Evaluation of Coffee Bean Defects, Quality of Brewed Coffee, and Caffeine Content of Premium Ground Coffee

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Abstract. Premium coffee has a market segmentation with high prices because it has carried out coffee bean processing following SNI standards, especially coffee quality defects. Drinking coffee is related to the effect of freshness after drinking coffee, and the refreshing product comes from the caffeine content. The study to identify the relationship between defects in bean quality, organoleptic quality coffee, and the caffeine content of premium coffee in the coffee industry in Kebun Tebu West Lampung. Sampling using the Purposive Sampling method by considering that the selected SMEs is a SMEs whose coffee ground products use premium coffee beans, namely from three SMEs (Raosan, Rope, and TM Coffee) processing ground coffee based on processing carried out and physical observations of coffee beans (coffee bean quality defects) with SNI 01-2907-200 8, taste test based on SCAA and caffeine levels with SNI 01-3542—2004 using UV/Vis Spectrophotometric. The results of the observations show that the Small and Medium Industry of ground coffee in Kebun Tebu District has produced premium coffee beans and quality grades ranging from 2-3, with the type of defects that contribute to the quality of coffee beans being one hollow coffee beans caused by the kind of damage produced from the garden and cracked beans caused by the type of damage produced from the processing process. The diversity of organoleptic quality from the brewing of the three SMEs coffees makes the cup quality of the specialty category so that all of them have the potential to be used as single cultivar specialty coffee. Caffeine levels tend to decrease with the higher temperature in the roasting process, and caffeine levels exceed the SNI limit of 0.3%. However, it is still acceptable because the coffee beans used are Robusta coffee beans with high caffeine levels.

Keywords: Coffee Bean, Quality of Brewed, Caffeine

1 Introduction

Drinking coffee is a habit of Indonesian people, especially in the morning, so it becomes a business prospect for developing café shops in Bandar Lampung. The result of coffee shops in Bandar Lampung is inseparable from the current coffee-drinking trend favored by the younger generation, namely milk coffee, V60 coffee, toebroek coffee, espresso, and Vietnam drip. All of these drinks expect a taste, especially Caffeine, as an effect felt by coffee connoisseurs, namely a fresh flavor.

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The trend of consuming coffee is due to the distinctive taste of coffee and its physiological effects as a refreshing drink [1] Caffeine is a mild stimulant with physiological impacts on several body organs, including the digestive system, the brain's central nervous system, and urination. The adverse effects caused by consuming excess Caffeine are the onset of anxiety, palpitations, stomach acid, and indigestion [2] The caffeine content [3] produced by farmers in Gapoktan 4.5 Tribudisyukur village, Kebun Tebu District West Lampung, has a high caffeine content of 2.4-2.5% from premium coffee beans with a quality grade of 1-2. High levels of Caffeine because ground coffee comes from Robusta coffee clones which have high caffeine levels. Robusta coffee has a more bitter, slightly sour taste. It has levels much higher than the caffeine content of Robusta coffee, so in the world market, Robusta coffee is ranked second class after Arabica coffee [4].

The difference in caffeine levels is influenced by the geographical location and the type of coffee plant [5] Several types of [3] Robusta coffee consist of several clones in one cultivation bed, namely egawa, rope dora, rope dale, srintil, tugusari, ciari, and others that can provide different caffeine levels in coffee brewing drinks. Therefore, it is necessary to have information about the relationship between the types of coffee defects, taste, and caffeine content produced from ground coffee SMEs in the Kebun Tebu district, with several brands of ground coffee and caffeine standards set in SNI 01-3542-2004.

2 Material and Method

2.1 Material

The main ingredients of this research are Robusta coffee beans from natural and honey, processing methods from three (3) Three Small and Medium Industries (SMEs) in Kebun Tebu West Lampung, Indonesia.

2.2 Research Methods

The study was conducted in 2022. Detection of coffee bean defects was performed at the Agro-industrial Product Development laboratory of Politeknik Negeri Lampung, evaluation of coffee quality with a cupping test at the Puslitkoka Jember, and the test of caffeine levels was carried out at Baristand Bandar Lampung. The tools used in this study are digital scales, roasting tools, sifting and UV Vis spectrophotometers, and packaging containers. The study used rice coffee beans from red-picked fruit. SMEs Raosan coffee beans come from the Natural process, Rope Coffee from the Honey process, and TM Coffee from the Natural process. Coffee beans come from farmers' plantations in the Kebun Tebu West Lampung with an altitude of ± 900 meters above sea level, as much as 3 kg from the 2021 yields.

Purposive samples were carried out in three small and medium-sized industries (SMEs) of ground coffee (Raosan, Rope, and TM Coffee) using premium grade 1 and 2 raw materials in Kebun Tebu District West Lampung—testing of coffee bean defects based on SNI 01-2907-2004. Evaluation of coffee quality was carried out several tests

as followed the quality of coffee brewing flavors (cupping test), which refers to the standards of the Specialty Coffee Association of America / SCAA with variable flavors assessed, including aroma (smell of aroma when brewed), flavor (taste tongued), body (viscosity), acidity (acidity), aftertaste (taste that remains in the mouth), sweetness (sweetness), balance (an aspect of taste balance), clean cup (general taste impression), uniformity (uniformity of taste of each cup), and overalls (overall taste aspect). The coffee flavor character refers to the diagram of the coffee tasters' flavor wheel [6][7] If the total score of coffee brewing flavors ≥ 80 on a scale of 100 based on the cupping test, it can be categorized as specialty coffee (SCAA][8] and testing of caffeine levels based on SNI 01-3542-2004 using a UV Vis Spectrometer [9].

3 Results and Discussion

3.1 Coffee Bean Defects

Coffee bean defects are coffee quality standards to determine the quality grade of coffee so that it affects the selling price of coffee. Coffee with a higher selling price produces fewer quality defects [3] Premium coffee has quality defects ranging from 12-44, in the position of quality grade 1-2. The defects of the coffee beans contribute to the quality of the coffee produced after the coffee has undergone a brewing process [10].

Table 1 shows that in SMEs Raosan Coffee, the type of coffee bean defect is caused by cracked beans (32%), SMEs Rope Coffee and SMES TM Coffee due to one hollow seed (44%) (34%). The deformed type of cracked bean is a non-whole coffee bean of the same size or less than 3/4 of the part of the whole bean [11]. They have added that the cracked beans are caused by stripping the skin of the coffee fruit on the pulper machine or by stripping the skin of the dried coffee beans with a huller machine [12]. This type of damage is caused by damage during processing, namely cracked seeds, spotted seeds, horn-skinned seeds, brown beans, and coffee logs.

One type of hollow coffee bean defect is caused by the attack of the coffee fruit borer pest (*Hypothenemushampei*). Damage to coffee beans with holes due to pest attacks can be overcome by garden sanitation and increasing the nutrition of coffee fruit plants from the fruit peel waste farmers have used to make liquid organic fertilizer. POC can improve the quality of Robusta coffee products and provide adequate nutrition so that they have stronger pest resistance [13]. Coffee fruits attacked by fruit borer pests look pale yellowish like ripe fruits, so after processing, they become defective black seeds [12]. The damage that starts from the garden is a deformed type of hollow, black, and young seeds. Defects of young coffee beans only found in SMEs TM Coffee Beans with holes can cause chemical quality damage.

The type of defect of brown coffee beans and many hollow beans is the type of defect of primary coffee beans (central) based on SCAA (Specialty Coffee Association of America). In contrast, other types of coffee defects fall into the secondary defect type group [14].

Based on the calculation of coffee bean defects, the quality grade produced from the three SMEs of ground coffee is a quality grade of 2-3. The farmers have produced premium quality coffee beans and become one capital to expand the marketing of rice

coffee beans in the café, restaurant, and hotel segments [3]. In addition, to expand local raw material-based marketing, farmers must pay attention to maintaining product quality [15].

Table 1. Type and Number of quality defect values of three small and medium-sized industries (Raosan, Rope, and TM Coffee)

Type of defect/name of SMEs/type of processing	Number of Defects	Disability Value	Number of Defect Values*	Grade/Quality
SMEs Raosan Coffee/Natural				
Perforated >1	26	1/5	5.2	2
Partial Black	6	½	3.0	
Chocolate Seeds	19	¼	4.75	
Perforated One	38	1/10	3.8	
Cracked Seeds	41	1/5	8.2	
Total			24.95	
SMEs Rope Coffee/Honey				
Partial Black	63	½	31.5	3
Perforated >1	17	1/5	3.4	
Cracked Seeds	3	1/5	0.6	
Seed Hole 1	66	1/10	6.6	
Total			42.1	
SMEs TM Coffee/Natural				
Chocolate Seeds	12	½	6.0	2
Cracked Seeds	9	1/5	1.8	
Young Seeds	15	1/5	3	
Hollow Seeds >1	4	1/5	0.8	
Perforated Seeds 1	13	1/10	1.3	
Total			12.9	

*Quality is described from number of defect values where 1 (max. 11), 2 (12-25), 3 (26-44), 4a (45-60), 4b (61-80), 5 (81-150), and 6 (151-225)

3.2 Diversity of Quality of Brewed Coffee

The cupping test at PUSLITKOKA uses the SCAA method to determine brewing quality. The cupping test scores of each SMES of ground coffee (Raosan, TM, and Rope coffee) are presented in Figure 1. Figure 1 shows that the average ground coffee produced by the three SMEs in the Kebun Tebu sub-district has a taste score of > 80 (specialty), 81.5 – 84.0. Raosan coffee has the highest score (84) with Nutty, Caramelly, Spicy, and Very Sweet Aromas flavors. Rope Coffee, with a score of 83, has the taste of Brown Sugar, Spicy but Grassy, Astringent Aftertaste; and TM Coffee, with a score of 81.5, has the flavors of Cereals, Fishy, Very Sweet Aroma, Astringent Aftertaste, Rather Woody, Harsh. The score exceeded the minimum for the specialty coffee category of 80 [16].

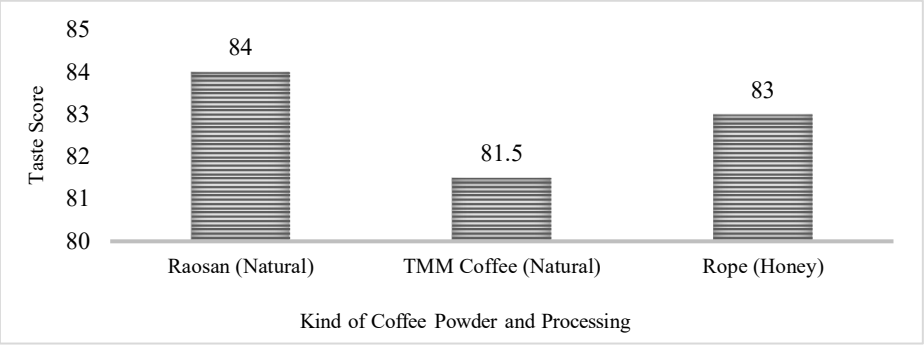

Fig. 1. The score of each SMEs Coffee in Kebun Tebu District West Lampung

Based on Fig. 1 shows that West Lampung coffee farmers have superior clones of Robusta coffee that have the potential to produce fine Robusta coffee. The excellent taste score does not result from the difference in the natural and honey processing method but because farmers have applied post-harvest standards by SNI 01-2907-2008 with grades 2-3 in Table 1.

The scores of each taste attribute of the three SMEs are exciting: the cleanliness score and the uniformity get the maximum score (10), which is included in the specialty category in Fig. 2. Cleanliness attributes show no worrying evidence of negative taste/aroma from the start of inhalation to the last sip. The uniformity attributes indicate that the flavor features are consistent across multiple sample tests. The body attributes on the three SMEs of ground coffee shows a score of eight (8); The body shows the viscosity of brewed coffee, the value of which will decrease as caffeine levels decrease. The caffeine level of three-SMEs ground coffee varies from 2.13% to 2.45%. The caffeine content value is still high, which contributes to producing a thickness body.

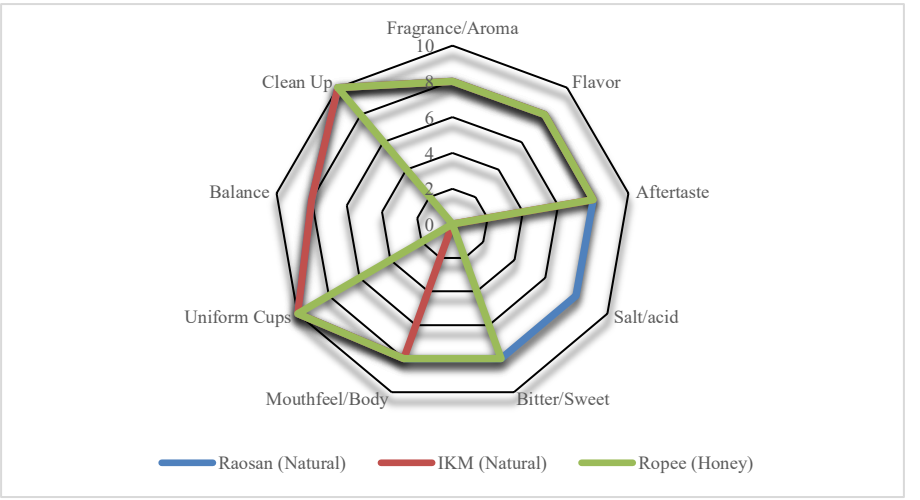

Fig. 2. Spider Web flavors from three SME ground coffee at Kebun Tebu District West Lampung

Ground coffee produced by the three SMEs gives different aromas. The difference is due to the different types of Robusta coffee clones, place of cultivation, climate, and processing methods [17] Ground coffee from SMEs Raosan produces a nutty aroma, caramelly, spicy, and sweet aroma. SMEs Rope produces the aroma of Brown Sugar, Spicy. However, there is also the aroma of green grass (Grasse), Astringent Aftertaste. TM produces the aromas of Cereals, Fishy, Very Sweet Aroma, Astringent Aftertaste, Rather Woody, and Harsh. Both SMEs, Raosan and Rope, possess a characteristic spicy (spicy) flavor. The product flavor gives the added value of the ground coffee produced by each SMEs. However, for value of uniformity and clean cup test reaching 10 from the results of taste testing and does not have a defect value of aroma (0) with defect taint and fault types. The results of the three processes of the post-harvest method at different altitudes on the organoleptic quality give a very good value (7) because the coffee beans produced do not have taste defects (0) [18]. Coffee bean defects, especially black bean defects, can have a strong influence on taste [1]. In this study, black coffee bean defects were not found in coffee beans in the three ground coffee industries.

3.3 Caffeine Levels

Caffeine (1,3,7-trimethylation) is coffee's second most common secondary metabolite after chlorogenic acid [19]. Caffeine does not exert a noticeable influence on the aroma of coffee and only gives a bitter taste of about 10-30% of the coffee brew [20]. Measurement of caffeine levels in this study used a UV-VIS Spectrophotometer. The principle of UV-VIS Spectrophotometry is the measurement of light absorption in the ultraviolet (200–350 nm) and visible light (350–800 nm) regions [21]. Caffeine levels in the three SMEs of Raosan, Rope, and TM Coffee at different initial roasting temperatures can be shown in Fig. 3.

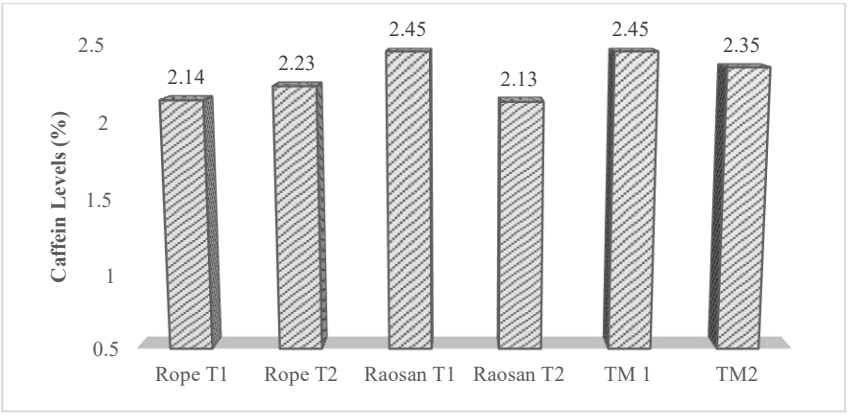

Fig. 3. Caffeine levels (%) at three SMEs (TM, Raosan, and Rope Coffee) with different initial temperature in Roasting (T1 = 100°C, T2 = 195°C)

Fig. 3 shows that the caffeine content range of the three SMEs ranges from 2.13% - 2.45% with the medium roasting level type using an electric heating source roasting

machine. The difference in caffeine levels is due to the difference in the temperature of coffee beans in the roasting machine at T1 = 100°C and T2 = 195°C with the engine temperature set at a temperature of 195°C (light roast).

The caffeine content in the Rope scrambler at the entrance bean temperature of the roasting machine with a coffee bean entry temperature of 195°C produces a higher caffeine level than the caffeine content in the coffee beans that enters at a temperature of 100°C. But not for SMEs Raosan and TM Coffee, the caffeine level is reduced according to the increase in the temperature of the coffee beans entering the roasting machine. Caffeine levels decrease with increasing roasting rates in Robusta juremian and Kirmanan clones [10]. The differences in caffeine levels between Rope, Raosan and TM are thought to be due to differences in the post-harvest processing of coffee beans. Rope Coffee uses raw materials from Honey post-harvest processing, while Raosan and TM Coffee from natural post-harvest processing. Post-harvest differences can affect green coffee beans antioxidant activity [22].

The caffeine content produced by the three SMEs 2.13-2.45% exceeded the SNI limit of ground coffee 01-3542-2004, which was 2%, so the excess caffeine content was 0.3%. However, explaining that the caffeine content in the three SMEs of Robusta coffee grounds is still acceptable [23], considering that the caffeine content in various types of roasted Robusta coffee is reported in the range of 1.7% to 4.0%.

4 Conclusion

The Small and Medium Industry of ground coffee in the Kebun Tebu District has produced premium coffee beans. Quality grades range from 2-3, with the types of defects that contribute to the quality of coffee beans being one-hole coffee beans caused by the type of damage produced from the garden and cracked beans caused by the type of damage caused by the processing process. The diversity of coffee quality from the brewing of the three SMEs coffees produces the quality of the specialty category, so that all of them have the potential to be used as single cultivar specialty coffee. Caffeine levels tend to decrease with the higher temperature in the roasting process, and caffeine levels exceed the SNI limit of 0.3%. However, it is still acceptable because the coffee beans used are Robusta coffee beans with high caffeine levels.

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