

The Effect of the Ratio of Rice Bran Flour and Wheat Flour on Some Quality Component and Sensory of Cup Cake

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Abstract: This research aims to determine the effect of the ratio of Rice Bran Flour (RBF) and Wheat Flour (WHF) on some quality component and sensory of Cup Cake. This research used a Completely Randomized Design (CRD) with a single factor, namely the combination of the proportion of rice bran and wheat, consisting of 6 treatments are as follows: b0 (RBF 0% : WHF 100%); b1 (5% RBF: WHF 95%); b2 (RBF 10% : WHF 90%); b3 (RBF 15% : WHF 85%); b4 (RBF 20% : WHF 80%); and b5 (RBF 25% : WHF 75%). The research data were analyzed using ANOVA at a 5% real level and further tests using Orthogonal Polynomials at a 5% real level. Also, a high percentage of fat (29.10%) was recorded for cake with RBF at 20% significant increase in the protein content compared to control cake (7.65%). With increasing the ratio of RBF to all cupcake samples at different proportions, some physical properties of the cupcake such as volume and specific volume were decreased, while others such as weight and specific weight were increased compared to the control cupcake. In the higher storage period, the higher staling of cupcake samples appeared, and thus, the moisture content of the fortified cupcake decreases with different proportions of RBF. It could be concluded that the RBF has a functional property higher than those of WHF. Finally, high-fiber cupcake can be prepared with substituted WHF up to 25% with RBF without any negative effects on the quality properties and sensory acceptability of the product

Keywords: Cup cake, Fiber, Protein, Rice bran flour, Sensory, Wheat flour.

I. Introduction

Rice bran is a by-product of the rice milling process which includes the bran part of the rice which is separated during the second polishing. Mulyani *et al* [19] stated that in the process of milling rice into milled rice, rice bran will be obtained amounting to (8-12%). The Indonesian Official National Statistics reported that national dry milled grain production in 2015 reached 75 million tons, so that 6-9 million tons of bran could be available [6]. Rice bran is known to have high nutritional value, with a protein content of 12-15.6%, fat 15-19.7%, carbohydrates 34.1-52.3% and crude fiber 7.0-11.4%. Rice bran also contains B vitamins, minerals and antioxidants [16]. Rice bran has been used as a substitute for sweet bread, cookies, cakes, chips and cereals. Substitution of 5-15% bran in wheat is reported to provide optimal results for consumer acceptance of cookies and sweet bread products. This substitution is known to increase the content of dietary fiber and niacin in cookies and sweet bread products [28]. The combination of rice bran and wheat aims to utilize rice bran as a nutritious food raw material, reducing imports and people's dependence on wheat. The combination of rice bran flour (RBF) and wheat aims to utilize rice bran as a nutritious food raw material, reducing imports and people's dependence on wheat. Therefore, the study is aimed at improving the nutritional quality of cupcake and studying the impact of incorporating different levels of RBF on chemical, physical, sensory properties of prepared high-fibre cupcake. Until now, the need for wheat raw materials is still imported. Rice bran has been used as a substitute for sweet bread, cookies, cakes, chips and cereals. Substitution of 5-15% bran in wheat is reported to provide optimal results for consumer acceptance of cookies and sweet bread products. This substitution is known to increase the content of dietary fiber and niacin in cookies and sweet bread products [28]. Cup cake is a modified type of cake which is like a cup, sweet in taste and soft in texture a snack made from dough formulated with flour, sugar, eggs and fat. In general, the flour used in making cup cakes is wheat. The advantage of flour is that it contains protein in the form of gluten which plays a role in forming a strong and elastic framework or structure to maintain the expansion of the dough. Until now, the need for wheat raw materials is still imported. In 2021 the volume of Indonesian wheat imports reached 7.57 million tons [6]. As an effort to reduce dependence on imported food ingredients, several studies have been carried out on the use of other food ingredients as alternative substitutes for wheat. One ingredient that can be used to replace some of the flour in making cup cakes is rice bran. Rice bran is known to have high nutritional value, with a protein content of 12-15.6%, fat 15-19.7%, carbohydrates 34.1-52.3%, crude fiber 7.0-11.4%, B vitamins, minerals and antioxidants [16]. Rice bran has been used as a substitute for sweet bread, cookies, cakes, chips and cereals. Substitution of 5-15% bran in wheat is reported to provide optimal results for consumer acceptance of cookies and sweet bread products. The combination of rice bran and wheat aims to utilize rice bran as a nutritious food raw material, reducing imports and people's dependence on wheat. Therefore, the study was aims to improve the nutritional quality of cupcake and monitoring the impact of incorporating different levels of rice bran flour on chemical, physical, sensory properties of prepared high-fibre cupcake.

II. Materials and Methods

Experimental Design and Data Analysis

The experimental design used in this research was a Completely Randomized Design (CRD) with single factor experiment was the proportion of RBF to wheat flour which consisted of 6 treatments, as follows: b0 = RBF 0%: WHF 100%; b1 = RBF 5%: WHF 95%; b2 = RBF 10%: WHF 90%; b3 = RBF 15%: WHF 85%; b4 = RBF 20%: WHF 80%; b5 = RBF 25%: WHF 75%

Each treatment was repeated 3 times to obtain 18 experimental sample units. The observation data were analyzed using ANOVA (analysis of variance) at a significance level of 5% using Co-Stat software and continued with Orthogonal Polynomial test at the 5% level, while the organoleptic with the Honestly Significant Difference (HSD) test at the 5% level [12].

Research Stages

This research has two stages of work, namely the first stage includes the process of making rice bran flour [19]. Meanwhile, the second stage is the process of making cup cakes using the creaming technique according to Habsari [11].

1) Making Rice Bran Flour

The rice bran of the C4 variety that will be used is sorted by sifting using a 60 mesh sieve to separate the bran from the husks that are included during the polishing process. Next, the size is reduced using a blender, then the rice bran is roasted for 10 minutes at 130°C. The roasting process aims to inactivate the lipase enzyme and reduce the water content of fresh rice bran. The roasted rice bran is then sieved using an 80 Mesh sieve. Then they converted to powder by grinding in a laboratory mill while being sifted using a sieve (0.6mm). It should be kept in sealed glass containers at ambient temperature (23° C) until use and analysis The resulting rice bran flour (RBF) was analyzed for chemical properties (moisture content, protein content and fat content).

2) Preparation of cup cakes

Weighed all raw materials including 5% RBF (6.25 g); 10% (12.5 g); 15% (18.75 g); 20% (25 g); 25% (31.25 g), 100% flour (125 g); 95% (118.75 g); 90% (112.5 g); 85% (106.25 g); 80% (100 g); 75% (93.75 g), 125 g powdered sugar, 125 g margarine, 72 g egg yolks, 90 g egg whites, 1 g baking powder, 1 g salt and 1 g vanilla. The First process is sugar and shortening were mixed for 3 min at slow speed and then on medium speed for 2 min. Add the eggs and mix for 2 min at medium speed. After that, add milk powder and baking powder, and mix for 4 min. Place 40 g of prepared cake mixture in cake cups, and bake in an electric oven at 180° C for 30 min. After baking, remove the cake samples from the oven, cool for one hour, and then pack in plastic bags until the analysis.

3) Research Parameters

The parameters observed include physical properties, namely swelling power [4], chemical properties including water content using the thermogravimetric method, protein (Kjedhal method) and fat (Soxhlet method) [3]. The organoleptic properties observed included color, aroma, texture and taste of cup cakes at five point Hedonic and Scoring tests [31].

III. Results and Discussion

1) Water Content

It can be seen that the proportion of RBF and wheat flour has no significantly different effect on the water content of the cup cake. The graph of the influence of the proportion of rice bran and flour on the water content of the cup cake can be seen in Figure 1.

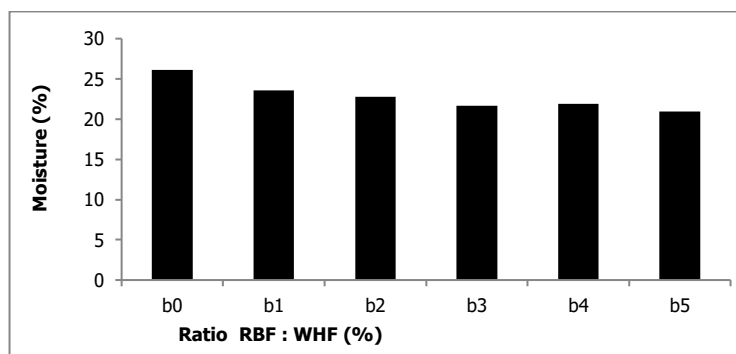


Figure 1. The effect of the Proportion of RBF and WHF on the Mosture content of Cup Cake.

It could be observed in graph that addition of RBF to cupcake resulted increase in moisture content, which ranged from 20.96% to 26.14% for cake with 5% RBF up to 25% RBF, respectively, compared to control cake sample (9.84). These results may be due to the ability of RBF to bind more amount of water when preparing the cake, and it can keep the moisture for long time without loss. Slight increase was found in the ash content of all prepared cupcake samples when incorporating RBF at different levels, and

the highest value was 1.92% appeared by cupcake with 20% . In addition, it could be noticed clearly significant increases in dietary fiber of prepared cupcake with RBF compared to control cake (2.73%). The dietary fiber values ranged from 10.46% for cupcake with 5% RBF to 17.00% with 20% of RBF. It may be due to the high content of ash and dietary fiber in RBF. These results were in agreement with Lotfy and Barakat [15]. They mentioned that a significant increase was found in the ash and fiber content of sponge cake compared with the control sample. The same trend in the results for crude protein and carbohydrate was observed when substituting wheat flour with RBF, whereas cupcake containing RBF had significant gradual decrease in protein content from 10.10% by 5% RBF up to 9.30% by 20% RBF addition when compared to control cake (10.60%). In addition, nitrogen-free extract was negatively affected by using RBF in cake manufacture; it was 63.70% for control sample, and then significantly lowers up to 52.47% at 20% of RBF. The reason for these results is the low protein content (3.45%) of RBF compared to wheat flour (11.73%).

The higher the proportion of RBF and the lower the proportion of flour used, the lower the water content of the cup cake. This is thought to be due to the water content of the raw material. RBF is known to have a lower moisture content, namely 1.69%, while wheat is 9.80% [8]. So as the proportion of flour decreases, the moisture content of the resulting cupcake decreases. Based on research that moisture content in cupcakes ranges from 26.14-20.96%, so it meets the criteria for good cupcake quality mentioned is that when eaten it feels soft and moist [25,26].

2) Protein Level

It shows that the protein content of cupcake with the addition of rice bran shows an increase in protein content. The control cupcake protein content (b0) was 7.1492%, while after adding rice bran, the cupcake protein content reached 8.7146%. This is because rice bran flour has a protein content of 12.14%. When compared with wheat, the protein content value is higher. According to Damayanthi (2006), the protein content in wheat is 10.31%.

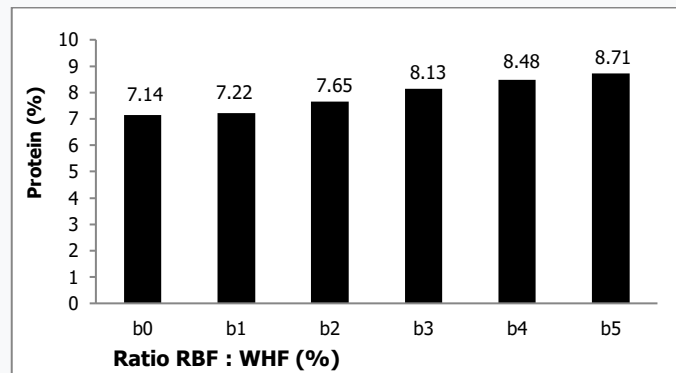


Figure 2. The effect of the proportion of RBF and WHF on the protein content of cupcake.

3) Fat Content

The tendency for an increase in cupcake fat content with the equation $y = 0.5676x + 27.25$ with a coefficient of determination (KD) $R^2 = 0.969$. The value 0.5676 determines the direction of linear regression which is positive. The higher proportion of bran added causes an increase in the fat content in the cupcake by 0.5676% with a coefficient of determination value of 0.969, meaning that 96.9% of the cup cake's fat content is influenced by the proportion of bran added to the cupcake while the remainder (3.1%) influenced by other things.

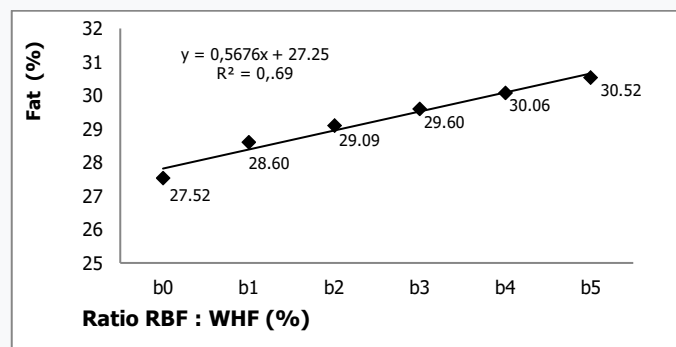


Figure 3. The effect of the proportion of RBF and WHF on the fat content of cup cakes.

The lowest fat content was obtained in treatment b0, namely 27.52% and the highest in treatment b5, amounting to 30.52%. (Fig.3). Margarine and eggs are sources of fat in the raw materials for making cup cakes. However, these two fat sources did not have an effect on increasing the cup cake fat content because they were added at the same concentration in all treatments. Cup cake fat content increased with increasing proportion of rice bran addition. This is because rice bran has a relatively high fat

content. The fat content in rice bran is 15.61%, while in wheat it is 1.09% [8]. According to Luh [16], rice bran contains 15-23% fat. The three main fatty acids in rice bran are palmitic (12-18%), oleic (40-50%) and linoleic (30-35%) which account for 90% of the total fatty acids in rice bran.

4). Physical Quality Analysis of Cup Cake

Chemical composition of wheat flour and RBF was determined, and the obtained results are found in Fig. It could be observed that the ratio of ash (5.32%) of RBF was significantly higher than that of wheat flour (0.58%). The dietary fibre value of the RBF was 12.12% compared to 0.99% for the wheat flour. On the other hand, RBF was lower in crude protein and carbohydrate (3.45 and 78.17%, respectively), when compared to wheat flour. The results obtained may be consistent with the findings of Mehder [18]. Therefore, RBF is a good source of dietary fiber and ash, which may be used to prepare high-fiber cakes. Also, these results are close to those by Fadavi *et al.* [9] and Kingsly *et al.* [14]. As a result, bread contained more fiber and ash with an increased level of RBF. These results confirmed that RBF should be used to fortify foodstuffs with fiber and ash [25]. It is showed that with increasing levels of RBF in cupcake, weight was gradually increased, while volume and specific volume were decreased significantly when compared to control cake. The highest weight (36.10 g) was given by adding 20% RBF to the cupcake sample with significantly increase compared to 34.20 g for control cake. This is due to high content of RBF in the cake samples caused the cohesion and convergence of molecules, which leads to an increase in weight. Incorporating RBF in cupcake had negative effect on volume and specific volume, where the highest values of 48.00 cm³ and 1.40 cm³/g were recorded by control cake. These results were in agreement with those obtained by Mehder [18], Lotfy and Barakat [15]. The reason for these results is the gluten of the wheat flour, which traps carbon dioxide and contributes to the rise in volume and the texture becomes spongy, while RBF caused dilution for the gluten level in the cake mixture. Gas retention in dough during baking is a property of wheat flour gluten which becomes strong and extensive. This prevents escape of the gas during baking and allows the dough to rise [28].

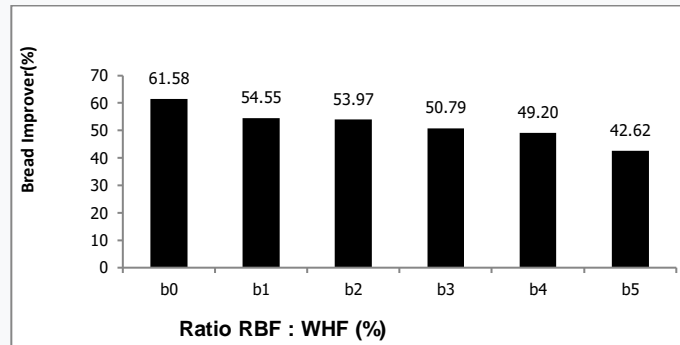


Figure 4. The effect of the Proportion of RBF and WHF on Swelling Power of Cup Cake.

Cake swelling power is the ability of a cake to increase in size (height) before and after the baking process [4]. Figure 4 shows that the rising power of cup cakes is lower with increasing proportion of bran added. This is caused by reducing the amount of flour containing gluten. Gluten is able to trap and hold gas better when compared to rice bran flour. According to Susilo and Imelda [27], gluten in cake plays a role in forming a strong and elastic framework or structure to maintain the expansion of the dough. So the greater the proportion of rice bran and the lower the proportion of flour added, the more the resulting cup cake's rising power will decrease.

5) Organoleptic Color (Hedonic and Scoring)

The influence of the proportion of rice bran and flour on the liking and scoring of cup cake colors can be seen in Figure 5.

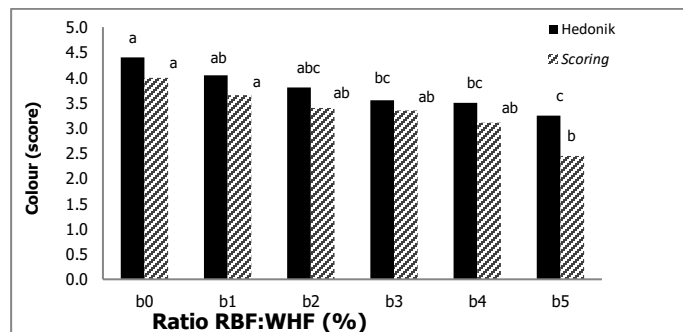
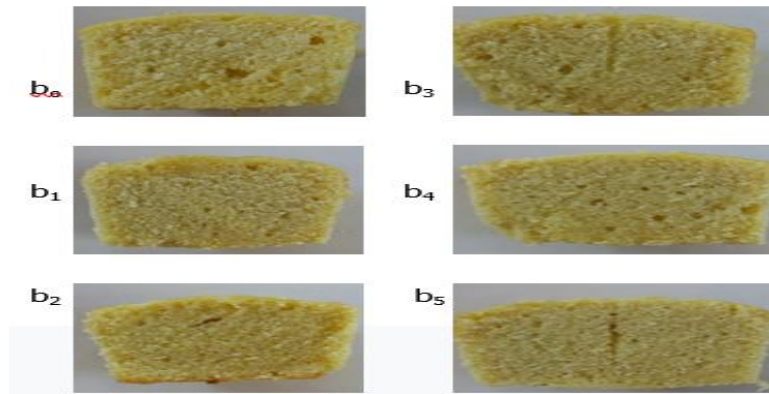


Figure 5. The effect of the proportion of RBF and WHF on cup cake color.

The color preference value is in the range of liking to somewhat liking. From the average results and data analysis, a significant value was obtained, namely, treatment b0 was not significantly different from treatments b1 and b2 but was significantly different from treatments b3, b4 and b5. Treatment b1 is not significantly different from treatments b0, b2, b3 and b4 but is significantly

different from treatment b5. Likewise, treatment b5 is not significantly different from treatments b2, b3 and b4 but is significantly different from treatments b0 and b1.

Figure 5 also shows that the level of panelists' liking for the color of the cup cake decreases with decreasing color scoring value. The cup cake color scoring value ranges between 4.00-2.45. Cup cakes with the addition of 5-25% bran flour proportion had a slightly pale yellow to pale yellow color when compared to control cup cakes which were yellow. This is caused by the darker color of the bran (brownish cream) when compared to the whiter color of the wheat. So the higher the proportion of bran added, the paler the color of the cup cake will be (Picture 5).



Picture 5. Color of Cup Cake for six treatments (b0 – b5).

From the average results and data analysis, significant values were obtained, namely, treatments b0 and b1 were not significantly different from treatments b2, b3 and b4 but were significantly different from treatments b5. Likewise, treatment b5 is not significantly different from treatments b2, b3 and b4 but is significantly different from treatments b0 and b1.

The results of cupcake sample color replaced with RBF at 5, 10, 15, and 20% are shown in Figure 6. It could be observed that a gradual significant decrease in the value (lightness) with incorporated different levels of RBF. The control cake had the highest value with significant increases compared to other cake samples, which ranged between 37.67 and 30.18 by 5% and 20% of RBF respectively. Substituting wheat flour in cake making with RBF at 5, 10, 15, and 20% resulted in clear significant high in redness (a) (5.03, 5.34, 7.70, and 6.37, respectively), when compared to control cake (0.64). These results were attributed to the red color of RBF, which was confirmed with their value 9.28. The control sample recorded the highest value, while RBF caused a significant decrease in the value. Cupcakes containing 20% of RBF recorded the lowest significant value at 12.93; on the other hand, no significant differences were observed between cupcake samples containing 5, 10, and 15% of RBF. These results were in agreement with Chasanah *et al* [7] who mentioned that cake crumb and crust and values decreased by increasing the amount of sweet potatoes.

6) Aroma Organoleptic (Hedonic)

The results of the analysis of variance in Table 6 show that the proportion of rice bran and flour has no significantly different influence on the level of preference for the aroma of cup cakes. The influence of the proportion of rice bran and flour on the taste of cup cake aroma can be seen in Figure 6.

The panelists' preference scores for the aroma of the cup cake produced ranged from 4.05-3.60. Treatment b0 (control) had the highest liking value for the aroma of cup cake, namely 4.05 with the criteria of liking, while the lowest liking value was in treatment b5 with a value of 3.60 with the criteria of liking somewhat. The greater the proportion of rice bran added, the more the panelists' liking for the cup cake aroma will decrease. This could be caused by the level of panelists' preference for the aroma of rice bran, where most panelists tend not to like the distinctive aroma of rice bran.

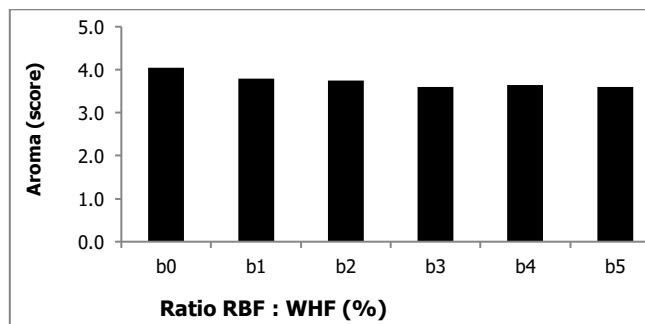


Figure 6. The effect of the proportion of RBF and WHF on the aroma of cup cake.

According to Widowati [29], the aroma of a good cake is delicious, namely a balance between sweet and fragrant. The typical fragrant aroma of cake arises from the basic ingredients and additional ingredients used, namely flour, margarine, eggs, sugar and vanilla. In this study all the ingredients used were the same except for the use of flour. Rice bran flour has a distinctive aroma, so if it is substituted with wheat it will affect the fragrant aroma of the resulting cup cake. From the explanation above, it is known that the addition of up to 10% rice bran gives a level of liking close to liking (3.75) for the aroma of cup cake.

7) Organoleptic Texture (Hedonics and Scoring)

The cup cake texture preference value ranges between 4.05-3.60. The liking value is in the range of like to somewhat like criteria. The highest texture preference value was obtained in treatment b0, namely 4.10, while the lowest value was obtained in treatment b5, namely 3.60. The proportion of added rice bran up to 15% gives a level of liking close to liking (3.70) for the texture of the cup cake.

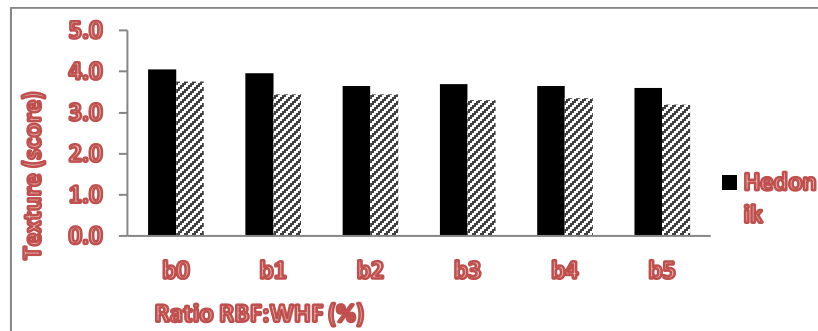


Figure 7. The effect of the proportion of RBF and WHF on texture of cup cake.

The cupcake texture scoring value ranges between 3.75-3.20, with the criteria being slightly soft in all treatments. Texture testing showed that the control cup cake (b0) had the highest liking and scoring values and this decreased further with the addition of rice bran. This is related to the softness of the cake, where in general panelists like cakes with a soft texture. The addition of rice bran causes the hardness of the cup cake to increase. This is because there is a reduction in the amount of flour containing gluten and this causes a decrease in the volume of the cake due to poor rising so that the resulting texture becomes denser and feels harder [30].

Regarding the textures, cupcake sample with 5% of RBF recorded the highest value of 4.05, whereas the sample with 20% of RBF had the lowest value of 3.6. These results were consistent with the results of Kaur and Singh [13] where they indicated that there is a direct correlation between the stiffness of the textures and the percentage of fibre contents added to the processed cake product. Lotfy [15] found that increasing RBF level in cakes caused an increase in hardness values of texture and decreasing in crumb cell structure and chewiness scores in sensory analysis. So we suggested increasing the liquid phase ratio in RBF cake batters.

As for the taste, it could be found that the highest value of taste was recorded by cupcake sample prepared by replacing wheat flour by 5% of RBF (18.75), while the higher the level of RBF, the taste is less acceptable, and perhaps, this decreases in the taste due to the high percentage of RBF fibre. These results were in agreement with those of Wijayanti and Zeinab [30,32]. In overall acceptability of the cupcake samples as the sum of the sensory qualities, it could be concluded that wheat flour could be replaced by 5 and 10% of RBF without negative effect on the sensory properties of prepared cupcakes.

8) Organoleptic Taste (Hedonic)

The influence of the proportion of rice bran and flour on the taste of cup cake can be seen in Fig. 9.

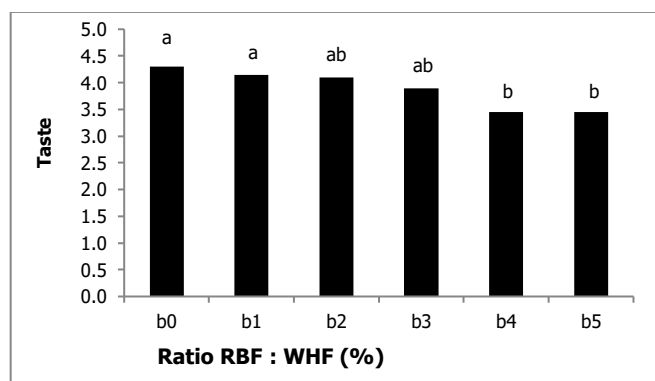


Figure 8. The effect of the proportion of RBF and WHF on the taste of cup cake.

It can be seen that treatment b0 (control) has the highest liking value for the taste of cup cake, namely 4.30 with the criteria of liking, while the lowest liking value is found in treatments b4 and b5 with a value of 3.45 with the criteria of liking somewhat. The higher the proportion of RBF added, the panelists' level of preference for the taste of cup cake tends to decrease. This is because the rice bran contributes a distinctive taste to the cup cake which influences the panelists' acceptance. RBF has a distinctive taste, so if it is substituted with wheat it will affect the sweet taste of the resulting cup cake. According to Sari [24], good quality cup cakes have a sweet taste. The perceived sweet taste is caused by the use of sugar in processing the cupcake [10]. As for the taste, it could be found that the highest value of taste was recorded by cupcake sample prepared by replacing wheat flour by 5% of RBF (18.75), while the higher the level of RBF, the taste is less acceptable, and perhaps, this decreases in the taste due to the high percentage of RBF fibre. These results were in agreement with those of Wijayanti [30] and Zeinab *et al.* [32]. In overall acceptability of the cupcake samples as the sum of the sensory qualities, it could be concluded that wheat flour could be replaced by 5 and 10% of RBF without negative effect on the sensory properties of prepared cupcakes.

The results of the sensory evaluation of the partially replaced cupcake with RBF showed that there were no significant differences in appearance values between both the control sample and the cupcake replaced with 5% and 10% RBF. Concerning crust color, it was noted that the cupcake replaced with 20% RBF recorded the lowest value for the crust color, where it was recorded 13.90 with no significant difference between it and other samples replaced with the RBF. There was no significant difference in crumb color of cake between all samples. This is consistent with Mehder. [18] as they mentioned that the color of cookies replaced with RBF had the significant impact on sensory evaluation. Similar results were also recorded by Sari [24].

IV. Conclusion

It could be concluded that the RBF has a functional property higher than those of wheat flour. Also, a high percentage of fat (30.52%) was recorded for cake with RBF at 25% significant increase in the protein content compared to control cake (8.71%). With increasing the ratio of RBF to all cupcake samples at different proportions, some physical properties of the cupcake such as volume and specific volume were decreased, while others such as weight and specific weight were increased compared to the control cupcake. In the higher storage period, the higher staling of cupcake samples appeared, and thus, the moisture content of the fortified cupcake decreases with different proportions of RBF. Finally, high-fiber cupcake can be prepared with substituted wheat flour up to 25 % with RBF without any negative effects on the quality properties and sensory acceptability of the product

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