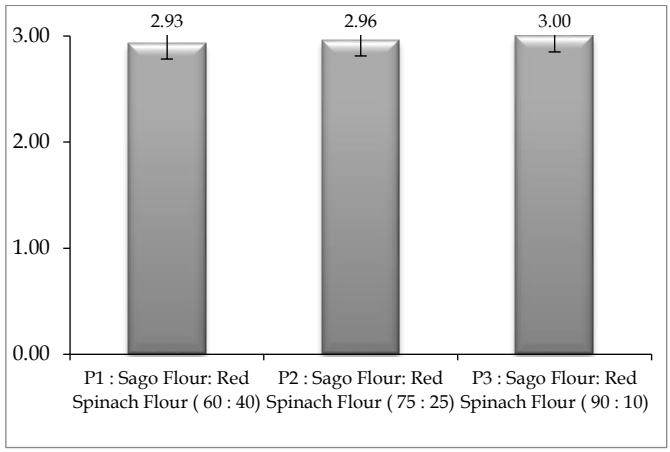

Figure 10. Average Texture Quality Comparison of Cereals

Texture is defined as the properties of a food ingredient that can be observed by the eyes, skin and muscles in the mouth. Texture is a description of the attributes of food ingredients that are produced through a combination of physical and chemical properties, widely accepted by touch and sight (Siska Kristina Zalukhu, 2019). Judging from the average treatment between 2.93-3, it was found that the texture of seral was

Acceptability of Sago Flour-Based Cereals Combination of Red Spinach Flour for Patients with Diabetes Mellitus, the panelist's most preferred treatment was based on texture parameters, namely P3, with a crunchy texture.

Of the three treatments, it was found that there was no difference in texture between the treatments. The texture with the highest value is in the P3 treatment. Based on Siska (2019) research which states that the more use of sago flour the more crunchy the texture of

the flakes. This is due to the low protein content in sago flour, which is 0.42% (DKMB), while red spinach flour is 2.2 grams (3.6%). Supported by Umar (2018) which states that the higher the protein content in an ingredient, the harder the texture of the resulting product will be.

Table 2. Effect of adding spinach flour on organoleptic quality

Parameter	Sample			Average	*P Value*
	P1	P2	P3		
Color	3.67	2.60	2.30	2.83	0.000
Sago fragrance	2.47	2.50	2.73	2.57	0.193
Spinach Aroma	2.53	2.30	2.26	2.37	0.191
Sweetness	1.37	1.33	1.07	1.31	0.190
Sago flavor	2.17	2.30	2.40	2.29	0.334
Spinach Flavor	2.10	2.00	1.93	2.00	0.610
Texture	2.93	2.97	3.00	2.97	0.460

The results of the Kruskal Walis test found that there was a difference in color between treatments which was marked with a significant value (P Value) < (0.05) and there was no difference in aroma, taste and texture between treatments which was marked with (P Value) > (0.05).

Conclusion

The color of the resulting cereal is red close to brownish red. The aroma of the cereal produced is that of sago and that of spinach. The resulting cereal taste is not sweet, sago and spinach taste. The texture of the resulting cereal is a crunchy texture close to very crunchy. The addition of red spinach flour has an effect on the color of the cereal and has no effect on the aroma, taste and texture. The most preferred cereal was P1 cereal with a composition of 60:40.

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