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Dr. Pooja Bhanushali
Postgraduate Student, Department of Periodontics and Implantology, Pacific Dental College & Hospital, Rajasthan, India

Dr. Neema Shetty
Professor and Head, Department of Periodontics and Implantology, Pacific Dental College & Hospital, Rajasthan, India

Dr. Aditi Mathur
Professor, Department of Periodontics and Implantology, Pacific Dental College & Hospital, Rajasthan, India

Dr. Ashish Bali
Reader, Department of Periodontics and Implantology, Pacific Dental College & Hospital, Rajasthan, India

Dr. Pritish Pal
Senior Lecturer, Department of Periodontics and Implantology, Pacific Dental College & Hospital, Rajasthan, India

Dr. Krishna Agarwala
Postgraduate Student, Department of Periodontics and Implantology, Pacific Dental College & Hospital, Rajasthan, India

Corresponding Author:
Dr. Pooja Bhanushali
Postgraduate Student, Department of Periodontics and Implantology, Pacific Dental College & Hospital, Rajasthan, India

Comparative evaluation of 4% mangosteen mouthwash with 0.2% chlorhexidine mouthwash as an adjunct to SRP in patients with gingivitis

Dr. Pooja Bhanushali, Dr. Neema Shetty, Dr. Aditi Mathur, Dr. Ashish Bali, Dr. Pritish Pal and Dr. Krishna Agarwala

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Abstract
Introduction: Mangosteen, a fruit indigenous to tropical rainforest regions such as Southeast Asia, has been used as a key component in Chinese medicine and Ayurveda. It possesses antibacterial, anti-plaque, and anti-inflammatory properties. While chlorhexidine mouthwash is considered the gold standard, its multiple side effects necessitate the search for an herbal substitute.
Aim: To evaluate the anti-inflammatory and anti-plaque efficacy of 4% mangosteen mouthwash as an adjunct to SRP in patients with generalized moderate to severe gingivitis.
Methodology: The study recruited 30 participants between the ages of 20 and 70 years who had moderate to severe gingivitis. After undergoing scaling and root planning (SRP) therapy, they were randomly allocated to two groups: GROUP 1 (Test) received mangosteen mouthwash (n=15) while GROUP 2 (Control) received chlorhexidine mouthwash (n=15). Participants were instructed to rinse their mouth with 10 ml of the mouthwash twice daily for 14 days after brushing. The clinical outcomes assessed were the Plaque Index (Silness and Loe 1964) and Gingival index (Loe and Silness 1963) at baseline, day 14, and day 21. Statistical analysis was performed using the student 't'-test.
Result: Both the group that received mangosteen mouthwash and the group that received chlorhexidine mouthwash showed significant improvements in their gingival and plaque indices from baseline to day 14 and day 21.
Conclusion: The study found that the 4% mangosteen mouthwash was equally effective as the 0.2% chlorhexidine mouthwash in reducing plaque and gingivitis.

Keywords: Mangosteen mouthwash, gingivitis, anti-plaque

1. Introduction

For several years, oral hygiene has been a top concern for dentists and dental hygienists. Due to the current global pandemic, mouthwash has become increasingly important, yet many individuals are not aware of its benefits. The microbial load in the oral cavity is reduced by mouthwashes or mouth rinses which are a form of liquid or a solution. Mouthwash also helps in reducing the risk of dental caries, various gingival and periodontal diseases, infectious disease and also helps to reduce the bacteria which causes oral malodor.

The mouthwashes that are commercially available generally consist of alcohol or phenol derivatives such as chlorhexidine gluconate, octenidine and triclosan mouthwashes. These types of mouthwashes can have potential side effects, including dryness of the mouth, a burning sensation, and loss of taste sensation. Additionally, chlorhexidine mouthwash has been known to cause teeth staining and, in some cases, swelling of the parotid gland. To overcome these drawbacks of commercially available mouthwashes, various herbal alternatives have been available in the market lately. One of the key benefits of natural mouthwashes is that they do not contain alcohol or artificial coloring, and are instead plant-based.

Phytochemicals obtained from plants which are Pharmacologically active are widely identified as useful aids for the prevention, treatment and maintenance therapy of periodontal disease [2].

Mangosteen (*Garciana mangostana* Linnaeus) which grows in tropical rainforest country such Southeast Asia, is a fruit plant and also known as 'the queen of fruits". It belongs to the Guttiferae family. The appealing color and high nutrition makes mangosteen an exotic fruit. Numerous researches have been done about the nutritional content of mangosteen. Various bioactive compounds are present in it, including camphene, garcinones A, B, and C, Sesquiterpenoids, gartanin, and tannins. It's antioxidant, antimicrobial and anti-inflammatory properties are some of mangosteen's significant characteristics [3-7].

Mangosteen mouthwash has been compared to the commercially available mouthwash (0.2% Chlorhexidine gluconate) in a recent study and the anti-inflammatory and anti-plaque effectuality of Mangosteen mouthwash have been evaluated.

2. Materials and Methods

2.1 Study population and selection criteria

Selection of 30 participants with mild to moderate gingivitis was done from the outpatient Department of Periodontics, Pacific Dental College and Hospital, Udaipur, Rajasthan and this single centered, randomized controlled clinical trial was carried out among them. Subjects between the age of 20 to 70 years with a minimum complement of 20 teeth who had not undergone periodontal treatment in the past 6 months were included in the study. Patients with systemic conditions, pregnant and lactating mothers and on medications like anti-inflammatory, antibiotics and immuno-suppressant or oral contraceptives were excluded from the study. 30 patients satisfying the criteria are divided into two groups: Group I (n-15) – 4% Mangosteen mouthwash adjunct to Scaling and root planning. (Test group) and Group II (n-15) – Scaling and root planning only (Control group).

2.2 Preparation of 4% Mangosteen Mouthwash

The extract of Mangosteen was obtained from svagro food in Mumbai, while the College of Pharmacy in Udaipur was responsible for preparing the Mangosteen mouthwash. 100 ml of Mangosteen mouthwash can be prepared by 4 g of Mangosteen extract dissolved in 100 ml of distilled water using sodium saccharine as a sweetening agent and sodium benzoate as a preservative. The mouthwash was maintained at a weight/ volume concentration of 4% [5].

2.3 Study protocol

After phase I therapy's completion, every participant in the test group was instructed to use 10 ml of mouthwash twice daily for 14 days, and instruction were given not to rinse their mouth for 30 minutes, i.e. half an hour. Oral hygiene instructions were given and patients were called again on 14th day and 21st day. Plaque Index (Silness and Loe 1964) and Gingival index (Loe and Silness 1963) recorded at baseline, 14th and 21st day.

2.4 Statistical analysis

An Excel sheet was used to collect all the clinical parameters and the paired t-test and unpaired t-test were used to analyse the statistical significance for comparing intergroup and intragroup. SPSS Statistical Software (version 25, IBM, Chicago, IL, USA) was used to conduct the statistical analysis. The significance level was kept at $P \leq 0.05$.

3. Results and Discussion

Total of 40 patients were assessed and out of them, 30 patients were selected for the study based on the inclusion and exclusion criteria. Their age ranged between 20 and 70 years with 32 years being the mean age. The study included 54% of males and 46% of females. None of these patients reported any adverse signs or symptoms. All 30 patients were assessed for the clinical parameters (PI and GI) at baseline, 14th day and 21st day. On follow-up till 30 days, zero patients were lost. Patients did not report any adverse reactions caused due to the use of mouthwash. Table 1, 2, and graph 1 display a statistically significant decrease in PI and GI in both the test and control groups during intragroup comparison ($p< 0.001$). There was no significant difference in PI scores between the test and control groups at the 14th day (P = 0.629), but a significant difference was observed at the 21st day (P = 0.001). Similarly, there was no significant difference in GI scores between the test and control groups at the 14th day (P = 0.386) and a significant difference was observed at the 21st day (P = 0.026), as presented in table 3 and graph 2.

Figures

Fig 1a: At baseline **Fig 1b:** 21st day

Fig 1: Scaling with 0.2% Chlorhexidine mouthwash

Fig 2a: At baseline **Fig 2b:** 21st day

Fig 2: Scaling with 4% Mangosteen mouthwash

Fig 3: Prepared mangosteen mouthwash

Tables and Graphs

Table 1: Intragroup comparison of 4% Mangosteen mouthwash (test) group at different time intervals.

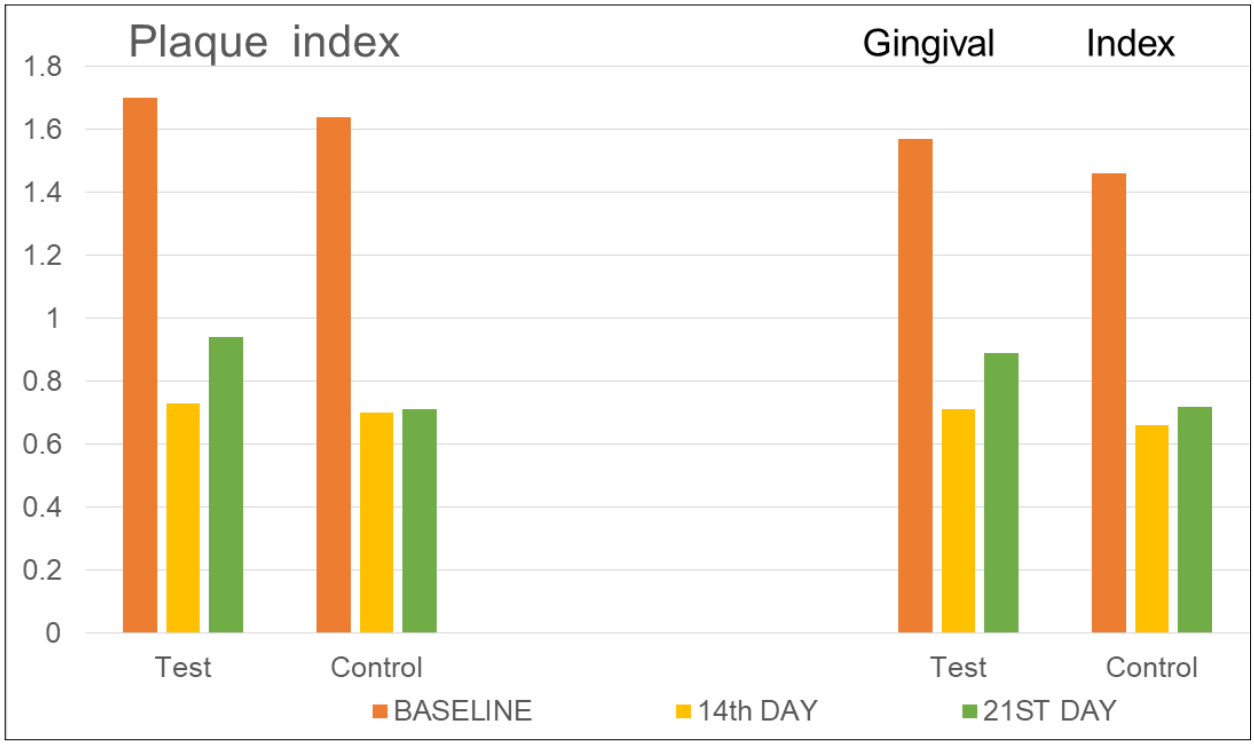
Parameter	interval	Mean ± SD	Difference	p
PI	Baseline 14th day 21st day	1.70±0.33 0.73±0.26 0.94±0.22	0.970 0.756	< 0.001* < 0.001*
GI	Baseline 14th day 21st day	1.57±0.29 0.71±0.23 0.89±0.20	0.859 0.680	< 0.001* < 0.001*

Table 2: Intragroup comparison of 0.2% chlorhexidine mouthwash (control) group at different time intervals

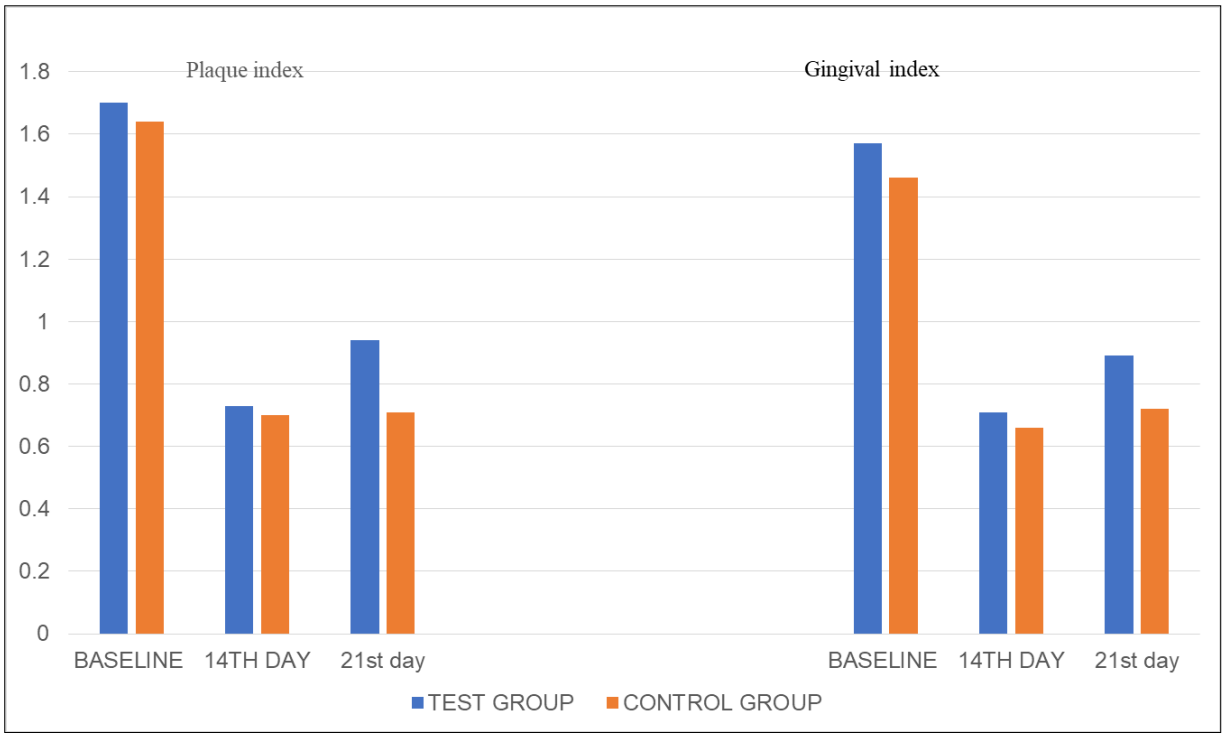
Parameter	interval	Mean ± SD	Difference	p
PI	Baseline 14th day 21st day	1.64±0.22 0.70±0.17 0.71±0.20	0.943 0.934	< 0.001* < 0.001*
GI	Baseline 14th day 21st day	1.46±0.35 0.66±0.16 0.72±0.27	0.802 0.742	< 0.001* < 0.001*

Table 3: Intergroup comparison between the 0.2% chlorhexidine and 4% Mangosteen group

Parameter	interval	Groups	Mean ± SD	Difference	p
PI	Baseline	MS CHX	1.70±0.33 1.64±0.22	0.060	0.501 (NS)
	14th day	MS CHX	0.73±0.26 0.70±0.17	0.034	0.629(NS)
	21st day	MS CHX	0.94±0.22 0.71±0.20	0.238	0.001*
GI	Baseline	MS CHX	1.57±0.29 1.46±0.35	0.112	0.277 (NS)
	14th day	MS CHX	0.71±0.23 0.66±0.16	0.055	0.386 (NS)
	21st day	MS CHX	0.89±0.20 0.72±0.27	0.174	0.026 (NS)



Graph 1: Intragroup comparison of Plaque and gingival index



Graph 2: Intergroup comparison of Plaque and gingival index

4. Discussion

Although chlorhexidine has been the gold standard for its long-lasting antibacterial activity and has been commonly used in dental practice since 1970 as an antiseptic agent, its prolonged use has been associated with adverse effects. Consequently, there has been an increasing interest in the field of dentistry to identify newer alternatives. In this study, mangosteen mouthwash was found to be equally effective as chlorhexidine mouthwash in reducing gingival inflammation.

The study demonstrated that both groups treated with scaling and root planning in addition to adjunctive therapy with either mangosteen mouthwash in the test group or chlorhexidine mouthwash in the control group exhibited improvements in all clinical parameters. The mouthwash was used as an adjunctive therapy following the initial treatment stage, which involved eliminating etiological factors, such as bacteria or other risk factors, to prevent further disease progression and restore the periodontal tissues to a healthy state.

Mangosteen has a long history of use in Chinese medicine and Ayurveda, and it is commonly used in the Middle East for treating diarrhea, skin infections, and chronic wounds. Research has shown that mangosteen has several properties, including antifungal, anticytotoxic, antiviral, antibacterial, antihistamine, antioxidant, and anti-inflammatory effects.

Studies have shown that the ethanolic extract (80%) from the pericarp of mangosteen has the ability to inhibit the growth of Porphyromonas gingivalis (P. gingivalis), the main bacteria associated with periodontal disease, with a minimum inhibitory concentration (MIC) of 3.91 mg/mL 8, 9. In addition, a 4% mangosteen gel was found to be effective in reducing clinical inflammation in patients with chronic periodontitis. As a result, a 4% mangosteen mouthwash preparation was considered for use in the present study.

The main active components of mangosteen are xanthone derivatives, including α-, β-, and γ-mangostin, gartinin, and 1- and 3-isomangostin, with α-mangostin exhibiting the strongest antibacterial effect

Studies have also shown that mangosteen flavonoids have anti-biofilm properties. According to the theory, flavonoids can disrupt the bacterial cell membrane by destroying the lipid layer and disrupting the function of the barrier cell membrane, leading to intramembrane leakage. This results in a decrease in bacterial aggregation and a reduction in the formation of bacterial colonies on surfaces. By reducing the activity of α-hemolysin, a bacterial exotoxin, flavonoids can interfere with cell signaling and result in the permanent adhesion and inhibition of colony formation on the tooth surface. In terms of biofilm inhibition, flavonoid compounds containing phenols can inactivate bacterial enzymes and stimulate the activity of glucosyltransferase enzyme used by bacteria to synthesize sucrose in the media into glucans (EPS). As a result, the formation of biofilms is inhibited due to the limited amount of glucan available for bacterial attachment. These findings suggest that flavonoid compounds in phenols have the potential to inhibit bacterial biofilm formation.

The study conducted by Mahendra *et al*. demonstrated that the use of mangosteen peel extract led to a significant reduction in gingival index compared to the placebo group (34.27% vs. 53.76%). The current study also found a strong positive correlation between the use of mangosteen peel extract and improvement in clinical parameters such as gingival index, pocket depth, and loss of attachment level. These findings are consistent with the results of Mahendra *et al*.'s study, which showed that a gel containing 4% mangosteen peel extract was effective in reducing periodontal inflammation and improving clinical parameters such as gingival index, loss of attachment level, and pocket depth in a sample of 50 subjects.

5. Conclusion

From the comparison between mangosteen and Chlorhexidine mouthwash, valuable insights regarding the effects of different mouthwashes on dental plaque can be drawn. While Chlorhexidine mouthwash is considered the gold standard in treating moderate to severe gingivitis, mangosteen mouthwash has demonstrated potential anti-inflammatory and antiplaque efficacy. These findings suggest that further exploration of the favorable effects of mangosteen

mouthwash on oral hygiene is warranted, particularly through microbiological examination of its effects on specific micro-organisms.

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