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Evaluation of the Efficacy of 0.5 % Black Tea Mouthwash, as an Adjunct to Scaling, in the Management of Chronic Gingivitis: A Pilot Study

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ABSTRACT:
Aim: To clinically evaluate the efficacy of black tea mouthwash, as an adjunct to scaling, in the management of chronic gingivitis.
Methods: A total of 16 subjects were divided into two groups:
Group A (8 subjects) –Scaling alone (control group) and
Group B (8 subjects) – 0.5% Black tea mouthwash (test group) dispensed post scaling to be used twice a day, 5ml to be rinsed for 30 seconds.

Clinical parameters included:
1. Plaque index (PI) (Loe H, 1967), Gingival Index (GI) (Loe H and Silness J, 1963), Sulcus Bleeding Index (SBI) (Muhlemann H.R and Son S, 1971).
2. Evaluated at baseline (pre-scaling) and 21 days (post scaling).

Results:
1. There was a statistically non-significant difference seen with intra group comparison of the variables at various time intervals for both group A and group B ($p>0.05$)
2. There was a statistically non-significant difference seen with intergroup comparison of all the variables ($p>0.05$).

Conclusion: Clinical evaluation the efficacy of black tea mouthwash, as an adjunct to scaling, in the management of chronic gingivitis showed statistically non-significant results when compared to scaling alone.

Key words: Black Tea, Chronic Gingivitis, Scaling, Mouthwash.

I. INTRODUCTION

Gingivitis is a form of periodontal disease that is prevalent in most children and adult populations.[1] It is an inflammation of the gingiva, which is characterized by the presence of clinical signs of inflammation that are confined to the gingiva.[2] Local factors may contribute to gingivitis, in addition to the plaque retentive calculus formation on the crown and the root surfaces of the tooth. Pathological changes in gingivitis are associated with the presence of oral microorganisms attached to the tooth and perhaps in or near the gingival sulcus[3]. Although progression is not predictable, the prevention of gingivitis in the individual population is still the first step towards preventing periodontitis *(Burt et al.2005).*[4]

Bacterial plaque is the primary aetiological agent in gingivitis. Mechanical plaque control, like scaling and root planing (SRP), is the first recommended step in the management of gingivitis and periodontitis.[1]

Tea stands as one of the most frequently consumed non-alcoholic beverages around the world. It is also the less expensive one *(Sharangi, 2009).*[5] Native from South-East Asia, it has been grown since ancient times. India and China are the two main tea producing countries. All the types of tea- black, green, and oolong are made from the leaves of the species Camellia sinensis.[6] It is grown mainly in tropical and temperate areas and made through the harvest of young leaflets *(Hampton, 1999).*[7] The drink derives its name from the Chinese Amoy dialect word "t'e," pronounced "tay".

TEA			
MAJORLY CLASSIFIED AS *(Ratnasooriva and Fernando, 2008)*[8]	**Black tea- fermented/ fully aerated**	**Green tea - non fermented**	**Oolong tea- partially fermented**
GLOBAL CONSUMPTION[6]	**78%**	**20%**	**2%**

Other types of tea are [5]

- **White tea**- leaves are steamed and dried with minimum amount of processing.
- **Pu'erh tea**- processing is similar to that of black tea however its uniqueness is that, once it is picked, it is piled and aged for as long as 50-100 years.
- **Roobios or "Red" tea**- it comes from a shrub in South Africa and is naturally caffeine free making it a good choice for pregnant or breastfeeding women.

Main components of black tea: *Dufresne CJ, Farnworth ER (2001)*[9]

	Components	*% Dry weight*
Catechins	Epigallocatechin gallate [EGCG]	10–12
Theaflavins	Resulting from oxidation of catechins during black tea processing	3–6
Thearubigins		12–18
Flavonols	Quercetin Keampherol Rutin	6–8
Methylxanthines	Caffeine	8–11[a]
Phenolic acids	Caffeic acid Quinic acid Gallic acid	Not available
Amino acids	Theanine	Not available

The fermentation process during manufacturing of Black tea allows the leaves to undergo enzymatic oxidation causing polymerization of flavan-3-ols (monomeric catechins) to a large extent, resulting in formation of dimeric (theaflavins) and oligomeric (thearubigins) forms, that decide the liquor characteristics of Black tea.[10] Three main types of theaflavins are found in Black tea, namely theaflavin (TF-1), theaflavin-3-gallate (TF-2), and theaflavin-3, 3-digallate (TF-3). [11]

Biological activities of black tea are as follows:[12]

- Anti-oxidant
- Anti-inflammatory
- Antimicrobial
- Anticarcinogenic
- Antiallergic

Human studies have shown an increase in blood antioxidant capacity after consumption of black tea. *(Gardner EJ, 2007, Popkin BM etal, 2006)*

Black tea is not only popular, but also economical and considered a safe drink which is enjoyed daily by millions of people all across the world.[12] This made us evaluate the efficacy of black tea mouthwash on gingival health and its use in the treatment of gingivitis.

Therefore, the **AIM OF THIS STUDY** was to clinically evaluate the efficacy of black tea mouthwash, as an adjunct to scaling, in the management of chronic gingivitis.

The **OBJECTIVES OF THIS STUDY** were as follows:

1. To evaluate the efficacy of black tea mouthwash, when used as an adjunct to scaling, on clinical parameters in chronic gingivitis.
2. To clinically compare the efficacy of black tea mouthwash as an adjunct to scaling versus scaling alone in the management of chronic gingivitis.
3. To record any side effects such staining of teeth due to the usage of black tea mouthwash within a period of 21 days.

II. MATERIALS AND METHODSOURCE OF DATA

Subjects with probing depth ≤ 3 mm, diagnosed with mild to moderate chronic gingivitis were included in the study. This study was conducted on subjects who gave verbal and signed written consent after being informed about the study protocol. All observations were recorded by a single examiner.

Subjects were selected according to the following selection criteria:

INCLUSION CRITERIA

- Systemically healthy and cooperative subjects.
- Subjects with minimum of 20 teeth present in the dentition.
- Subjects with mild to moderate chronic gingivitis having probing depth ≤ 3mm.

(Gingival index scores – 1,2; according to Loe and Silness J,1963)

- Subjects who were willing to avoid green or black tea consumption during the study period.

EXCLUSION CRITERIA

- Smokers and tobacco chewers (as per AHA guidelines).
- Pregnant and lactating women.
- Subjects with a history of periodontal therapy undertaken in the past 6 months.
- Subjects who have undergone antibiotic, anti-inflammatory or nutritional supplement therapy in the past 3 months or who were currently on any of these.
- Subjects having no allergy to tea.

CLINICAL PARAMETERS

- **Plaque index (PI) (Loe H, 1967)**
- **Gingival Index (GI) (Loe H and Silness J, 1963)**
- **Sulcus Bleeding Index (SBI) (Muhlemann H.R and Son S, 1971)**
- **Visual examination of any side effects, such as staining of teeth or any other discomfort was also recorded.**

The **clinical parameters** were **evaluated at baseline** (pre scaling) and **the 21st day** (post scaling).

- A questionnaire was prepared and completed by the interviewer as an aid in evaluating patient compliance at the end of the study period for the subjects using the black tea mouthwash.

III. METHODOLOGY

- Once the subjects were selected depending on the inclusion and exclusion criteria they were assigned into:
  - Group 1 (8 subjects) –Scaling alone (control group) or
  - Group 2 (8 subjects) – Black tea mouthwash dispensed post scaling
- In each group, a case history of the subjects participating in the study was recorded.
- Modified Bass tooth brushing technique was demonstrated and frequency of brushing twice a day was explained to all the subjects.
- Subjects were prescribed soft toothbrushes and a standardized dentifrice through the study period.

In the Control group/ Group 1 -

Ultrasonic scaling was done (**Ultrasonic Scaler DTE - D3** by **woodpecker)**.

 In the Test group/ Group 2 –
Ultrasonic scaling was done (**Ultrasonic Scaler DTE - D3** by **woodpecker)**. The subjects were instructed to use 5ml of 0.5% black tea mouthwash twice a day after brushing, to be rinsed for 30 seconds.

Preparation of black tea mouthwash[13,14]
224 grams of black tea leaves was added to 1 litre water (95 ℃ – 98 ℃) hot water for 1 minute). This was then strained into a container and covered with a lid, tea leaves discarded. After cooling completely the concentrated tea was mixed with 2 litres distilled water to get a 0.5% solution of tea mouthwash. 2 grams of Sodium Benzoate preservative was added. The mouthwash was poured into 240 ml bottles each and refrigerated.

The clinical parameters were evaluated at baseline (pre scaling) and the 21st day (post scaling).

IV. STATISTICAL ANALYSIS

- Data obtained was compiled on a MS Office Excel Sheet (v 2010) and subjected to statistical analysis using Statistical package for social sciences (SPSS v 22.0, IBM).
- Intergroup comparison of various variables like Plaque index, gingival index, SBI was done using t test.
- Intra group comparison of these variables in each of the 2 groups at baseline vs 21 days was done using paired t test.
- For all the statistical tests, $p<0.05$ was considered to be statistically significant keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

V. RESULTS

Gender	Frequency	Percent
Female	11	68.8
Male	5	31.3
Total	16	100.0

Minimum Age	Maximum Age	Mean	Std. Deviation
17	22	19.75	1.483

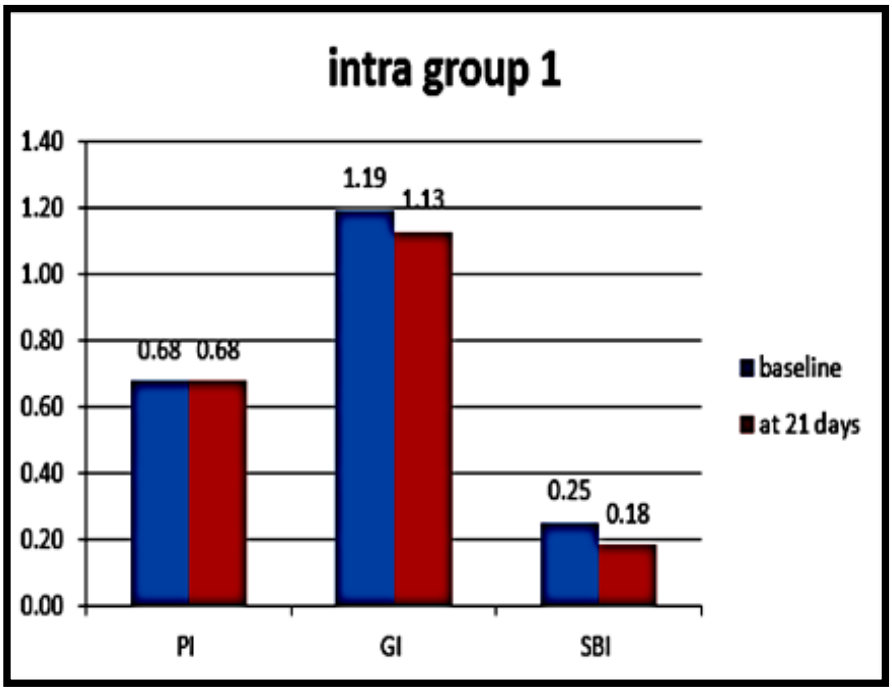
INTRA GROUP COMPARISON FOR THE CONTROL GROUP/ GROUP 1 ATBASELINE & AFTER 21 DAYS

Groups	Mean	N	Std. Deviation	Std. Error Mean	p value of paired t test
PI B	.677500	8	.2466779	.0872138	0.983 #
PI 21	.678750	8	.2511936	.0888103	
GI B	1.191250	8	.1064274	.0376278	0.098 #
GI 21	1.126250	8	.1126229	.0398182	
SBI B	.2500	8	.25014	.08844	0.313 #
SBI 21	.1838	8	.20255	.07161	

***** *** = Statistically highly significant difference (p<0.01)**

***** **= Statistically significant difference (p<0.05)**

 # = statistically non significant difference (p>0.05)



Graphical representation of PI, GI & SBI at baseline & 21 days within Group 1 (Scaling alone).

There was a statistically non significant difference seen with comparison of the variables within group 1, at baseline & 21 days. (p>0.05)

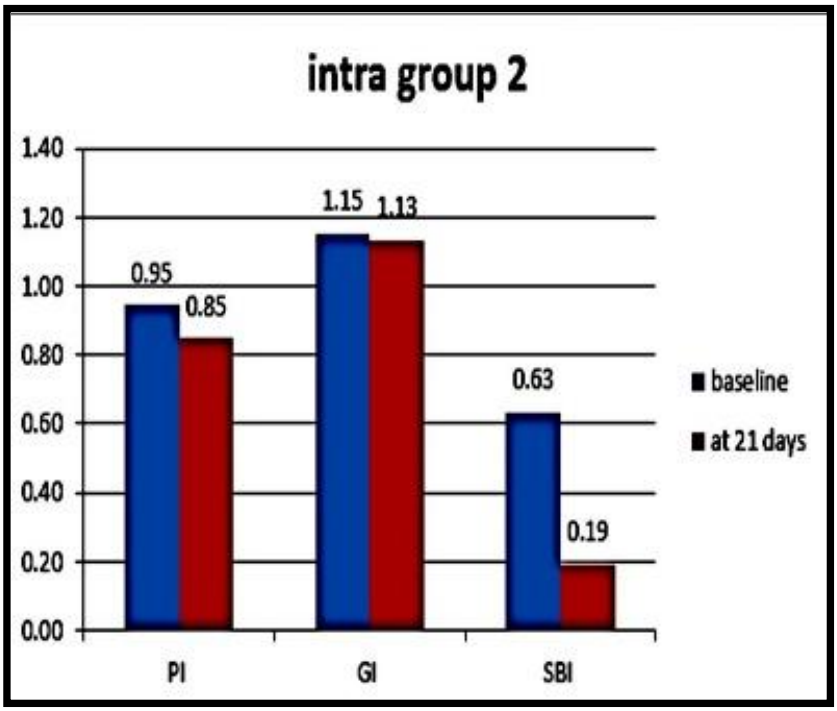
INTRA GROUP COMPARISON FOR THE TEST GROUP/ GROUP 2 AT BASELINE& AFTER 21 DAYS

Groups	Mean	N	Std. Deviation	Std. Error Mean	p value of paired t test
PI B	.945000	8	.2740177	.0968799	0.585 #
PI 21	.847500	8	.4327239	.1529910	
GI B	1.151250	8	.4438609	.1569285	0.922 #
GI 21	1.133750	8	.2585088	.0913967	
SBI B	.6325	8	.77939	.27556	0.167 #
SBI 21	.1912	8	.11765	.04159	

***** *** = Statistically highly significant difference (p<0.01)**

***** **= Statistically significant difference (p<0.05)**

 # = statistically non significant difference (p>0.05)



Graphical representation of PI, GI & SBI at baseline & 21 days within Group 2 (Scaling + Black tea mouthwash).

There was a statistically non significant difference seen with comparison of the variables within group 2, at baseline & 21 days. (p>0.05)

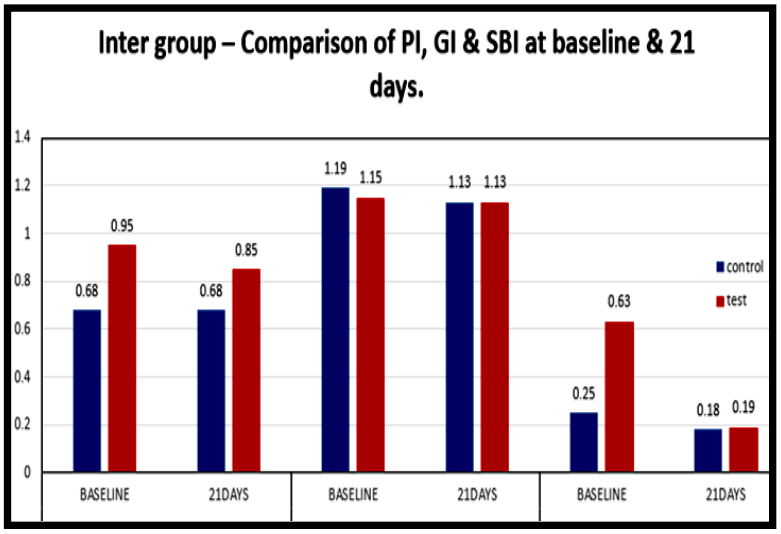
INTER GROUP COMPARISON

	Groups	N	Mean	Std. Deviation	Std. Error Mean	p value of t test
PI B	1	8	.677500	.2466779	.0872138	0.059 #
	2	8	.945000	.2740177	.0968799	
GI B	1	8	1.191250	.1064274	.0376278	0.808 #
	2	8	1.151250	.4438609	.1569285	
SBI B	1	8	.2500	.25014	.08844	0.207 #
	2	8	.6325	.77939	.27556	
PI 21	1	8	.678750	.2511936	.0888103	0.356 #
	2	8	.847500	.4327239	.1529910	
GI 21	1	8	1.126250	.1126229	.0398182	0.941 #
	2	8	1.133750	.2585088	.0913967	
SBI 21	1	8	.1838	.20255	.07161	0.929 #
	2	8	.1912	.11765	.04159	

***** *** = Statistically highly significant difference (p<0.01)**

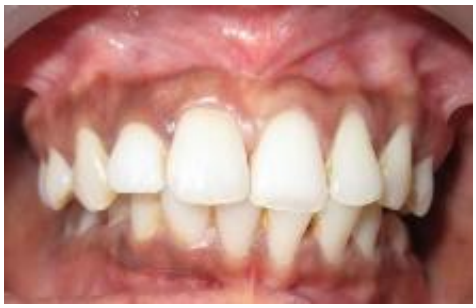
***** **= Statistically significant difference (p<0.05)**

 # = statistically non significant difference (p>0.05)

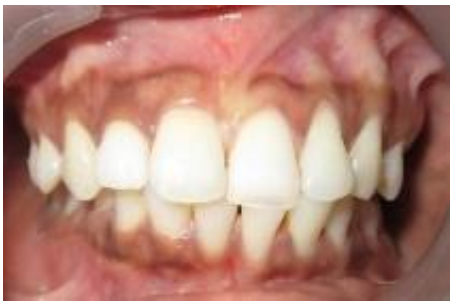


Graphical representation of PI, GI & SBI at baseline & 21 days between the test and control groups. Statistically non significant difference seen with inter group comparison of the variables at baseline and 21 days for both group 1 (Scaling alone) and group 2 (Scaling + Black tea mouthwash).(p>0.05)

Control/Group 1 (Scaling alone) –



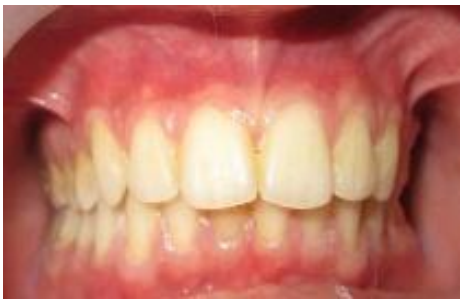
Baseline



21 days

Test/Group 2 (Scaling + Black tea mouthwash) –

Baseline



21 days

VI. DISCUSSION

Plaque is the main cause for the breakdown of periodontal tissues leading to periodontal disease. The inability of the adult population to perform adequate mechanical tooth cleaning has stimulated the search for chemotherapeutic agents added to dentifrices to improve plaque control and prevent gingivitis. So various means have been established and search is going on to reduce the bacterial load. Phyto-therapeutic products have been investigated for these purposes and have shown satisfactory results.[3]

Phytotherapy is the use ofplant-derived medications in thetreatmentand prevention ofdisease.Phytotherapy is ascience-basedmedical practiceand thus is distinguished from other, more traditional approaches, such as medical herbalism, which relies on anempiricalappreciation of medicinal herbs and which is often linked to traditional knowledge.[15]

Studies have been reported that black tea caused a decrease in tooth surface pH and suppressed the growth and virulence of periodontal pathogens in vitro.***(Simpson et al., 2001; Wei and Wu, 2001)***.[16,17]

The antimicrobial activity of tea[18] is probably due to their ability to form a complex with extracellular and soluble proteins, which binds to bacterial cell wall. More lipophilic flavonoids may also disrupt microbial membranes.[19] Flavonoids lacking hydroxyl groups on their β-rings are more active against micro-organisms and the microbial target in the membrane with –OH groups. Polyphenols can form heavy soluble complexes with proteins and may bind to bacterial adhesions, thereby disturbing the availability of receptor on the cell surface. Other mechanisms that might be responsible for antimicrobial effect of tea include inhibition of topoisomerase (topoisomerase I and II), which are enzymes that control the changes in DNA structure by catalyzing the breaking and rejoining of the phosphodiester backbone of DNA strands during the normal cell cycle.[20] Although not yet conclusive, there is a growing amount of evidences identifying tea's potential for oral health benefits.

Ben Lagha A, Grenier D (2017) [21] investigated the effects of black tea theaflavins (TFs) on the virulence properties of Porphyromonasgingivalis and gingival keratinocyte tight junction integrity. In addition, the effects of black tea TFs on the nuclear factor-κB (NF-κB) signaling pathway and proinflammatory cytokine/matrix metalloproteinase (MMP) secretion by monocytes/macrophages were assessed. They concluded that there was clear evidence that black tea TFs, through their effects on P. gingivalis and the host inflammatory response, the two etiological components of chronic periodontitis, may represent promising multifunctional therapeutic agents for treating these diseases and promoting oral health. Black tea TFs can attenuate the virulence of P. gingivalis and increase gingival keratinocyte tight junction integrity in order to protect against

bacterial invasion. Moreover, TFs can reduce cytokine and MMP secretion by macrophages, probably by blocking the activation of the NF-κBsignaling pathway. Future human clinical trials should evaluate whether the daily intake of black tea or the use of oral hygiene products (mouthrinses and chewing gums) or slow periodontal release devices (to be inserted in diseased periodontal sites) containing bioactive TFs may provide benefits.

Over the years, several studies have brought evidence suggesting that tea polyphenols, mostly from green tea, may have oral health benefits. Since few data are available concerning the beneficial properties of black tea and its theaflavin derivatives against periodontal disease, ***Lombardo Bedran TB et al (2015)***[22] investigated their antibacterial activity as well as their ability to modulate interleukin-8 and human β-defensin (hBD) secretion in oral epithelial cells. Among the periodontopathogenic bacteria tested, Porphyromonasgingivalis was found to be highly susceptible to the black tea extract and theaflavins.They concluded that, the ability of a black tea extract and theaflavins to exert antibacterial activity against major periodontopathogens, to attenuate the secretion of IL-8, and to induce hBD secretion in oral epithelial cells suggest that these components may have a beneficial effect against periodontal disease.

Zhao L et al (2013)[23]conducted a study to investigate green tea, white tea, oolong tea, and black tea extracts with a high polyphenol content for their effects on (i) the growth and adherence of P. gingivalis, (ii) the activity of host and bacterial proteases, and (iii) cytokine secretion by oral epithelial cells. No marked differences in the various effects were observed among the four tea extracts. They concluded that extracts from green tea, white tea, oolong tea, and black tea show promise for controlling periodontal disease by their capacity to interfere with P. gingivalis growth and virulence properties, host destructive enzymes, and inflammatory mediator secretion. Such extracts may be incorporated to oral hygiene products or locally delivered into diseased periodontal sites.

However, till date no study has been published to evaluate the efficacy of black tea mouthwash in the treatment of periodontal disease. This made us evaluate the efficacy of black tea mouthwash on gingival health and its use in the treatment of gingivitis.

The present study reported statistically non significant reduction of gingival inflammation, plaque index &sulcular bleeding index at 21 days when scaling with a black tea mouthwash adjunct was compared to scaling alone.

Visual examination of any side effects, such as distinct staining of teeth, or any other discomfort was not appreciated.

A questionnaire was prepared and completed by the interviewer as an aid in evaluating patient compliance at the end of the study period for the subjects using the black tea mouthwash. 4 subjects found the mouthwash to be bitter, thus not very palatable.

Theaflavins are responsible for bright red or orange colour of brew and contribute to the unique taste and astringency of black tea.[24] Additional sensory studies affirmed that the flavanol-3glycosides gives a velvety astringent taste sensation to the oral cavity, contributing as well to the known bitter taste of tea infusions by amplifying the bitterness of caffeine.[25] The astringency of Black tea is due to the precipitation of the mucous glycoproteins in the mouth by polyphenols.[12]

Drawbacks

- Palatability of the mouthwash
- Compliance of the subjects

VII. CONCLUSION

- Black tea mouthwash, when used as an adjunct to scaling, in the management of chronic gingivitis showed similar efficacy when compared to scaling alone.
- Definitive conclusions on the effectiveness of black tea mouthwash as an adjunct to mechanical plaque control measures will have to come from well-designed interventional studies with a larger sample size and measures to improve the palatability of the mouthwash.

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