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THE EFFECT OF CONSUMPTION OF ROBUSTA COFFEE (*Coffea canephora*) ON PH AND SALIVA FLOW RATE: SCOPING REVIEW

Elok Nafilah Fitri [1,*], Sawitri Dwi Indah Pertami [2], Puspa Dila Rohmaniar [2], Bambang Sumaryono [2], Niswatun Chasanah [3] and Chaidir Aulia [1]

[1] Department of Biomaterials, Faculty of Dental Medicine, Bhakti Wiyata Institute of Health Sciences, Indonesia.
[2] Department of Oral Pathology, Faculty of Dental Medicine, Bhakti Wiyata Institute of Health Sciences, Indonesia.
[3] Department of Biomedic and Traditional Medicine, Faculty of Dental Medicine, Bhakti Wiyata Institute of Health Sciences, Indonesia.
* Corresponding Author

ORCID Details
Elok Nafilah Fitri: https://orcid.org/0009-0002-8792-8145
Sawitri Dwi Indah Pertami: https://orcid.org/0000-0003-0019-3458
Puspa Dila Rohmaniar: https://orcid.org/0000-0002-1210-606X
Niswatun Chasanah: https://orcid.org/0000-0001-9731-1590

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ABSTRACT

Introduction: Saliva is a complex fluid in the mouth that contains proteins, hormones, antibodies, minerals, and other body ions. Almost 90% of saliva is produced at the time of eating due to stimuli that can be in the form of taste and mastication. Food not only affects the volume or amount of saliva produced, but also affects the level of acidity (pH) and the flow rate of the saliva itself. Saliva can be affected by the stimulation of drinks that contain excessive acid. One of the drinks that contain acid is coffee. Coffee contains simple carbohydrates in high concentrations, fermenting carbohydrates will produce acids which can cause a decrease in salivary pH. Changes in salivary pH are influenced by the type of food consumed, stimulation of salivary secretion, salivary flow rate, time, oral microorganisms, and salivary buffering capacity. Salivary pH becomes lower due to the production of acid from bacteria after ingestion of carbohydrates. So coffee can be classified as a drink that can increase the risk of dental caries if consumed continuously for more than 30-60 minutes. The purpose of this scoping review is to determine the difference between salivary pH and salivary flow rate before and after consuming robusta coffee (*Coffea canephora*).

Method: To obtain journal data, a search was conducted using two database: PubMed and Google Scholar. Of the two found 577 journals. Data were selected based on inclusion and exclusion criteria. The title, abstract and full text of each study were carefully analysed. Data extraction was made based on the difference between salivary pH and salivary flow rate before and after consuming robusta coffee (*Coffea canephora*).

Result: There were 7 selected articles and the results showed there is an effect of robusta coffee (*Coffea canephora*) consumption on the pH and the salivary flow rate.

Conclusion: Consuming robusta coffee (*Coffea canephora*) effect pH saliva and salivary flow rate.

Keywords: Robusta Coffee; *Coffea canephora*; Salivary flow rate; Saliva pH

1 INTRODUCTION

Coffee is one of the most frequently consumed beverages. It contains various components, including caffeine, trigonelline, sucrose, monosaccharides, chlorogenic acid, and nicotinic acid. Robusta coffee (*Coffea canephora*) is among the most popular types of coffee globally. It has a more bitter taste compared to other varieties, which is due to its higher caffeine content—ranging from approximately 1.7% to 4.0%—whereas coffee in general typically contains only about 0.8% to 1.4% caffeine.[1] Monosaccharides and sucrose are types of simple carbohydrates present in coffee at high concentrations. These can be fermented by oral bacteria, producing acids that lead to a reduction in buffer capacity and a decrease in the salivary flow rate.[2]

Salivary secretion is regulated by the sympathetic and parasympathetic nervous systems, both of which control the function of the salivary glands.[3] Coffee contains two types of acids—chlorogenic acid and nicotinic acid—which directly influence the pH balance of saliva; furthermore, they lead to a reduction in both salivary flow and the buffering capacity of saliva.[1] A persistent decrease in saliva results in the demineralization of dental enamel, which can subsequently develop into dental caries.[4] Demineralization of dental hard tissues is influenced by the acidity of the oral cavity, which can lead to dental caries. Factors contributing to dental caries include the host, the substrate, and plaque containing bacteria. Salivary viscosity—a host-related factor—can affect oral health; higher salivary viscosity can lead to a reduced salivary flow rate, causing food debris to accumulate and resulting in dental caries. Saliva with a low pH level can cause the loss of calcium, phosphate, and hydroxide ions from hydroxyapatite crystals. Saliva reaching a critical pH of 5.5 can trigger the demineralization of teeth.[5] The buffer capacity and pH level of saliva are influenced by changes in circadian rhythms, dietary patterns, and stimuli that affect the rate of salivary secretion. Coffee consumption can significantly reduce salivary secretion; caffeine has an inhibitory effect of approximately 6.5% on salivary stimulation.[2]

Saliva is a complex fluid produced by the major and minor salivary glands. It plays several important roles, including facilitating swallowing, maintaining oral moisture, acting as a solvent for molecules that stimulate the sense of taste, and aiding speech by easing the movement of the lips and tongue. Furthermore, saliva contains a buffering system that keeps its pH level constant, thereby contributing to the maintenance of oral and dental health.[6]

Coffee containing high concentrations of simple carbohydrates produces acids that can lower salivary pH. Furthermore, the balance of salivary pH is influenced by factors such as the type of food consumed, the stimulation of salivary secretion, the salivary flow rate, time, the presence of oral microorganisms, and the buffering capacity of saliva. Salivary pH drops due to the production of acids by bacteria following the consumption of carbohydrates. Consequently, coffee can be classified as a beverage that may increase the risk of dental caries if consumed regularly over periods exceeding 30–60 minutes. [7] Salivary flow is stimulated by the chewing reflex and by taste—for instance, through the act of chewing gum that contains xylitol. An increased salivary flow rate leads to a rise in salivary pH due to the presence of bicarbonate ions, which enhances the saliva's ability to maintain its pH level. Additionally, the levels of calcium and phosphate ions increase, fostering a balance between demineralization and remineralization. [8]

Based on the above background, this scoping review aims to examine the literature in order to determine the difference between salivary pH and salivary flow rate before and after consuming robusta coffee (*Coffea canephora*).

2 METHODS

2.1 Searching and selection studies

In the beginning of the study, the author made a research question whether consuming robusta coffee (*Coffea canephora*) effect salivary pH and salivary flow rate. Electronic journal searches used the Pubmed and Google Scholar databases. The search process to get the results according to the purpose using the keywords Coffee, Salivary pH, and Saliva flow rate, using the Boolean "AND". Modification of the search on the database was done to get more relevant results (Table 1). The literature search process was carried out for two months.

Journal collection was carried out based on topics and research objectives that are in accordance with predefined keywords. All journals collected were then selected, if there were the same journal title, the duplicate journal will be deleted. The inclusion criteria used were studies involving a journal published in 2016 until 2022, discussing about coffee, pH saliva, salivary flow rate, experimental studies, and clinical trial study design. Exclusion criteria included

journal not examine the difference between salivary pH and salivary flow rate before and after consuming robusta coffee (*Coffea canephora*) and data in the form of article reviews, clinical case studies, qualitative studies, and case reports.

This study used a scoping review by adapting the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-analyses) for journal search strategies.

2.2 Data extraction and synthesis

The data extraction process was taken from journals with titles and abstracts that match the topics and keywords. In the final step, 7 studies were selected for data extraction. Characteristics of research data in selected journals were extracted based on the difference between salivary pH and salivary flow rate before and after consuming robusta coffee (*Coffea canephora*). Data included author and year of publication.

The next strategy for synthesizing data, this review used tables to describe the most discussion of the findings. The journals were then read carefully in full paper. See Table 1.

Table 1: Search keywords

Keywords	Synonyms
robusta coffee	*"Coffea canephora", "Coffea robusta", "Rio Nunez coffee", "Coffea laurentii De Wild"*
salivary pH	*"saliva pH", "oral pH", "buccal pH"*
saliva flow rate	*"salivary secretion rate","salivary production","salivation", "salivary gland function"*

3 RESULT

3.1 Study Selection and Data Collection Process

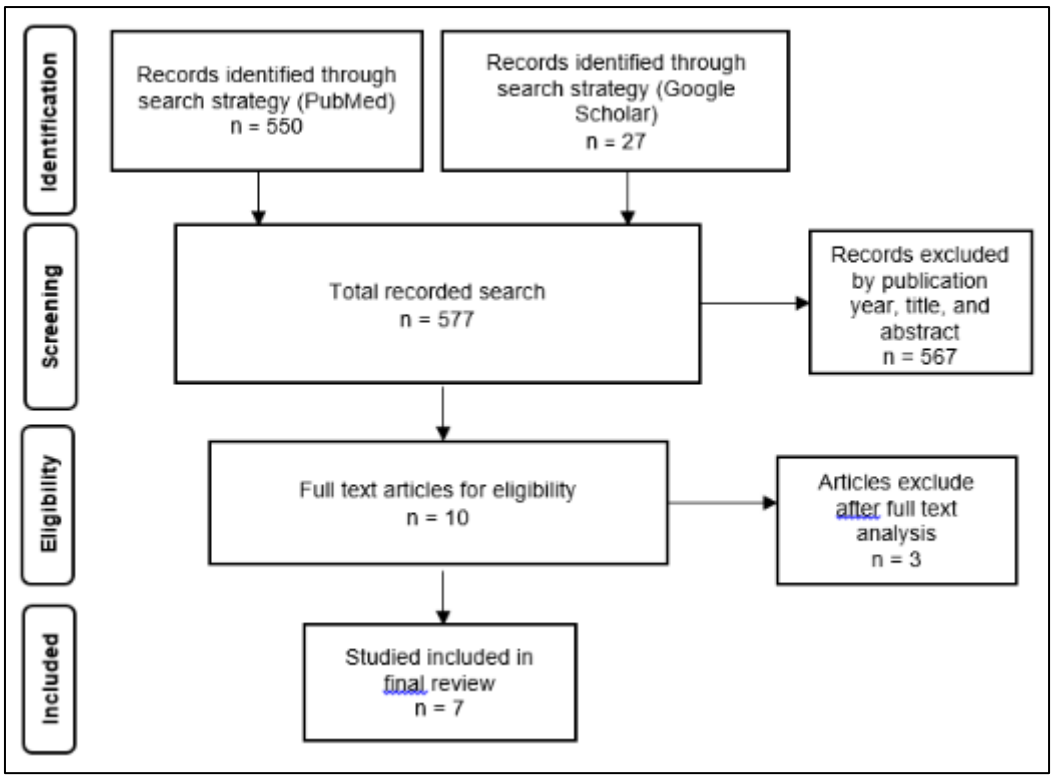


Figure 1: Flow chart of literature adapted from PRISMA method: from identification and screening inclusion of studies.

The author divided 2 groups with the stages of finding journals, distributing journals and extracting journals based on the inclusion and exclusion criteria at PICO, with P (Problem) in the form of saliva pH and salivary flow rate, I (Intervention) in the form of a group after consuming coffee robusta, C (Comparison) in the form of a group before

consuming coffee robusta (*Coffea canephora*), and O (Outcome) in decrease or increase the saliva pH and salivary flow rate. In the initial journal search of all databases, PubMed 550 journals and Google Scholar 27 journals were found. The total number of journal searches is 577 journals. Among them, 249 journals were excluded because after reviewing the publication year the journals did not meet the criteria. Then 237 journals were excluded because after reviewing the titles and abstracts the journals did not meet the criteria. The eligible journals are 7 journals that meet the inclusion criteria (Figure 1). The results of the journal search found the difference between salivary pH and salivary flow rate before and after consuming robusta coffee (*Coffea canephora*). The author used these due to the findings of most studies and can represent data that show the deacrease or increase salivary pH and salivary flow rate before and after consuming robusta coffee (*Coffea canephora*).

3.2 Scoping Review

Table 2: Summary of articles from references

No	Author	Journal Title	Method	Result
1.	Karina Sa'diah and Maulida Hayati (2018) [5]	The Effect of Coffee (*Coffea sp.*) Consumption on Salivary pH, Flow Rate, and Viscosity in Coffee Addicts ("Coffee Holics")	Experimental laboratory with post test only control group design	There are differences between the control group and the group of coffee addicts: a decrease in salivary pH, a reduction in salivary flow rate, and an increase in salivary viscosity.
2.	Herry Imran, Nurdin and Nasri (2016) [7]	The Effect of Coffee Consumption on the Decrease in Salivary pH in Adults	Descriptive quantitative design with cross sectional method	Research findings indicate a significant relationship between coffee consumption and a decrease in salivary pH. Coffee lowers salivary pH and increases the risk of dental caries because it contains acidic substances, such as chlorogenic acid and nicotinic acid. Furthermore, coffee also contains high concentrations of simple carbohydrates, including monosaccharides and sucrose.
3.	Zaza Paroza and Saluna Deynilisa (2021) [9]	Comparison of the Effects of Consuming Arabica and Robusta Coffee on Salivary pH	Experimental laboratory with pre and post test design, using purposive sampling	The research results show that the mean salivary pH before consuming Arabica coffee is 6.887, and 4.867 after consumption. Meanwhile, the mean salivary pH before consuming Robusta coffee is 7.020, and 5.537 after consumption.
4.	M Rizki Fauzi Lubis and Yumi Lindawati (2018) [10]	The Effect of Robusta Coffee Bean (*Coffea canephora*) Extract on Salivary pH and the Growth of *Staphylococcus aureus* Bacteria	Experimental laboratory with Pre and Post Test Group Design	The Minimum Inhibitory Concentration (MIC) of Robusta coffee extract is 12.5% and the Minimum Bactericidal Concentration (MBC) is 100%, against the growth of *Staphylococcus aureus* colonies. Robusta coffee extract significantly lowers salivary pH at concentrations of 100%, 50%, and 25%.
5.	Erni Mardiati, Endah Aryati, Irmanita Wiradona, Bedjo Santoso (2017) [11]	The Effect of Black Coffee and Tea Consumption to Saliva Degree of Acidity in Preventing Tooth Decay	Quasy experimental with pre test and post test design	The research results indicate that the consumption of black coffee can affect salivary pH, specifically by lowering it; the average change in salivary pH before and after consuming black coffee is 0.4.
6.	Santi Chismirina, Afrina, Cut Maidis Safrianda (2016) [12]	Comparison of Salivary Flow Rates Before and After Consumption of Robusta Coffee	Comparative analytics using a paired categorical method	The research results indicate a significant difference between the conditions before and after consuming Robusta coffee. The salivary flow rate was found to be lower before the consumption of Robusta

				coffee, whereas a higher salivary flow rate was observed after its consumption.
7.	Harvina Sawitri, Nora Maulina (2021) [13]	Salivary pH Levels Among Medical Students at the Faculty of Medicine, Universitas Malikussaleh, Who Consume Coffee (2020)	Observasional sstudy with cross sectional design	The research results indicate that 30% of students consume coffee three times a week, while 70% consume coffee less than three times a week. Furthermore, 55% of the students have a normal salivary pH, whereas 45% have an acidic salivary pH. The findings also show a significant association between coffee consumption and the level of salivary pH.

4 DISCUSSION

The study titled "The Effect of Coffee (Coffea sp.) Consumption on Salivary pH, Flow Rate, and Viscosity in Coffee Addicts ('Coffeeholics')" aimed to investigate how coffee consumption influences these salivary parameters. The research concludes that there is a significant difference in salivary pH between the control group and the group of coffee addicts; a decrease in salivary pH is observed because coffee contains simple carbohydrates that can be fermented by bacteria, thereby hindering the effectiveness of the salivary buffer system. One of the primary functions of saliva in the oral cavity is to maintain an acid-base balance—a mechanism known as the buffer system or buffering capacity—which helps protect teeth against enamel demineralization. Furthermore, a difference in salivary flow rate was found between the control group and the coffee addicts, with the latter exhibiting a reduced flow rate; this is attributed to an increase in salivary viscosity, which results in a thicker consistency that, in turn, diminishes the rate of salivary secretion. There is also a clear difference in salivary viscosity, with coffee addicts showing higher levels. A drop in salivary pH occurs within 5 to 7 minutes of coffee consumption. This is partly due to the presence of sucrose, which promotes the proliferation of *Streptococcus mutans* colonies, leading to a decrease in pH. Additionally, compounds such as chlorogenic acid and nicotinic acid contribute directly to lowering the salivary pH, making it more acidic. Salivary pH plays a critical role in the demineralization process; a low pH increases the concentration of hydrogen ions, which can damage hydroxyapatite. [5]

The study, titled "The Effect of Arabica Coffee (*Coffea arabica*) and Robusta Coffee (*Coffea canephora*) on Salivary Viscosity: An In Vitro Study," was conducted to determine the impact of Arabica and Robusta coffee on salivary viscosity under in vitro conditions. The results indicate that both Arabica and Robusta coffee affect salivary viscosity, with Robusta coffee exerting a more significant influence than Arabica coffee. This difference is attributed to the varying chemical compositions of the two types of coffee: Arabica coffee contains trigonelline (0.3%–0.9%) and chlorogenic acid (5%–7.5%), whereas Robusta coffee contains higher levels of these compounds—trigonelline (0.6%–1.3%) and chlorogenic acid (7.0%–10.5%). It is hypothesized that the higher concentration of these components in Robusta coffee increases salivary viscosity (resulting in thicker saliva), which in turn reduces the salivary flow rate. This reduction can lead to the accumulation of food debris, potentially resulting in the development of dental caries. Conversely, lower salivary viscosity (thinner saliva) enhances the salivary flow rate, facilitating an effective "self-cleansing" effect that helps reduce the risk of dental caries. [12]

A third study was conducted by Herry Imran, Nurdin, and Nasri (2016), titled "The Effect of Coffee Consumption on the Decrease in Salivary pH in Adults." This study aimed to determine the impact of coffee consumption on the reduction of salivary pH in adults. The results indicate a significant relationship between coffee consumption and a decrease in salivary pH. Coffee causes a drop in salivary pH and increases the risk of dental caries, as it contains acidic substances such as chlorogenic acid and nicotinic acid. Furthermore, coffee contains high concentrations of simple carbohydrates—including monosaccharides and sucrose—suggesting that individuals could benefit from minimal intervention or dietary control regarding their coffee intake. Coffee consumption leads to a decrease in salivary pH because the carbohydrates it contains are fermented by bacteria, which can lower the pH to below 5.5. This state is known as the "critical pH," which can trigger the demineralization of tooth enamel by increasing the concentration of hydrogen ions, thereby damaging hydroxyapatite ions. [7]

A subsequent study was conducted by Zaza Paroza and Saluna Deynilisa (2021), titled "A Comparison of the Effects of Consuming Arabica and Robusta Coffee on Salivary pH." This study aimed to compare the impact of consuming Arabica coffee versus Robusta coffee on salivary pH. The results indicate that the mean salivary pH before consuming Arabica coffee was 6.887, and 4.867 after consumption. Meanwhile, the mean salivary pH before consuming Robusta coffee was 7.020, and 5.537 after consumption. Consequently, there is a difference in the effect of consuming Arabica versus Robusta coffee on salivary pH; statistically, the mean decrease in salivary pH was greater in the group that consumed Arabica coffee compared to the group that consumed Robusta coffee. [9]

A subsequent study was conducted by M. Rizki Fauzi Lubis and Yumi Lindawati (2018), titled "The Effect of Robusta Coffee Bean (*Coffea canephora*) Extract on Salivary pH and the Growth of *Staphylococcus aureus*." This research aimed to determine the effect of Robusta coffee bean (*Coffea canephora*) extract on salivary pH and the growth of the bacterium *Staphylococcus aureus*. The study found that a 12.5% concentration of Robusta coffee extract is effective in maintaining salivary pH. The Minimum Inhibitory Concentration (MIC) of the Robusta coffee extract was determined to be 12.5%, while the Minimum Bactericidal Concentration (MBC) was 100% against the growth of *Staphylococcus aureus* colonies. At a 12.5% concentration, the Robusta coffee extract caused an insignificant decrease in salivary pH; this occurs because higher concentrations of coffee extract lead to a more acidic pH. Coffee contains simple carbohydrates, which—at high concentrations—undergo fermentation, producing acid. This acid causes a drop in salivary pH, thereby increasing the risk of dental caries if consumed continuously for more than 40–60 minutes. [10]

A subsequent study conducted by Erni Mardiati, Endah Aryati, Irmanita Wiradona, and Bedjo Santoso (2017), titled "The effect of Black Coffee and Tea Consumption on The Acidity Level of Saliva in Preventing Tooth Decay," aimed to determine the impact of consuming black coffee and tea on salivary pH levels in the context of preventing tooth decay. The results indicate that the consumption of black coffee affects salivary pH by causing a decrease; the average change in salivary pH before and after consuming black coffee was found to be 0.4. [11]

A subsequent study conducted by Santi Chismirina, Afrina, and Cut Maidis Safrianda (2016), titled "Comparison of Salivary Flow Rate Before and After Consumption of Robusta Coffee," aimed to compare salivary flow rates before and after the consumption of Robusta coffee. The results of the study indicate a significant difference between the flow rates measured before and after consuming Robusta coffee; the salivary flow rate was found to be lower before consumption, while a higher salivary flow rate was observed after consuming the coffee. [14]

Recent study conducted by Harvina Sawitri and Nora Maulina (2021), titled "Salivary pH Levels Among Medical Students at the Faculty of Medicine, Universitas Malikussaleh, Who Consume Coffee (2020)," aimed to determine the acidity (pH) level of saliva in medical students at Universitas Malikussaleh who consume coffee. The results indicate that 30% of the students consume coffee three times a week, while 70% consume it less than three times a week. Furthermore, 55% of the students were found to have a normal salivary pH, whereas 45% had an acidic salivary pH. The study also reveals a significant association between coffee consumption and salivary pH levels. [13]

5 CONCLUSION

There is difference between salivary pH and salivary flow rate before and after consuming robusta coffee (*Coffea canephora*). Consuming robusta coffee (*Coffea canephora*) decrease pH saliva and salivary flow rate.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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