

The Effects of Additioning Purple Sweet Potato Flour (*Ipomoea batatas* L.) on The Characteristics of White Dragon Fruit Pudding (*Selenicereus undatus*)

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Abstract. Pudding is one of the processed foods made by mixing agar powder into water, milk, fruit pulp, to vegetable pulp which can produce a gel and has a soft texture. White dragon fruit is a type of fruit that is rarely used as pudding, because it has a less attractive color after being processed. In this research, white dragon fruit pudding by adding purple sweet potato flour to increase the attractiveness of color, enrich the antioxidant activity, and increase the fiber content contained in the pudding to obtain a pudding of functional value. This study used a simple randomized design group (RAK), with a focus factor concentration of purple sweet potato flour consisting of 6 levels, including P0 (0% purple sweet potato flour), P1 (5% purple sweet potato flour), P2 (10% purple sweet potato flour), P3 (15% purple sweet potato flour), P4 (20% purple sweet potato flour), and P5 (25% purple sweet potato flour) with 4 times repetitions. The raw material analysis of purple sweet potato flour includes water content, ash content, fat content, fiber content, and antioxidant activity. Analysis of white dragon fruit pudding products includes analysis of water content, ash content, fat content, fiber content, antioxidant activity, color intensity, texture, and organoleptic test (texture, taste, aroma, color, and preference). The addition of purple sweet potato flour significantly affected the water content, ash content, antioxidant activity, color intensity, texture, and organoleptic test of white dragon fruit pudding. P1 formulation (5% purple sweet potato flour) was the best formulation with the water content of 76.41%, ash content of 0.28%, fat content of 3.56%, fiber content of 0.89%, antioxidant activity of 14.33%, brightness level of 39.35, redness level of 8.02, yellowish level of 3.92, and texture of 0.34 N. Organoleptic test results texture 5 (somewhat chewy), taste 3 (somewhat tasteless purple yam), aroma 2 (not scented purple yam), color 6 (attractive), and preference 6 (like).

Keywords: Antioxidant Activity, Pudding, Purple Sweet Potato, White Dragon Fruit

1 Introduction

Pudding is one of the foods that are popular among the public. Pudding is not only for dessert, it is also included as a birthday or wedding gift as well as similar events. Pudding is one of the processed foods made by mixing agar powder into water, milk, fruit pulp, to vegetable pulp so that it can produce a gel and has a soft texture [1]. At this time many people use fruits and vegetables in processed pudding [2, 3, 4, 5, 6]. A type of fruit that is widely used as pudding and other food is dragon fruit [7, 8, 9]. Dragon fruit has several types, including red dragon fruit and white dragon fruit. The use of red dragon fruit in pudding is often done because red dragon fruit has a nice and natural color which results in its attractiveness when consumed [10, 11, 12, 13]. The benefits of white dragon fruit are still not widely used as pudding due to its white color which is seen as less attractive. Nutrients contained in the white dragon fruit can be more than the red dragon fruit [14, 15]. The content of phenols and unsaturated fatty acids in white dragon fruit is higher than in red dragon fruit [16].

Making white dragon fruit pudding in this study by adding purple sweet potato flour in the hope help improve the color. The content of purple sweet potato powder plays a role in strengthening the gel contained in the pudding. Sweet purple potato and white dragon fruit have a fairly high fiber content [17]. Purple sweet potato flour has a natural color in pudding because there are anthocyanin compounds [18]. Anthocyanins in purple sweet potato can function as antioxidants and free radical scavengers, as a condition called functional food [19, 20]. In the future, the results of this study case are expected to show that a white dragon fruit pudding product that has 18 functional properties in the presence of antioxidant content can counteract free radicals inside the body. Other than that, the high fiber in this pudding is expected to improve the digestive system.

2 Research Methodology

This research was conducted at the Laboratory of Food Technology, Faculty of Agriculture-Animal Husbandry, University of Muhammadiyah Malang for 4 months starting from March-June 2023. This study uses a randomized Group Design (RAK) with a simple pattern, where there is one factor focused on the concentration of purple sweet potato flour consisting of 6 levels (0%;5%;10%;15%;20%;25%) and repeated 4 times. The tools are used in making purple sweet potato flour and pudding such as knife, spoon, Basin, grater, oven (Kirin), strainer (80 mesh sieve), mixer, pan, stove (Rinnai), digital scale (GSF G-4405) and blender (Panasonic). The ingredients used in making pudding include white dragon fruit (obtained from Merjosari Fruit Store, Malang), purple sweet potato flour, granulated sugar (*Rose Brand*), and agar-agar powder (Nutrijell). This study begins with the process of making purple sweet potato flour [21], which will be made white dragon fruit pudding [22], with continuing to add purple sweet potato flour according to the formulation. Parameters of the analysis include moisture content, ash content, fiber content, antioxidant activity, color intensity, texture, and organoleptic test (texture, taste, aroma, color, and appearance). The Data gained proceeded using ANOVA (*Analysis of Variance*) on the trust level $\alpha = 0,05$. Each formulation has a real impact on the next *post hoc test* and calculation of DMRT (*Duncan Multiple Range Test*) in 5%.

2.1 The Analysis of Moisture Content

The higher the moisture content, the shorter the storage time, as free water in a product or food material provides a growth medium for bacteria that causes the product to deteriorate quickly [23]. In determining this moisture content, an empty porcelain crucible is dried in an oven for 24 hours at a temperature of 100-105 °C. The porcelain crucible is cooled in a desiccator for 15 minutes and weighed as the weight of the crucible. The sample is crushed using a mortar. A 2-gram sample is weighed and placed in the dried porcelain crucible. The sample is dried in an oven at a temperature of 100-105 °C for 4 hours. The sample is cooled in a desiccator for 15 minutes and reweighed as the final sample weight. The moisture content of the sample is calculated using the formula:

$$\% \text{ Moisture Content} = (\text{Initial weight (g)} - \text{Final weight (g)}) / (\text{Initial weight (g)}) \times 100\% [24].$$

2.2 The Ash Content Analysis

The ash content analysis is conducted with the aim of to determining the mineral content present in a product or food material [25]. Samples obtained from the drying process in the oven, following the moisture content analysis, are further subjected to ash content testing. The samples are placed in a furnace at a temperature of 600 °C for 5 hours. Afterward, the samples are taken out and placed in a desiccator for 15 minutes. The samples are then weighed to obtain the final mass. The ash content is calculated using the formula:

$$\% \text{ Ash Content} = (\text{Ash Mass (g)} / \text{Initial Sample Mass (g)}) \times 100\%$$

2.3 Dietary Fiber Content Test

Dietary fiber is a carbohydrate resistant to digestive enzymes in the intestines [26]. Dietary fiber can help control weight, provide a longer-lasting feeling of fullness, and also reduce cholesterol levels by binding fats in the small intestine [27]. Top of form the fiber content was tested by grinding a 2-gram sample, freeing fat by dissolving it in the organic solvent hexane. The dried filter paper was weighed (A = initial filter paper weight). The remaining sample residue after fat extraction was weighed (B = sample weight) and placed in a 500 ml Erlenmeyer flask. 50 ml of H₂SO₄ 1.25 % was added to the Erlenmeyer flask containing the sample on a hotplate under the condenser until obtaining C (C = final filter paper weight). The dietary fiber content was calculated using the formula: Crude fiber content (%) = (C - A) 100 / B [28]

2.4 Antioxidant Activity Analysis

The antioxidant activity in purple sweet potatoes is attributed to anthocyanin pigments, the primary source of antioxidants in purple sweet potatoes. [29].The determination of antioxidant activity analysis is carried out by adding 4 ml of the sample solution to a test tube. Then, 1 ml of DPPH solution is added, and the mixture is homogenized. The test tube is tightly sealed with aluminum foil, and the sample is stored in the dark for 30 minutes. Absorbance is measured using a UV-Vis spectrophotometer at a wavelength of 517 nm. The percentage of inhibition is calculated using the formula:

$$\% \text{ Inhibition} = (\text{Absorbance blank} - \text{Absorbance sample}) \times 100\% \text{ [30].}$$

2.5 Gel Strength Test

The gel strength of agar pudding is influenced by the amount of agar, water, and supporting ingredients in the food material [31]. The test was conducted by placing the sample between plates of a prepared texture analyzer. The plates pulled the sample until it broke, measuring it as gel strength. The measurement results appeared on the computer [32].

2.6 Color Intensity Test

Color is one of the important attributes determining consumer acceptance of a product [33]. Color measurement was performed using the Color Reader CR-10 (Konica Minolta Sensing, Inc., Japan). The sample was placed on a plastic clip, flattened, slightly pressed with the color reader, and measured by pressing the button on the color reader. The measurement method used the absolute color system L^* , a^* , and b^* . Color analysis results were read and recorded (L^* = brightness ($L(+)$ = bright, $L(-)$ = dark); a^* = redness ($a(+)$ = red, ranging from 0 to 100, $a(-)$ = green, ranging from 0 to -80); and b^* = yellowness, indicating the chromatic color mixture of blue-yellow with $+b^*$ = yellow, ranging from 0 to +70, and $-b^*$ = blue, ranging from 0 to -70) [34].

2.7 Organoleptic Test

Organoleptic refers to describing the sensory characteristics of a food product, including color, appearance, shape, taste, and texture [35]. This attribute must be considered to enhance the appeal of the food product [36]. Organoleptic testing on the product used the hedonic test method to determine the panelists' acceptance level of the presented samples. The organoleptic test was conducted by 30 untrained panelists. The scale given in the organoleptic test ranged from 1 to 5 for each attribute tested, including texture, taste, aroma, and color. The scale and attributes of the organoleptic test can be seen in Table 1.

Table 1. Organoleptic Test Rating Scale [37]

Score	Test Parameter			
	Texture	Taste	Aroma	Color
1	Very Chewy	Very Not Sweet	Very Fra-grant	Very Unattrac-tive
2	Not Chewy	Not Sweet	Not Fragrant	Not Attractive
3	Quite Chewy	Not Sweet	Quite Fragrant	Quite Attrac-tive
4	Chewy	Sweet	Fragrant	Attractive
5	Very Chewy	Very Sweet	Very Fragrant	Very Attrac-tive

3 Results and Discussion Analysis of Raw Material Analysis

Raw material analysis of purple sweet potato flour is done of determining the chemical content in the flour before it is added in the processing of making white dragon fruit pudding. The results of the purple sweet potato flour analyses that have been carried out are subsequently compared with the results from the literature. The nutritional content of purple sweet potato flour that has been analyzed is presented in Table 1.

Table 2. The Results Of The Analysis The Nutritional Content Of Purple Sweet Potato Flour

Analysis	Purple Sweet Potato Flour Analysis	
	Literature	Result
Water (%)	10,92*	10,81
Ash (%)	2,58*	1,71
Fat (%)	0,61*	2,58
Fiber (%)	2,40*	3,16
antioxidant (%)	36,88**	23,28

Source : *[38]

**[39]

The analysis results of purple sweet potato flour in Table 1 present the value of the water content of the analysis is not much different from the results of the water content in the literature. This water content is considered low. The water content in wheat flour has a maximum value of 14.5%. The water content contained in cassava flour has a maximum value of 12% [40]. The water content of purple sweet potato flour in the analysis is in accordance with Indonesia's National quality standards (SNI) that have been set. Ash content analysis has resulted in a lower value than the results from the literature. The maximum ash content in wheat flour is required to be 0.70% [41]. The ash method used in the analysis of ash levels is one of the factors that can change the ash levels [42]. Analysis of fat content and fiber content in raw materials has a higher value than the literature. This proves that the flour quickly rancides which can not be stored for a long period of time because it can reduce the quality of materials and products. High fiber content in sweet potato flour is considered to add value to the product, because the fiber content contained in food ingredients has a positive role in nutrition and metabolism [43]. The results of the analysis of the antioxidant activity of purple sweet potato flour were lower compared to the literature. The difference in formulation tends to be caused by the processing of purple sweet potato flour using a fairly high drying temperature. Antioxidants are not resistant to high heating temperatures resulting in decreased antioxidant activity [44, 45].

4 Analysis Of White Dragon Fruit Pudding

4.1 Water Content

The addition of purple sweet potato flour in the manufacture of white dragon fruit pudding has a very real effect on the water content of the pudding. The results of the average water content of white dragon fruit pudding are presented in Table 2.

Table 3. Average Analysis Water Content of White Dragon Fruit Pudding with the Addition of Purple Sweet Potato flour

Treatment	Water content (%)
P0	78,87 ^f
P1	76,41 ^c
P2	72,64 ^d
P3	71,26 ^c
P4	69,09 ^b
P5	67,38 ^a

The average result of the value of water content in the white dragon fruit pudding with the addition of purple sweet potato flour ranged from 67.38 to 78.87%. The highest water content of pudding is at P0 (purple sweet potato flour 0%) with a water content value of 78.87%. The lowest water content of pudding is found in P5 (purple sweet potato flour 25%) which is 67.38%. The water content in the pudding is a maximum of 73.1% [46]. The water content in this study is in accordance with the standards. Contributors to the water content in this study apart from the water that is added Also from Dragon Fruit, where the water content of dragon fruit is 85.7 g/100g. [47].

4.2 Ash Content

The addition of purple sweet potato flour in the manufacture of white dragon fruit pudding significantly affects the ash content of the pudding. The results of the average ash content of white dragon fruit pudding are presented in Table 3.

Table 4. Average Analysis Ash Content of White Dragon Fruit Pudding with the Addition of Purple Sweet Potato Flour

Treatment	Ash Content (%)
P0	0,22 ^a
P1	0,28 ^a
P2	0,40 ^b
P3	0,46 ^{bc}
P4	0,53 ^{cd}
P5	0,57 ^d

The results of the value of the ash content in the white dragon fruit pudding with the addition of purple sweet potato flour ranged from 0.22 - to 0.57%. The ash content of pudding at P4 (20% purple sweet potato flour) and P5 (25% purple sweet potato flour) did not differ significantly. The ash content in the pudding is a maximum of 0.92,92%. The ash content in this study is in accordance with the standard. The higher ash content in the product, indicates the higher the mineral content in the product [48].

4.3 Fiber Rate

The addition of purple sweet potato flour in the manufacture of white dragon fruit pudding does not significantly affect the fat content of the pudding. The results of the average fat content of white dragon fruit pudding are presented in Figure 1.

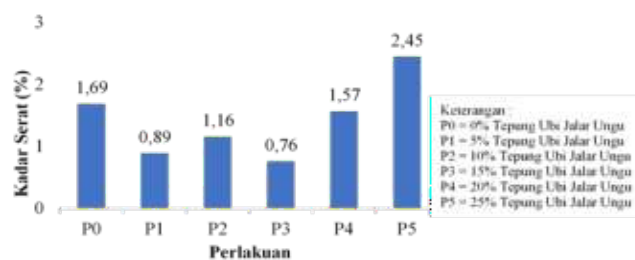


Figure 1. Fiber Content Analysis Graph Fiber Content of White Dragon Fruit Pudding with the Addition of Purple Sweet Potato Flour

The average value of pudding fiber content in each formulation varies between 0.76 - 2.45%. The highest average value of fiber content is found in P5 (25% sweet potato flour) which is 2.45%. The lowest fiber content value is found in P3 (15% sweet potato flour) which is 0.76%. The results of fiber content in this study are based on standard value, which is about 0.8 % [36]. Pudding that tends to get added sweet potato flour tends to contain greater fiber. Every 100 grams of purple sweet potatoes contributes 1.2 grams of fiber. Fiber contained in food products is a coarse fiber that cannot be absorbed by the human body, but has an important role in the human digestive system [49].

4.4 Antioxidant Activity

The addition of purple sweet potato flour in the preparation of white dragon fruit pudding has a significant effect on the antioxidant activity of the pudding. The results of the average antioxidant activity of white dragon fruit pudding are presented in Table 4.

Table 5. Average Analysis of the Antioxidant Activity of White Dragon Fruit Pudding Putih with the Addition of Purple Sweet Potato Flour

Treatment	Antixidant (%)
P0	8,68 ^a
P1	14,33 ^b
P2	19,16 ^{bc}
P3	20,61 ^{cd}
P4	25,02 ^d
P5	31,45 ^e

The results of the value of antioxidant activity in white dragon fruit pudding with the addition of purple sweet potato flour ranged from 8.68 - to 31.45%. The highest antioxidant activity was found in P5 (purple sweet potato flour 25%) which amounted to 31.45%. The result of lowest antioxidant activity found in P0 (0% purple sweet potato flour) which is equal to 8.68%. High antioxidant activity in purple sweet potatoes is influenced by the presence of anthocyanin pigments characterized by purple in sweet potatoes. The existence of antioxidants in pudding strengthens the fact that pudding is a functional food [50]

4.5 Color Intensity

The addition of purple sweet potatoes in the preparation of white dragon fruit pudding significantly affects the brightness (L), redness (A*), and blueness (b*) of the pudding. The results of the average color intensity of white dragon fruit pudding are presented in Table 5.

Table 6. Average Color Intensity Analysis of White Dragon Fruit Pudding with the Addition of Purple Sweet Potato Flour

Treatment	Brightness (L)	Redness (a*)	Blueness (b*)
P0	41,47 ^c	1,62 ^a	1,2 ^a
P1	39,35 ^b	8,02 ^b	3,92 ^b
P2	37,47 ^a	9,75 ^c	4 ^b
P3	37,25 ^a	11,12 ^d	3,37 ^b
P4	37,1 ^a	11,72 ^c	3,8 ^b
P5	36,75 ^a	12,5 ^f	4,02 ^b

The results of the average brightness on the white dragon fruit pudding with the addition of purple sweet potato flour ranged from 36.75 to 41.47. Brightness level starts resulting in P2 (10% purple sweet potato flour) to P5 (25% purple sweet potato flour) did not show a significant difference. The addition of purple sweet potato flour concentration darkens the color of the resulting pudding. The brightness of the pudding, according to addition, tends to be influenced by differences in concentration of flour added, and is also influenced by the making process, varieties of sweet potatoes, the flour making process, as well as the content of pigments in sweet potatoes. The results of the average value of redness in white dragon fruit pudding with the addition of purple sweet potato flour ranged from 1.62 to 12.5. The highest level of redness results in P5 (purple sweet potato flour 25%) which is equal to 12.5. The lowest level of redness is found in P0 (0% purple sweet potato flour) which is equal to 1.62. The redness of the pudding increases as the concentration of purple sweet potato flour increases. The results of the previous study showed that the more the addition of purple sweet potato flour the higher the A* Color intensity. The results of the average value of blueness in white dragon fruit pudding with the addition of purple sweet potato flour ranged from 1.2 - to 4.02. The appearance of blue goes hand in hand with the red because purple is a combination of red and blue. The results of the yellowness in P1 (5% purple sweet potato flour) to P5 (25% purple sweet potato flour) showed no significantly different results. The addition of purple sweet potatoes, has no effect on the addition of yellow in it [51].

4.6 Texture (Elasticity/Gumminess)

The addition of purple sweet potato flour in the manufacture of white dragon fruit pudding significantly affects the texture of the pudding. The results of the average texture pudding of white dragon fruit pudding are presented in Table 6.

Table 7. Average Analysis Texture White Dragon Fruit Pudding with the Addition of Purple Sweet Potato Flour

Treatment	Texture (N)
P0	2,82 ^b
P1	0,34 ^a
P2	0,27 ^a
P3	0,25 ^a
P4	0,13 ^a
P5	0,10 ^a

The results of the texture from white dragon fruit pudding with the addition of purple sweet potato flour ranged from 0.10-2.82 N. Texture results in P1 (5% purple sweet potato flour) to P5 (25% purple sweet potato flour) showed no real difference. The higher the texture indicates the harder the texture of the product. Formulation P0 has the highest texture because P0 is a formulation without adding purple sweet potato flour and makes the texture most supple. Agar powder or pudding which has purple sweet potato flour added has a softer texture due to the starch content in it which can make the texture of the pudding softer. Purple sweet potato flour contains amylopectin which is high enough that it can affect the hardness of the texture [52].

4.7 Organoleptic Test

The addition of purple sweet potato flour in the preparation of white dragon fruit pudding significantly affects the entire organoleptic value (texture, taste, aroma, color, and preference) in the pudding. The results of the average organoleptic test pudding of white dragon fruit pudding are presented in Table 7.

Table 8. The Average Value of Organoleptic Test Pudding of White Dragon Fruit Pudding with the Addition of Purple Sweet Potato Flour

Treatment	Parameter Of Organoleptic Parameters				
	Texture	Flavor	Aroma	Color	Favorite
P0	6,60 ^f	1,27 ^a	1,33 ^a	2,67 ^a	5,07 ^c
P1	4,90 ^e	3,03 ^b	2,47 ^b	5,73 ^c	5,70 ^d
P2	3,83 ^d	3,97 ^c	4,30 ^c	4,57 ^{bc}	4,57 ^{bc}
P3	3,27 ^c	4,43 ^d	4,20 ^c	4,40 ^{bc}	4,47 ^b
P4	2,37 ^b	5,80 ^e	5,30 ^d	4,57 ^{bc}	3,53 ^a
P5	1,27 ^a	6,40 ^f	6,23 ^c	4,07 ^b	3,27 ^a

The results of the average value of the texture organoleptic test on white dragon fruit pudding with the addition of purple sweet potato flour ranged from 1.27 to 6.60. The highest texture organoleptic test results are found in P0 (purple sweet potato flour 0%) which is 6.60 with very chewy. The height of the texture value in the product is influenced by the presence of fiber content of the main raw material. The fiber content in pudding comes from the fiber content found in purple yam flour and agar-agar. Fiber resulting in the product texture becomes hard [53].

The results of the average value of the taste organoleptic test on white dragon fruit pudding with the addition of purple sweet potato flour ranged from 1.27 to 6.40. The highest taste organoleptic test results are found in P5 (purple sweet potato flour 25%) which is equal to 6.40 with purple sweet potato taste information. The lowest taste organoleptic test result was found at P0 (0% purple sweet potato flour) which was 1.27 with a very tasteless description of purple sweet potatoes. Taste is an important parameter in determining the degree of favorite matter for a product. Flavor in food is one of the important factors that determine consumer acceptance of a food product. Flavor in food products is influenced by several factors including chemical compounds, the concentration of constituent components, the interaction of other flavor components, as well as the temperature in the processing process [54].

The results of the average value of the aroma organoleptic test on white dragon fruit pudding with the addition of purple sweet potato flour ranged from 1.33 to 6.23. The highest aroma organoleptic test results are found in P5 (purple sweet potato flour 25%) which is equal to 6.23 with purple sweet potato flavored information. The lowest aroma organoleptic test result was found at P0 (0% purple sweet potato flour) which was 1.33 with very no purple sweet potato aroma. Sweet potato has a distinctive volatile compound content. Each type of sweet potato has different volatile compounds. Aroma typical aroma from sweet potatoes is still attached even though it has gone through the processing process [55].

The results of the average color organoleptic test on white dragon fruit pudding with the addition of purple sweet potato flour ranged from 2.67 to 5.73. The results of color organoleptic tests on P1 (5% purple sweet potato flour) to P5 (25% purple sweet potato flour) showed that the results were not significantly different with quite interesting to interesting information. P0 formulation has the lowest color organoleptic Test value. P0 color formulation is white in accordance with the original color of white dragon fruit so the panelists are less interested in the color of the pudding. Aspect color assessment becomes the main attraction in a food product [56].

The results of the average value of organoleptic test preferences in white dragon fruit pudding with the addition of purple sweet potato flour ranged from 3.27 to 5.70. The results of organoleptic test preference on P1 (purple sweet potato flour 5%) are the most significantly different from the results of other formulations, and the results of organoleptic test preference on P1 is a pudding with the highest value of 5.70 with a description like.

This result shows that the increasing concentration of purple sweet potato flour added to the decreasing level of preference for pudding products panelists. Evaluation of the parameters of preference in the pudding is done based on of an assessment of all parameters that include texture, taste, aroma, and color in the pudding. Parameters of preference affect the decision in choosing products for consumption.

4.8 The Best Formulation

The determination of the best formulation in this study was obtained from the results of all analysis parameters that have been carried out including analysis of physicochemical and organoleptic. The best formulation in this study was found in P1 (5% purple sweet potato flour). The results of physicochemical testing on P1 (5% purple sweet potato flour) obtained water content of 76.41%, ash content of 0.28%, fat content of 3.56%, fiber content of 0.89%, antioxidant activity of 14.33%, brightness (L) 39.35, Reddish (a*) 8.02, bluish (b*) 3.92, and 0.34 n texture. The results of organoleptic testing using the modus method on the formulation of P1 (5% purple sweet potato flour) became the most preferred formulation by the panelists. The results of the measurement parameter of texture parameters obtained a value of 5 (somewhat chewy), taste obtained a value of 3 (somewhat tasteless purple yam), aroma obtained a value of 2 (not scented purple yam), color obtained a value of 6 (interesting), and preferences obtained a value of 6 (like). The best implementation of physicochemical and organoleptic testing results on white dragon fruit pudding is with the addition of 5% purple sweet potato flour which is expected to be an innovative pudding product that has good nutritional content and is suitable for consumption.

5 Conclusion

This study concludes that the addition of purple sweet potato flour with various concentrations significantly affects the water content, ash content, antioxidant activity, color intensity, and texture of white dragon fruit pudding. The addition of purple sweet potato flour with various concentrations had a significant effect on all organoleptic test parameters including texture, taste, color, aroma, and preference. Based on the Physicochemical and organoleptic testing that has been done in this study, the best formulation is obtained on P1 (5% purple sweet potato flour).

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