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Sensory evaluation of Poncokusumo Liberica Coffee based on bean size and post-harvest processing

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ABSTRACT

Coffea liberica from local farm in Poncokusumo, Indonesia has several accessions identified, unfortunately there has been no further sensory research to develop it into high quality coffee products. This study was aimed to evaluate the sensory attributes of different liberica coffee accessions from a local farm in Poncokusumo based on beans size and post-harvest processes. Liberica coffee green beans were dried using two processes: natural and wine, followed by measuring its bean size. The beans were roasted using three roasting levels (light, medium, and dark), and sensory attributes were tested using a cupping test with nine trained panelists based on Specialty Coffee Association (SCA) guidelines. The findings show that the bean size and post-harvesting processes affected the coffee's sensory quality. The highest total score was 77.69 for beans that were dried by natural process and roasted at a light level. Compared to wine processing which earns a "good" score, the optimal drying technique for liberica coffee beans that receive a "very good" grade was natural processing. The flavor of liberica coffee was most optimal at light to medium roasting levels, which produced "very good" results that differed from dark levels. The link between bean size, post-harvest, and sensory attribute values demonstrates that the size and procedure of coffee processing is an important sequence to be observed in order to improve the result to the highest quality. It is expected that the findings of this study can be applied to examine the quality standards of local liberica coffee products in Poncokusumo.

Key words: Coffea Liberica; sensory attributes; post-harvesting process; beans size; Poncokusumo.

1 INTRODUCTION

Coffea liberica W. Bull ex Hiern, also known as Liberica coffee, is one of the various varieties of coffee that have recently attracted attention in their development. Liberica coffee is a species of plant that may grow into a woody tree without being pruned (Hakim et al., 2022). Liberica coffee can also be used as an opportunity for peatland conservation in Indonesia with growth resistance of 98% (Fadillah et al., 2020). Climate change and the problem of coffee plant resilience to pathogens/pests are thought to be the main reasons for the reduction in coffee taste, this has become a focus for global coffee development (Hameed et al., 2018). It is hoped that liberica coffee will become an alternative coffee plant that is resistant to environmental changes and also has resistance to pathogens (Kwok, 2023).

Liberica coffee is grown in several countries, including Vietnam, Indonesia, the Philippines, and Malaysia (Halim-Lim et al., 2022). This coffee has a larger plant structure compared to other types of coffee such as robusta coffee (*Coffea canephora*) and arabica coffee (*Coffea arabica*). Additionally, the size of the fruit and beans is also larger, that is the length of the fruit can reach 2-3cm while the other types of coffee are only about 1-1,5cm (Maxiselly; Nafy; Anjarsari, 2023). *Coffea liberica* is a type of coffee known for its jackfruit and sour taste like arabica. According to research (Mubarak et al., 2019), liberica coffee has a phenolic and polyphenol content that is balanced with the content in arabica coffee so this is potential to be further developed to maximum liberica coffee sensory results. Liberica coffee is one of the coffees with a relatively low commercial bean potential, but exploring sensory qualities is very interesting to increase its marketable value. Pre-harvesting and post-harvesting activities can alter the richness of coffee flavor and hence improve the taste of liberica coffee (Wibowo et al., 2021). The pre-harvesting process includes variety selection, agroecology (soil, altitude, fertilization, climate, and so on), and harvesting method, whereas the post-harvesting process includes fermentation, drying, roasting, storage, grinding, and brewing (Bosselmann et al., 2009). This set of pre and post- harvest coffee processes is regarded to be crucial and plays a significant role in the flavor yields.

Liberica coffee grown in Jajang Hamlet, Poncokusumo Subdistrict, East Java, Indonesia. The local farm is unique in which the beans from the same source of seeds result in three different types of coffee (Wafaretta et al., 2023). This accession group can arise as a result of environmental factors surrounding the tree. Poncokusumo has a high potential for coffee development because the geographical parameters are suitable for coffee and the site is now being developed for conservation and tourism (Hakim et al., 2019). The best post-harvest process and flavours of liberica coffee in this location are still not explored yet, necessitating further investigation to improve the quality of liberica coffee to Indonesian coffee standard requirements SNI 01-2907-2008 (BSN, 2008) (Kemenprin, 2008). The quality of coffee sensory outputs can be influenced by the pre-harvest process (environmental, maintenance, and genetic) and post-harvesting process (harvesting method, drying process, roasting, and storage) (Santos et al., 2018). In this study, we compared coffee beans size, post-harvesting process and the sensory attributes produced. The purpose of this study was to evaluate the sensory attributes of three liberica coffee accessions from local farm in Poncokusumo after some post-harvest treatments.

2 MATERIAL AND METHODS

2.1 Materials

Green beans from three accessions of liberica coffee collected from the local Jajang Hamlet, Poncokusumo Subdistrict farm in East Java, Indonesia at latitude 80.83969, -112.810467 at an altitude of 999-1000 meters above sea level. Green beans are grouped based on their tree morphology, namely accession 1 (A-1), accession 2 (A-2), and accession 3 (A-3) which can be seen inside Table 1. The coffee utilized in this study was harvested using a red picking method.

2.2 Drying

The natural and wine process are the two methods for drying coffee. The natural technique is the most commonly employed by local processors, beginning with the liberica coffee harvest being sorted (coffee cherries with defects are rejected), then sun-dried for 40 days (Haile; Kang, 2020; Sunarharum et al., 2018). The wine drying process was started with the washing and sorting of the harvested coffee cherries, followed by sun-drying for 5 hours. The coffee beans were stored in impermeable plastic for 45 days and being sun-dried for 3 hours every 5 days until water content was 11-12% (Prono-Widayat et al., 2021). Sun-drying was conducted on a net box to maintain humidity and moisture content achieved at 12% (Taveira et al., 2015).

2.3 Green bean measurement

Green beans were obtained after the drying process completed, pulping, and then grouped according to their accessions in each drying process. The length (L), width (W), and thickness (T) of the beans were measured using vernier calipers with a sample of 30 beans of each accession. Then the results of these calculations are used to calculate the volume index (V) and shape index (SI) equation 1 (Wondimkun; Emire; Esho, 2020):
Volume Index (V) equation 2:

$$V = \frac{\pi}{6} LWT \qquad (1)$$

Shape Index (SI):

$$SI = \frac{L}{\sqrt{(W * T}} \qquad (2)$$

2.4 Roasting

The roasting process was divided into three levels: light, medium, and dark (Sunarharum; Williams; Smyth, 2014). Each variant that has been dried using two procedures (natural and wine) was roasted to generate NL (natural light), NM (natural medium), ND (natural dark), WL (wine light), WM (wine medium), and WD (wine dark). The following roasting parameters employed in this study were initial temperature 190^{o}C, final temperature 210 ^{o}C, roasting time depends on the roasting level (determined based on the color of the roast beans), room temperature 30 ^{o}C, weight of each roast 100 g, and coffee roasting machine using WE x SUJI Mini Roaster.

2.5 Sensory Test

Sensory attributes of liberica coffee were identified using the Specialty Coffee Association (SCA) method by nine trained panelists consisting of coffee roasters (4), senior baristas (4), and Q grader (1). The subjects or panelists required for this research are subjects who are physically and mentally healthy, do not have congenital diseases (particularly those affecting sensory processes such as sinuses), not colorblind, and have good taste perception skills, particularly for coffee. Cupping takes place at a local Malang coffee shop,

Table 1: Morphological differences of 3 accessions in the local Poncokusumo garden (Wafaretta et al., 2023).

Morphology	Accession-1	Accession -2	Accession -3
Tree Height (m)	6.63	5.23	4.78
Stem circumference (cm)	34.25	29.00	28.50
Tree architecture model	Rauh	Massart	Roux
Laminar length (cm)	31.8 ± 2.9	34.5 ± 4.50	29.4 ± 3.17
Laminar morphology width (cm)	14.65 ± 1.59	16.01 ± 2.28	15.93 ± 1.81
Margin type	Entire-Undulate	Undulate	Entire
Apex angle	Acute-Obtuse	Acute	Acute
Base angle	Acute	Rounded	Acute

with cupping facilities include tables and chairs separated by ±0.5-1 m, an open room for air circulation, health protocols like masks, hand sanitizers, and thermometers, clean cupping equipment, and clean water. In the sensory test, 15 g of ground coffee were brewed in 150 mL of hot water (95-99^{0}C) in a cupping bowl, with each sample was brewed in five cup for repetition. Sensory attribute parameters assessed quantitatively in this study were aroma, taste, aftertaste, acidity, body, balance, sweetness, clean cup, uniformity, overall, defects, and qualitatively were tasting notes and ground coffee aroma. The blind test method was used to ensure that panelists provided the objective results. The SCA score has five quality levels: good (scoring 6.0-<7), very good (score 7.0-<8), excellent (score 8.0-<9), and outstanding (score 9.0-<10) (SCAA, 2015). This research is also appropriate and has received a code of ethics number 718 / KEPK-POLKESMA/ 2022.

2.6 Statistical Analysis

The results were analyzed statistically using Kruskal-Wallis analysis and one-way analysis of variance (ANOVA) to determine the mean value, standard error, coefficient of variation, correlation value, and r-square with the SPSS ver.20 program. The values were expressed as a mean, ± standard deviation to determine the significant differences among all testing means at $\alpha = 0.05$. The correlation between beans size, post harvest process, and sensory test results was studied through correlation analysis. Descriptive analysis of the relationship between beans size with sensory attributes was carried out by comparing the results from correlation analysis with the Spearman correlation coefficient value classification, namely r < 0.20 very weak relationship, r = 0.20–0.39 weak correlation, r = 0.40–0.59 median correlation, and r = 0.60 –0.79 of a strong correlation.

3 RESULT

The liberica coffee found in the local Poncokusumo garden suggests the presence of three distinct accessions based on plant morphology. Figure 1 shows the morphological differences of these three accessions in terms of the shape of the beans. The third color of liberica coffee beans is obtained following the drying process and pulping, which appears yellowish.

Table 2 shows the size of the ratio derived from each accession group that has been dried natural and wine process. In general, beans that are dried through natural processes have a larger size compared to beans dried using the wine process at the three accesions.

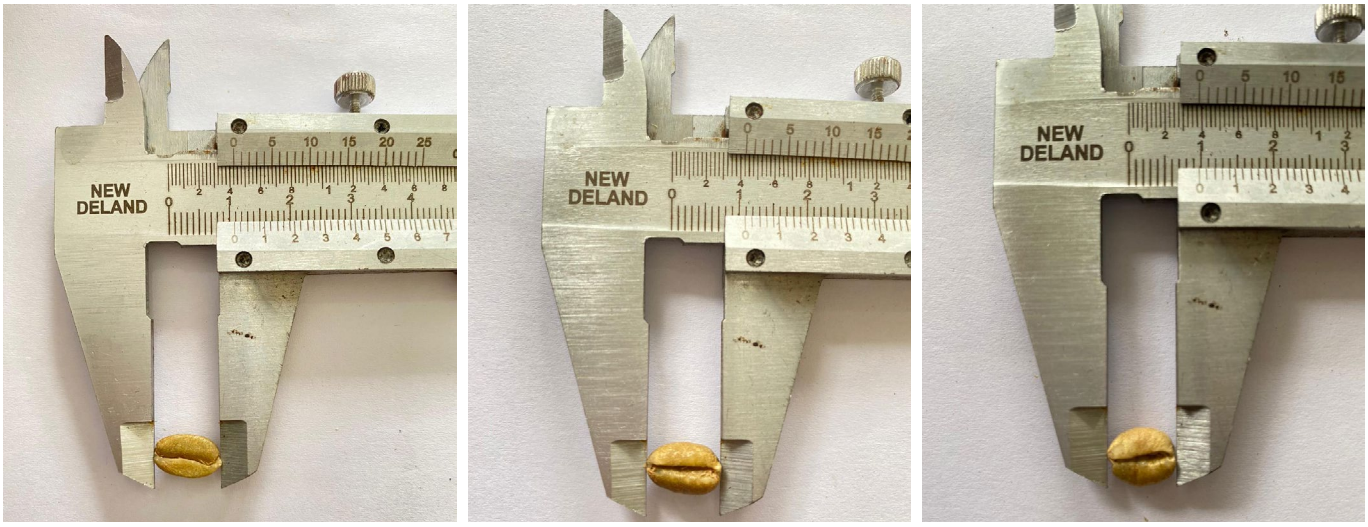

Figure 1: Morphology of liberica coffee green beans. (Source: research data).

Table 2: Size of green beans for liberica coffee (Wafaretta et al., 2023).

Measurement	Accession 1		Accession 2		Accession 3	
	Natural	Wine	Natural	Wine	Natural	Wine
Length (mm)	10.32 ±0.72	9.78 ±0.79	11.41 ±0.53	11.25 ±0.57	10.55 ±0.73	9.95 ±0.94
Width (mm)	7.6 ±0.55	7.60 ±0.38	6.95 ±0.45	6.95 ±0.50	7.62 ±0.58	7.58 ±0.59
Thickness (mm)	4.48 ±0.34	4.59 ±0.46	4.27 ±0.36	4.15 ±0.42	4.9 ±0.58	4.84 ±0.48
Beans Volume (mm^3)	177.93	175.37	177.69	168.15	192.16	188.16
Shape Index	1.85	1.65	2.11	2.06	1.78	1.62

The drying process appears to have a significant impact on the size of the beans obtained, with the size reduction appearing higher in beans treated in wine. This could be related to the length of drying process used in this research, which is wine process takes longer time than the natural process. The sizes of A1 and A3 coffee beans are similar, with natural process A1 having length; width; and thickness of average of 10.32; 7.6; 4.48 and A3 having 10.55; 7.62; 4.9, which is the same as the average of the wine process length; width; thickness on average A1 9.78; 7.60; 4.59 and A3 9.95; 7.58; 4.84. A2 differs from the other accessions in that the average length, width, and thickness of natural processed beans are 11.41; 6.95; 4.27, whereas the wine process is 11.25; 6.95; 4.15. Beans volume indicates that A3 has the biggest overall volume size, whereas A1 and A2 have nearly identical volume indexes. The biggest shape index is shown in A2, where A2 dimensions are bigger than the other accessions.

The results of 9 trained panelists are shown in Figure 2, where the sensory differences among naturally and wine processed liberica coffee are significant. The greatest aroma value results in the natural process were A-2 NL 7.33 and A-1 WL 7.19 in the wine process. The highest comparison of flavor values is seen in A-1 NL 7.45 and A-2 WD 6.78. Flavor value is a perception formed by combining taste in the mouth with aroma in the retronasal olfactory area. The aftertaste is a flavor continuation that appears in the mouth and throat (Specialty Coffee Association - SCA, 2023). The highest aftertaste scores were A-2 NM 7.33 and A-2 WD 6.69.

A-1 NL 7.53 and A-2 WL 6.92 have the highest acidity levels from both process. High acidity may lead to a dissimilar flavor in the sensory attributes of coffee, while low avidity makes the taste of coffee flat and relatively bitter (kind of like tobacco) (Nebesny; Budryn, 2006). The greatest uniformity scores are A-2 ND and A-3 NL, both with 9.33, and A-1 WD, A-2 WL, A-3 WM, and A-3 WD, all with 9.78, indicating that coffee cupping in this study was consistent among samples. Samples with a high balance score are A-1 NL 7.72 and A-2 WL 6.83. The highest clean cup score is A-2 NL 9.78, followed by A-1 WL and A-2 WL 8.89, indicating that the brewed liberica coffee is quite clean with nothing interfering with the taste.Sweetness or the sweet taste attribute had the highest score in samples A-2 ND 8.89 and A-3 WL 7.33, indicating the presence of sweet flavor varieties in this coffee. The largest defect only found at A-3 ND with 1.33 and the rest had a score of 0, indicating that the sorting and post-harvest procedure in this study was fairly good without leaving a defect perception. The A-1 NL sample had the greatest overall value of liberica coffee in the natural process, with a value of 7.39, followed by the A-1 WM wine process, with a value of 6.67. The total value of this cupping shows that numerous sensory attributs, such as flavor, aftertaste, and balance, are not optimal. The liberica coffee sensory qualities of the natural drying process receive a “very good” rating in the range 7-<8, whereas wine drying receives a “good” rating in the range 6-<7.

Figure 3 shows the total sensory scores obtained from each process carried out in this study. Coffee processing is a complex method, hence coffee evaluation has become a standard for evaluating coffee quality (Huch; Franz, 2014). The total score of all liberica coffee taste assessments displayed in Figure 3 shows that the natural process score is higher than the wine process but the wine process has a consistent taste score than the natural process. The best score is 77.69 at A-1 NL and the lowest is 69.69 at A-3 ND. The differences between these coffee processes were also tested using the Kruskal Wallis test (at $P \leq 0.05$). The drying procedure of each accession presents significantly difference effects in various sensory attributes, including aftertaste, body, balance, and overall. Accessions within one coffee species have a significant impact on the aroma and sensory attributes of the coffee.

Table 3 shows the results of the aroma of ground coffee and liberica coffee tasting notes from each treatment showing different results, especially in the natural and wine processes. The SCA cupping test offers results in the form of ground coffee aroma and tasting notes in addition to sensory attribute score results. The results of this research findings are very interesting. Liberica coffee well known for having jackfruit overtones in its flavor, yet Table 3 shows that only A-2 NL, A-3 NL, and A-1 WM are present. The results in Table 3 suggest that natural drying can improve the aroma and flavor of liberica coffee. Aromas of tropical fruit, chocolate, sweet, and cinnamon arise after the natural process. Tasting notes in the natural drying process differ from those drying in wine process that the aromas of the wine are woody, nutty, fruity, and winey. The tasting notes of each roasting method also got differentiation, although it can be noticed that liberica coffee processed by NL (Natural Light) has more fruity tasting notes, while the NM (Natural Medium) process has fruity, choco, and caramel tones, and the ND (Natural Dark) procedure can generate bitter, astringent, and brown sugar flavors. The results of tasting notes from drying wine, notably WL and WD, indicate parallels in that unpleasant aromas such as rubbery, woody, smokey, and burnt occur, which is much different from the natural drying process. Even though a burnt taste remains, it appears that the wine process with a medium roasting level is a more acceptable procedure and can offer the sense of richer flavors such as fruity, choco, bitter, and caramel. According to the findings of this study, liberica coffee accessions in the local Poncokusumo coffee farm are less able to release their aromas utilizing the wine drying method than the natural drying procedure.

Table 4 show the simple coefficient of correlation from each process. The correlation results in Table 4 show that the type of accession doesn’t give a relationship to the sensory results, but the size and shape of the coffee beans and

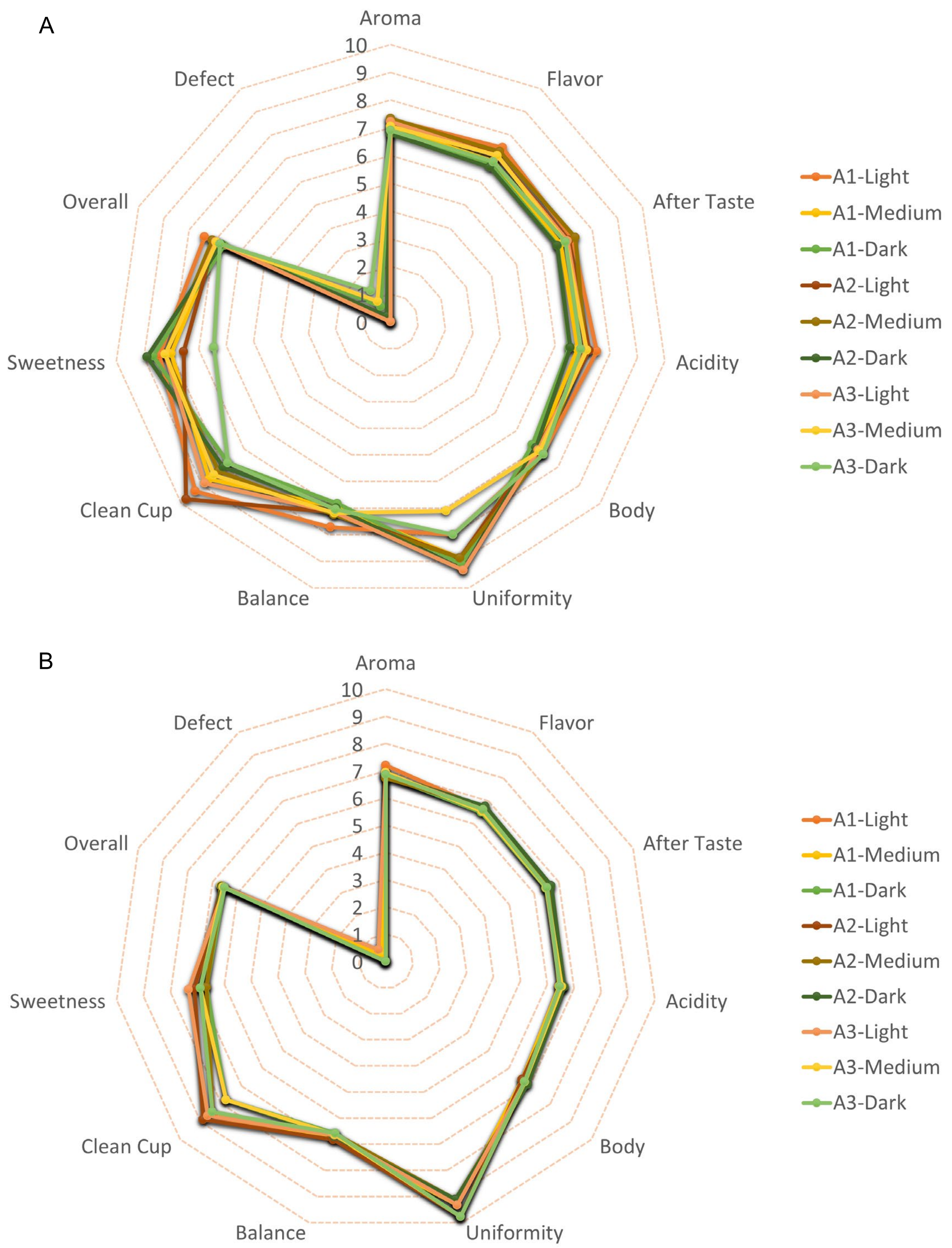

Figure 2: Sensory Test Result Natural process (A) and wine process (B).

the method of processing present a correlation to the sensory attributes. The drying process presents a positive correlation where different types of drying have an influence on aroma, flavor, aftertaste, acidity, body, balance, sweetness, and overall, but they also have a negative correlation on uniformity. The roasting process gives a negative correlation where the higher the roasting level, the smaller the cleancup value. The length of the beans shows a positive correlation, which is the bigger the length of the beans, the higher the value of flavor, aftertaste, balance, sweetness and overall. Positive corellation demonstrates that the higher the volume index, the higher the aroma value, and the higher the shape index of liberica coffee beans, the better the sensory results in aftertaste, balance, and overall. The drying and roasting methods were strongly correlated with sensory qualities, but bean length, volume index, and shape index in moderately correlation.

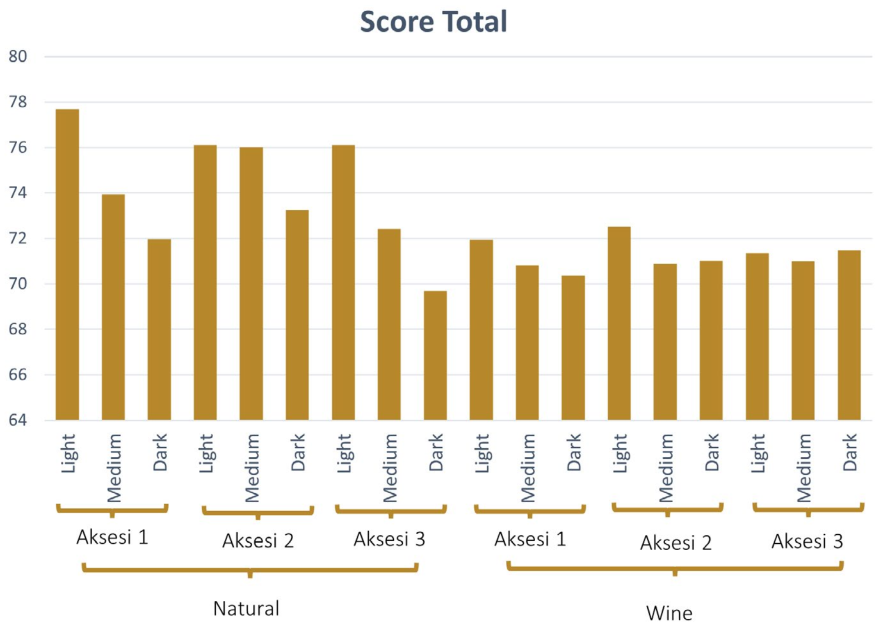

Figure 3: Total score of sensory test.

Table 3: Aroma of liberica coffee ground coffee and liberica coffee tasting notes based on sample type and treatment carried out in the taste test.

Sample			Ground Coffee Aroma	Tasting Notes
Natural	A-1	Light Roast	Tropical Fruit, Green, Vegetal, Sweet, Apple	Vegetal, Pinnaple, Mango, Malic acid, Tartaric, Caramel, Grape, Apple
		Medium Roast	Dark Choco, Sweet, Nutty, Mango, Fruity, Tropical Fruit	Caramel, Nutty, Dark choco, Mango, Starfruit, Grape, Orange peel
		Dark Roast	Smokey, Burn, Dark Choco	Dark Choco, Brown Sugar, Smoky, Bitter, Astringent, Long After Taste
	A-2	Light Roast	Nutty, Jackfruit, Tropical Fruit, Sweet	Tropical fruit, Spices, Malic acid, Choco, Jackfruit
		Medium Roast	Sweet, Brown Sugar, Fruity	Tropical Fruit, Caramel, Nutty, Unpleasant bitter, Malic acid, Bitter, Astringent
		Dark Roast	Dark Choco, Spices, Smokey, Earthy	Astringent, Bitter, Smokey
	A-3	Light Roast	Cinnamon, Nutty, Jackfruit, Caramel, Bread toast	Nutty, Lime peel, Caramel, Malic acid, Tartaric acid, Starfruit
		Medium Roast	Sweet, Brown Sugar, Choco	Hint of tropical fruit, Pinnaple, Tobacco, Caramel, Malic acid, Astringent, Tamarind
		Dark Roast	Choco, Hint of caramel, Burn, Nutty	Tobacco, Jack Fruit, Spices, Nutty, Smoky, Bitter
Wine	A-1	Light Roast	Woody, Winey, Herbs, Dry fruit	Bitter, Astringent, Nutty, Earthy
		Medium Roast	Nutty, Choco, Vegetal, Burn	Jack Fruit, Passion fruit, Spice, Bitter, Astringent
		Dark Roast	Nutty, Kaffir lime, Burnt	Rubber, Burnt, Bitter, Astringent
	A-2	Light Roast	Passion fruit, Plum, Woody	Mango, Smokey, Fermented
		Medium Roast	Cinnamon, Mango	Mango, Passion fruit, Bitter, Astringent, Woody
		Dark Roast	Tropical fruit, Spices, Choco, Caramel	Choco, Caramel, Passion fruit, Bitter, Astringent, Jack fruit, Nutty
	A-3	Light Roast	Nutty, Passion fruit, Mango, Kaffir lime	Bitter, Astringent, Rubbery
		Medium Roast	Nutty, Passion fruit, Mango, Cashew	Choco, Caramel, Mango, Passion fruit, Nutty, Bitter, Astringent
		Dark Roast	Nutty, Passion fruit, Spice, Burnt, Mango	Bitter, Astringent, Rubbery

Table 4: Simple coefficient of correlation.

		Aroma	Flavor	After Taste	Acidity	Body	Uni-formity	Balance	Clean Cup	Sweetness	Overall	Defect
Accession type	Correlation Coefficient	-.184 ns	.171 ns	.204 ns	.099 ns	-.039 ns	-.080 ns	.112 ns	.080 ns	.125 ns	.237 ns	-.373 ns
	Sig. (2-tailed)	.464	.497	.417	.697	.876	.751	.659	.752	.620	.344	.127
Drying process	Correlation Coefficient	.602 **	.699 **	.806 **	.708 **	.806 **	-.710 **	.858 **	.120 ns	.679 **	.795 **	.195 ns
	Sig. (2-tailed)	.008	.001	.000	.001	.000	.001	.000	.635	.002	.000	.438
Roasting process	Correlation Coefficient	-.434 ns	-.323 ns	-.171 ns	-.368 ns	-.039 ns	.047 ns	-.315 ns	-.868 **	-.224 ns	-.283 ns	.172 ns
	Sig. (2-tailed)	.072	.191	.497	.133	.876	.854	.202	.000	.371	.255	.496
Beans length	Correlation Coefficient	.083 ns	.469 *	.555 *	.450 ns	.395 ns	-.344 ns	.527 *	.119 ns	.491 *	.577 *	-.202 ns
	Sig. (2-tailed)	.744	.050	.017	.061	.105	.162	.024	.639	.038	.012	.421
Beans width	Correlation Coefficient	.375 ns	-.063 ns	-.140 ns	.013 ns	.004 ns	.090 ns	-.077 ns	.127 ns	.022 ns	-.213 ns	.222 ns
	Sig. (2-tailed)	.125	.805	.580	.958	.987	.724	.761	.616	.931	.396	.375
Beans thick	Correlation Coefficient	.185 ns	-.315 ns	-.339 ns	-.213 ns	-.087 ns	.342 ns	-.219 ns	.067 ns	-.116 ns	-.302 ns	.119 ns
	Sig. (2-tailed)	.463	.204	.169	.397	.732	.164	.383	.792	.646	.224	.638
Beans Index Volume	Correlation Coefficient	.499 *	.073 ns	.073 ns	.211 ns	.309 ns	-.066 ns	.242 ns	.089 ns	.324 ns	.054 ns	.320 ns
	Sig. (2-tailed)	.035	.775	.775	.401	.213	.794	.333	.724	.189	.832	.196
Beans Shape Index	Correlation Coefficient	-.052 ns	.438 ns	.497 *	.396 ns	.300 ns	-.389 ns	.476 *	.101 ns	.377 ns	.512 *	-.120 ns
	Sig. (2-tailed)	.838	.069	.036	.104	.226	.111	.046	.690	.123	.030	.635

N=18; * = significant at α 0,05; ** significant at α 0,01; ns= not significant.

4 DISCUSSION

The length of Poncokusumo liberica coffee beans is classed as regular because, in terms of beans, two liberica coffee beans have a length of 7-15 mm (Diperpa, 2018). These results indicate that the reduction of A1 and A3 in the wine process is higher compared to A2, which has a fairly similar average between the two drying processes. A2 bean's shape is more oval than the other accessions because they have a longer seed length but a shorter seed width, although seed thickness appears to be the same amongst the three accessions. The drying process of coffee is very directly related to the size of the coffee beans obtained since it reduces the water content of the coffee beans. The length and type of drying process also have an impact, for exampl the wet process produces green coffee beans that are more voluminous than drying without water, which takes a lengthy period, similar to the wine process. (Hameed et al., 2018).

Different drying procedures have a significant impact on the quality of the green beans produced. For example, the natural approach of drying without pulping first results in different outcomes than the wet process, which means pulping before drying (Taveira et al., 2015). Each coffee variant will have a distinct shape and size of coffee beans, which will affect the sensory, as larger coffee beans are typically more flavorful than smaller coffee beans (Seninde; Chambers, 2020). The coffee processing procedure appears to have a positive sensory influence, with the natural process in this study being able to improve the taste of Poncokusumo liberica coffee. The fermentation process will take place all over the drying phase, which will involve various variables such as bacteria, the number of coffee beans, water, temperature, and humidity (Wibowo et al., 2021). Natural drying process coffee typically has a "hard" taste with herbal undertones (Sunarharum; Williams; Smyth, 2014).

The results of aroma ground coffee and tasting notes show that there are better variations, not only dominating jackfruit notes but also the improve of other flavors in the aroma and tasting notes as a result of natural processes. Almost all the aromas and tasting notes varied except accession 3 with dark roasting which got the lowest total score having unpleasant tastes such as tobacco, spices, bitter, and astringent. Natural drying is a drying method that uses direct sunlight to dry the coffee beans has "heavy body" sensory attributes compared to wet drying, and it has a sweet, juicy, orange-citrus flavor profile. Additionally, the natural process can increase aldehyde and lipid ester molecules. Drying wine is a fermentation process that produces various chemical components, including aldehydes, esters, alcohols, and ketones, all of which have an impact on the aroma and flavor (Seninde; Chambers, 2020) and degrades several compounds such as glucose and fructose (Kleinwächter; Bytof; Selmar, 2015). Coffee fermentation, like wine drying process, is a process that requires careful attention in the way it is carried out. The wine process used in this study is relatively simple and the fermentation process during drying in the coffee fruit takes longer than other processes (Sulaiman; Hasni; Alkausar, 2022); however, there are weaknesses that can occur, such as the long drying process, which can result in over-fermentation, contamination, and a reduction in complex sensory attributes (Hameed et al., 2018). In comparison to wine, the results of this study show that liberica coffee from the local Poncokusumo plantation has good sensory qualities when processed naturally. The roasting technique that produces the most fragrance and flavor notes is at the light to medium level. The sensory attributes of the three accessions used in this study varied, with the highest score being Accession 1 natural drying process light roast which achieved a "very good" score of 77.69, with ground coffee aromas of tropical fruit, green, vegetal, sweet, and apple, and tasting notes of vegetal, pineapple, mango, malic acid, tartaric, caramel, grape, and apple. These findings can be used by local communities to sort and focus on the plant qualities listed in order to reach the best quality and obtain quality standards. The overall findings of this study indicate that the accessions in this study have a key part in influencing the taste results, and each accession from the same garden has a different taste.

The relationship between the drying process on the post-harvest and the sensory outcome has a strong correlation and a significant rate of 1%, thus the drying process is considered the most important phase to be noted for improving the quality of the liberica coffee sensory in this Poncokusumo. Basically, a precursor to the taste of coffee is formed starting from the development of the fruit, then the complexity of the taste will become more complete when it enters the post-harvest process (Sunarharum; Williams; Smyth, 2014) 40% of the pre-harvest process influences the sensory results produced by coffee beans and 60% comes from the post-harvest process (Musebe; Agwanda; Mekonen, 2007). Although the impact is indirect because it passes through numerous processes before providing sensory input, but the size of the plant shape and the environment are crucial factors. Gonzalez-Rios et al. (2007) discovered that the size and shape of coffee beans have a substantial influence on sensory findings, specifically flavor, aftertaste, sweetness, and final score. Larger coffee beans typically produce a wider range of sensory results than smaller coffee beans. Additionally, the size of the coffee beans influences the roasting process, resulting in a higher sensory similarity produced by a coffee variant compared to beans of varying sizes. This discussion confirms the findings of this study, which found that coffee bean shape and post-harvest procedures influence sensory attribute results. A high correlation coefficient value in post-harvest can indicate that this procedure is one that truly impacts the end outcome of the coffee taste, although the size of the coffee beans has an indirect influence, resulting in a suitable correlation coefficient value.

5 CONCLUSIONS

It's concluded that the relationship of corellation found between bean size, post-harvest, and sensory attribute values indicates that the size and coffee processing method are crucial steps to follow in order to optimize the sensory outcome to get the highest score. The sensory attributes of three Liberica coffee accessions from local plantations in Poncokusumo, which were evaluated for bean size and post-harvest treatment, found that the best process was a natural drying process followed by a light roasting level. Both processes are able to improve the aroma of ground coffee, tasting notes, and the value of its sensory attributes. These findings can be a reference for use in the commercialization of Liberica coffee or further exploration. The three coffee accessions in the Poncokusumo coffee plantation that got the best score were accession 1 (A1), so farmers can use these findings to focus on cultivating this accession compared to other accessions in the coffee plantation. The wine process which has not shown maximum results is a limitation in this research, so exploring other drying and post-harvest processes is highly recommended to develop the taste of Liberica coffee.

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7 AUTHOR'S CONTRIBUTION

Conceptual Idea: Hakim, L.; Methodology design: Hakim, L., Jatmiko, Y. D., and Sunarharum, W. B. ; Data collection: Wafaretta, E. , Data analysis and interpretation: Wafaretta, E., and Writing and editing: Wafaretta, E., Jatmiko, Y. D., and Sunarharum, W. B.

8 REFERENCE

BOSSELMANN, A.S. et al. The influence of shade trees on coffee quality in small holder coffee agroforestry systems in Southern Colombia. **Agriculture, Ecosystems & Environment**, 129:253-260, 2009.

BADAN STANDARDISASI NASIONAL – BSN. **SNI 01-2907-2008**. 2008. Available in: https://www.cctcid.com/wp-content/uploads/2018/08/SNI_2907-2008_Biji_Kopi-1.pdf. Access in: 27 August 2024.

FADILLAH, A. et al. Development of peatland-friendly commodities to achieve sustainable forest management in Jambi Province. **IOP Conference Series: Earth and Environmental Science**, 528:012007, 2020.

DIPERPA. Mengenal tanaman kopi liberika. **Jurnal Bumi.com, Bandung**. 2018. Available in: https://diperpa.badungkab.go.id/artikel/18070-mengenal-tanaman-kopi-liberica. Access in: 27 August 2024.

GONZALEZ-RIOS, O. et al. Impact of "ecological" post-harvest processing on coffee aroma: II. Roasted coffee. **Journal of Food Composition and Analysis**, 20(3-4):297-307, 2007.

HALIM-LIM, S. A. et al. Optimum condition of roasting process of Liberica coffee towards the local and international preference. **Food Research**, 6(3):115-123, 2022.

HAILE, M.; KANG, W. H. The harvest and post harvest management practices impact on coffee quality. London: IntechOpen. In: CASTANHEIRA, D. T. **Coffee - Production and research**: 1-18. 2020.

HAKIM, L. et al. Coffee landscape of banyuwangi geopark: Ecology, conservation, and sustainable tourism development. **Journal of Tropical Life Science**, 12:107-116, 2022.

HAKIM, L. et al. Fostering coffee agroforestry for agrotourism de velopment in degraded land in a buffer zone of a national park: A case study from Poncokusumo, Malang, Indonesia. **EurAsian Journal of BioSciences**, 13:1613-1620, 2019.

HAMEED, A. et al. Farm to consumer: Factors affecting the organoleptic characteristics of coffee. II: Postharvest processing factors. **Comprehensive Reviews in Food Science and Food Safety**, 17(5):1184-1237, 2018.

HUCH, M.; FRANZ, C. Coffee: Fermentation and microbiota. *In*: HOLZAPFEL, W. **Advances in fermented foods and beverages improving quality: Technologies and health benefits**. A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition. p. 501-513, 2014.

KLEINWÄCHTER, M.; BYTOF, G.; SELMAR, D. Coffee beans and processing. *In*: PREEDY, V. R. **Coffee in health and disease prevention**. Elsevier, pp. 73-81, 2015.

KWOK, R. S. New sensory lexicon for liberica coffee: Insights into the sensory attributes of the different origins, processing methods, elevation, and roasting. **Proceedings**, 89(1):250, 2023.

MAXISELLY, Y.; NAFY, F. R.; ANJARSARI, I. R. D. Morphological trait variation of the immature liberica coffee (*Coffea liberica*) from West Java, Indonesia applied difference of coffee husk compost and biofertilizer. **Biodiversitas**, 24(11):5988-5994 2023.

MUBARAK, A. et al. Comparison of liberica and arabica coffee: Chlorogenic acid, caffeine, total phenolic and DPPH radical scavenging activity. **Asian Journal of Agriculture and Biology**, 7(1):130-136, 2019.

MUSEBE, R.; AGWANDA, C.; MEKONEN, M. Primary coffee processing in Ethiopia: patterns, constraints and determinants. **African Crop Science Conference Proceedings**, 8:1417-1421, 2007.

NEBESNY, E.; BUDRYN, G. Evaluation of sensory attributes of coffee brews from robusta coffee roasted under different conditions. **European Food Research and Technology**, 224:159-165, 2006.

PRONO-WIDAYAT, H. et al. Chemical analysis of cascara tea from wine coffee processing with a different fermentation times. **IOP Conference Series: Earth and Environmental Science**, 667:012104, 2021.

SANTOS, M. J.; MACATO, J.; LAGMAN, M. C. **Comparison of trigonelline content in three philippine coffee varieties**. Research Congress: Building Impact on Firm Foundation. 2018. Available in: www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2018/fnh-06.pdf. Access in: 27 August 2024.

SPECIALTY COFFEE ASSOCIATION - SCA. **A new system to assess coffee value**. 2023. Available in: <https://sca.coffee/value-assessment>. Access in: 27 August 2024.

SPECIALTY COFFEE ASSOCIATION OF AMERICA - SCAA. **SCAA protocols cupping specialty coffee**. 2015. The Specialty Coffee Association of America. Available in: www.coffeecloud.one/coffee-cupping/docs/cupping-protocols.pdf. Access in: 27 August 2024.

SENINDE, D. R.; CHAMBERS, E. Coffee flavor: A review. **Beverages**, 6(3):44, 2020.

SULAIMAN, I.; HASNI, D.; ALKAUSAR, R. Effect of moisture contents and roasting degree on quality of wine coffee from arabica gayo. **International Journal on Advanced Science, Engineering and Information Technology**, 12:1586, 2022.

SUNARHARUM, W. B. et al. **Sains kopi Indonesia**. UB Press, Malang, Indonesia. 2018. 175p.

SUNARHARUM, W. B.; WILLIAMS, D. J.; SMYTH, H. E. Complexity of coffee flavor: A compositional and sensory perspective. **Food Research International**, 62:315-325, 2014.

TAVEIRA, J. H. D. S. et al. Post-harvest effects on beverage quality and physiological performance of coffee beans. **African Journal of Agricultural Research**, 10:1457-1466, 2015.

WAFARETTA, E. et al. Coffea liberica leaf and tree architecture model of confusing accession in Poncokusumo, Malang District, East Java, Indonesia. **Biodiversitas**, 24(5):3073-3080, 2023.

WIBOWO, N. A. et al. Effect of fermentation on sensory quality of Liberica coffee beans inoculated with bacteria from saliva Arctictis binturong Raffles, 1821. **Biodiversitas**, 22(9):3922-3928, 2021.

WONDIMKUN, Y. W.; EMIRE, S. A.; ESHO, T. B. Investigation of physical and sensory properties of ethiopian specialty dry processed Green Coffee Beans. **Acta Universitatis Cibiniensis. Series E: Food Technology**, 24(1):39-48, 2020.