The Effect of Addition Papaya Leaf Extract (Carica papaya L.) on Reducing Caffeine Levels in Robusta Coffee

by Satrijo Saloko

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Abstract. The purpose of this study was to determine the effect of adding papaya leaf extract (*Carica papaya* L.) to a decrease in caffeine content in coffee. This study used a randomized completely block design (RCBD) using one factor, namely the addition factor of papaya leaf extract that consisting of 3 replications. The parameters tested were moisture content, ash content, caffeine content, antioxidant activity and total phenols, physical quality parameters in the form of colour °Hue value and L* value and organoleptic quality in the form of taste and aroma. The effect of adding different papaya leaf extracts had a significant influence on (moisture content, caffeine content, antioxidant activity and total phenol), the colour parameters (L* values) and the organoleptic parameters were (taste scoring methods). Treat the addition of 25% papaya leaf extract was the best treatment in reducing caffeine levels in coffee. The treatment produces coffee with a moisture content 4.87%; caffeine content 0.66%; antioxidant activity 53.33%; total phenol 510.48 mg GAE/g; colour L* 8.48 and taste 4.35 (bitter).
Keywords: papaya leaf, caffeine, coffee

1. Introduction

Indonesia is an agrarian country that is famous for its various agricultural and a plantation product, one of the products that are famous is coffee. Countries in other parts of the world with four seasons have shortcomings in agriculture and agricultural processes but are encouraged to improve these conditions to improve their agriculture using highly advanced and extraordinary technology and equipment. Coffee (*Coffea sp*) is a tropical plant that grows in Indonesia. Several types of coffee including Arabica coffee, Robusta coffee and Liberica coffee. Coffee comes from the African Continent [1]. In the era of the 1990s Indonesia was once the 3rd largest coffee exporting country in the world after Brazil and Columbia, since coffee in Indonesia is the largest export commodity from plantation products.

The flesh of the coffee fruit has 2 parts, the outer part which is harder and thicker in nature such as gel or mucus contains 85% of air in its containing form and the inner part containing hydrophilic colloids consisting of ± 80% protein and ± 20% sugar [2]. Coffee has 2 cores, namely caffeine and caffeine. In general, rice coffee contains water, sugar, fat, cellulose, caffeine and ash. Caffeine is a type of alkaloid that is widely found in coffee beans, tea leaves, and cocoa beans. Caffeine has beneficial pharmacological effects, such as stimulating the central nervous system, smooth muscle relaxation, bronchi and stimulation of the heart muscle. [3] reported that high levels of caffeine in coffee were questioned which would cause several health problems, mostly for coffee lovers who were higher than caffeine. For coffee lovers who get used to have a high portion of caffeine, caffeine consumption will

make people become fresher and warmer, while those who have a low resistant of caffeine will experience insomnia, challenge, increase, and increase rapid heart rate [4]. One effort that can be done by customers who have low caffeine resistant is to buy low caffeine coffee. Decaffeination is a process to reduce caffeine levels in coffee and other ingredients that contain caffeine. Decaffeinated coffee beans are usually carried out before the roasting process and coffee can be declared decaffeinated if it has caffeine levels between 0.1-0.3% [5].

The caffeine content in Robusta coffee is slightly higher than Arabica coffee, while on the contrary, the Arabica type has more sugars and essential oils. In flavour formation, compounds that play an important role are sugar, volatile compounds, trigonelline, amino acids, and peptides. Meanwhile the taste and steeping are influenced by carboxylic acid and phenolic acid. The content and nature of sugar in coffee is very important in the formation of flavours and colouring during roasting [6]. In addition, coffee contains tannins. Tannin is a polyphenol compound that can be found in every plant whose location and number are different [7]. Tannin compounds can cause fruit-like taste and cause browning of the ingredients.

Papaya (*Carica papaya* L.) is one type of plant that has high economic value. Besides has a high nutritional value, the sap can also be utilized as well. Papaya sap contains many enzymes, especially proteolytic enzymes [8]. The most common proteolytic enzyme found in papaya sap is papain. Coffee decaffeination research using bromalin enzyme from pineapple conducted by [9] shows that the use of pineapple extract in the decaffeination process of Robusta coffee beans can reduce caffeine levels by 0.71%. Research on the use of papaya leaf extract in the decaffeination process of Robusta coffee beans has not been done much, so this research has been carried out to determine the effect of the decaffeination process of Robusta coffee beans with the addition of papaya leaf extract.

2. Methods

2.1 Place and Time of Research

This research was located in the Analytical Chemistry Laboratory of the Faculty of Mathematics and Natural Sciences, the Laboratory of Food Chemistry and Biochemistry, Food Processing, Quality Control of the Faculty of Food Technology and Agroindustry, Mataram University.

2.2 Tools and Materials

The materials used in this study are Robusta coffee from North Lombok Regency. California papaya leaves were obtained from papaya gardens in Lingsar, West Lombok District, 70% methanol, 96% ethanol solvent, distilled water, caffeine standard, gallic acid standard, Na_2CO_3 7%, DPPH ((2,2-diphenyl -1-picryhidrazy), and folin solution.

2.3 Methods

The method used in this study is an experimental method with a Randomized Completely Block Design (RCBD) with a single factor experiment namely coffee concentration (K) with the addition of papaya leaf extract consisting of 6 treatments:

- K0 = 150 g coffee beans without the addition of papaya leaf extract
- K1 = 150 g coffee beans + 5% papaya leaf extract
- K2 = 150 g coffee beans + 10% papaya leaf extract
- K3 = 150 g coffee beans + 15% papaya leaf extract
- K4 = 150 g coffee beans + 20% papaya leaf extract
- K5 = 150 g coffee beans + 25% papaya leaf extract

Each treatment was repeated 3 times to get 18 experimental units. Observation data were analysed using Analysis of Variance at 5% significance level using Co-Stat software. If there is a significant difference, a further test is done with the Honestly Significant Difference test (HSD) at the 5% level. Parameters analysed were water content, ash content, caffeine content, antioxidant activity, total phenol, colour, sensory parameters including aroma and taste.

2.4 Research Implementation

2.4.1. Production of Papaya Leaf Extract

First, harvesting fresh leaves process is carried out in the morning at 10:00 until 12.00; fresh leaf number 5 is selected. Second, the leaf was washed to remove dirt and dust. Sorting papaya leaves aimed to eliminate the pests found in the leaves in order to get good papaya leaves, then cutting is done to reduce the size of papaya leaves. Third, drying papaya leaves that have been cut are then dried using a cabinet dryer at 60˚C for 2 hours. Papaya leaves that have dried and then mashed using a blender to obtain dry powder. Fourth, the dry powder that is obtained, it is macerated using 96% ethanol solvent. Soaking after the papaya leaves are macerated, the maceration results are soaked for 24 hours with ethanol until filtrate is obtained. Fifth, the filtrate is then concentrated using a Rotary Evaporator until a thick extract is obtained. Having obtained the thick extract and then diluted using distilled water to produce papaya leaf extract.

2.4.2. Decaffeination Process of Robusta Coffee

First, sorting process aims to eliminate pests, damaged seeds and other ingredients mixed in the coffee beans so that the resulting coffee beans are in accordance with the standards. Second, weighing the beans is done so that the number of beans in each treatment is equal. Third, mixing coffee beans that have been weighed are then mixed with papaya leaf extract according to treatment. Then the coffee beans that have been mixed with papaya leaf extract are fermented for 36 hours at room temperature. Fourth, the fermented coffee beans are then washed to remove the lenders found during the fermentation process. Fifth, drying coffee beans that have been washed and then dried using a dryer Cabinets Dryer at a temperature of 60˚C for 2 hours so that the water content contained in coffee beans is reduced. Sixth, roasting coffee beans that have been dried later in the sangria use the Gene Café with a temperature of 250˚C for 17 minutes. Seventh, milling coffee beans that are already in sangria are then ground using a blender. Finally, sifting coffee beans that have been mashed and then sieved using a 60-mesh sieve.

3. Results and Discussion

3.1 Water Content

Water is one of the most important components in a food product whose presence can affect the appearance, texture, taste of food, determine the acceptability, freshness and durability of food ingredients in the storage process. Water content of a material is related to the storability of the material, because the water contained in the material can be a growth medium for microbes that cause damage [10]. The graph of the effect of the addition of papaya leaf extract can be seen in Figure 1.

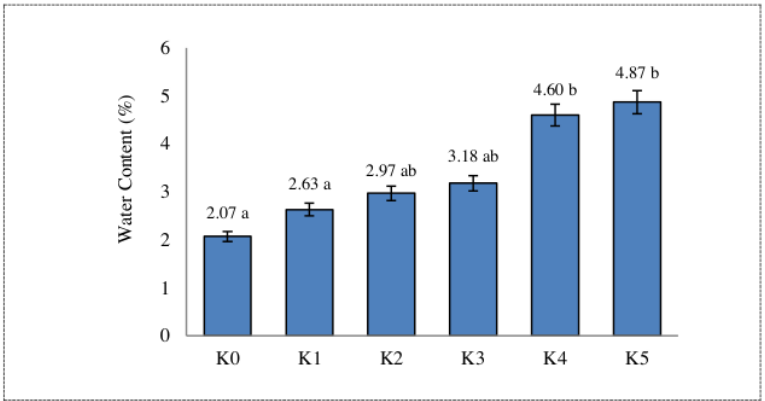

Figure 1. The Effect of Papaya Leaf Extract Addition on Water Content

Based on the results obtained from Figure 1, the water content produced ranges between 2.07-4.87%. The lowest water content was obtained at K0 treatment at 2.07%, while the highest water content was at the K5 treatment at 4.87%. The increase in water content occurs due to the addition of papaya leaf extract which is carried out during the fermentation process. The increase in water content is influenced by the number of papaya leaf extract additions; the more addition of papaya leaf extract is carried out, the more water content produced. This happens because papaya leaf extract contains a water content of around 9.41%. The resulting water content is the process of bound and entry of water contained in each component, so that the water can be absorbed by the pores when the fermentation process takes place. The graph shows that the higher the papaya leaf extract added the higher the water content produced. The water content produced in each treatment meets SNI 01-3542-2004 requirements, with a maximum water content of 7%.

The increase of water content in the coffee beans with papaya gum concentration treatment is higher due to the immersion process in papaya sap solution. Soaking with papaya sap will break down the protein components that exist in the cell wall so that the pores of the coffee bean tissue become open and utilized by the solvent water to enter it. Water molecules get into the coffee beans by diffusion then break through cell walls in the seed causing water molecules trapped inside the cell [11].

3.2 Ash Content

Ash is an inorganic substance from the combustion of an organic material. The ash content and composition depend on the type of material and how it is used [12]. Ash content is mineral elements as the remnants left after the material is burned to carbon free. Ash content is included in non-volatile components, remains in the combustion and incandescent of organic compounds [13]. The graph of the effect of the addition of papaya leaf extract can be seen in Figure 2.

Based on Figure 2. Shows that the ash content produced in the treatment of papaya leaf extract addition ranged from 3.14 to 4.14%. The highest ash content value was at K5 treatment that was equal to 4.14% while the lowest ash content value was at K0 treatment at 3.14%. The graph shows that the more papaya leaf extracts added to coffee, the higher the ash content in it. This is due to the addition of the concentration of papaya leaf extract. In addition to the concentration of papaya leaf extract which influences high ash content, the type of coffee used can also affect because each coffee has a different ash standard.

According to [14], determination of ash content is closely related to the mineral content contained in an ingredient, purity, and cleanliness of a material produced. The yield of ground coffee ash produced is higher than the quality requirements of ground coffee where the maximum permissible ash requirement is 5%. However, the ash content produced in this study was lower than the results of [15]

which showed that the best treatment value for 36 hours of coffee fermentation produced ash content of 5.62%. Ash content in this study has met the quality standards for ground coffee because the maximum value for ash content in the quality standards for ground coffee according to SNI 01-3542-2004 is 5%.

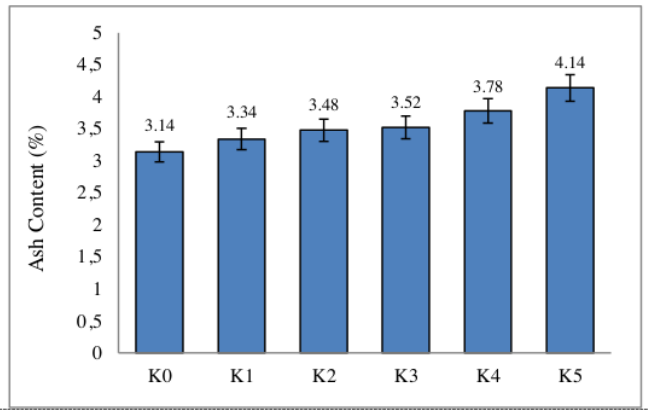

Figure 2. The Effect of Papaya Leaf Extract Addition on Ash Content

3.3 Caffeine Content

Caffeine is a crystalline compound; whose main constituent is a protein derivative compound called purine xanthene. Caffeine is an important compound found in Robusta coffee. Although it tastes bitter, but caffeine only contributes to the taste of bitterness (bitterness) of less than 10%. Caffeine has no direct effect on taste. However, there are some coffee cultivars, caffeine is associated with other components such as fat and chlorogenic acid, thus determining bitterness (bitterness) steeping. The caffeine content in a coffee variety can be an index of its organoleptic quality [16]. The graph of the effect of the addition of papaya leaf extract can be seen in Figure 3.

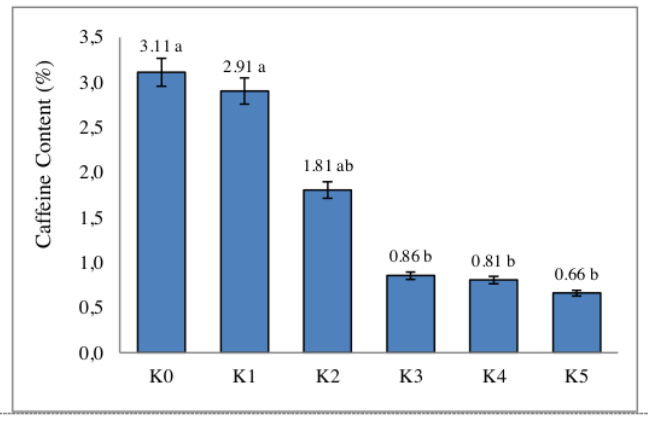

Figure 3. The Effect of Papaya Leaf Extract Addition on Caffeine Content

Figure 3 shows that the caffeine content in coffee ranges from 0.66 to 3.11%. The lowest caffeine level was in the K5 treatment with a value of 0.66%, while the highest caffeine content was in the K0 treatment which was 3.11%. The graph shows that the more papaya leaf extracts added to coffee, the

lower the caffeine content. The decrease in caffeine levels shows that proteolytic enzymes can reduce caffeine levels in coffee beans. Coffee beans fermented with papaya leaf extract have decreased levels of caffeine. During the fermentation process, the enzyme papain hydrolyses proteins in vacuoles to become amino acids. The compounds in vacuoles such as caffeine and amino acids will come out. This is due to damage to the cell membrane and vacuole due to the activity of proteolytic enzymes. This decrease in caffeine levels occurs after washing the coffee beans after the fermentation process so that some of the caffeine in coffee disappears during the washing process. This is in accordance with [15] which states that caffeine in coffee beans can be removed by adding compounds that are proteolytic in the fermentation stage and subsequently washing. Caffeine levels in the K0 treatment had the highest caffeine levels compared to other treatments; this is because the K0 treatment was not added with papaya leaf extract. The powdered caffeine content in this study varies from 0.66 to 3.11%, while according to SNI 01-3542-2004; the maximum powdered coffee caffeine content is 2%, meaning that the ground coffee caffeine content in this study fulfils the maximum limit of ground coffee caffeine content.

3.4 Antioxidants Activity

Antioxidants are compounds that can inhibit or prevent oxidation reactions by binding to free radicals and highly reactive molecules so that the damage process can be prevented. Antioxidants work by donating one electron to an oxidant compound so that the oxidant compound can be trapped [17]. Antioxidants in food play an important role in maintaining product quality, preventing rancidity, changes in nutritional value, changes in colour and aroma, and other physical damage caused by oxidation reactions [18]. The graph of the effect of the addition of papaya leaf extract can be seen in Figure 4.

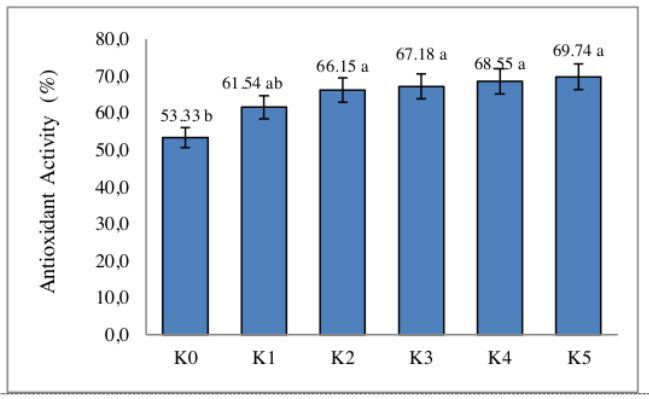

Figure 4. The Effect of Papaya Leaf Extract Addition on Antioxidant Activity

Figure 4 shows that the antioxidant activity produced by the addition of papaya leaf extract to coffee ranged from 53.33% - 69.74%. The lowest antioxidant activity value was in the K0 treatment that was 53.33%, while the highest antioxidant activity value was in the K5 treatment that was 69.74%. Based on further tests BNJ 5% showed that the antioxidant activity in the K0 treatment was significantly different from the treatments of K5, K4, K3, K2 and K1. At each treatment antioxidant activity has increased, this shows that during the fermentation process an increase in antioxidant activity. Increased antioxidant activity is influenced by phenolic compounds and organic acids. In the fermentation process, phenolic compounds and organic acids are easily hydrolysed so that the solubility of phenolic compounds and organic acids in fermented coffee will increase which causes antioxidant activity to increase as well.

Increased antioxidant activity in addition to being influenced by phenolic compounds and organic acids can also be caused by heating during drying, which triggering the degradation of polyphenols and

Maillard reactions between proteins and polyphenols. Thus, it produced melanoidin which has the potential as an antidote to free radicals. The Maillard reaction is the reaction between an amino group of a free amino acid, a peptide chain residue or a protein and a carbonyl group of a carbohydrate if the heat is heated up or stored for a relatively long time. The α-amino group of residual residues bound to peptides and proteins play an important role in the reaction. In addition, terminal α-amino groups also play a role in the Maillard reaction. According to [19], heating with a temperature of 85C for 3 minutes will reduce the polyphenol oxidase enzyme to only 5.49%. An increase in temperature will cause a decrease in the catalytic activity of the enzyme polyphenol oxidase.

3.5 Total Number of Phenol

Phenol leaves are compounds that have an aromatic ring with one or more hydroxyl groups. Phenol compounds in food can be grouped into simple and folic acid [20]. The standard used in the analysis of phenolic content is gallic acid, this is because gallic acid is stable, has high sensitivity, and the price is quite affordable. The phenolic content of gallic acid standards was determined using the Folin-Ciocalteau method [21]. The graph of the effect of the addition of papaya leaf extract can be seen in Figure 5.

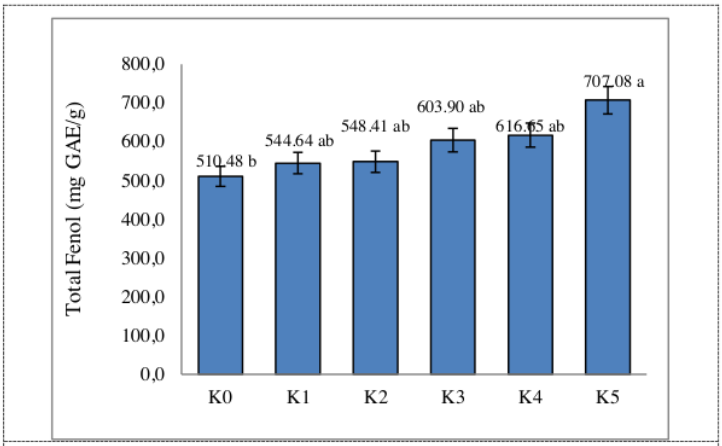

Figure 5. The Effect of Papaya Leaf Extract Addition on Total Phenol

Figure 5 shows that the total phenols produced by all treatments of papaya leaf extract addition ranged from 510.48% - 707.08%. The highest total phenol value is in the K5 treatment that is equal to 707.08% while the lowest total phenol value is in the K0 treatment that is equal to 510.48%. Based on further tests of BNJ 5%, the total phenol in the K0 treatment was significantly different from the K5 treatment. The more papaya leaf extract added to coffee, the greater the total phenol levels. Increased levels of total phenols are thought to be due to protein denaturation so that the phenolic component that was originally bound to the protein becomes loose. In addition, an increase in total phenol levels is also thought to occur due to the degradation of complex phenol compounds to simple phenols. Total phenol levels can be increased because it is influenced by phenolic compounds and organic acids. In the fermentation process, phenolic compounds and organic acids are easily hydrolysed so that the solubility of phenolic compounds and organic acids in fermented coffee will increase which causes total phenol levels to increase as well.

Increased levels of total phenols are not only caused by the fermentation process but also can be caused by a relatively long heating process and high heating power. This is because, during the heating process, the polyphenol oxidase enzyme experiences inactivation or decreases in catalytic activity. According to [19], heating with a temperature of 85C for 3 minutes will reduce the activity of the

polyphenol oxidase enzyme to only 5.49%. An increase in temperature will cause a decrease in the catalytic activity of the enzyme polyphenol oxidase.

3.6 Colour

Colour is one of the benchmarks for quality that is used as a determinant of the acceptance or rejection of a product by consumers. According to [22], colour or appearance is a quality attribute that is captured by the eyes of consumers before the assessment of other quality attributes of the whole product. The role of colour is very real because generally consumers will get a first impression and decide whether they like or dislike the food product from its colour [23]. The graph of the effect of the addition of papaya leaf extract can be seen in Figure 6.

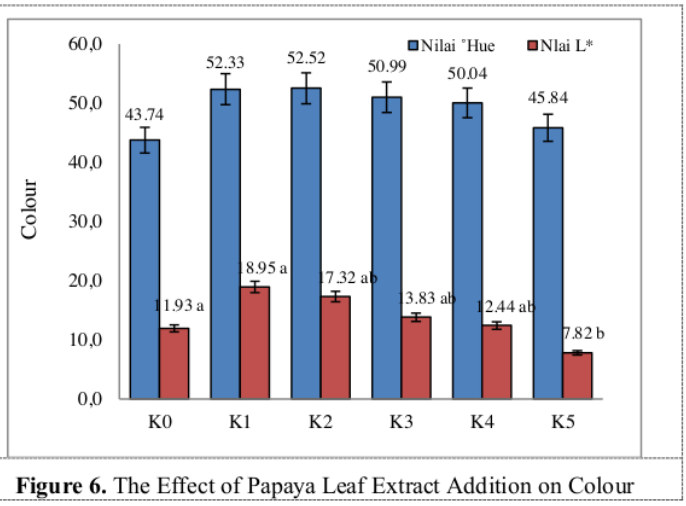

Figure 6. The Effect of Papaya Leaf Extract Addition on Colour

Based on Figure 6, the average colour value of °Hue produced by all treatments ranged from 43.74 to 52.52 which shows the colour red purple (brown). The highest value is in the K2 treatment that is 52.52 while the lowest value is in the K0 treatment that is 43.74. The treatment of papaya leaf extract addition on the value of °Hue in succession included 52.52; 52.33; 50.99; 50.04; 45.84 and 43.74. The average colour value of °Hue shows red purple (brown). The °Hue value indicates an insignificant difference. The graph shows that the more papaya leaf extract is added, the less the colour value of °Hue in coffee will be. Colour changes can be caused by Maillard reactions involving carbonyl group compounds (reducing sugars) and amino groups (amino acids). Maillard reaction is a non-enzymatic browning reaction between the reducing group and the primary amine group [24]. The results of these reactions produce brown material, which is often desired or sometimes a sign of deterioration [10].

The highest L value or the brightness level obtained is in the treatment K1 with a value of 19.28 and the lowest value is found in the treatment K5 with a value of 8.84. L values ranged from 8.84 to 19.28. The treatment of the addition of papaya leaf extract at L* values, among others, 19.28; 17.32; 13.83; 12.44; 11.93 and 8.84. The gravel shows that the more papaya leaf extract is added, the less the L* coffee value will be. Decrease in L* value in Robusta ground coffee can be caused by coffee beans during the roasting process which changes colour to darker namely blackish brown. The discoloration is caused by the roasting process which causes the Maillard reaction. The Maillard reaction will produce melanoidin compounds which are indicated by the brown discoloration of roasted coffee beans, thereby reducing the L* value of the roasted ground coffee yield. These results are consistent with [25] which states that the decrease in the value of L* indicates that the colour of the seeds becomes darker with the roasting process. The colour change to blackish brown was caused by the roasting process of the coffee beans the Maillard reaction occurs. The Maillard reaction provides an important contribution in the

formation of aromas and antioxidant compounds. The reaction occurs between sugar and amino acids, the end result of which is melanoidin. The presence of melanoidin is indicated by a brown discoloration in heated coffee beans.

3.7 Aroma

Aroma is one of the parameters that determine the quality of a food product. The distinctive aroma can be felt by the sense of smell depends on the ingredients added to the food. Thus, the aroma can directly influence consumer interest to try a food product [26]. [27] states that the aroma of a product in many ways determines the smell or not of a product, even the aroma or odour is more complex than only taste. The sensitivity of the smell is usually higher than taste. Even the food industry considers that the smell test is very important because it can quickly provide the results of a product's assessment. The graph of the effect of the addition of papaya leaf extract can be seen in Figure 7.

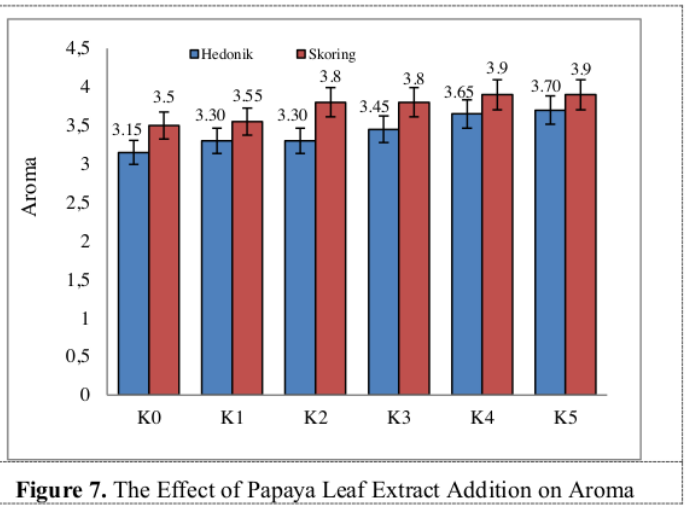

Figure 7. The Effect of Papaya Leaf Extract Addition on Aroma

Based on Figure 7, the aroma organoleptic test using panelled hedonic methods provides Robusta coffee powder brewing criteria with values ranging from 3.15-3.70. The highest value is in the K5 treatment which is 3.70 and the lowest value is in the K0 treatment which is 3.15. The graph shows that the higher the papaya leaf extract added to the coffee, the greater the hedonic value of Robusta coffee brewing aroma will be. [22] states that aromas are odours those are difficult to measure, giving rise to different opinions in assessing quality. Differences of opinion could occur due to each person has a different ability to smell, although they can distinguish scents, but each person has different preferences.

The aroma scoring value shown in Figure 15 gives the criteria for Robusta ground coffee brewing from slightly coffee-flavoured to coffee-scented with values ranging from 3.5 - 3.9. The highest value was obtained in the treatments of K4 and K5 that is 3.9 while the lowest value was found in treatment K0 which is 3.5. The graph shows that the more papaya leaf extracts are added, the aroma of coffee will increase. The roasting process uses a high temperature that can produce unwanted scents, and vice versa, if the roasting process uses a low temperature it will produces an unexpected coffee aroma or even has no taste at all.

The aroma produced during the roasting process can be caused by the presence of volatile and non-volatile compounds formed during the roasting process which is supported by the use of temperature and duration of the roasting. Various volatile compounds in coffee are formed from the Maillard reaction. Volatile compounds are generally compounds derived from pyrazine, aldehyde, ketone, phenol, pyridine, pyrole, furan, pyrone amine, oxazole, thiazole, thiophene, alcohol, benzene, esters, organic acids and sulphur. This is consistent with the statement of [28] which states that volatile

compounds contribute to the smell of the nose; the type and amount of flavour compounds formed in the roasting process are highly dependent on variations in the content of precursor compounds of rice coffee beans. Mino acid precursors that play an important role in the Maillard reaction are contained in many types so that they will add variations in the types of flavour compounds that are formed. These volatile compounds are generally compounding of pyrazine, aldehyde, ketone, phenol, pyridine, pyrole, furan, pyrone amine, oxazole, thiazole, thiophene, alcohol, benzene, esters, organic acids, sulphur. One type of non-volatile compounds that affect the aroma of coffee is caffeoyl.

3.8 Taste

Taste is related to the component of material that is captured by the sense of tongue. Taste is also one of the determinants in the level of panellist acceptance [29]. The results of the analysis of diversity at 5% level showed that the addition of papaya leaf extract had a significantly different effect on the scoring value and not significantly different on the hedonic value. The graph of the effect of the addition of papaya leaf extract can be seen in Figure 8.

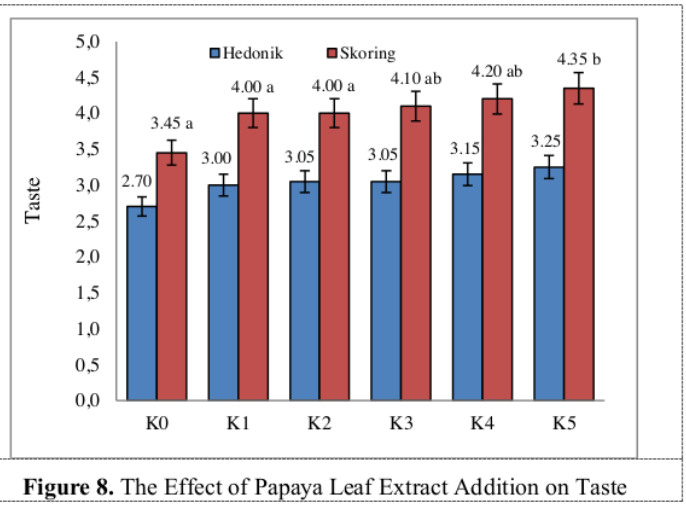

Figure 8. The Effect of Papaya Leaf Extract Addition on Taste

Based on Figure 8, taste organoleptic were tested using panelled hedonic methods that provides Robusta coffee powder brewing criteria from dislike to somewhat like with values ranging from 2.70 to 3.25. The highest value was obtained at treatment K5 with a value of 3.25 and the lowest value was found at treatment K0 with a value of 2.70. The graph shows that the higher addition of papaya leaf extract to the coffee, the higher the hedonic value of Robusta coffee.

The flavour scoring value shown in Figure 16. gives the criteria for Robusta ground coffee brewing from slightly bitter to bitter coffee tastes with values ranging from 3.45 – 4.35. The highest value was obtained at treatment K5 with a value of 4.35 and the lowest value was found at treatment K0 with a value of 3.45. The graph shows that the higher the temperature and the roasting time for coffee, the higher the scoring value of Robusta coffee brewed flavour. Flavours produced in steeping ground coffee can come from the degradation and formation of chemical compounds resulting from the Maillard reaction, degradation of the strecker, decomposition of amino acids, degradation of trigonelin, quinic acid, caffeine, chlorogenic acid, and lipids that occur during the roasting process.

[25] states that the taste in coffee was influenced by the degradation of several compounds such as carbohydrates, alkaloids, chlorogenic acid, volatile compounds, and trigonellins. In roasting there is a lot of loss due to degradation. Degraded carbohydrates form sucrose and simple sugars that produce a sweet taste. Alkaloids namely caffeine undergo sublimation to form caffeol. Caffeine has a strong bitter taste besides chlorogenic acid and trigonellin. Caffeine contributes as much as 10% in the formation of

bitter taste. Chlorogenic acid decomposes by 50% during the roasting and will be lost to the degree of roasting.

4. Conclusions

The addition of papaya leaf extract to coffee gives a significantly different effect on the parameters of water content, caffeine content, antioxidant activity, total phenol, colour value of L*, and organoleptic scoring method, but has no significantly different effects to the parameters of ash content, ˚Hue colour, aroma (hedonic and scoring) and taste (hedonic). The results of the analysis show that the higher the addition of papaya leaf extract added, the higher the water content, ash content, antioxidant activity, total phenol, aroma (hedonic and scoring) and taste (hedonic and scoring). Making Robusta ground coffee with the treatment of adding papaya leaf extract as much as 25% was the best treatment since it produces Robusta ground coffee with a moisture content of 4.87%; ash content of 4.14%; antioxidant activity 69.74%; total phenol 707.08 mg GAE/g; caffeine content of 0.66%; Robusta coffee powder (˚Hue value = 45.84 and L* value = 8.84), hedonic parameters of aroma and taste somewhat preferred as well as aroma scoring parameters which produce somewhat coffee-scented and rather bitter taste.

Acknowledgments

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