Comparison of Drying Temperature and Three Types of Coffee Beans on Physical Quality

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Abstract: ***South Kalimantan is one of the provinces that develops local coffee which is carried out by coffee activists together with indigenous communities and farmer groups. The types of coffee that dominate in South Kalimantan are robusta coffee (village coffee), liberica (wood coffee), and excelsa (yellow coffee) which are cultivated in lowlands such as peatlands and tidal swamps. Based on the results of observations made in the field, several causes are the low selling price of coffee beans on the market because the post-harvest process is not managed well and according to standards to improve the quality of coffee. The aim of the research was to determine the treatment response of different drying temperatures and three types of coffee beans to physical quality and to find out the combination of treatment comparisons of drying temperatures and three types of coffee beans to physical quality which was close to the SNI quality value of coffee beans. This research used a two-factor Randomized Block Design (RAK). The factors studied were drying temperature (S) for 3 treatments and coffee bean type treatment (J) for 3 experimental treatments consisting of 9 combinations and each treatment was repeated 3 times so that the total experiment was 27 experimental units, consisting of S1: Drying temperature 80 oC, S2: Drying temperature 90 oC, S3: Drying temperature 100 oC, J1: Liberica coffee, J2: Robusta coffee, J3: Excelsa coffee. The treatment of different drying temperatures and three types of coffee beans provides a response to the parameters, namely, water content, number of bean defects, color and size compared to the quality value of SNI 01-2907-2008. The combination of treatments that provide a response close to the quality value of SNI 01-2907-2008 is, the wet base water content is the Robusta treatment with a temperature of 90 oC, the defective coffee beans are the Liberica coffee type and the temperature is 100 oC, the color of the coffee beans is robusta and excelsa, while for temperatures of 80 oC and 90 oC, the size of the coffee beans is liberica with a temperature of 80-90 oC.***

Keywords: Coffee beans, Drying, Temperature, Quality

1. Introduction

South Kalimantan is one of the provinces that develops local coffee, undertaken by coffee enthusiasts alongside indigenous communities and farmer groups to drive the economy through collaborative patterns. In Kalimantan, three types of coffee cultivated by the local community are found, namely robusta coffee, known locally as "kopi kampung", liberica coffee, referred to by locals as "kopi kayu", and the last one being excelsa coffee, commonly known as "kopi kuning" among the locals. The majority of the population cultivates coffee in lowland areas such as peatlands and tidal swamps. This is possible because these types of coffee are adaptive and resilient, capable of growing at altitudes of 0-750 meters above sea level. Based on field observations, several factors contribute to this decline, including low selling prices of coffee beans in the market, the presence of unproductive old trees, and inadequate post-harvest processes to improve coffee quality. Consequently, consumers acknowledge that the physical quality of local coffee in South Kalimantan is still low in terms of moisture content, size, weight, inconsistent color, and flavor. Therefore, they tend to choose other types of coffee not cultivated in South Kalimantan.

According to Santoso et al. (2018) [1], the management of coffee cultivation and post-harvest processing greatly influences the flavor and quality of coffee beans. With the increasing demand for coffee with good flavor and quality both domestically and internationally, post-harvest processes and cultivation become crucial factors determining the quality of the resulting coffee beans. One of the crucial processes in managing harvested coffee beans that significantly affects the flavor of coffee is the drying process. The drying process greatly affects the shelf life and quality of coffee beans. The drying process aims to reduce the moisture content to meet national standards, which typically range from 12% to 14% for commercially traded coffee beans.

According to Widyotomo et al. (2005) [2], the optimal drying temperature for coffee falls within the range of 50°C to 55°C. Within this temperature range, an optimum point for evaporation or removal of water particles from coffee beans is observed. Drying temperatures that are too high can result in physical damage to the surface of the coffee beans, known as case hardening, which hinders the evaporation process and indirectly lowers the quality of the resulting coffee beans.

2. Methodology

This study utilized materials such as ripe fruit from three types of coffee, namely robusta, liberica, and excelsa coffee. The research implementation involved the use of equipment including digital scales, a pulping machine, a mortar and pestle, buckets, an electric oven, calipers, a camera, writing utensils, plastic clips, and label paper. The research was conducted at the Integrated Laboratory of the Department of Agroecotechnology, Faculty of Agriculture, Lambung Mangkurat University. The study was carried out over a period of four months from June to September 2022.

The researcher employed a Randomized Complete Block Design with two test factors. The observed objects in this study were determined by the drying oven temperature (S) with three different temperature treatments, namely S1: Drying temperature of 80°C, S2: Drying temperature of 90°C, and S3: Drying temperature of 100°C. The second factor tested in this research was the type of coffee beans used (J). These three types of coffee beans consisted of liberica coffee (J1), robusta coffee (J2), and excelsa coffee (J3). The treatments comprised nine types of treatment combinations, with each treatment being repeated three times, resulting in a total of 27 experimental units.

Sample Preparation. The preparation of samples began by collecting ripe fruits of liberica, robusta, and excelsa coffee. The coffee fruits used as samples in this study were obtained from coffee plantations in two villages. Robusta coffee was sourced from the Deva Robusta Borneo coffee plantation in Bentok Village, Bati-Bati Subdistrict, Tanah Laut Regency, while liberica and excelsa coffee were sourced from Nusa Indah Village, Bati-Bati Subdistrict, Tanah Laut Regency, South Kalimantan Province. For each type of coffee, a minimum of 10 kg of ripe red coffee fruits ready for harvest was required for preparation.

Sorting. The liberica, robusta, and excelsa coffee harvested and deemed suitable as samples in this study are coffee fruits with a maturity level of 6 or coffee that has reached a reddish-yellow color. The yellow to red color indicator can be a sign that the coffee fruit is ready for harvesting. The sorting process is carried out to standardize the coffee fruit samples used in this study. Additionally, the sorting process is also performed to separate good coffee fruits from branches, leaves, gravel, and defective coffee fruits.

Coffee Fruit Depulping. The post-harvest process employed in this study is the wet milling process using a wet pulping machine or pulper. Depulping in this study aims to separate the coffee pulp from the coffee beans. The depulping process on the pulper machine involves feeding sorted fresh coffee fruits into the machine along with flowing water. The fruits are then pulped using two rotating cylinders, resulting in coffee beans still encased in parchment skin, which will then undergo fermentation (Rahardjo, 2012) [3].

Coffee Bean Fermentation. The fermentation process after coffee fruit depulping is necessary to remove the mucilage layer that protects the coffee beans. Additionally, fermentation is partly conducted to reduce the bitterness in the resulting coffee. This process involves soaking the coffee beans, still coated with mucilage, in clean water for 24 hours. This soaking process helps remove the mucilage layer from the coffee beans. After 24 hours, the coffee beans must be rinsed again with flowing water to ensure the cleanliness of the beans that have undergone the fermentation process.

Washing: The washing process aims to clean the remaining mucilage from the fermentation process that still adheres to the coffee beans. For small-scale operations, the washing process is carried out manually using buckets. Once the washing process of the coffee beans is complete, the washed coffee beans are left to air dry before proceeding to the next step.

Drying: The drying of liberica, robusta, and excelsa coffee beans is carried out through an oven drying process lasting approximately 7 hours. Drying is conducted at three different temperatures: 80°C, 90°C, and 100°C. Once dried, the coffee beans are wrapped in aluminum foil and then placed in plastic clips labeled with the respective experimental unit code to keep them separated and uncontaminated from external air and other contaminants. The drying duration remains consistent at approximately 7 hours across all treatments, with variations in temperature set at 80°C, 90°C, and 100°C.

Measurement of Moisture Content: According to the National Standardization Agency (2008) [4], moisture content measurement is conducted through the oven drying method. The drying process using an oven begins by sterilizing porcelain dishes at 105°C for approximately 60 minutes. Subsequently, the dishes are placed in a desiccator for 15 minutes to cool them down before weighing. Then, the dishes are filled with the sample material, with each sample weighing 3 grams, and dried in the oven at 105°C for 6 hours. This treatment is repeated 3 times until the sample material's weight remains constant. To calculate the moisture content, the following formula can be used:

$$MC\ (\%) = \frac{W1 - W2}{W1} \times 100\%$$

Where:
MC = Moisture Content (%)
W1 = Initial weight of the sample (grams)
W2 = Weight of the sample after oven drying (grams)

Separation of Defective Beans: The separation of defective or defective coffee beans is carried out after the oven drying process is complete. Normal and defective coffee beans are separated according to the standards set in (SNI 01-2907-2008) (BSN, 2008) [4].

Color of Coffee Beans: Color testing on coffee beans is conducted using an RGB Color Detector application, assisted by a camera capturing images of the coffee beans against a white background. Color observations of the coffee beans are made using the camera of an iPhone 13 Pro smartphone with a resolution of 12 MP.

Measurement of Coffee Beans: Measurements are conducted using a caliper with millimeter units. The measurement units include length (L) and diameter (D) of the coffee beans. Measurements are taken before and after the oven drying process. According to (SNI 01-2907-2008), good quality coffee beans exhibit high uniformity in size (BSN, 2008)

3. Discussion

Moisture Content

One of the crucial indicators in determining the quality of coffee beans is the moisture content contained within the beans. This calculation is based on a wet basis, which is the comparison between the weight of water in the coffee beans and the weight of the wet coffee beans. Several factors influence the moisture content value of coffee beans, including the raw material or coffee fruit used, and the moisture content of the coffee beans is also greatly influenced by the storage conditions of the coffee beans. Coffee beans with moisture content that meets the standard will minimize chemical and biological damage during the storage process (Hidayat, 2021) [5].

Temperature is a key factor in the coffee bean drying process to achieve moisture content suitable for SNI quality standards. According to Zahro et al. (2009) [6], drying temperature significantly affects the evaporation process of water contained in coffee beans. High temperatures aid in the evaporation of water molecules. However, excessively high temperatures can cause evaporation to occur too quickly, leading to an imbalance between the rate of evaporation and the forces of attraction between liquid and solid substances.

Excessively high moisture content in coffee beans can trigger oxidation reactions and increase the rate of hydrolysis processes. The longer the drying time, the lower the moisture content of the coffee beans. This occurs because the moisture content in the material reaches saturation point, leading to evaporation or conversion of liquid into gas (Wiranata, 2016) [7].

Table 1: Average Moisture Content Values of Coffee Beans with Different Temperatures and Three Different Coffee varieties

Number	Treatments	Respective Moisture Content	Quality Criteria
1	J1S1	29,9 - 33,1%	Ineligible Criteria
2	J1S2	40,2 - 42%	Ineligible Criteria
3	J1S3	40,7- 42,7%	Ineligible Criteria
4	J2S1	31,5 - 34,5%	Ineligible Criteria
5	J2S2	45,3 - 47,1%	Ineligible Criteria
6	J2S3	40,1 – 42%	Ineligible Criteria
7	J3S1	32,2 - 34,3%	Ineligible Criteria
8	J3S2	43,3 - 45,8%	Ineligible Criteria
9	J3S3	41,7 - 43,5%	Ineligible Criteria

Description: J1S1 = Temperature 80°C Liberika coffee; J1S2 = Temperature 90°C Liberika coffee; J1S3 = Temperature 100°C Liberika coffee; J2S1 = Temperature 80°C Robusta coffee; J2S2 = Temperature 90°C Robusta coffee; J2S3 = Temperature 100°C Robusta coffee; J3S1 = Temperature 80°C Excelsa coffee; J3S2 = Temperature 90°C Excelsa coffee; J3S3 = Temperature 100°C Excelsa coffee.

The results indicate that analyzing moisture content using ovens at temperatures of 80°C, 90°C, and 100°C does not meet the quality criteria. This is because, based on the data ranges above, the moisture content did not meet the quality standards set for coffee beans in the Indonesian national standard for coffee commodities, where each treatment should meet the standard moisture content range, which is a maximum of 12.50%. The average range of moisture content values in coffee beans with different temperatures and three different coffee varieties can be seen in Table 1.

According to Lubis (2008) [8], the drying temperature parameter significantly affects the moisture content because higher temperatures trigger an increase in the evaporation rate, which removes moisture content from the coffee beans. Moisture content ranges exceeding 13.00% will increase the growth of microorganisms such as fungi during coffee bean storage, while moisture content below 8.50% will make the coffee beans very brittle and increase the risk of decreasing coffee bean quality due to the high number of defective beans caused by breakage or splitting (Farah, 2012) [9]. The high percentage of moisture content ranges obtained in this study, as well as the difference in percentage of moisture content in each treatment, is not significant. This occurs because before the drying process, the moisture content in each treatment sample varied. The researchers did this with the aim of determining the wet basis percentage moisture content using variations in drying temperature using mechanical drying methods (ovens) tested without undergoing dry basis moisture content testing stages.

The moisture content in food ingredients also plays a role in forming the organoleptic properties of products (Lestari et al., 2017) [10]. Moisture content is a focus for consumers when selecting products to purchase because it affects the physical appearance of a product. Excessively high moisture content, especially in dried grain products, will have a negative impact on the quality and integrity of the material. This is related to oxidation reactions and optimal microbial growth conditions that have the potential to degrade quality and integrity (Winarno, 2008).

This study employed wet basis drying with a single oven drying process, starting from coffee beans after they were washed and briefly drained, leaving the test material slightly damp. Based on the data in Table 1, which shows the range of moisture content generated in the drying process in this study, it does not comply with the quality standard criteria of the Indonesian National Standard (SNI), where the moisture content range for coffee beans should be a maximum of 12.50%. Therefore, the results of this study do not meet the SNI Coffee Bean standard criteria. Further testing through dry basis moisture content testing is necessary to obtain more significant results.

3.1 Defective Coffee Beans

According to Novita et al. (2010) [11], damaged or defective coffee beans are categorized into several types of damage, including those occurring since cultivation, such as hollow beans, black beans, and immature beans. Additionally, there are damages resulting from processing or post-harvest processes, such as broken beans, beans still with husks, beans with brownish coloration, beans with many spots on their surface, and the presence of empty coffee shells or coffee that has passed through processing. The last category involves contamination from foreign objects mixed into the coffee bean collection. If the total defects due to contamination from foreign objects reach 20-25%, then the coffee beans are classified as "asalan" coffee [12].

The post-harvest process also affects the physical quality of coffee beans. The physical quality of coffee plays a crucial role in the implementation of post-harvest technology if done correctly. Based on the defect value calculated from samples that have undergone drying treatment, if a single coffee bean has more than one defect value, then the determination of the defect value is based on the weight of the largest defect value (BSN, 2008) [4]

Table 2: Average Defect Values of Coffee Beans with Different Temperatures and Three Different Coffee Varieties

Number	Treatments	Average Defect Values	Quality Criteria
1	J1S1	66,07	4th Criteria
2	J1S2	50,93	4th Criteria
3	J1S3	77,63	4th Criteria
4	J2S1	296,97	Ineligible Criteria
5	J2S2	177,18	6th Criteria
6	J2S3	356,52	Ineligible Criteria
7	J3S1	168,85	6th Criteria
8	J3S2	190,78	6th Criteria
9	J3S3	72,87	4th Criteria

Description: J1S1 = Temperature 80°C Liberika coffee; J1S2 = Temperature 90°C Liberika coffee; J1S3 = Temperature 100°C Liberika coffee; J2S1 = Temperature 80°C Robusta coffee; J2S2 = Temperature 90°C Robusta coffee; J2S3 = Temperature 100°C Robusta coffee; J3S1 = Temperature 80°C Excelsa coffee; J3S2 = Temperature 90°C Excelsa coffee; J3S3 = Temperature 100°C Excelsa coffee.

Based on the average defect values of coffee beans with different temperatures and three different coffee varieties, as shown in Table 2, the percentage of defective beans obtained in this study does not meet the standards of SNI 01-2907-2008 [4]. In the table, it can be observed that the defect values for all samples range from 50.93 to 356.52. Thus, with this range of defect values, the quality classification varies from Grade 4 to not meeting the criteria, falling into the category of "asalan" coffee.

Black bean defects in coffee are classified into fully black beans, partially black beans found only on part of the surface, and beans that are not only black but also cracked due to processing. If defects are found with holes on the surface of the beans, this is usually caused by attacks from coffee berry borer (CBB) pests. Pest attacks on coffee berries will ultimately result in chemical damage to the coffee beans [11].

Damage to coffee beans can be minimized with proper sorting processes. The diversity in shape and size often found in coffee berries will naturally lead to various outcomes during the coffee cherry pulp removal process. Coffee beans with relatively large sizes usually have their husks removed along with the pulp. Husks can minimize the occurrence of damage to coffee beans during processing (Wahyudi et al., 1999) [13].

Based on the quality classification criteria for robusta and arabica coffee, the percentage results obtained for liberica and excelsa coffee types using the arabica coffee quality fall into grade 4, where the percentage of defective beans ranges from 45-80 beans (SNI 01-2907-2008). The treatment duration of ±7 hours with varying temperatures of 80°C, 90°C, and 100°C tested in this study has met the optimal drying time for liberica and excelsa coffee types but has not met the criteria for good quality, as the obtained defect values do not meet the grade 1 or 2 coffee quality standards according to the Indonesian National Standard.

Based on the quality classification criteria for robusta and arabica coffee, the percentage results obtained for robusta coffee using the robusta coffee quality fall into grade 6, and two treatments do not meet the criteria, where the percentage of defective beans ranges from 151-225 beans, and those not meeting the criteria have defect values exceeding 225 beans (SNI 01-2907-2008) [4]. The treatment duration of ±7 hours with varying temperatures of 80°C, 90°C, and 100°C tested in this study has met the optimal drying time for robusta coffee types but has not met the criteria for good quality, as the obtained defect values do not meet the grade 1 or 2 coffee quality standards according to the Indonesian National Standard.

The temperature and duration of drying treatments tested in this study have not met the optimal drying time for coffee because they fall into the wet basis. Further testing with a dry basis is needed to obtain the maximum moisture content from drying. This is because moisture content significantly affects the defect value of coffee beans.

According to Yusianto & Mulato (2002) [12], coffee beans that enter the drying process without husks will experience physical damage and flavor loss. This is because the husks on the outer part of the coffee bean serve as protection before reaching the core of the coffee bean. Therefore, coffee beans that still have husk layers are protected from potential physical defects that may affect the flavor of the final processed coffee

3.2 Colors of Coffee Beans

The color of coffee beans is a crucial parameter in determining the quality of coffee beans. The colors typically found in coffee beans vary, ranging from yellow, grayish-blue, black, to brown. According to Rosmaya (2020) [14], coffee beans with good quality are those with a grayish-blue color and a uniform appearance. Conversely, coffee beans with a brown or dark color are considered to have relatively lower quality.

Table 3: Average Color Code of Coffee Beans with Different Temperatures and Three Different Types of Coffee

Number	Treatments	Color Code				Color Description	Color
		Red	Green	Blue	Hex Code		
1	J1S1	130,9	111,8	73,9	#ff816f49	French Bistre	
2	J1S2	98,7	91,43	73,13	#ff625b49	Umber	
3	J1S3	77,23	66,5	46,67	#ff4d422e	Terra Brown	
4	J2S1	88,53	80,67	67,3	#ff585043	Brown Grey	
5	J2S2	125,7	117,5	96,9	#ff7d7560	Reed Green	
6	J2S3	109,1	103,13	89,7	#ff6d6759	Quartz Grey	
7	J3S1	126	110	72,47	#ff7e6e48	French Bistre	
8	J3S2	137,2	131,2	113,5	#ff898371	Pearl Mouse	
9	J3S3	136,5	121,77	73	#ff887949	Gold Fusion	

Description: J1S1 = Temperature 80°C Liberika coffee; J1S2 = Temperature 90°C Liberika coffee; J1S3 = Temperature 100°C Liberika coffee; J2S1 = Temperature 80°C Robusta coffee; J2S2 = Temperature 90°C Robusta coffee; J2S3 = Temperature 100°C Robusta coffee; J3S1 = Temperature 80°C Excelsa coffee; J3S2 = Temperature 90°C Excelsa coffee; J3S3 = Temperature 100°C Excelsa coffee.

According to Farah (2012) [9], a moisture content exceeding 13.00% will increase the growth of microorganisms such as fungi during coffee bean storage, while a moisture content of less than 8.50% will make the coffee beans very brittle and increase the risk of decreased quality due to the high number of defective beans caused by breakage. According to Kembaren et al. (2021) [15], to reduce the occurrence of brown-colored defects on the surface of coffee beans, it is advisable for the coffee beans to undergo pre-drying shortly before mechanical drying.

The coffee bean color table shows the color after drying using an oven, as the color of coffee beans is influenced by post-harvest and drying processes, resulting in changes in the color of the coffee beans. As seen in the table above, at 100 °C, the color appears darker compared to drying using ovens at 80-90 °C.

The color parameter of coffee beans is always associated with the final taste produced by the coffee beans. For example, coffee beans with a bluish-green color are considered to have a high level of freshness, while coffee beans with a yellow to brownish-yellow color suggest that the coffee can be stored for a longer period. ISO provides recommendations for categorizing the color of coffee beans, including greenish, blue, brownish, yellowish, and whitish (Illy & Vianni, 1995) [16]. The average color codes of coffee beans with different temperatures and three different types of coffee can be seen in Table 2.

Based on Table 2, it is observed that at a temperature of 100 °C, the coffee beans tend to have a brownish color. According to (SNI 01-2907-2008) [4], a brownish color dominating the surface of coffee bean skins can indicate that the post-harvest processing, particularly the drying process, was not carried out properly.

In Table 2, for Liberica coffee beans, the color tends to range from slightly yellowish to dark brown, as Liberica coffee beans typically have a yellowish color, unlike Arabica and Robusta coffee beans, which tend to be greenish to bluish-gray. This distinction arises because Liberica coffee grows at low altitudes below 100 meters above sea level, resulting in a different color characteristic compared to highland coffee varieties such as Robusta and Arabica.

Similarly, for Excelsa coffee beans, the color tends to range from slightly yellowish to grayish-brown. This is because Excelsa coffee beans, like Liberica, typically have a yellowish color, unlike Arabica and Robusta coffee beans, which tend to be greenish to bluish-gray. This difference in color characteristic is due to the fact that Excelsa coffee also grows at low altitudes below 100 meters above sea level, resulting in a different color compared to highland coffee varieties such as Robusta and Arabica.

Robusta coffee beans generally have a greenish to bluish-gray color, but in this study, they exhibit a yellowish to brownish-gray color. This color variation may be attributed to suboptimal drying and the length of the fermentation process after coffee bean washing. Soaking during coffee fermentation can help remove the mucilage covering the coffee bean skins. It is known that this mucilage is composed of glucose or simple sugars, which can degrade during the fermentation or soaking process. Fidiyana et al. (2018) argue that the longer the soaking duration of the coffee beans, the darker the color of the resulting coffee beans tends to be [17].

Widyotomo (2005) [2] stated that the uniformity of coffee bean size is one of the crucial aspects in determining the quality of coffee beans for consumers. Consumers prefer large and uniform-sized beans as they are believed to have better flavor. Not only end consumers but also coffee powder industry players pay significant attention to the homogeneity or uniformity of coffee bean sizes, which will be used as their raw material. Therefore, the selection or classification of coffee beans includes the parameter of bean size to enhance the homogeneity of coffee beans resulting from the sorting process.

According to Yusianto & Mulato (2002) [12], physical properties of coffee beans such as bean size do not significantly affect the taste of coffee beans. The difference in coffee bean size will affect the moisture content and the number of constituent cells in the coffee beans. The average value of coffee bean size with different temperatures and three different types of coffee can be seen in Table 4.

Table 4: Average Value of Coffee Bean Size with Different Temperatures and Three Different Types of Coffee

Number	Treatments	Length of Coffee Bean (mm)	Width of Coffee Bean (mm)	Criteria for Passing the Sieve Size
1	J1S1	9,67	6,67	Large
2	J1S2	8,73	6,13	Medium
3	J1S3	9,03	6,3	Medium
4	J2S1	9,97	7,17	Medium
5	J2S2	9,53	6,87	Medium
6	J2S3	10,4	7,33	Medium
7	J3S1	8,47	5,3	Small
8	J3S2	8,37	5,11	Small
9	J3S3	8,43	5,13	Small

Description: J1S1 = Temperature 80°C Liberika coffee; J1S2 = Temperature 90°C Liberika coffee; J1S3 = Temperature 100°C Liberika coffee; J2S1 = Temperature 80°C Robusta coffee; J2S2 = Temperature 90°C Robusta coffee; J2S3 = Temperature 100°C Robusta coffee; J3S1 = Temperature 80°C Excelsa coffee; J3S2 = Temperature 90°C Excelsa coffee; J3S3 = Temperature 100°C Excelsa coffee.

Coffee beans that are relatively large and uniform facilitate the roasting process in producing consistent coffee flavors and prevent easy burning (Nathsubedi, 2011) [18]. Several factors known to influence the size of coffee beans produced from cultivation processes include the type of coffee grown, the altitude of the coffee-growing region, the variety used, climatic conditions, weather, as well as the availability of water and light during the flowering and fruit maturation process (Decazy et al., 2003) [19].

Based on specific criteria for the size of Arabica coffee beans, the percentage results obtained for Liberica and Excelsa coffee using Arabica coffee quality fall into the categories of large, medium, and small sizes. Liberica coffee falls into the large and medium size categories, while Excelsa falls into the small size category. The criteria for large size are measured using a sieve diameter of 6.5 mm, with coffee beans having a diameter greater than 6.5 mm not passing through the sieve and categorized as large. For medium size, it falls within the diameter range of 6.5-6 mm, based on (SNI 01-2907-2008) [4].

Based on specific criteria for the size of Robusta coffee beans, the percentage results obtained for Robusta coffee using wet processing fall into the medium size category. The criteria for medium size are measured within the sieve diameter range of 7.5-6.5 mm. For Arabica coffee beans, the percentage results obtained for Excelsa coffee using Arabica coffee quality fall into the small size category. The criteria for small size are measured within the sieve diameter range of 6-5 mm (SNI 01-2907-2008) [4].

4. Conclusion

The different drying temperature treatments applied to three distinct types of coffee beans resulted in varied responses across several parameters, including moisture content, the occurrence of defective beans, color, and size. These responses were compared against the quality standards stipulated in SNI 01-2907-2008. Among the treatments, Robusta coffee dried at 90°C exhibited a moisture content closest to the specified standard. Liberica coffee subjected to drying at 100°C demonstrated the most alignment with the quality criteria in terms of defective beans. Regarding the color of coffee beans, those from Robusta and Excelsa varieties displayed characteristics that approached the quality standards. Additionally, in terms of bean size, Liberica coffee dried at temperatures ranging from 80-90°C showed dimensions that closely matched the standards outlined in SNI 01-2907-2008. These findings suggest that specific combinations of drying temperatures and coffee bean types can yield results that closely approximate the quality standards set forth by SNI 01-2907-2008.

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