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Comparison of Antibacterial Effectiveness of Arabica Coffee Bean Extract (*Coffea arabica L.*) Roasted and Non-Roasted Against Bacteria *Enterococcus faecalis*

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ABSTRACT

Background: Dental caries that are not handled properly cause cavities and open the dental pulp so that it becomes a pathway for microorganisms to enter the root canals. The most common microorganisms found in root canal infections are *Enterococcus faecalis*. Arabica coffee beans have bioactive compounds such as alkaloids, saponins, and tannins, which inhibit the growth of bacteria. This study aimed to compare the antibacterial effectiveness of roasted and non-roasted Arabica coffee bean extracts against bacteria *Enterococcus faecalis*. **Methods:** This study was an in vitro experimental study. This research uses culture *Enterococcus faecalis*, which were divided into 10 groups (2 control groups, 4 treatment groups of roasted coffee beans, and 4 groups of non-roasted coffee beans). Inhibition zone diameter analysis was carried out with the help of SPSS using univariate and bivariate. **Results:** Non-roasted Arabica coffee bean extract showed better effectiveness in inhibiting bacterial growth *Enterococcus faecalis*, along with increasing the concentration of the extract. **Conclusion:** Non-roasted Arabica coffee bean extract is more effective as an antibacterial against the bacteria *Enterococcus faecalis* compared to roasted Arabica coffee bean extract.

1. Introduction

Dental caries is a dental and oral health problem that is very common in the world community, including in Indonesia. Dental caries that are not handled properly cause cavities and open the dental pulp so that it becomes a pathway for microorganisms to enter the root canals. This causes the pulp to become necrotic, so that root canal treatment is required. The goal of root canal treatment is to keep the tooth functioning by removing infected pulp tissue and shaping and refilling the root canal to prevent bacteria from entering the root canal. The most common microorganisms found in root canal infections are *Enterococcus faecalis*. *Enterococcus*

faecalis is a gram-positive facultative anaerobic bacterium *coccus* can also develop even in the absence of oxygen. In addition, these bacteria are able to survive in alkaline pH and high temperatures. This bacterium can also grow in areas that are difficult to reach with instrumentation, is resistant to drugs, and can survive for 12 months without nutrition in the root canals.¹⁻⁵

One of the common irrigating solutions commonly used by clinicians for root canal treatment is Sodium hypochlorite or NaOCl, which has antibacterial properties and is able to dissolve organic components. Sodium hypochlorite is rated to be a good antimicrobial for exterminating *Enterococcus*,

Actinomyces, and *C. albicans*, as well as other microorganisms that are difficult to clean in the root canal. In addition, NaOCl fluids have the advantage of dissolving soft tissues, causing lubrication of the canals, and they are easy to obtain and affordable. In addition to having advantages, at high concentrations NaOCl is toxic to the periapical tissues of the teeth, can cause irritation, cannot dissolve in organic milk, and has an unpleasant odor.⁶⁻⁸ Therefore, an effort is needed to explore a root canal irrigation solution that is safer for the apical tissue. Indonesia, with its biodiversity, has various potentials for the development of modalities of canal irrigation solutions based on natural materials. Indonesia is one of the largest coffee-producing countries in the world. This is because coffee is very much liked by people, both in the world and in Indonesia. One type of coffee that is cultivated in Indonesia is Arabica coffee (*Coffea arabica* L.). Based on the phytochemical tests, it is known that Arabica coffee beans have bioactive compounds such as alkaloids, saponins, and tannins. These compounds play a role in inhibiting the growth of bacteria. In addition, Arabica coffee has various benefits as antioxidant, anti-inflammatory, and antibacterial.⁹⁻¹³ This study aimed to compare the antibacterial effectiveness of roasted and non-roasted Arabica coffee bean extracts against bacteria *Enterococcus faecalis*.

2. Methods

This study was an in vitro experimental study and used bacterial culture *Enterococcus faecalis* on petri dishes obtained from the laboratory of microbiology, Faculty of Pharmacy, Universitas Sumatra Utara, Medan, Indonesia. Arabica coffee bean (*Coffea arabica* L.) was roasted and non-roasted as the test material, and the extraction process was carried out using 96% ethanol solvent by maceration for 1x24 hours. The macerate resulting from maceration is thickened into an extract using a rotary evaporator. This study was

approved by the medical and health research ethics committee of the Faculty of Medicine, Dentistry and Health Sciences, Universitas Prima Indonesia, Medan, Indonesia.

Bacterial culture *Enterococcus faecalis* Standardization of bacterial concentrations was carried out using McFarland 0.5 solution. The similarity of turbidity levels showed the same concentration of bacteria between test groups. A total of 30 petri dishes that have been added 1-2 ose of bacterial culture *Enterococcus faecalis* and MHA (mueller hinton agar) were used in this study. There are 10 test groups, namely Chlorhexidine digluconate 2% as a positive control (K1), negative control, DMSO (K2), group treated with roasted Arabica coffee bean extract 25%, 50%, 75%, and 100% respectively as K3-K6, group treated with non-roasted coffee bean extract 25 %, 50%, 75% and 100% as K7-K10 respectively. A total of 3 test petri dishes were used in each group. Furthermore, the inhibition of bacteria was measured by measuring the diameter of the inhibition zone of each treatment group. Data analysis was performed with the help of SPSS software version 25. Univariate analysis was performed to present the data distribution for each test variable. Bivariate analysis was carried out to see statistical differences in each test variable, where $p < 0.05$.

3. Results

Table 1 shows a comparison of the inhibition of roasted and non-roasted Arabica coffee bean extracts against the bacteria *Enterococcus faecalis*. Non-roasted Arabica coffee bean extract showed better effectiveness in inhibiting bacterial growth of *Enterococcus faecalis* along with the increase in extract concentration. The results of this study also showed that the inhibition diameter of non-roasted Arabica coffee bean extract at 100% concentration was almost the same as the positive control.

Table 1. Comparison of the inhibitory of Arabica coffee bean extract (*Coffea arabica L.*) roasted and non-roasted against bacteria *Enterococcus faecalis*.

Group	Concentration	Inhibition diameter
		Mean±SD
Roasted Arabica coffee bean extract	25%	9,07±0,32
	50%	9,47±0,21
	75%	10,47±0,67
	100%	11,90±0,92
Non-roasted Arabica coffee bean extract	25%	13,30±0,72
	50%	14,17±0,35
	75%	15,47±0,76
	100%	17,53±0,87
Positive control		18,37±2,32
Negative control		0

4. Discussion

Non-roasted Arabica coffee beans are processed coffee without the roasting process, meaning that the compounds contained in non-roasted coffee beans are higher than roasted coffee beans. Meanwhile, roasted Arabica coffee beans experience physical and chemical changes, as well as the contents in the coffee beans. Compounds contained in coffee beans will experience degradation during the roasting process so that the levels become lower than in non-roasted coffee beans. One of the chemical compounds that have decreased drastically when roasting coffee beans is chlorogenic acid.¹⁴⁻¹⁶

Chlorogenic acid is the most abundant component in coffee and is a phenolic compound that works by affecting the permeability of the outer membrane and bacterial plasma, causing bacterial lysis, likewise for several other chemical compounds that have decreased due to roasting, such as caffeine, trigolenin, and so on. This is the reason that non-roasted Arabica coffee bean extract has a more dominant inhibitory effect on the bacteria *Enterococcus faecalis* compared to roasted Arabica coffee bean extract.¹⁷⁻²⁰

5. Conclusion

Non-roasted Arabica coffee bean extract is more effective as an antibacterial against the bacteria *Enterococcus faecalis* compared to roasted Arabica coffee bean extract.

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