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THE EFFECT OF TEMPERATURE AND ROASTING DURATION ON PHYSICAL CHARACTERISTICS AND SENSORY QUALITY OF SINGGALANG ARABICA COFFEE (*Coffea arabica*) AGAM REGENCY

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Abstract. *The purpose of this study were to determine the effect of temperature and roasting duration on physical characteristics and quality of arabica coffee sensory,: find out the best temperature and roasting duration treatmen to physical characteristics and quality of arabica coffee sensory. This study used a factorial complete randomized design with two factors (200°C, 220°C and 240°C) and duration of roasting (12, 15, and 18 minutes). The variables observed in this study were rendemen (sucrose content of sugar cane crop or sample), water content, color value, acidity and sensory test of arabica coffee. The results showed that temperature and duration of roasting had effect on rendemen, water content, color value, acidity, flavor, taste and color of arabica coffee. The temperature of 220 ° C with 12 minutes of roasting is produceed the best physical characteristics and sensory quality of Singgalang arabica coffee, with 88.1% of rendemen, 1.23% of water content (bb), different color L (Lightness) 6,07, acidity 5.81, scent score 3.5), taste score value of 3.2, color score 3.6.*

Keywords: *singgalang arabica coffee, roasting temperature, roasting duration, physical characteristics, sensory quality*

1. Introduction

The coffee industry in West Sumatera keeps continue to build from upstream to downstream. West Sumatera is in sixth position as Indonesia's coffee producing province. Coffee centers in West Sumatera are in Solok, Tanah Datar, Lima Puluh Kota, Solok Selatan (South Solok), Agam and Pasaman. The coffee plantation area in the six centers is based on data from the Provincial Plantation in 2017, which recorded 21,789 hectares with a production of around 16,670 tons per year. Each coffee-producing region has its distinctive taste, even though it is Arabica but the flavor and taste are very different.

Harvested coffee fruit requires a very long process until become a favorite drink. The stages of coffee processing can be classified into primary and secondary coffee processing. Secondary coffee processing is the process of roasting, cooling and grinding. In this stage, roasting is the key to the coffee powder production process (Mulato et al., 2006). If the ratio of the determinants of coffee flavor is composed, 30% of the coffee flavor is determined through the roasting process, 60% is determined by the process of

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cultivation and harvesting in the garden and 10% is determined by the barista during presentation (Pengabean, 2012).

Roasting process is the final stage that will determine the flavor of coffee produced. The classification of roasting based on the degree of color is divided into three, namely light, medium, and dark (Vignoli, et al, 2012). The roasting process will determine the fat content and protein in coffee beans which act as precursors of the flavor and flavor of coffee. The roasting process of coffee beans will produce the flavor and taste hidden from behind the coffee beans which were originally greenish. The chemical roasting process will change the flavor of coffee beans that used to be like fruit, becoming a distinctive flavor.

Roasting process requires certain techniques and expertise. Roasting process is the process of forming the taste and flavor of coffee beans. If coffee beans have uniformity in size, specific gravity, texture, water content and chemical structure, the roasting process will be relatively easier to control. In fact, coffee beans have a huge difference, so the roasting process is an art and requires skills and experience as consumers demand (Vignoli et al., 2012).

Roasting is a unitary operation that is very important to develop specific organoleptic properties (flavor, taste and color) that underlie the quality of coffee. This process is very complex, because the amount of heat transferred to the seeds is very important. There was a decrease in moisture in coffee beans from 11% to 3.2% for 12 minutes roasting (Massini et al., 1990). The temperature needed to roast coffee is around 60-240^{0}C (Pengabean, 2012). Meanwhile, the duration of roasting time varies depending on the system and the type of roasting machine used. Generally, roasting process takes 15-30 minutes to maintain the quality of coffee in terms of coffee color and most importantly in terms of the taste of coffee desired. The duration of roasting coffee will greatly affect the type of coffee and the desired results (Massini et al., 1990).

Different temperatures and durations of roasting each time the production process results in different qualities of Arabica coffee. One effort that can be done to provide added value for coffee products is by carrying out secondary coffee processing, which is processing coffee beans into ground coffee and knowing the physical characteristics and sensory quality of coffee (Pengabean, 2012).

The purpose of this study were 1) to determined the effect of temperature and roasting duration on the physical characteristics and sensory quality of Singgalang

Arabica coffee in Agam Regency; 2) and determined the best temperature and roasting to produce the best physical characteristics and sensory quality of Singgalang arabica coffee.

2. Materials and Methods

Place and Time

This research was conducted in Agam district, chemical laboratory, laboratory, microbiology laboratory, processing laboratory, and sensory laboratory of Payakumbuh State Agricultural Polytechnic, Fianda Rostery and Two-door Roastery. The study was conducted from January to May 2019.

Materials and Tools

The material used in this study was dried green beans which have been sorted from Singgalang, Agam Regency, label paper, plastic. The chemicals used analysis were aquadest and water.

The equipments used in this study were: pH-meter (Model PHS-3D-01, China), Colorimeter color measuring device (Model HH06 Accu Probe, USA), roaster machine (Berto Roaster), roasted coffee bean grinding machine (Model Expobar, Spain), analytic scales (Shimadzu model, Japan), 5 kg scale (OEM model, China), desiccator, measuring cup, measuring flask, oven, coffee filter, weighing bottle, sucker pipette, basin, spoon, packaging coffee type Aluminum Foil Standing Pouch (silver size 240 g with 125 micron thickness), camera, markers and stationery.

Experimental Design

The experimental design of this study was a completely randomized design of factorial patterns with two factors; the first factor was temperature of roasting (200°C, 220°C and 240°C) and the second factor was roasting duration (12, 15, and 18 minutes). The data obtained in this study are reported as means of two replicate determination.

All data were analyzed by analysis of variance and significance levels were obtained with Duncan's Multiple Range Test (DMRT) test. A significant level of $p<0.05$ was used. The stage of this research begins by preparing material of each region as much as 6 kg of rice coffee with 12% water content which has been peeled with a coffee huller machine. Rice coffee is then manually sorted to remove foreign objects such as stone, wood, gravel and choose coffee beans that are intact or not smashed and broken. Before the roasting process, first prepare the Berto roaster machine. This machine has a minimum roasting capacity of 300 g with a control limit of 0 to 30 minutes and a control temperature of 0 to 250 ° C. Furthermore, the weighing of coffee is 200 g per sample using an OEM model scale. Weighed rice coffee is put into the roaster and locks the glass cover on the machine so that the roasting process takes place without contamination from outside air.

Roasting process ends, the machine will ring and automatically cool the roasted coffee for 10 minutes then cool it again with the container open. Roasted coffee was then weighed again to determine the weight loss during roasting and continued with the grinding process with a grinding machine. The ground coffee produced from the milling is then packaged using coffee foil aluminum standing pouch with zipper and valve. Packaging has a high shelf life, is strong and is not easy to tear, resistant to sunlight so that the content contained in the product can be maintained properly, and can maintain the taste and freshness of coffee before observing it in the laboratory.

Observations are carried out in an objective and subjective manner. Objective observations by observing the physicality of coffee include the rendemen of roasted coffee beans that have been roasted with a 5 kg scale (OEM model, China), water content of coffee powder by oven method (Sudarmadji et al., 1997), different color values of L to coffee powder with colorimeter (Model HH06, Accu Probe, USA) and acidity of coffee brewing with a pH meter (Model PHS-3D-01, China). While subjective observations carried out sensory tests of flavor, taste and color in steeping arabica coffee (Soekarto, 1985).

3. Results and Discussion

Rendemen of Singgalang Arabica Coffee

Rendemen of Singgalang Arabica Coffee of different temperatures and roasting duration shown in Table 1.

Table 1. Rendemen of Singgalang arabica coffee beans

Roasting Duration (Minute)	Roasting Temperature ^{0}C 200	220	240	Rendemen (%)
12	88,10a	83,30b	83,20b	85,50a
15	81,90b	76,90c	70,30d	76,37b
18	85,20ab	77,00c	75,20d	76,03b
	85,06a	79,3b	72,90c	

Note: Different letters behind the value show significant differences in the Duncan test

Table 1 shows that rendemen of roasted coffee beans at 200°C is significantly different from temperatures of 220°C and 240°C. Than rendemen of roasted coffee beans with a temperature treatment of 240°C is lower at 72.9% compared to the treatment temperature of 220 ° C which was 79.3% and the treatment temperature of 200 ° C was 85.06%. From Table 1 it can be seen that the higher the temperature treatment used in roasting the coffee, the lower the rendemen of roasted coffee beans. From Table 1 it is also known that the duration of roasting of coffee beans for 18 minutes was significantly different from the duration of roasting 15 and 12 minutes. The average rendemen of roasted coffee beans for 15 minutes was lower at 75% compared to the duration treatment of roasting for 18 minutes which was 76.03% and the duration treatment of roasting 12 minutes was 85.5%.

Based on Table 1, the interaction of the treatment temperature of 200 ° C and the duration of roasting 12 minutes resulted in the highest rendemen of 88.1% which was significantly different from the treatment temperature of 240 ° C for 18 minutes which produced the lowest rendemen of 75.2%. This is in accordance with the average rendemen of coffee roaster from the domestic market with a range of 80.4 to 91.4 (Yusianto et al., 2003). The high and low rendemen of ground coffee produced can be caused by the evaporation of substances contained in the material during different roasting processes. Shrinkage occurs due to evaporation of water and pyrolysis of organic materials, generally ranging from 10-25%.

Depreciation value is very dependent on temperature and duration of roasting. The longer the roasting process and the higher the temperature used, the higher the shrinkage. Roasting shrinkage is used as a measure of the duration of roasting, because the relationship between the two is very close (Woodman et al., 1967). Roasting use high temperatures more evaporates the water content and volatile compounds (caffeine, acetic acid, propionate, butyrate and volerate) contained in coffee beans compared to the use of low temperatures. Sivetz & Foote (1963), stated that in the early stages of the process, the heat energy available in the roast chamber was used to evaporate water. Water content of coffee beans decrease rapidly at the beginning of roasting and relatively slowly at the end of process. This phenomenon is related to the velocity of water propagation (diffusion) in the tissue of coffee bean cells.

Water Content

Table 2. Average value of arabica coffee powder water content

Roasting Duration (Minute)	Roasting Temperature ^{0}C			Water Content (%b/b)
	200	220	240	
12	1,23a	1,09bc	1,15a	1,57a
15	0,98c	1,37a	0,99c	1,11ab
18	1,09ab	0,97cd	0,84d	0,97b
	1,1	1,43	0,99	

Note: Different letters behind the value show significant differences in the Duncan test

Table 2 has shows that the water content of coffee powder at 18 minute roasting duration has significant effect with 15 and 12 minutes of roasting time. The treatment duration of 18 minutes of roasting produced a lower water content of 1.09% (bb) compared to the duration treatment of roasting 15 minutes which was 0.98% (bb) and 12 minutes which was 1.23% (bb). the interaction of the temperature treatment of 240 °C and the duration of roasting 18 minutes produced the lowest water content of 0.84% (bb) which was significantly different from the treatment temperature of 220 ° C for 15 minutes which produced the highest powder water content of 1.37% (bb) , Based on the table above the coffee powder water content in this study has met the quality requirements of ground coffee (SNI 01-3542-2004) which is a maximum of 7% (bb), the water content decreases along with the length of roasting time, from the initial water content of 12 % (bb) fell to the range of 0.82-1.34% (bb). Research on changes in water content during the roasting process of Robusta coffee was previously carried out by Widyotomo, S. (2012). Changes that occur are a decrease in water content over time. With the roasting time for 18 minutes, the coffee water content of 11% (bb) dropped to 1.24-4.28% (bb) at the roasting temperature between 160-220 ° C.

The phenomenon of decreasing water content in the roasting process is related to the rapid propagation of water (diffusion) in the coffee bean cell network. The lower the water content in coffee beans, the faster the rate of evaporation of water because the position of water molecules lies further away from the surface of the seeds Sivetz & Foote (1963) With the evaporation of large amounts of water in the coffee beans, it makes the coffee beans dry. The moisture content of an ingredient needs to be known, because water can affect taste. In addition, the water content also affects the freshness and durability of the material against the attack of microorganisms during handling (Winarno, 1992). The water content expected from the product to be produced from the treatment is the lowest moisture content. The lower the water content, the longer the absorption of moisture from the air. This will maintain the resistance of the material from damage by microorganisms during storage. The difference in the final water content obtained is due to the instability of coffee beans to environmental air humidity after losing the dry horn skin on the coffee beans before roasting.

Different Color L

Table 3. The value of the difference in color values of Arabica coffee powder

Roasting Duration (Minute)	Roasting Temperature ^{0}C 200	220	240	L color value

12	6,07gh	6,61fg	7,12ef	6,63c
15	10,43bc	10,03cd	6,08h	8,85ab
18	8,09de	10,06ab	11,02a	9,27a
	8,20	9,15	8,07	

Note: Different letters behind the value show significant differences in the Duncan test

Maillard reaction can influence the formation of 1 color value in coffee powder grounds due to a reaction between an amino acid and a reducing sugar and causing exessive browning (Jing & Kitts, 2002). Table 3 shows that the difference in the color value of coffee powder at the duration of roasting 18 minutes was significant different from the 15 and 12 minutes roasting time. The average treatment for 15 minutes of roasting resulted in a higher color value of 9.27 compared to the 15 minute long roasting treatment of 8.85 and 12 minutes, which was 6.63. Table 3 shows that the interaction of the temperature treatment of 240 ° C and the duration of roasting 18 minutes resulted in the highest difference in color values of 11.02 compared to the interaction of the treatment temperature of 240 °C for 15 minutes and interaction of the treatment temperature of 220 ° C for 12 minutes resulting in a difference in value the lowest colors are 7.12 and 6.08 respectively.

According to Sivetz & Foote (1963), during the roasting process there are color changes that can be distinguished visually. The L color change starts from green to brown and then black cinnamon with an oily surface. According to Rahardian (2013) if the value of ΔE <0.2 does not appear to affect the color of food, the value of ΔE 0.2-1.0 has very little effect on the color of food, the value of 1,0E 1.0-3.0 has an effect very small in the color of food, the value of 3,0E 3.0-6.0 has an effect on the color of food, and if the value of ΔE> 6.0 has a large effect on the color of food. This statement is proven by the results of research conducted that the value of ΔE L is greater than 6.0, which means that the treatment of temperature and duration of roasting has a large effect on the color of food. The measurement of color values in rice coffee beans before roasting using a colorimeter drops in the range 6.08-11.02. The value of a, also tends to increase, which is due to the change in the color of the coffee beans to become brownish and darker. This occurs because of the Maillard reaction which results in the appearance of carbonyl compounds (reduction groups) and amino groups. Maillard reaction is a non enzymatic browning reaction that produces complex compounds with high molecular weight. The irregularity of the color of the coffee beans before roasting resulted in the non-uniform color grafting. This results in the level of brightness (lightness) obtained is not stable. But in general the data obtained can illustrate the change in the brightness of coffee beans during roasting.

Acidity

The results of the variance analysis showed that the roasting temperature had a significant effect ($P < 0.05$) on the acidity of steeping arabica coffee. The duration of roasting has a significant effect on the acidity of steeping Arabica coffee and treatment interactions have a significant effect on the acidity of steeping arabica coffee. Table 4 shows that the mean pH value of coffee brewing at 200 ° C is significantly different from temperatures of 220 ° C and 240 ° C. The mean pH value of coffee steeping with a treatment temperature of 220 ° C is higher which is equal to 6.21 compared to the treatment of roasting temperature of 240 ° C which is 6.15 and the treatment temperature of 220 ° C which is 5.96. From Table 4 it is also known that the mean pH value of coffee steeping with the duration of roasting 18 minutes was significantly different from the duration of roasting 15 and 12 minutes.

The mean pH value of coffee brewing that roasted for 18 minutes is higher, which is equal to 6.69 compared to the treatment time of 15 minutes roasting which is 6.54 and the time treatment of roasting 12 minutes is 5.11. Based on table 4 the interaction of the treatment temperature of 220 ° C and the duration of roasting 12 minutes resulted in the lowest pH value of 5.81 which was significantly different from the treatment temperature of 240 ° C for 18 minutes which resulted in the highest pH value of 6.45. The average value of changes in acidity levels of roasted arabica coffee and DMRT test results can be seen in Table 4.

Table 4. The average value of changes in the pH value of steeping arabica coffee

Roasting Duration (Minute)	Roasting Temperature ^{0}C			Water Content (%b/b)
	200	220	240	
12	5,81gh	5,81e	5,58de	5,81e
15	5,93d	6,27bc	5,94d	6,05ab
18	6,11cd	6,54ab	6,69a	6,45a
	5,9c	6,1a	6,15	

Note: Different letters behind the value show significant differences in the Duncan test

In this study coffee powder was produced from a wet fermentation process. The principle of fermentation is decomposition of compounds contained in the mucus layer by natural microbes and assisted with oxygen from the air. The fermentation process can be done wet (soaking coffee beans in a pool of water) and dry (without water immersion) (Drake & McKillip, 2000). The value of acidity decreases towards a neutral pH value along with the higher and longer the roasting process. This decrease in acidity is caused by the evaporation of some acids (chlorogenic acid and carboxylic acid) when roasted.

This is in accordance with the statement of Mulato et al., (2006) which states that coffee beans naturally contain various types of volatile compounds such as aldehydes, furfural, ketones, alcohols, esters, formic acid, and acetic acid which have volatile properties. The degree of acidity (pH) greatly affects the taste and flavor of coffee. According to Kustiyah (1985), in general the pH interval between 4.9-5.2 will provide the preferred coffee beverage.

This was supported by Sivetz & Foote (1963), who stated that at the pH interval above, the flavor component had emerged from the medium roasting of arabica coffee and this also showed optimum roasting for arabica coffee.

Steeping Coffee Sensory

Flavor

Table 5 shows the results of various sensory tests of the flavor of steeping coffee. Treatment interactions significantly ($P < 0.05$) on the flavor of steeping coffee. In table 5, it can be seen that the panelist's preference for the flavor of steeping Arabica coffee is 3.5 (between ordinary and like) obtained from the treatment temperature of 220 °C and the duration of roasting 12 minutes, while the panelists' preference for flavor of Arabica coffee is as low as 1.4 (between very dislike and dislike) was obtained from the treatment of 240 °C roasting temperature for 18 minutes. Table 5 below shows the average flavor value and DMRT test results.

Flavor of a product in many ways determines the smell or not of a product, even the flavor or smell is more complex than taste. Sensory sensitivity is usually higher than sensory taste. Even the food industry considers odor testing to be very important because it can quickly provide results for the assessment of a product. The flavor of coffee arises from volatile compounds caught by the human sense of smell. Volatile compounds that affect the flavor of roasted coffee are formed from Maillard reactions or non-enzymatic browning reactions, free amino acid degradation, degradation of trigonelin, sugar degradation and degradation of phenolic compounds because of this, the typical flavor of coffee slowly will appear after the roasted seeds are cooled. The longer the roasting, the more volatile compounds that evaporate so that it will affect the flavor of ground coffee (Soekarto, 1985).

Table 5. The average score of flavor steeping roasted arabica coffee

Roasting Duaration (Minute)	Roasting Temperature ^{0}C 200	220	240
12	2,8abc	3,5a	2,6bc
15	3,2ab	2,8abc	2,8abc

18	2,8abc	2,4c	1,5d

The flavor of roasted coffee at 220 ° C gives a distinctive flavor of coffee and does not burn compared to the flavor of roasted coffee at 240 ° C with a length roasting time of 18 minutes. Based on table 5 panelists tend to like the flavor of steeping coffee which is roasted at 220 ° C compared to temperatures of 220 ° C and 240 ° C. Sivetz & Foote (1963) states that the flavor formation that is typical of coffee is caused by caffeine and other coffee-forming compounds. Flavor is a value contained in products that can be directly enjoyed by consumers.

Taste

In Table 6 it can be seen that the value of the panelists' acceptance of the highest flavor of Arabica coffee steeping was obtained at 3.2 obtained in the experiment with 200 °C for 18 minutes and 220 °C for 15 minutes. While the level of preference of the panelists for the lowest coffee brewing was 1.9 (between very dislikes and dislikes) in the experiment of 240 °C for 18 minutes. This is caused by the flavor of roasted coffee at 240 °C tends to be bitter and concentrated compared to roasted coffee flavor at 220 °C with a long roasting time of 15 minutes or roasting with a temperature of 220 °C with a length of 18 minutes.

Table 6. Average value organoleptic of taste Singgalang arabica coffee

Roasting Duration (Minute)	Roasting Temperature ^{0}C		
	200	220	240
12	2,9a	3,2a	3,1a
15	2,7a	3,1a	3,0a
18	3,2a	2,7c	1,9b

Research conducted by Sari et al. (2012) states that the taste in coffee is influenced by the results of the degradation of several compounds such as carbohydrates, alkaloids, chlorogenic acid, volatile compounds, and trigonelin. The roasting process results in the loss of compounds due to degradation. Degraded carbohydrates form sucrose and simple sugars that produce sweetness. Alkaloids, caffeine, sublimate to form cafeol. Caffeine has a strong bitter taste besides chlorogenic acid and trigonelin. Caffeine contributes as much as 10% in the formation of bitter taste. Chlorogenic acid decomposes as much as 50% during roasting and will disappear at high degrees of roasting. Whereas trigonelin is only 15% decomposed for each degree of roasting. The higher the temperature and the longer the roasting time the compound will heat up faster, so the atoms will move harder and will break the chemical bonds this causes coffee taste to be bitter and has no taste when roasted at high temperatures.

Color

Table 7 shows the results of steeping coffee color sensory test. Treatment interactions significantly effected (P <0.05) to the steeping coffee color. The average score of the panelists to the steeping color of roasted roasted arabica coffee and the results of the DMRT test can be seen in Table 7.

Table 7. Scoring average value of of color Singgalang arabica coffee color

Roasting Duration (Minute)	Roasting temperature ^{0}C		
	200	220	240
12	3,2b	3,6ab	3,2ab
15	3,4ab	3,5a	3,1ab
18	3,4ab	3,2b	2,2c

Based on Table 7, it can be seen that the value of the panelist's acceptance to the highest color of steeping coffee is 3.5 (between normal and like) obtained in the experiment of roasting temperature 220 °C for 15 minutes. And the value of the panelist's acceptance of the lowest coffee steeping color is 2.2 (dislike) in the experiment of roasting temperature 240 °C for 18 minutes. The coffee color which is roasted at 220 °C with 15 minutes of roasting causes a blackish brown color favored by consumers compared to the color of roasted coffee at 240 °C with a long roasting time of 18 minutes which tends to be pitch black with a charred flavor. According to Sari et al. (2012), other factors that affect the color of coffee steeping are produced because of the sugar caramelization process that causes dark brown to appear.

Relationship between Objective and Subjective Parameters

Objective parameters are closely related to subjective parameters, therefore decision making to determine the best treatment is based on determining the best value in each parameter. The best results of rendemen objective parameters are based on the highest rendemen value. The higher the rendemen value, the better the temperature and duration of roasting treatment, the lower the rendemen value, the treatment gets worse because there is a lot of loss in the weight of the coffee.

Based on Table 1 it was found that the best rendemen was obtained from a treatment temperature of 220 °C for 12 minutes with a rendemen value of 88.1%. Determination of the best value for water content is based on the lowest value of the results of each treatment study. Because it is expected that the treatment of temperature and duration of roasting resulting low water levels coffee to avoid damage due to the activity of microorganisms during storage, the lower the water content contained, the better the quality of coffee produced due to evaporation that occurs with greater effectiveness of the roasting machine.

Based on Table 2, it was found that the best water content was obtained from a treatment of roasting temperature 240 °C for 18 minutes of 0.84% (bb). Based on the results of the research for the best treatment of the value of the difference color L based on the panelists' preference for the color of coffee steeping which has an average value (likes) at 220 °C for 15 minutes which has a value of ΔEL 10.03. For the best value of acidity content generally at a pH interval between 4.9-5.2 will provide the preferred coffee beverage. Based on Table 4 the best value obtained at roasting temperature of 220 °C for 12 minutes with a pH value of 5.81 and 220 °C for 15 minutes which had a pH value of 5.81.

The best subjective parameter results for each temperature treatment and roasting duration were taken based on the highest organoleptic value (level of preference) from the panelist's acceptance of the surface (flavor, taste and color) of coffee steeping. Based on Table 5, the highest average level of preference for panelists on the sensory flavor of steeping Arabica coffee was obtained from a treatment with a temperature of 220 ° C for 12 minutes which was 3.5 (between normal and like). And the highest level of preference for panelists on the sensory flavor of steeping Arabica coffee can be seen in Table 6 obtained the highest value in the treatment temperature of 200 ° C for 18 minutes, which is equal to 3.3 (between ordinary and like). Whereas the color sensory shown in Table 7 obtained the highest value or the highest level of preference for panelists in roasting with a temperature of 220 ° C for 15 minutes, which is 3.5 (between normal and like).

Treatment combination of roasting temperature of 220° C and 12 minutes of roasting time produces the highest organoleptic of color value which most preferred by panelists. Based on the results of the seven objective and subjective parameters, it can be concluded that the treatment of 220 ° C roasting temperature for 12 minutes is the best combination of treatments for the physical characteristics and sensory quality of arabica coffee compared to other combinations of treatments. This is because the combination of 220 ° C treatment for 12 minutes has the best value mentioned more than 2 parameters.

4. Conclusion

The treatment of temperature and duration of roasting significantly affected the rendemen of roasted arabica coffee beans and acidity of coffee steeping, but the treatment of roasting temperature did not affect the water content and color value of L (Lightness).

The interaction of temperature treatment and roasting duration had a significant effect on the level of 5% on rendemen, water content, L color value, acidity and panelist acceptance of the flavor, taste and color of arabica roasted coffee brew. The best roasting temperature is best used to produce the best physical characteristics and sensory quality, which is a temperature of 220 ° C with 12 minutes of roasting time, which is 88.1%, water content 1.23% (bb), L color value 6.07, acidity 5.81, scent 3.5 (between usual and like), taste score 3.2 (between usual and like), color scoring 3.6 (between normal and like).

Based on the results of the study, to produce the best physical characteristics and sensory quality in arabica coffee it is recommended to use a 220 ° C roasting temperature with a duration of roasting of 12 minutes.

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