Transformation of Sensory Profile of Robusta Coffee Beans (*Coffea Canephora L.)* Fermentation Products Due to Roasting Time and Yeast Dosage Treatment

Andi Setiawan, Kabul Warsito, Sufi Rafli Ramadhan

Abstract

One of the most popular types of coffee is Robusta (Coffea canephora), which has a different aroma before roasting: Robusta tends to have a nutty aroma. This study aimed to examine the combination treatments (roasting time and yeast dosage) on the flavor of Robusta coffee, and the above hypothesis helped to guide the focus of the experiment in identifying the optimal conditions for the coffee processing. The research method used in this study was a factorial randomized block design (RBD) consisting of 25 combinations, with 2 replications. The factors were: Factor 1: Roasting time M0 = Control (green beans 200 g), M1 = Roasting time 15 minutes at 200°C (green beans 200 g), M2 = Roasting time 25 minutes at 200°C (green beans 200 g), M3 = Roasting time 35 minutes at 200°C (green beans 200 g) and M4 = Roasting time 45 minutes at 200°C (green beans 200 g). Factor 2: Yeast dosage P0 = Control, P1 = Yeast dosage 5 g, P2 = Yeast dosage 10 g, P3 = Yeast dosage 15 g and P4 = Yeast dosage 20 g. The results of the analysis of variance showed that both roasting time and yeast dosage had a significant effect on all observed parameters.

Keywords: Robusta Coffee, Aroma, Taste

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Introduction

Nowadays, coffee is one of the drinks that is often used as a drink when gathering or working, and coffee has now become a lifestyle in big cities, or even in cafes, because coffee is a global drink among people, especially for young people and adults. The most popular types are Arabica and Robusta (Coffea icanephora), which have different aromas before roasting: Robusta tends to have a nutty aroma, while Arabica is characterized by a fruity aroma [1]. The roasting process is an essential step in developing the flavor and aroma profile of Arabica coffee. This step reduces the moisture content of the coffee beans to the required quality level. In addition to affecting sensory characteristics, the roasting process also contributes to changes in the color of the beans and modifications in their bioactive compound content [2]. Roasting is generally carried out after harvest, using coffee beans that have reached optimal physiological maturity with a standard red color, resulting in a superior flavor and aroma profile. The mucilage layer of coffee cherries contains sugars and protopectin. Water-soluble sugars are broken down during fermentation, while the insoluble protopectin in the fruit pulp is also broken down. The washing process removes sugars and decomposes caffeine, as it is a weak monosidic base and can be separated from water upon evaporation. This process aims to reduce the content of certain compounds, such as hydrocyanic acid, chlorogenic acid, and several organic acids, which can have negative effects if consumed in excess. Fermentation involves microorganisms such as yeast, mold, and bacteria [3].

Literature Review

Coffee is a plantation commodity with high economic value compared to other plantation crops and plays a significant role as a source of foreign exchange for the country. Coffee also provides income for approximately one and a half million coffee farmers in Indonesia. The quality of coffee beans depends heavily on proper post-harvest handling. With proper postharvest handling at every stage, coffee quality can be improved. [4]

Fermenting coffee beans with the addition of Lactobacillus plantarum can degrade the mucilage layer of coffee beans and inhibit the growth of toxigenic fungi, resulting in coffee that is safe for consumption. Fermenting coffee with the addition of Lactobacillus plantarum also stimulates the production of volatile aromatic compounds, such as ethyl acetate, ethyl isobutyrate, and acetaldehyde, resulting in coffee with better sensory and aromatic qualities compared to conventional post-harvest processing methods [5].

Robusta coffee has a higher caffeine content than Arabica coffee. Robusta coffee has a caffeine content of around 1%–2% and Arabica of 0.4%–2.4% (Farida et al, 2013). Caffeine contained in coffee is one of the xanthine derivatives that has the ability as a brain nerve stimulant, heart muscle stimulant, smooth muscle relaxant and increase dieresis at different levels. According to [7], drinking drinks containing caffeine will experience side effects in the form of palpitations, insomnia, headaches, tremors, restlessness, vomiting and nausea [6].

Research Methodology

This research was conducted in Iak Sabaon Village, Imarancar District, South Tapanuli Regency at an altitude of 1,850 meters above sea level, which will be implemented from December 2024 to January 2024. The materials used in this study were Robusta coffee beans in the form of sorted Green Beans originating from the Tyana coffea plantation, Saccharomyces cerevisiae yeast and the tools used in this study included: roasting machine, coffee bean grinder, digital scales, oven, pH/meter, tray, spoon, mobile phone, and stationery. The research method used in this study was a factorial randomized block design (RBD) consisting of 25 combinations and repeated twice:

Factor 1: roasting time, marked with the symbol M

M0 = Control: 200 grams of green beans
M1 = Roasting time: 15 minutes at 200°C
M2 = Roasting time: 25 minutes at 200°C
M3 = Roasting time: 35 minutes at 200°C
M4 = Roasting time: 45 minutes at 200°C
Factor 2: yeast addition, marked with the letter P
P0 = Control
P1 = 5 grams of yeast addition
P2 = 10 grams of yeast addition
P3 = 15 grams of yeast addition
P4 = 20 grams of yeast addition
Observed Parameters namely coffee color, water content, and acidity pH

Results 4.1 Coffee Aroma

The results of the analysis of variance of coffee aroma parameters in Table 1 show that statistically there is a significant difference in the effects of roasting time and yeast dosage, so further tests were carried out using Duncan at the 5% level, which is presented in Table 1.

Table 1. Results of the 5% Duncan Test of Coffee Aroma Parameters Due to Roasting Time and Yeast Dosage Treatment.

Treatment	Coffee Aroma	
Waktu Roasting (M)		
M0 = Control Grean bean 200 gr	6,06	b
M1 = Roasting Time 15 minutes at 200ºC Grean bean 200 gr	6,66	c
M2 = Roasting Time 25 minutes at 200ºC Grean bean 200 gr	6,96	c
M3 = Roasting Time 35 minutes at 200ºC Grean bean 200 gr	6,53	c
M4 = Roasting Time 45 minutes at 200ºC Grean bean 200 gr	5,39	a
Pemberian Ragi (P) P0		
= Control	5,29	b
P1 = Giving as much yeast as possible 5 gr	6,72	c
P2 = Giving as much yeast as possible 10 gr	8,22	d
P3 = Giving as much yeast as possible 15 gr	6,61	c
P4 = Giving as much yeast as possible 20 gr	4,76	a

Description: Numbers in the same column followed by the same letter indicate no significant difference at the 5% level.

Based on the results of the 5% Duncan further test in the table above, it shows that the roasting time treatment has a significant effect, namely that the M2 treatment (6.96) is not significantly different from the M1 (6.66) and M3 (6.53) treatments, but is significantly different from the M0 (6.06) and M4 (5.39) treatments. The Duncan test results show that the P2 treatment (8.22) provides the best water content which is significantly different from the P1 (6.72), P3 (6.61), P0 (5.29) and P4 (4.76) treatments because this yeast dose is able to optimize the fermentation process.

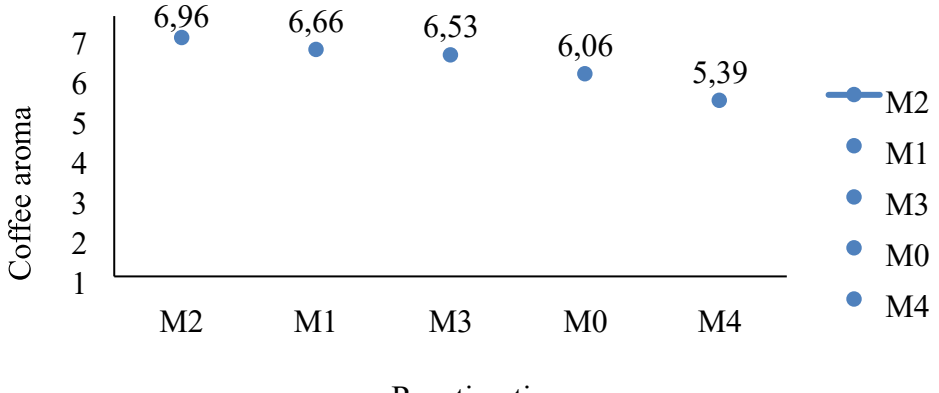


Figure 1. Roasting Time

Treatment M2 (roasting for 25 minutes at 200°C, 200 grams of green beans) produces an ideal coffee aroma because the combination of temperature and roasting time allows water to evaporate evenly without removing excess moisture. This condition maintains the water content at around 12%, which is important for the aroma, taste, and shelf life of coffee, while also preventing the growth of microorganisms [4] stated that roasting at 190–210°C for 20–30 minutes effectively reduces the water content of Arabica coffee beans to 11.5–13% without damaging the bean structure, while maintaining the quality of the coffee's taste and aroma.

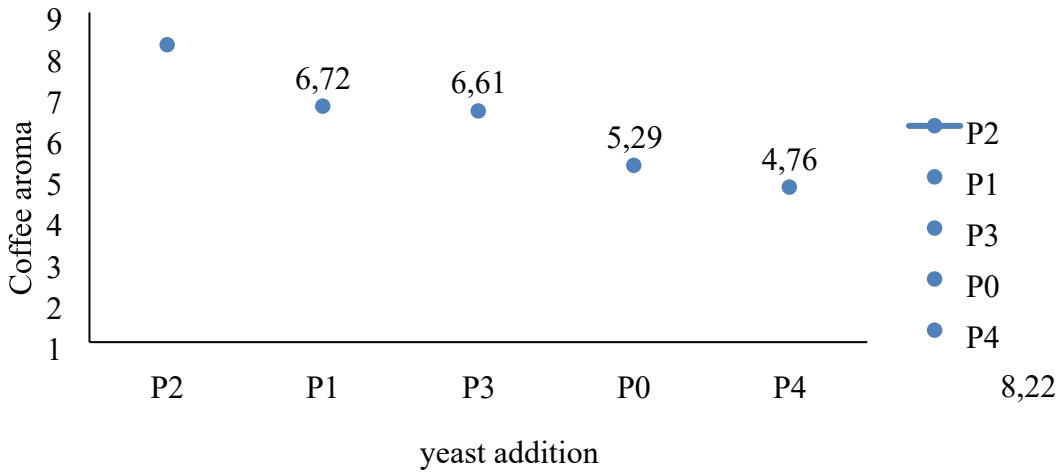


Figure 2. Yeast Addition

Controlled fermentation accelerates the breakdown of mucilage (slime) on the surface of coffee beans, allowing water bound to the mucilage to be more effectively removed during drying or roasting. Adding 10 grams of Saccharomyces cerevisiae helps optimally break down the mucilage without producing excess metabolites that can trigger high humidity or spoilage. As a result, coffee beans maintain a suitable moisture content to maintain aroma, flavor, and shelf life. [5] state that fermentation with this yeast accelerates drying and maintains the moisture content of the beans within a safe range (11–13%) to protect quality and prevent microbial contamination.

4.2 coffee taste

The results of the analysis of variance of coffee taste parameters in Table 2 show that statistically there is a significantly different effect due to the roasting time and yeast dose treatment, so further testing was carried out using Duncan at the 5% level presented.

Table 2. Results of the 5% Duncan Test of Coffee taste Parameters Due to Roasting Time and Yeast Dosage Treatment.

Perlakuan	Coffee taste	
Waktu Roasting (M)		
M0 = Control Grean bean 200 gr	4,96	ab
M1 = Roasting Time 15 minutes at 200ºC Grean bean 200 gr	6,44	d
M2 = Roasting Time 25 minutes at 200ºC Grean bean 200 gr	6,23	d
M3 = Roasting Time 35 minutes at 200ºC Grean bean 200 gr	5,12	bc
M4 = Roasting Time 45 minutes at 200ºC Grean bean 200 gr	4,66	a
Pemberian Ragi (P) P0		
= Control	4,65	ab
P1 = Giving as much yeast as possible 5 gr	5,74	cd
P2 = Giving as much yeast as possible 10 gr	7,45	e
P3 = Giving as much yeast as possible 15 gr	5,30	c
P4 = Giving as much yeast as possible 20 gr	4,27	a

Based on Table 2, it can be explained that the best coffee taste in treatment M1 (6.44) is significantly different from treatments M3 (5.12), M0 (4.96) and treatment M4 (4.66). In Table 2, it can be explained that the best coffee taste in treatment P2 (7.45) is significantly different from treatments P1 (5.74), P3 (5.30), P0 (4.65) and treatment P4 (4.27).

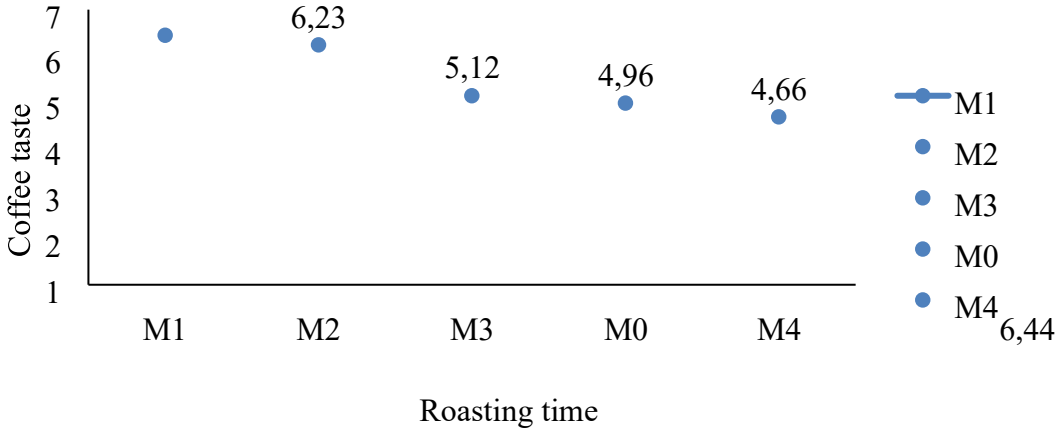


Figure 3. International Conference Roasting Time

Previous research by Situmeang et al. (2021) found that roasting at 200°C for 15 minutes produced a coffee flavor in the range of 6.23–6.44, considered the best sensory attribute for fresh and clean acidity. Roasting M1 (15 minutes at 200°C) produced a flavor index of 6.44, reflecting the ideal flavor of Robusta coffee. This temperature and duration promote the breakdown of chlorogenic acid into stable organic acids, maintaining a fresh and balanced acidity. Susilo and Yulianto (2020) confirmed that the combination of temperature and roasting time influences coffee's natural acidity, with an ideal pH of 4.5–5.0, helping to maintain complex flavors without bitterness.

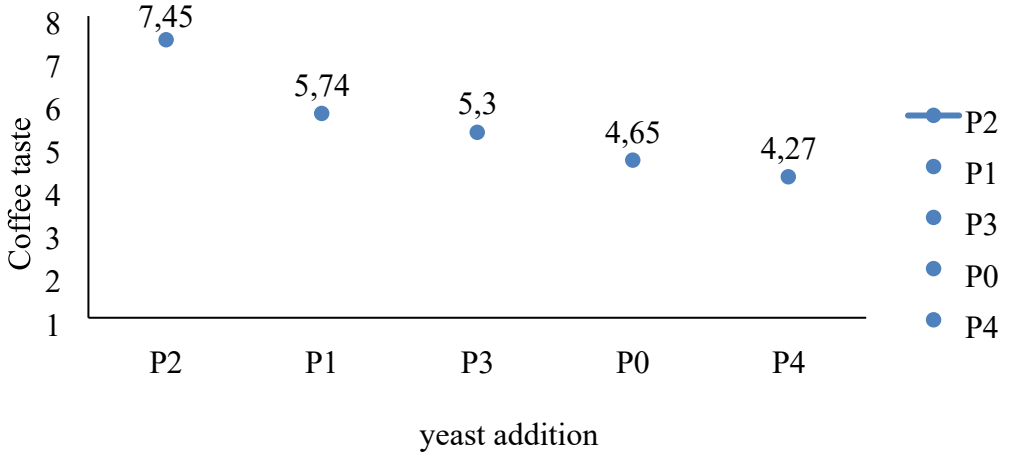


Figure 4. International Conference Yeast Adittion

Research by [8] found that coffee fermentation with a yeast starter culture produces a flavor profile of 7.45, which supports the development of a fresh acidity and enhances the complexity of the coffee's flavor. Adding 10 grams of Saccharomyces cerevisiae to Robusta coffee fermentation produces a flavor profile of 7.45, which is appropriate for creating a distinctive acidity without being too sharp. This dosage supports balanced fermentation and the formation of sufficient organic acids. [6] stated that yeast accelerates the decomposition of mucilage and produces organic acids, which provide a fresh, clean, and complex flavor that consumers prefer.

Conclusion

The roasting conditions in this treatment are able to maintain the water content of coffee beans in the optimal range (±12%), thus supporting the formation of aroma and flavor and maintaining storage stability. The right dose can provide the most optimal results in increasing the intensity of the aroma and taste of coffee.

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