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Original Paper

Characterization of Robusta Coffee Powder with Addition of Palm Sugar and Vanilla Powder to Improve The Quality of Robusta Coffee (Coffea canephora Pierre)

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***Abstract*— Bondowoso Robusta Coffee is a type of Robusta coffee that has a distinctive taste and high quality. The distinctive taste and high quality are obtained from the results of harvest management and post-harvest processing in accordance with Standard Operating Procedures (SOP). This research will be carried out by testing the characteristics of Robusta ground coffee with a mixture of palm sugar and vanilla flavoring to improve the quality of Robusta ground coffee. This was done by knowing the physicochemical and organoleptic properties of the mixed Robusta ground coffee. The aim of this research is to determine the interaction between roasting level and the composition of palm sugar and vanilla powder on the physiochemical and organoleptic properties of 3 in 1 Robusta Coffee. This research uses an experimental plan arranged factorially with the basic pattern of a Completely Randomized Design (CRD) with 4 replications. This design has two factors, the first factor is the roasting level and the second is the mixture composition. The results of this research show (1) The interaction of Roasting Level and Mixture (palm sugar and vanilla powder) has no significant effect on all observed variables such as water content, Brix content, pH value, and powder bulk density. (2) The effect of the main level of roasting has a very significant effect on the observed variables of rainfall density and an insignificant effect on the variables of air content, Brix content and pH value. (3) The effect of the main mixture has a very significant effect on the observed variables of air content, Brix content and powder bulk density and has no significant effect on the variable pH value.**

Keywords*— Coffee blend, Roasting, Robusta coffees

I. INTRODUCTION

Guibourtia coleosperma (Benth.) J.Leonard is an evergreen Coffee (Coffea sp.) is one of the most important plantation commodities in Indonesia. important plantation commodity in Indonesia. The results of coffee plantations are a source of income for farmers, producers of industrial raw materials, foreign exchange earners, as well as in processing, marketing, and trading activities that can create jobs. processing, marketing, and trading activities can create jobs. According to data from the Central Statistics Agency (BPS) in 2020, in Purbalingga Regency, coffee plantation production reached 292.01 million hectares. coffee plantation production reached 292.01 thousand tons. Total coffee production in 6 provinces in Indonesia as the center of smallholder plantation production also reached 418.42 thousand tons. In Indonesia, there are generally 2 types of coffee that are widely cultivated, namely Robusta Coffee and Arabica Coffee.

The demand for coffee consumption in Indonesia continues to increase every year. East Java Province is one of the largest robusta coffee producers with an average production of 27.94 thousand tons per year [33]. average production of 27.94 thousand tons per year [33]. Robusta coffee which has a strong flavor and tends to be more bitter and more acidic is quite popular with the public. demanded by the public. In 2016, Bondowoso robusta coffee production reached 2,985 tons [51]. Bondowoso robusta coffee is one of the robusta coffees that has a distinctive taste and high quality. high quality. The distinctive taste and high quality are obtained from the results of harvest management and appropriate post-harvest processing. harvest management and post-harvest processing in accordance with Standard Operating Procedures (SOPs) [20].

There are many types of processed coffee, based on its purity. coffee is divided into pure and mixed coffee [58]. Apart from being processed and marketed in the form of green bean, many industries process coffee in the form of powder. powder form. Ground coffee is obtained from the process of coffee beans that have been roasted with an adjusted level of maturity, then processed into powdered coffee.with a customized maturity level, then processed using a grinder machine to produce coffee powder [54]. grinder machine to produce coffee powder [30]. Ground coffee can be added with several other ingredients such as the addition of sugar and powdered flavors. The addition of some of these ingredients will create coffee derivative products with a mixture of other commodities.

Blended coffee can consist of a mixture of ground coffee, sugar, and powdered flavors. It is also common for blended coffee to be produced by processing industries as a sachet drink. According to [23], the robusta coffee flavor is strong, if added with several ingredients, it can produce a strong taste. strong

flavor, if added with some mixed ingredients, it will be able to produce a distinctive taste. distinctive flavor. Giving coffee and palm sugar can also increase power and endurance higher in its consumption compared to giving coffee with the addition of other mixed ingredients [25]. with the addition of other mixed ingredients [25]. In addition in palm sugar there is a simple carbohydrate content so that the need for energy needs can be available quickly [55].

This research will be conducted by testing the characterization of ground coffee robusta with a mixture of palm sugar and vanilla flavor to improve the quality of robusta ground coffee. robusta ground coffee. This is done by knowing the physicochemical properties and organoleptic properties of organoleptic properties of the blended robusta ground coffee. The addition of several composition has a purpose such as the addition of palm sugar as a counterweight to the strong flavor of robusta coffee. flavor of strong robusta coffee and the addition of vanilla flavoring to balance the aroma of the brewed coffee. balancing the aroma of brewed coffee. This mixed ground robusta coffee can also be called "Robusta 3 in 1 Coffee" because there are three compositions including composition including ground robusta coffee, palm sugar, and vanilla powder. Therefore, this research was conducted to improve the quality of the existing robusta coffee powder.

II. Materials And Methods

A. Time and Place

Research with the title "Characterization of Ground Robusta Coffee With Addition of Aren Sugar and Vanilla Powder to Improve the Quality of Coffee Robusta (Coffea canephora Pierre)" was conducted on March 04 - April 04, 2024.and took place at the Laboratory of Plantation Crop Production Technology, PS. Agricultural Sciences, Faculty of Agriculture, University of Jember, Bondowoso Campus.

B. Tools and Materials

The tools used in this research are coffee roasting machine, grinder, analytical balance, basin, plate, glass, spoon, beaker glass, measuring cup, and measuring cup. grinder, analytical balance, basin, plate, glass, spoon, beaker glass, measuring cup, stove, pan, pH meter, oven, refracto meter, thermos, and other supporting tools. other supporting tools. The materials used in this research are green bean, palm sugar, vanilla powder, distilled water, plastic clip packaging, powder, distilled water, plastic clip packaging, label paper, silica gel, mineral water, and other supporting materials.

C. Experimental Design

This study used an experimental design that was arranged in Factorial with the basic pattern of Completely Randomized Design (CRD) with 4 replications. This design has two factors, the first factor has 2 levels while the second factor has 4 levels so that the experimental units are 2 x 4 x 4 = 4 replicates. The second factor has 4 levels so that the experimental unit becomes 2 x 4 x 4 = 32 experimental units.

32 experimental units. The first factor is the variation of roasting level on green bean, consisting of 2 levels:

- R_1 = Medium roast
- R_2 = Dark roast

The second factor is the composition of a mixture of palm sugar and vanilla powder (12 grams),

consisting of 4 levels:

- C_1 = 100% ground robusta coffee (control)
- C_2 = 40% ground coffee (8g), 54% palm sugar (10.8g), 6% vanilla powder (1.2g)
- C_3 = 40% ground coffee (8g), 42% palm sugar (8.4g), 18% vanilla powder (3.6g)
- C_4 = 40% ground coffee (8g), 30% palm sugar (6g), 30% vanilla powder (6g)

The treatment combination used consisted of 8 combinations and was repeated 4 times so that 32 combinations were obtained. repetition 4 times therefore 32 experimental units were obtained.

III. Results And Discussion

A. Result

The results of the analysis of variance conducted on all observation variables are presented in Table 4.1.

TABLE 1. SUMMARY OF ANALYSIS OF VARIANCE RESULTS (F-COUNT) ON ALL VARIABLES OBSERVATIONS

No.	Observed Variable	Value of F-Count		
		Level of Roasting (R)	Mixture (C)	Combination (R x C)
1.	Water content (%)	$3{,}27^{ns}$	$146{,}23^{**}$	$0{,}19^{ns}$
2.	Brix value (% brix)	$1{,}00^{ns}$	$1003{,}67^{**}$	$1{,}00^{ns}$
3.	pH value	$0{,}43^{ns}$	$1{,}85^{ns}$	$0{,}19^{ns}$
4.	Powder bulk density (g/ml)	$29{,}27^{**}$	$143{,}32^{**}$	$1{,}66^{ns}$

Notes: ** Significantly different, ns Not significantly different.

Proteins function as enzymes, hormones, and antibodies as The results of the analysis of variance in Table 4.1 show that the interaction of Roasting Level and Mixture (palm sugar and vanilla powder) is not significant. Roasting Level and Mixture (palm sugar and vanilla powder) had no significant effect on all observational variables such as water content, brix content, pH value, and pH value. on all observation variables such as moisture content, brix content, pH value, and powder bulk density. powder bulk density. The main effect of roasting level had a very significant effect on the observation variable of powder bulk density and had no significant effect on the variables of moisture content, brix content, and pH value. The main effect of mixture had a very significant effect on the observation variables of moisture content, brix content, powder bulk density and had no significant effect on the variable of pH value.

1. Interaction of Roasting Level and Blend on Physicochemical Properties of Ground Coffee

The result of analysis of variance in Table 4.1 above, shows that the effect of interaction of roasting level (medium roast and dark roast) with mixture (palm sugar and vanilla powder) had no significant effect on all variable properties. (palm sugar and vanilla powder) had no significant effect on all variables of physicochemical properties, namely water content, brix content, pH value, and bulk density of powder. physicochemical properties, namely moisture content, brix content, pH value, and powder bulk density. With this, there is no need to conduct further tests using the Duncan level of 5%.

2. Effect of Roasting Level on Physicochemical Properties of Ground Coffee

The results of the analysis of variance in table 4.1 show that the main effect of roasting level has a very significant effect on the observation variable of powder bulk density and has no significant effect on the variables of moisture content, brix content, and pH value. The results of the average test of the main effect of roasting level treatment on the variable of powder bulk density using Duncan's multiple range follow-up test at the 5% level as well as the average value on the variables of moisture content, brix content, and pH value are presented in Figure 4.1, Figure 4.2, Figure 4.3, and Figure 4.4 as follows:

a) Water Content

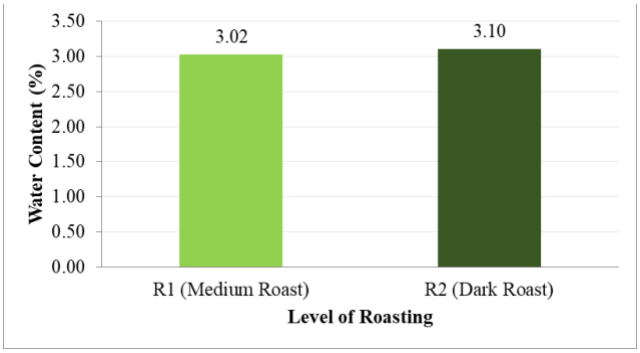

Fig. 1. Image of *Guibourtia coleosperma* seeds collected from Shakawe, Botswana

b) Brix Value (% Brix)

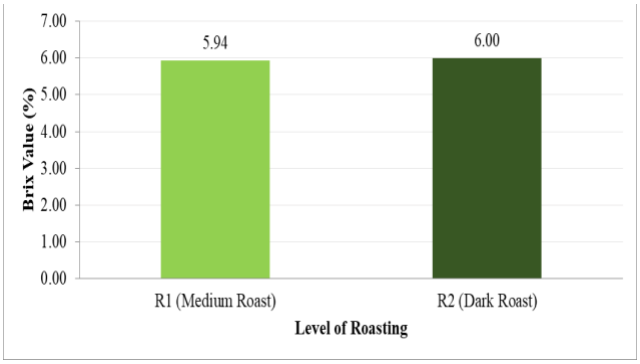

Fig 2. Main effect of roasting level on brix value variable (%)

c) pH value

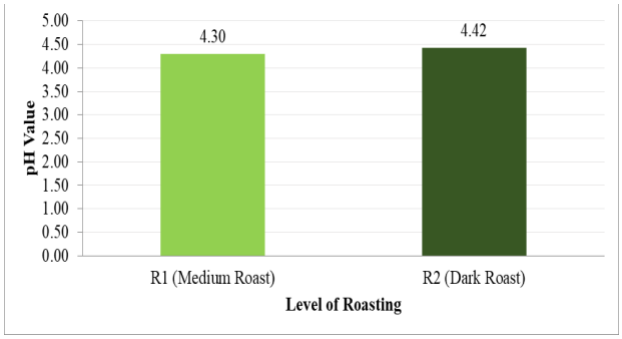

Fig 3. Results of the main effect of roasting level on the pH value variable

d) Powder Bulk density (g/ml)

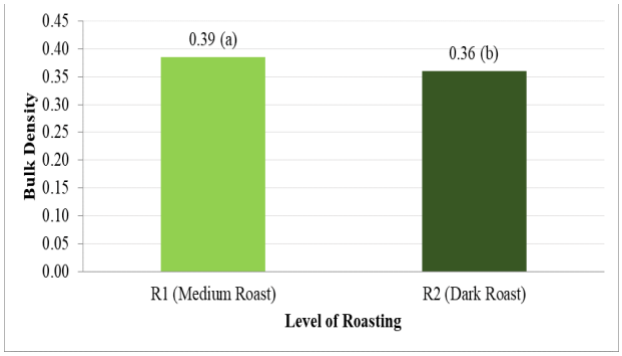

Fig 4. Results of the main effect of roasting level on the variable bulk density of powder (g/ml)

3. Effect of Blend (Palm Sugar and Vanilla) on Physicochemical Properties of Ground Coffee

The results of the analysis of variance in table 1 show that the main effect of the mixture level (palm sugar and vanilla) has a very significant effect on the observation variables of moisture content, brix content, powder bulk density and has no significant effect on the variable pH value. The results of the average test of the main effect of the mixture treatment (palm sugar and vanilla) on the variables of moisture content, brix content, powder bulk density using Duncan's multiple range further test at the 5% level as well as the average value on the variable pH value are presented in Fig 5, Fig 6, Fig 7, and Fig 8 as follows:

a) Water Content

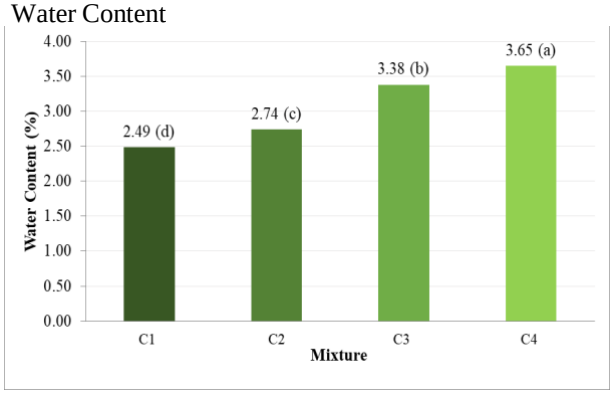

Fig 5. Results of main effect of mixture on variable moisture content (%)

b) Brix Value (% Brix)

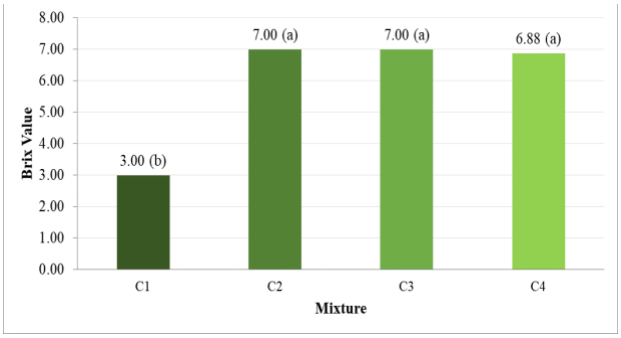

Fig 6. Results of main effect of mixture on variable brix content (%)

c) pH value

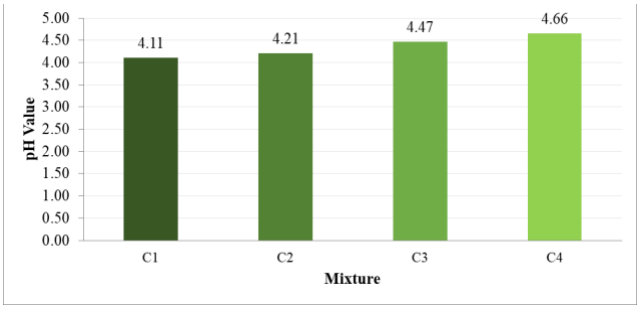

Fig 7. Results of the main effect of mixture on variable pH values

d) Powder Bulk density (g/ml)

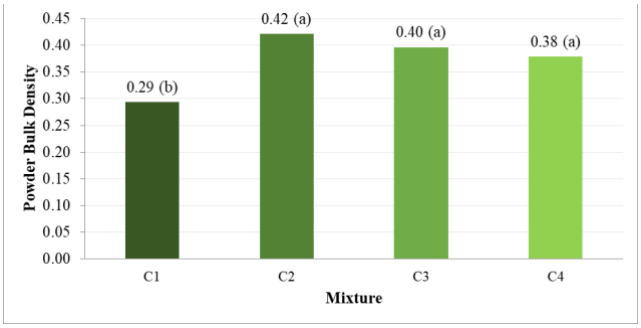

Fig 8. Results Main effect of mixture on powder bulk density variable (g/ml)

4. Effect of Roasting Level and Mixture of Palm Sugar and Vanilla Powder on Organoleptic Properties of Ground Coffee *3 in 1*

The results of the average value of the panelists' level of preference on the use of palm sugar and vanilla powder on organoleptic tests are presented in Table 2 and Table 3. There are 2 types of 3 in 1 coffee that are presented and assessed by panelists including 3 in 1 Powder Coffee and 3 in 1 Brewed Coffee. Powdered 3 in 1 coffee is presented with an assessment of color preference, aroma-coffee, aroma-palm sugar, aroma-vanilla, appearance, and overall acceptance. Meanwhile, 3 in 1 brewed coffee is presented with an assessment of color preference, coffee aroma, palm sugar aroma, vanilla aroma, acidity, sweetness, bitterness, body, and overall acceptance.

TABLE 2. AVERAGE DATA OF ORGANOLEPTIC TEST RESULTS OF *3 IN 1* GROUND COFFEE

Treatment	Organoleptic Variable					
	Color	Aroma of Coffee	Aroma of Palm Sugar	Aroma of Vanili	Appearance	Overall Acceptance
R_1C_1	3,58	3,63	1,00	1,00	3,69	3,50
R_1C_2	3,38	3,27	3,02	2,75	3,44	3,48
R_1C_3	3,00	3,44	2,98	3,00	3,38	3,50
R_1C_4	2,98	3,42	3,25	3,42	3,17	3,48
R_2C_1	3,81	3,29	1,00	1,00	3,63	3,52
R_2C_2	3,44	3,38	3,06	2,83	3,44	3,54
R_2C_3	3,13	3,15	3,04	3,06	3,31	3,40
R_2C_4	2,65	3,04	3,02	3,17	3,15	3,27

Description:
Value 1 = very dislike; 2 = dislike; 3 = neutral; 4 = like; 5 = very like.

The average value of the organoleptic test results in Table 2 shows the level of panelist preference for 3 in 1 ground coffee on organoleptic variables including color, coffee aroma, palm sugar aroma, vanilla aroma, appearance, and overall acceptance. The level of panelist preference on the color variable with the highest value of 3.81 was shown by the combination of dark roast treatment and 100% pure coffee (R2C1). Then the aroma-coffee variable showed the highest value in the treatment combination of medium roast and 100% pure coffee (R1C1) which amounted to 3.63. The highest values in the aroma-palm sugar and aroma-vanilla variables were shown in the same treatment combination, namely medium roast and a mixture of 30% palm sugar and 30% ground vanilla (R1C4), which amounted to 3.25 and 3.42. In the appearance variable, the highest value was 3.69 with the treatment combination of medium roast and 100% pure coffee. While in the overall acceptance variable, the highest value shown was 3.54 with a combination of dark roast treatment and a mixture of 54% palm sugar and 6% ground vanilla (R2C2).

TABLE 3. AVERAGE DATA OF ORGANOLEPTIC TEST RESULTS OF *3 IN 1* BREWED COFFEE

Treatment	Organoleptic Variable								
	Color	Coffee Aroma	Aroma of Palm Sugar	Aroma of Vanili	Acidity	Sweetness	Bitterness	Body	Overall Acceptance
R_1C_1	3,33	3,13	1,00	1,00	2,27	1,85	3,10	2,67	2,17
R_1C_2	3,31	3,35	3,04	2,94	2,85	3,50	2,79	3,21	3,60
R_1C_3	3,10	2,90	2,98	2,83	2,77	2,96	2,77	2,98	3,38
R_1C_4	3,17	3,10	3,00	2,69	2,56	2,56	3,04	3,15	3,23
R_2C_1	3,40	3,23	1,00	1,00	2,58	2,04	2,56	2,79	2,73
R_2C_2	3,54	3,44	3,25	2,92	3,15	3,63	3,10	3,10	3,52
R_2C_3	3,21	3,23	2,96	2,96	2,96	3,13	2,90	3,02	3,25
R_2C_4	3,25	3,06	2,92	2,98	2,81	2,88	2,83	3,27	3,23

Description:
Value 1 = very dislike; 2 = dislike; 3 = neutral; 4 = like; 5 = very like.

The average value of the organoleptic test results in Table 3 shows the level of panelist preference for 3 in 1 brewed coffee on organoleptic variables including color, coffee aroma, palm sugar aroma, vanilla aroma, acidity, sweetness, bitterness, body, and overall acceptance. The combination of dark roast treatment and a mixture of 54% palm sugar and 6% vanilla powder (R2C2)

showed the highest average value on several organoleptic variables including the color variable of 3.54; the aroma-coffee variable of 3.44; the aroma-palm sugar variable of 3.25; the acidity variable of 3.15; the sweetness variable of 3.63; and the bitterness variable of 3.10. The treatment combination of dark roast and a mixture of 30% palm sugar and 30% vanilla powder (R2C4) showed the highest values in the aroma-vanilla and body observation variables of 2.98 and 3.27. While on the overall acceptance variable, the combination of medium roast and a mixture of 54% palm sugar and 6% vanilla powder (R1C2) showed the highest value of 3.60.

Table 4.2 shows the organoleptic properties of ground coffee before brewing and Table 4.3 shows the sensory properties of ground coffee after brewing. In this research, the roasted coffee Cup Test has not been carried out by standard panelists. This organoleptic test uses non-standard panelists because the purpose of developing this product is for the general public. Measuring the organoleptic properties of ground coffee before brewing is useful for knowing how the initial perception of non-standard panelists before tasting the product. The parameters in the organoleptic test used are slightly adapted from the SCAA testing standards, especially for brewed 3 in 1 coffee. This product is not a specialty coffee. However, with the addition of palm sugar and vanilla powder, there are several sensory properties that need to be investigated regarding aroma, acidity, sweetness, bitterness, body and overall acceptability. Palm sugar has a sweeter taste and stronger aroma, as well as vanilla powder, so organoleptic testing by slightly adapting the SCAA cup test parameters can support the extraction of information on the product made. However, the author did not conclude that this product is a specialty coffee product, because specialty coffee must have a minimum score of 80 determined by expert panelists.

B. Discussion

1. Interaction of Roasting Level and Blend on Physicochemical Properties of Ground Coffee

Based on the results of the research that has been carried out, it can be seen from the results of the analysis of variance which can be seen in Table 4.1 shows that the effect of the combination of roasting level (R) and mixture (C) on the physicochemical properties and organoleptic properties of *3 in 1* ground coffee is not significantly different from all observed observation variables. The interaction that is not significantly different comes from the combination of treatments given. The combination of treatments given has the same reaction or effect. This can be suspected because the roasting level with the addition of a mixture of palm sugar and vanilla powder is not appropriate so that there is no change in physicochemical properties, especially in the variables of moisture content, brix content, pH value, and powder bulk density. The accuracy of the roasting level can also be influenced by the length of roasting, temperature, and roasting technique. While the mixture in coffee can be influenced by the accuracy of the selection of the type of product used as a mixture which can later support the quality of the coffee. Therefore, the accuracy of the roasting level and mixture will affect the characteristics of a coffee product.

This condition is in accordance with the results of research conducted by [2], which stated that the formulation of coffee types, roasting levels with the addition of palm sugar and cream had a significant effect on the water content and pH of the functional coffee solution. The roasting level used is in accordance with the initial level of the process, namely yellow-tan stage, light brown, and brown stage so that the taste obtained is not too bitter. The improvement of the flavor can be enhanced by the addition of palm sugar and cream. The roasting process affects the content of chemical compounds in coffee beans such as chlorogenic acid, caffeine, and has an impact on physicochemical properties which are also supported by the composition of the coffee blend. In addition to physicochemical properties, organoleptic properties are also influenced by the combination of roasting level and blend treatment. Organoleptic properties indicate the level of panelist preference for the treatment combination.

2. Interaction of Roasting Level and Blend on Physicochemical Properties of Ground Coffee

The results of the analysis of variance in Table 4.1 show that the roasting level factor gives an effect that is not significantly different on the observation variables of moisture content, brix content, and pH value and gives a significantly different effect on the observation variable of powder bulk density. It can be said that the effect of roasting level is not significantly different on all the observation variables of physicochemical properties. The cause could be the lack of roasting time and too high temperature during roasting. Too high a temperature during roasting can cause a loss of characteristics in the coffee. The physicochemical properties of coffee are affected by the level of roasting. The best quality roasted coffee results from selecting the appropriate roasting level [1].

The initial stage of roasting begins with the evaporation of water contained in the coffee beans. This water evaporation occurs due to the amount of heat energy given to the coffee beans and is then followed by a pyrolysis reaction. Pyrolysis reaction is a decomposition reaction of hydrocarbon compounds including carbohydrates, hemicellulose, and cellulose in coffee beans [37]. According to [5], when the roasting process lasts a long time, the moisture content in coffee beans generally decreases. The longer the time and higher the roasting temperature, the higher the decrease in moisture content in the ground coffee. However, in the research that has been carried out, the highest average value of water content is shown by the dark roast treatment (R2) of 3.10% and the lowest water content value is shown by the medium roast treatment (R1) of 3.02% which can be seen in Figure 4.1. This result is different from the research conducted by [17], where the lowest water content was 1.47% with the longest roasting time of 25 minutes while the highest water content was 5.29% with the shortest roasting time of 10 minutes. However, in this study, the moisture content of ground coffee has met the Indonesian national standard according to SNI 01-3542-2004 which states that the maximum moisture content in coffee powder is 7%.

Moisture content, brix content, and pH value are related in determining coffee properties. The level of sugar content in coffee can affect the flavor characteristics of the coffee. Brix degree is the total dissolved solids associated with the sugar content in a solution. The sweeter the solution, the higher the brix degree. The highest brix level value from the roasting level

was 6.00% Brix at the dark roast roasting level (R2). While the lowest brix level value was 5.94% Brix at the medium roast roasting level (R1). In the research of [4], the results showed that the value of Total Dissolved Solids (TPT) was found in samples with dark roast roasting level with a value of 1.23°brix. Sucrose in robusta coffee will degrade due to acidic environments, heat, and certain minerals through hydrolysis reactions which cause the Total Dissolved Solids (TPT) of robusta coffee to be higher than arabica coffee [35].

The pH value of coffee is related to acidity. Various acids such as aliphatic acid, chlorogenic acid, alicyclic acid, carboxylic acid (malic acid, citric acid, and acetic acid) and phenolic acid affect the pH value of coffee brewing [1]. The pH value influenced by the roasting level in this study is relatively low. At the medium roast level (R1) the pH value obtained was 4.30 and the pH value at the dark roast level (R2) was 4.42. The results of the low pH value are different from the results of research conducted by [32], which stated that the results of the pH value of robusta coffee after roasting at various temperatures ranged from 5.5-5.8. Meanwhile, according to the roasting level, the lowest pH value was shown by coffee with medium roast level and the highest pH value was shown by coffee with dark roast level [2]. The pH value can be influenced by several things including the location or place where the plant grows, roasting temperature, type of roaster, and fermentation method.

In addition to the chemical properties of moisture content, brix content, and pH value, there are also physical properties that are affected by roasting level such as bulk density. Bulk density is useful for field operations such as estimating the need for space, warehouses, and transportation of large quantities of materials [47]. Bulk density can be measured by putting a sample of material into a container that has a known volume. The bulk density of coffee powder influenced by the roasting level at the medium roast level was 0.39 g/ml and at the dark roast level was 0.36 g/ml. The high bulk density value is caused by the density of the powder which results in a more uniform material particle size so that it can streamline packaging in the product storage and packaging process [40]. The provisions of the bulk density value of the material in powder form are 0.3-0.8 g/cm3 [41] and the bulk density value in this study meets these provisions.

3. Effect of Aren Sugar and Vanilla Powder Mixture on Physicochemical Properties and Organoleptic Properties of *3 in 1* Ground Coffee

The results of the analysis of variance in Table 4.1 show that the factor of palm sugar mixture and vanilla powder gave a significantly different effect on the observation variables of moisture content, brix content, and bulk density of powder and gave a significantly different effect on the observation variable of pH value. The effect of palm sugar mixture and vanilla powder was significantly different on the observation variable of physicochemical properties. The mixture of palm sugar and vanilla powder in coffee can also have a unique effect on taste and aroma. According to [21], palm sugar does not lose important nutrients such as vitamins, minerals and proteins, including vitamin B12 which is very rarely found from other sugar sources because the palm sugar production process is shorter and simpler than the production of granulated sugar. In addition, the addition of powdered mix composition can support longer shelf life due to low water content.

The maximum moisture content in palm sugar according to SNI 01-3743-1995 is 3%. Meanwhile, the maximum moisture content in vegetable krimmer according to SNI 4444:2009 is 4%. In this study, the lowest moisture content of 2.49% was shown by the treatment of 100% pure coffee (C1) and the highest moisture content of 3.65% was shown by coffee with a mixture of 30% palm sugar and 30% vanilla powder (C4). This result is in accordance with a study conducted by [26], which stated the lowest moisture content of 4.25% in the control treatment and the highest moisture content of 6.15% in the coffee treatment with the addition of 12 grams of palm sugar and 12 grams of vegetable creamer. In addition, the addition of composition also affects the brix level in mixed coffee. The highest brix content was shown by the treatment of coffee with a mixture of 54% palm sugar and 6% vanilla powder (C2) and coffee with a mixture of 42% palm sugar and 18% vanilla powder (C3), which was 7.00%. The results of the brix level are in accordance with [4] that the increase in Total Dissolved Solids (TPT) is influenced by the addition of a large amount of sugar and the 1960s was the first year that total dissolved solids for coffee drinks were discovered and similar results were obtained from research that has been repeated for decades. This is also influenced by the total sugar contained in palm sugar in the form of higher powder. The results of the analysis on several forms of palm sugar products are as follows: the total value of sugar in liquid palm sugar is 81.25%; the total value of sugar in palm sugar was 96.59%; and the total sugar value in ant palm sugar is 98.68% [9].

The results in Figure 4.7 show that the higher the added concentration of the mixture of palm sugar and vanilla powder, the higher the pH value. However, the pH value of the main effect of the mixture of palm sugar and vanilla powder in this study is very low. The lowest pH value was produced by the treatment of 100% pure coffee without mixture (C1) at 4.11% and the highest pH value was produced by the treatment of coffee with a mixture of 30% palm sugar and 30% vanilla powder (C4) at 4.66%. The addition of palm sugar and other compositions such as vegetable creamer should be able to increase pH because palm sugar and vegetable creamer have an alkaline pH [46]. In a product, moisture content, brix content, pH value, and bulk density can show the characteristics of the product. The bulk density of 3 in 1 coffee powder in this study has met the provisions of the bulk density value of materials in powder form. The bulk density value of ground coffee with a mixture of palm sugar and vanilla powder can be seen in Figure 4.8. The highest powder bulk density value of 0.42 g/ml was shown by the coffee treatment with a mixture of 54% palm sugar and 6% vanilla powder (C2). The lowest value of 0.29 g/ml was shown by the treatment of 100% pure coffee without mixture (C1). According to [41], the greater the bulk density of the particles, the smaller the space required. This can streamline packaging in the product packaging and storage process. So that one of the ingredients of the 3 in 1 coffee mixture, namely ground vanilla, which has the potential to be contaminated with physical, chemical and biological contamination, can maintain its quality during the product packaging and storage process [27].

The organoleptic properties of a product can be influenced by complex physicochemical properties. In this study, there were 2 forms of 3 in 1 coffee presented and assessed by panelists including 3 in 1 Powder Coffee and 3 in 1 Brewed Coffee. The highest average result of panelists' assessment of the overall acceptance of 3 in 1 coffee powder with a value of 3.54 was shown by the combination of coffee treatment with dark roast roasting level and a mixture of 54% palm sugar and 6% vanilla powder (R2C2). While the highest average result of panelists' assessment of the overall acceptance of 3 in 1 brewed coffee products was shown by the combination of coffee treatment with medium roast roasting level and a mixture of 54% palm sugar and 6% vanilla powder (R1C2) with a value of 3.60. These results are in accordance with research conducted by [32], which states that robusta coffee organoleptic properties such as blackish brown color, distinctive aroma, and bitter taste in coffee are influenced by the provision of palm sugar in robusta coffee making. The value of the panelists' level of liking increases and becomes very like the higher the amount of palm ant sugar in robusta coffee. The blackish brown color is a combination of the color of the black robusta coffee added with brown palm sugar. The appearance of coffee with the addition of white vanilla powder also makes the color of 3 in 1 coffee not too dark. *3 in 1* coffee powder has the appearance of a mixture of brown color.

According to [7], coffee aroma comes from volatile compounds formed through milliard reactions or non-enzymatic browning reactions, as well as the degradation of free amino acids, sugars, and phenolic compounds. The process of heating, processing, and roasting coffee, which depends on the temperature and roasting time, the type of coffee, and the origin of the coffee beans, plays a role in the aroma and flavor of coffee. Vanilla powder is one of the processed vanilla products that contains flavonoids and phenolic compounds that can be used to add flavor and aroma [38]. Vanilla spice (vanilla planifolia) as a fragrance/flavor product provides characteristics of creamy, sweet, and vanilla smoky aroma [28]. The highest average value of panelists' preference for the aroma of *3 in 1* coffee powder with the highest value in the aroma of palm sugar and vanilla powder was shown by the combination of coffee treatment with medium roast level and a mixture of 30% palm sugar and 30% vanilla powder (R1C4).

IV. Conclusions

The interaction of Roasting Level and Mixture (palm sugar and vanilla powder) has no significant effect on all observation variables such as moisture content, brix content, pH value, and powder bulk density. The recommendation given is the combination of dark roast treatment and a mixture of 54% palm sugar and 6% vanilla powder (R2C2). The recommendation is based on the results of the tested parameters and the results of organoleptic tests.

The main effect of roasting level has a very significant effect on the observation variable of powder bulk density and has no significant effect on the variables of water content, brix content, and pH value. The recommendation given is the dark roast treatment (R2). The main effect of mixture has a very significant effect on the observation variables of water content, brix content, and bulk density of powder and has no significant effect on the variable of pH value. The recommendation given is a mixture treatment of 54% palm sugar and 6% vanilla powder (C2).

Organoleptic tests that show the organoleptic properties of *3 in 1* coffee, there are 2 kinds of *3 in 1* coffee forms, namely powder and brew. The recommendation for ground *3 in 1* coffee given uses the R2C2 treatment combination and the recommendation for brewed *3 in 1* coffee given uses the R2C2 treatment

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