

Efficacy of White and Black Tea Extract Mouthwash on Reducing Plaque and Gingivitis: A Rapid Review

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Abstract

One of the chemical control treatment of plaque and gingivitis as a support for the mechanical control treatments is the use of mouthwash. The main strength of herbal-based mouthwash is no side effects are known and it does not contain any alcohol or sugar. White tea and black tea are tea products that are known to contain catechins and phenols, both of which have the ability to fight and prevent the growth of microorganisms. This study aims to identify the efficacy of using herbal mouthwash based on white tea and black tea extracts against plaque and gingivitis. This research was conducted using a rapid review method which refers to a systematic literature review through the PICO framework based on Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA). Literature searches were performed using PubMed, Science Direct, Cochrane, Garuda, and Google Scholar. There are 10 articles in total with RCT, true experiment, and quasy-experiment research designs obtained based on the inclusion criteria to be analyzed qualitatively. Experimental research on 10 articles with a period of one day to one month showed that gargling with white tea and black tea extracts mouthwash can reduce plaque, gingival inflammation, and inhibit bacteria (*Porphyromonas gingivalis*, *Prevotella intermedia*, and *Aggregatibacter actinomycetemcomitans*). In conclusion, gargling using white tea and black tea extract mouthwash can reduce plaque, reduce gingival inflammation, and inhibit bacteria such as *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Aggregatibacter actinomycetemcomitans*.

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Introduction

The Global Burden of Disease Study 2016 stated that dental and oral health problems are disease that affects approximately 3.58 billion people, almost half of the world's population. Gum or periodontal disease ranks 11th as the most common disease in the world.¹ Plaque is one of the most common local causes of dental and oral health problems.² Plaque is a soft, grayish-white or yellow deposit that adheres tightly to the tooth surface^{3,4} and it consists of multispecies biofilms of microorganisms that grow as an ecosystem on the hard and soft tissues of the oral cavity. Plaque microorganisms included facultative gram-positive bacteria such as *Actinomyces viscosus* and *Streptococcus*

sanguinis, and secondary colony bacteria such as *Prevotella intermedia*, *Capnocytophaga*, and *Porphyromonas gingivalis*.⁵ The interaction of plaque microorganisms with host inflammatory cells and tissues results to *Dental-biofilm induced gingivitis*, which is a classification of gingivitis according to the *American Association of Periodontology* (AAP) in 2017.⁶ The majority of gingivitis microbiology is gram-negative anaerobic bacteria, such as *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Tannerella forsythia*, *Staphylococcus intermedius*, and *Treponema sp.*⁷

Plaque and gingivitis in the oral cavity can be prevented by maintaining good oral hygiene and can be controlled mechanically as well as by chemical means, one of which is the use of antimicrobial mouthwash.⁸ Mouthwash is one of the chemical agents that can be used to inhibit plaque and prevent the development of gingival inflammation. Therapeutic mouth wash contains active ingredients that are intended to help control or reduce conditions such as bad breath,

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plaque, and gingivitis. As long as it's not used as a substitute for regular toothbrushes and flossing, the use of mouthwash can be a useful addition to daily oral hygiene for some people as it provides the advantage of reaching areas not easily accessible by a toothbrush.⁹

White tea is a tea made from the very young and have not yet bloomed *Camellia sinensis* leaves that is still covered with silvery white fine hairs, which when dry will turn white.¹⁰ The active substances contained in white tea include polyphenols¹¹, tannins, flavonoids, *gallic acid*¹², catechins, phenols, and other ingredients such as enzymes, minerals, vitamins.¹³ Catechins have anti-inflammatory and antibacterial effects, and it helps reducing the periodontal inflammation, thereby improving dental and gingival health.¹⁴ Phenol has bactericidal or bacteriostatic properties depending on its concentration.¹⁵

Black tea is a type of tea that is common in South Asia and most countries on the African continent.¹⁶ Black tea is processed through the stages of withering, rolling, polyphenol oxidation, drying, and sorting. Black tea is obtained by using a fermentation process from enzymatic oxidation of the tea catechin content.¹⁷ Black tea contains phenolic compounds and flavonoids. One component of tea that plays an active role in inhibiting microbes is *tannin* or catechin, which has the ability to fight and prevent the growth of microorganisms.¹⁸

Considering the possibility of positive effects from the black tea and white tea active substances, gargling with black tea and white tea extracts mouthwash may have a good effect on periodontal health. The aim of this study was to further identify the efficacy of herbal mouthwash made from extract of white tea and black tea against plaque and gingivitis in the oral cavity.

Materials and methods

This study used the rapid review method, a type of knowledge synthesis in which the systematic review steps are accelerated to produce evidence *in* a shortened period of time.⁽¹⁹⁾ Specific research questions were designed based on the PICO concept. Literature searches for articles were conducted on databases and search engines using PubMed, Science Direct, Cochrane, Garuda, and Google Scholar. The search and selection of articles to

be analyzed qualitatively was carried out based on the *Preferred Reporting Items for Systematic Review and Meta-Analysis* guidelines (PRISMA). The keywords used to search scientific articles on databases and search engines are “((White tea) AND (Plaque) OR (Gingivitis))” and “((Black tea) AND (Plaque) OR (Gingivitis))”. The inclusion criteria used as references in the selection of research articles were articles published within the last 10 years from the PubMed NCBI, Elsevier, Cochrane, Garuda, and Google Scholar databases; articles in Indonesian and English; full text articles from accredited and indexed journals; and articles with keywords “white tea”, “black tea”, “plaque” and “gingivitis”. While the exclusion criteria in this study were literature review type articles and articles with experimental research not on humans.

In the initial search, there were 489 articles identified for the keywords white tea and 3,647 articles identified for the keywords black tea through a search through the database . At the end, total of 4 articles for white tea and 6 articles for black tea met the eligibility criteria. The PRISMA diagram as article selection process can be seen in Figures 1 and 2.

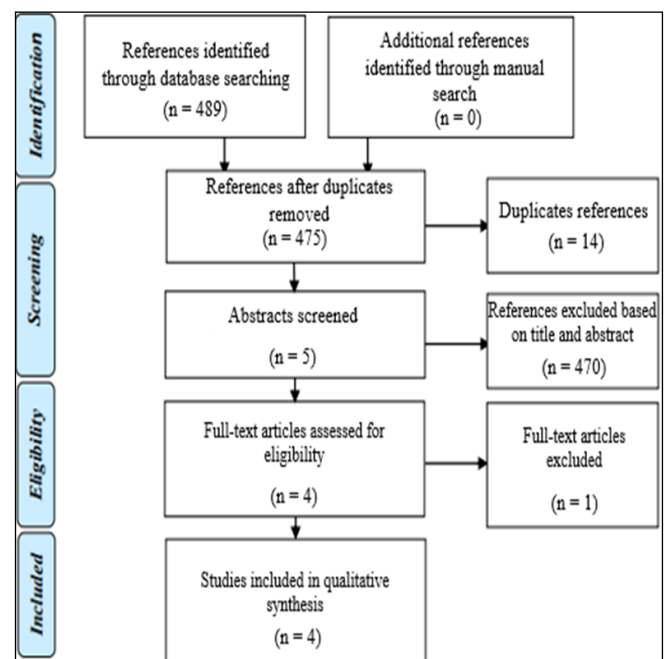


Figure 1. PRISMA diagram for keywords White Tea, Plaque, and Gingivitis.

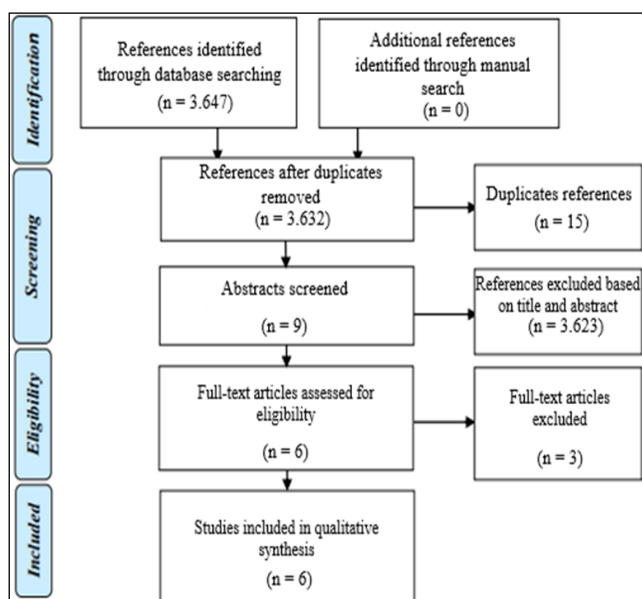


Figure 2. PRISMA diagram for keywords Black Tea, Plaque, and Gingivitis.

Results

There were 10 articles obtained that were included in the inclusion criteria. All of the study consisted of 384 participants. Four study used the Randomized Controlled Trial (RCT) method, five articles used the Quasy-experiment method, and one article used the True-experiment method. The articles assessed clinical parameters such as plaque index, oral hygiene index, gingival index, and microbiological parameters such as Colony Forming Unit (CFU) and Bacteria inhibition. After participants gargled with white tea or black tea mouthwash, all articles showed reduction on plaque index score, oral hygiene index score, gingival index score, and microbiological parameter (bacterial inhibition and Colony Forming Unit). The data extraction from ten articles are summarized in Table 1 and Table 2. The results from ten articles are shown in Table 3.

Discussion

The main clinical parameters used to measure the periodontal and oral tissue health are plaque indices such as Plaque Index, O'Leary Plaque Index, Loe and Silness Plaque Index, and Patient Hygiene Performance Index. The severity of gingivitis are measured by the Gingival Index and the Gingival Bleeding Index. Another parameter that can assess oral health is

the Oral Hygiene Index. In addition to clinical parameters, there are microbiological parameters such as the level of bacterial inhibition and the Colony Forming Unit that is measured by *in vitro* studies that can also be used as a guide in assessing the ability of a mouthwash as an anti-plaque and anti-inflammatory agent.

Mitra²⁰ in the research stated that there was a significant reduction on plaque index in the group of participants who gargled with white tea when compared to the group of participants who gargled with distilled water during the study. This is in accordance with research conducted by Nagar¹⁴ and Noorfadhila¹² which stated that there was reduction on plaque index scores in the group that gargled with white tea, so that gargling white tea was considered significant in reducing plaque index. However, Mitra²⁰ and Nagar¹⁴ in their research stated that the effectiveness and efficacy of gargling white tea on reducing plaque index was lower than gargling using chlorhexidine. This is inversely proportional to the results of research reported by Noorfadhila¹² which stated that the average difference in the treatment by gargling white tea was more effective than gargling chlorhexidine.

In research conducted by Satryadi²¹, the group that gargled with black tea showed a significant reduction on plaque index between before and after gargling compared to gargling with distilled water. This is in line with the research results reported by Suma²² that gargling black tea was more effective on reducing plaque index compared to the group that gargled with mineral water. The results of research conducted by Halid²³ also support this statement. Halid²³ reported that the *p-value* results in the pre-test and post-test distilled water group showed no significant difference between the plaque index before and after treatment, while the *p-value* in the pre -test and post -test of black tea showed a significant difference in the plaque index value before and after treatment. Thus, gargling black tea is effective on reducing plaque formation.²³

The study of Pujirahayu²⁴, which compare the effectiveness of gargling black tea with chlorhexidine, reported a smaller reduction on plaque accumulation in the black tea treatment group than in the chlorhexidine control group. Pujirahayu²⁴ stated that black tea had an effect on reducing plaque accumulation in children aged 7-8 years, but the effect was lower than chlorhexidine. Halid²³ in the research stated that

there was no significant difference in the treatment of gargling with black tea and chlorhexidine, so black tea was considered as effective as chlorhexidine in reducing plaque formation.

Research conducted by Rosnaeni²⁵ that compare the effects of gargling steeped green betel and black tea resulted in the conclusion that gargling steeped black tea and green betel on reducing plaque index is potentially equivalent. Setianingtyas²⁶ in the study which compared the effectiveness of gargling black tea and fluor also stated that gargling with black tea can be assumed to have the same ability as fluor because there is no significant difference between the two. Thus gargling with black tea has a potency that can be considered equivalent to gargling using green betel and fluor.

The reduction on plaque index reported in the studies above occurred because tea, both white tea and black tea, contains rich sources of polyphenols called catechins which are part of flavonoids which have anti-inflammatory and antibacterial effects. Catechins in tea have role in maintaining the pH of saliva and dental plaque while maintaining the pH in the normal range (7.2-7.4), so it is not beneficial for bacterial growth and can inhibit the growth of *Streptococcus mutans*, *Streptococcus sobrinus* and *Lactobacillus* bacteria which are the bacteria that cause dental plaque formation.^{12,14} Polyphenols in tea are the main components that can inhibit glucan from sucrose which has adhesion and is important in inhibiting plaque.¹² In addition, tea contains phenol which has bactericidal or bacteriostatic properties.

Niveditha¹³ in the study using the Oral Hygiene Index and Gingival Bleeding Index parameters in assessing gingival inflammation stated that there was a significant reduction in the Oral Hygiene Index and Gingival Bleeding Index between baseline and day 21 of the study. The Oral Hygiene Index and Gingival Bleeding Index reduction in the group that rinsed with white tea and chlorhexidine was comparable and significant than the group that rinsed with distilled water. However, white tea mouthrinse has lower efficacy than chlorhexidine.¹³ Nagar's study¹⁴ that measured gingival index stated that chlorhexidine showed better statistical results regarding the gingival index when compared to green tea and white tea extract mouthwash. When the two types of tea were compared, green tea extract

mouthwash showed a statistically significant reduction in Gingival Index (GI) compared to white tea. The reduction in the value of Oral Hygiene Index (OHI), Gingival Bleeding Index (GBI), and Gingival Index (GI) occurred because catechins have anti-plaque and antibacterial properties and can prevent gingival enlargement. Hirasawa in the study found the bactericidal potential of green tea catechins at 1 mg/ml against *Prevotella* and *Porphyromonas gingivalis* species and investigated a significant reduction of cytokine profile markers in gingivitis after their use as a slow-release buccal delivery system applied over an 8-week period.¹⁴

Research conducted by Mitra²⁰ in vitro to determine the inhibition of white tea against *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Aggregatibacter actinomycetemcomitans* stated that the inhibition occurred at a concentration of 1%. Meanwhile, a study conducted by Nagar¹⁴ to determine the Colony Forming Unit of bacteria resulted that chlorhexidine showed better statistical results related to Colony Forming Unit when compared to green tea and white tea extract mouthwash. When compared between the two types of tea, green tea extract mouthwash showed a statistically significant reduction in Colony Forming Unit values compared to white tea. White tea contains mainly fluoride, tannins and flavonoids which are effective in inhibiting bacterial growth.¹⁴

Thus, the use of white tea and black tea is effective in reducing plaque index, gingival index (Gingival Index, Gingival Bleeding Index), and oral hygiene (OHI). In addition, white tea also produced significant results against the inhibition of *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Aggregatibacter actinomycetemcomitans* bacteria, and showed a significant decrease in the Colony Forming Unit bacteria. The effectiveness of using black tea and white tea as mouthwash is considered to be equivalent to the use of fluoride-based and green betel mouthwash, but the effectiveness of black tea and white tea in reducing plaque index, gingival index, and oral hygiene in the majority of studies showed lower results when compared to chlorhexidine mouthwash.

Conclusions

The findings from most clinical studies in

various methods such as RCTs, *true experiments*, and *quasy experiments* show that gargling with white and black tea mouthwash is effective on reducing plaque, reducing gingival inflammation (*Gingival Bleeding Index*, *Gingival Index*), and inhibiting bacteria (*Porphyromonas gingivalis*, *Prevotella intermedia*, and *Aggregatibacter actinomycetemcomitans*).

Pharmacy, Faculty of Dentistry, Padjadjaran University), Elin Karlina, drg., M.Kes (Department of Dentistry Material Technology, Faculty of Medicine Gigi, Padjadjaran University), and Wahyu Hidayat, drg., Sp. PM (Department of Oral Medicine, Faculty of Dentistry, Padjadjaran University) for the suggestions that have been given to this manuscript.

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Declaration of Interest

The authors report no conflict of interest.

No	Author	Title	Participants	Method
1.	Mitra, DK, et al. ²⁰ 2016	The antiplaque efficacy of white tea extract mouthrinse	45 subjects (11 males and 34 females) with healthy periodontium between the ages of 21-23 years	Clinical trial double-blinded, randomized, parallel, longitudinal study
2.	Nivedita, P., et al. ¹³ 2019	Efficacy of white tea extract mouthrinse as an anti-inflammatory agent – a randomized controlled clinical trial	30 healthy patients of Vivekanandha Dental College for women, aged over 13	In vitro study Randomized Controlled Trial
3.	Nagar, A., et al. ¹⁴ 2018	Comparative evaluation of the anti-plaque efficacy of green tea extract mouthrinse and white tea extract mouthrinse with chlorhexidine gluconate mouthrinse - a clinical and microbiological study	30 Participants (9 men, 21 women) with healthy periodontal age range 19-23 years	Clinical trial double-blinded, randomized, parallel, longitudinal study
4.	Noorfadhila HA, et al. ¹² 2019	Efektivitas berkumur seduhan the putih (<i>Camellia sinensis</i> L.) terhadap indeks plak gigi	36 respondents from UMS Dentistry	Microbiological study Quasy-experiment
5.	Satryadi, PA, et al. ²¹ 2016	Uji efektivitas berkumur menggunakan air seduhan teh hitam (<i>Camellia sinensis</i>) dalam menurunkan akumulasi plak	60 students from Unsrat Dentistry	Quasy-experimental with <i>pretest</i> and <i>posttest</i> design
6.	Rosnaeni, R. et al. ²⁵ 2019	Perbandingan efek berkumur dengan seduhan sirih hijau (<i>Piper betle</i> L.) dan teh hitam (<i>Camellia sinensis</i> L.) <i>kuntze</i> terhadap indeks plak dengan metode O'Leary	45 subjects who live in the Kuncup Harapan children's orphanage, Bandung	True experimental with <i>post test</i> only control group
7.	Setianingtyas, P., et al. ²⁶ 2018	Efektivitas berkumur teh hitam terhadap penurunan akumulasi plak pada anak usia 7-8 tahun	28 grade 1 students of SDN 012 Pagi Sumur Batu aged 7-8 years old	Field experiment Randomized Controlled Trial
8.	Pujirahayu, et al. ²⁴ 2019	Pengaruh berkumur larutan teh hitam (<i>bless tea</i>) dalam menurunkan akumulasi plak pada gigi anak usia sekolah dasar	40 respondents (16 males and 24 females) from Poasia Elementary School students	Pseudo-experimental with <i>pre test</i> and <i>post test</i> design
9.	Suma, FPA, et al. ²² 2016	Efektivitas berkumur seduhan teh hitam (<i>Camellia sinensis</i>) dalam penurunan indeks plak gigi (Tinjauan pada Siswa SMP 2 Banjarbaru)	60 Students from grade VII SMP Negeri 2 Banjarbaru aged 12 years	Quasy-experiment with pre- and post-test control group design
10.	Halid, I. et al. ²³ 2021	Efektivitas air seduhan teh hitam (<i>Camellia sinensis</i>) dalam menurunkan akumulasi plak	10 respondents	Quasy Experimental with pretest and posttest design

Table 1Articles Title, Author, Participants, and Method.

No	Author	Research time	Intervention
1.	Mitra, DK, et al. ²⁰ 2016	4 day mouthrinse study with the following follow-up: 1. Baseline 2. Follow up	15 patients got mouthwash label A (white tea), 15 patients got mouthwash label B (distilled water), and 15 patients got mouthwash label C (CHx). <u>Baseline</u> : Prophylaxis and plaque staining <u>Instruction</u> : - Do not : brush their teeth, use toothpaste, interdental cleaning aid, or chew gum for 4 days. - Rinsing: 2 times a day for 1 minute, 10 mL every day at the same time. <u>Post-test</u> : Day 5, the subject was recalled for measurement of PI (Tureskey, Quigley modification of PI) 10 patients got mouthwash label A (white tea), 10 patients got mouthwash label B (distilled water), and 10 patients got mouthwash label C (CHx)
2.	Niveditha, P., et al. ¹³ 2019	21 days with follow-up as follows: 1. Baseline 2. Follow up	<u>Pre-test</u> : measurement of GBI and OHI, and oral prophylaxis <u>Instruction</u> : gargle 10 ml of mouthwash twice a day for 21 days <u>Post-test</u> : re-measurement of OHI and GBI
3.	Nagar, A., et al. ¹⁴ 2018	10 day rinse study with follow up as follows: 1. Baseline 2. Follow Up	10 patients got mouthwash label A (green tea mouthrinse), 10 patients got mouthwash label B (white tea), and 10 patients got mouthwash label C (chlorhexidine gluconate). <u>Baseline</u> : oral prophylaxis, collecting plaque samples, measuring PI and GI <u>Instruction</u> : - Not to chew gum or use interdental aids within 10 days. - Gargle using the mouthwash given 2 times a day for 1 minute with 10 mL of mouthwash at the same time every day. <u>Post-test</u> : On day 10, the PI and GI were measured 18 participants as the treatment group (white tea), and 18 participants as the control group (0.2% Chlorhexidine)
4.	Noorfadhila HA, et al. ¹² 2019	1 day with follow up as follows: 1. Baseline 2. Follow up	<u>Baseline</u> : - Rinsed mouth with mineral water - Smeared disclosing solution with cotton pellet on 12 tooth surfaces, Plaque index was calculated using the PHP-M index. <u>Instruction</u> : - Rinsed their mouth with 10 mL of mouth wash given for 30 seconds. <u>Post-test</u> : The disclosing solution was smeared again as a posttest, the plaque index calculated by the PHP-M index.
5.	Satryadi, PA, et al. ²¹ 2016	1 day with follow up as follows: 1. Baseline 2. Follow up	30 students as black tea treatment group, 30 students as the aquadest control group. <u>Baseline</u> : recorded initial plaque scores in 6 dental segments <u>Instruction</u> : gargling 20 ml of mouthwash given for each group for 30 seconds <u>Post-test</u> : record plaque scores of both groups on 6 tooth segments
6.	Rosnaeni, R. et al. ²⁵ 2019	3 days of research with follow-up as follows: 1. Baseline 2. Treatment 3. Follow up	Group I (15 subjects) rinsed with green betel leaf infusion. Group II rinsed with black tea. Group III with water as control group. <u>Baseline</u> : Plaque index examination, subjects brushed their teeth <u>Instruction</u> : - Rinse their mouths 4 times a day with 30 ml of mouthwash given for 3 minutes. - For 24 hours on the D day of the study, subjects were only allowed to eat with the menu provided 3 times a day, and drink water. - Not allowed to clean teeth, mechanically or chemically. <u>Post-test</u> : Plaque index examination (on 4 surfaces per tooth), recorded with modified <i>Plaque Control Record</i> format
7.	Setianingtyas, P., et al. ²⁶ 2018	28 days with follow-up as follows: 1. Baseline 2. Follow up 1 3. Follow up 2	15 children in the black tea group 13 children in fluorine <u>Baseline</u> : informed consent signed by parents, scaling The second visit was to check the baseline plaque index using the <i>Loe and Silness method</i> visually. <u>Instruction</u> : - Rinsed mouth with 10 ml for 1 minute - subject was not allowed to eat or drink except water for 1 hour after gargling - Gargle every morning at school for 28 days <u>Post-test</u> : - The plaque index was checked again using <i>Loe and Silness method</i> every 2 weeks once after gargling

8. Pujirahayu, *et al.*²² 2019
1 month with a frequency of 2x a week
20 treatment group (black tea) and 20 control group CHx 0.2%

Baseline : initial plaque examination (*PHP-Index*) before intervention
Instruction : Gargled for 30 seconds, then the plaque index score is measured again
Post-test : Plaque index score is measured again

The research is conducted for 1 month with a frequency of gargling twice a week
9. Suma, FPA, *et al.*²⁴ 2016
1x treatment with pretest and posttest
30 people as the black tea water gargling group, and 30 people as the mineral water gargling group

Pre-test : Plaque index examination before treatment.
Instruction : Samples were asked to rinse their mouth.
Post-test : Plaque index was checked after treatment.
10. Halid, I. *et al.*²³ 2021
15 days of study rinse with the following follow-up:
1. Baseline
2. First follow-up
3. Second follow-up
4. Third follow-up
10 respondents rinsed their mouth with aquadest (negative control), black tea (treatment) and 0.12% chlorhexidine (positive control) each for 5 consecutive days, for a total of 15 days of the study.

Baseline (12 hours before the experiment): Respondents smeared sumba on the teeth and brushing without toothpaste until all the plaque is gone, then fasting without eating and not brushing teeth for 12 hours. Measurement of plaque index pre-test then conducted.

Instruction (during all days) : Respondents brushed their teeth without paste, fasted, did not eat and did not brush their teeth for 12 hours

First follow-up: The first night after baseline, respondents did the instruction, then rinsed with distilled water. The action was repeated for 5 days, the plaque index was measured after aquadest post-test.

Second follow-up: The next night (6th day) after measuring the plaque index post-aquadest, respondents did the instruction, followed by gargling black tea. The action was repeated for 5 days, the plaque index was measured after the black tea post-test.

Third follow-up: The next night (11th day) after measuring the plaque index in the black tea post-test, respondents did the instruction, followed by gargling chlorhexidine. The procedure was repeated for 5 days, Plaque index for Chlorhexidine post test then measured.

Table 2Articles Research Time and Intervention.

No	Author	Parameters	Research result
1.	Mitra, DK, <i>et al.</i> ²⁰ 2016	1. PI (Tureskey, Quigley modification of PI)	PI Value Placebo control 2.55 White tea 2.21 CHx 1.94 ANOVA test showed a statistically significant difference between the three PI scores (P= 0.001) The difference between each mouthwash with <i>distilled water</i> was determined by the <i>Bonferroni multiple comparison test</i> , which showed significantly lower plaque regrowth results in <i>chlorhexidine</i> mouthwash (P=1.94) and white tea (P=2.21) when compared to <i>distilled water</i> .
		2. Adverse effect	No burning sensation or <i>taste alteration</i> were reported by the subjects at the end of the study. There is no evidence of desquamation of the gingival epithelium on intraoral examination
2.	Niveditha, P., <i>et al.</i> ¹³ 2019	3. <i>Pg, Pi, Aa</i> . inhibition 1. GBI	Pg, Pi, Aa inhibition occurred at a concentration of 1% GBI Group A (White tea) 15.8 to 7.2 Group B (Distilled water) 17.8 to 10.6 Group C (Chlorhexidine) 14.2 to 2.9
		2. OHI	OHI Group A (White tea) 3.39 to 0.91 Group B (Distilled water) 2.71 to 1.38 Group C (Chlorhexidine) 2.45 to 0.33 The study showed a comparable and significant reduction in OHI and GBI in the <i>chlorhexidine</i> and white tea groups when compared to <i>distilled water</i> (P=0.001)

3. Nagar, A., et al.¹⁴
2018
 1. PI

PI
CHx 1.58 to 0.6380
White tea 1.51 to 0.7810
Green tea 1.55 to 0.9710
 2. GI

GI
CHx 1.5970 to 0.5630
White tea 1.3560 to 0.7590
Green tea 1.4490 to 0.6590
 3. CFU

CFU
CHx 115.70 to 69.60
White tea 113.00 to 90.80
Green tea 110.80 to 72.60
4. Noorfadhila HA, et al.¹²
2019

PI (PHP-M)

PI
CHx 2.14 to 1.70, The decrease in PI in the control group was 0.44
White Tea 1.77 to 1.18, The decrease in PI in the treatment group was 0.59

The results of the statistical analysis of the *dependent test t test* showed $p = 0.000$ ($p < 0.005$) so that there was a **significant difference** between the plaque index in the white tea group before and after treatment.

The results of the *independent statistical t test* showed that the 0.2% chlorhexidine control group had $p=0.024$ ($p < 0.005$) and white tea had $p=0.003$ ($p < 0.005$).
5. Satryadi, PA, et al.²¹
2016

PI

PI
Black Tea:
16 moderate categories and 14 bad categories into 16 good categories and 14 moderate categories

Aquadest:
18 moderate categories and 12 bad categories into 4 good categories and 26 bad categories

There is a **significant difference** between before and after gargling with black tea and distilled water
6. Rosnaeni, R. et al.²⁵
2019

PI (O'Leary)

PI
(after gargling)
Betel leaf : 38.56%
Black tea : 42.92%
Water : 65.58%

The potential for decreasing dental plaque index after rinsing with betel leaf (38.56%) had no significant difference ($p > 0.05$) when compared to steeping black tea (42.92%)
7. Setianingtyas, P., et al.²⁶
2018

PI
Loe's and Silness's Index

PI
Black Tea
Baseline = 4.77 ± 0.51
Follow up 1 = 3.74 ± 0.54
Follow up 2 = 2.33 ± 0.34

Fluor
Baseline = 3.47 ± 1.88
Follow up 1 = 3.51 ± 2.02
Follow up 2 = 1.54 ± 1.19

There was no significant difference in the black tea group between the baseline compared to the first 2 weeks, while at the time of the baseline examination with the second 2 weeks, there was a **significant difference**.

Examination between the first 2 weeks and the 2nd week there was also a **significant difference**.

There was no significant difference between the fluorine group at baseline and the first 2 weeks. There is a significant difference between the first 2 weeks and the second 2 weeks, and between the first 2 weeks and the second 2 weeks
8. Pujirahayu, et al.²²
2019

PHP Index

PHP
Black Tea 3.10 ± 1.3 to 1.81 ± 0.7 decreasing difference 1.10 ± 0.4

CHx 0.2%, decreasing difference 1.89 ± 0.5

The decrease in plaque accumulation in the treatment group (black tea) was smaller than the 0.2% CHx control group.

There was a significant difference between the reduction in plaque accumulation in the treatment and control groups

9. Suma, FPA, et al.²⁴ 2016
 1. PI Loe and Silness
Black Tea: 59.05 to 34.3
Mineral Water: 55.9 to 51.5
 2. PI O'Leary
O'Leary
Black Tea:
Before treatment: Good category 6.7%, Poor category 93.3%
After treatment: Good category 56.7%, Poor category 43.3%
Mineral water:
Before treatment: Good category 3.3%, Poor category 96.7%
After treatment: Good category 13.3%, Poor category 86.7%

There is a difference in plaque index before and after gargling with black tea at SMPN 2 Banjarbaru, and there is also a difference in plaque index before and after gargling with mineral water at SMPN 2 Banjarbaru.
10. Halid, I. et al.²³ 2021
 - PI
p value
1. Pre-test to post-test aquadest: 0.477
2. Pre-test to post-test black tea: 0.0193.
3. Pre-test to post-test CHx : 0.005

p value
1. Aquadest post-test to black tea post-test: 0.0432.
2. Aquadest post-test to chlorhexidine post-test: 0.0123.
3. Black tea post-test to chlorhexidine post-test: 0.854

The results of the *p value* on the pre-test and post-test aquadest (0.477) showed no significant difference between the plaque index before treatment and after 5 days of treatment. While the *p value* in the pre test and post test of black tea (0.019) and chlorhexidine (0.005) showed a significant difference in the plaque index value before and after 5 days of treatment .

In the second *p value* , the plaque index in the gargling group using black tea was significantly different from the group who rinsed with distilled water ($p = 0.043$). The chlorhexidine group also showed a significant difference with the group that rinsed with aquadest ($p = 0.012$). Meanwhile, there was no significant difference in the gargling treatment with black tea and chlorhexidine ($p = 0.854$).

Table 3Articles Parametes and Results.

*RCT : Randomized Clinical Trial, Pg : Porphyromonas gingivalis, Aa : Aggregatibacter Actinomycetemcomitans, Pi : Prevotella intermedia, GBI: Gingival Bleeding Index, OHI : Oral Hygiene Index, PI : Plaque Index, PHP : Patient Hygiene Performance Index , GI : Gingival Index, CFU : Colony Forming Unit

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