

**Original Article****Effectiveness of two commercially available herbal toothpastes on oral hygiene parameters in diabetic population- a randomized clinical crossover study**

Ashutosh Nirola, Megha Sharma, Shivian Chhabra

**Abstract:**

**Background:** Diabetes mellitus is a group of metabolic disorders that causes high blood sugar levels. The susceptibility and severity of periodontal diseases increases in diabetic patients, with the impact on the disease process inversely proportional to the level of glycemic control. Maintenance of oral hygiene therefore becomes utmost important in these patients.

**Aim:** The aim of this study is to evaluate the effectiveness of two commercially available herbal toothpastes on oral hygiene parameters in diabetic population.

**Material and methods:** The 6 week randomized clinical crossover trial included 50 diabetic patients of 35 years old and above who were randomly assigned to either the Colgate Diabetics Advanced Ayurvedic Solution toothpaste (Test group A) or Complete Care Herbal Toothpaste ( Test group B). Bleeding on probing, gingival index and plaque indices were assessed on day 0, 7 and 14. In addition a questionnaire was given to all the patients in both the groups evaluating their experiences after using the toothpastes.

**Results and Conclusion:**

Both the herbal toothpastes significantly reduced plaque levels, gingival inflammation and bleeding on probing but Colgate Diabetics Advanced Ayurvedic Solution toothpaste demonstrated comparatively better results.

**JK-Practitioner 2023;28(3-4):105-110****Introduction:**

A chronic metabolic disorder called diabetes mellitus is characterized by a rise in blood sugar levels linked to impaired insulin action and/or reduced insulin production[1]. Long term hyperglycemia being the immediate consequence of diabetes mellitus ultimately leads to multiorgan damage ranging from micro to macro vascular complications[2]. Except for cardiovascular diseases, the American Diabetic Association states that hemoglobin A1C (HbA1C) levels should be less than 7% to prevent the majority of diabetic complications.[3]

A recent study by the International Diabetic Foundation found that 463 million people worldwide have diabetes, and that number is projected to rise to 578 million by 2030. They also reported that India has the second largest diabetic population after China, estimated to be at 77 million in 2019, expected to rise to 101 million by 2030 and to 134 million in 2045 [4].

Dehydration, inadequate wound healing, diabetic ketoacidosis, and illnesses like MI, stroke, kidney failure, retinopathy, which causes blindness, neuropathy, and foot infections that may require amputation are just a few of the complications of diabetes [5]. Another complication of diabetes mellitus is periodontal disease, which affects the majority of diabetic adults [6]. Oral symptoms were found in more than 90% of diabetic patients. The oral tissues are known to be severely harmed by DM, which has been linked to periodontal disease, tooth loss, xerostomia, caries, dysfunctional salivary glands, sluggish wound healing, lichen planus, geographic tongue, and candidiasis. Diabetic neuropathy may contribute to trigeminal nerve pain and temporomandibular joint disorders as well as burning mouth syndrome (glossodynia), dysgeusia, and taste impairment.

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**Keywords**

Herbal Toothpaste, diabetes, oral hygiene

Compared to the general population, diabetic patients have a higher incidence of periodontal issues. Periodontal disease and diabetes have a strong reciprocal and negative impact on one another. Periodontal disease has a negative impact on a patient's glycemic control, which makes diabetes more severe and complicated. Diabetes increases the risk of gingival and periodontal problems in the population.

The inflammatory response to dental plaque is affected by hyperglycemia, which worsens gingivitis and periodontitis. As long as chronic infection and inflammation persist in the jaw bone, it can also contribute to the slower healing of lesions near the apex of the teeth. Extraction of teeth that suffer from chronic periodontitis or periapical periodontitis leads to decreased levels of inflammatory biomarkers. Moreover, diabetes and the use of diabetes medication can lead to dry mouth, which contributes to development of caries, periodontitis, and thrush (candidiasis). Both periodontitis and diabetes, together can lead to potentially severely diminished quality of life.

Instances of periodontal disease are more common in diabetic patients. The most effective method of mechanical oral hygiene, including proper tooth brushing with dentifrices, appears to be the maintenance of oral health. It is the most widely used and convenient oral health prevention tool. Toothpastes act as a delivery system for therapeutic agents, preventing plaque formation and gingival and periodontal disease by limiting the growth of microorganisms. Additionally, it was discovered that individuals who were more effective at brushing their teeth had lower HbA1C levels and plaque scores [7]. Studies have shown that some chemicals, such as triclosan and chlorhexidine, when added to toothpastes, inhibit the growth of plaque. However, long-term use of these chemicals can result in tooth discoloration, altered flavour, and the development of antimicrobial resistance[8].

Due to their fewer side effects, natural medicines are becoming more and more popular today. Many people believe that herbal toothpastes are safer than those made with chemicals. Several ingredients in them that have anti-inflammatory, anti-plaque, anti-oxidant, and antiseptic properties are responsible for their effectiveness. When it comes to preventing plaque and gingivitis, herbal toothpastes are just as effective as conventional or fluoride toothpastes [9]. Herbal toothpastes have been shown to reduce plaque accumulation, gingival bleeding, and salivary anaerobic bacterial counts [10].

There are many clinical studies in which oral healthcare products, such as toothpastes and mouthwashes have been evaluated for their efficacy in various health conditions, but only a few were conducted in diabetic patients. Therefore, the current randomized clinical control study aimed to assess the effectiveness of two commercially available herbal

toothpastes on oral hygiene parameters in diabetic population.

### Materials and Method

The study included a total of 50 diabetic patients with the age group of 35 years and above visiting the Department of Periodontology, LuxmiBaiDental College and Hospital, Patiala, Punjab. Patients were informed about the study and informed consent was taken. All the procedures in the present study were done by the main investigator to eliminate inter operator variability.

#### Inclusion criteria:

- Subjects in the age group of 35 years and above.
- Subjects with diabetes mellitus with HbA1c > 6.5 suffering from generalized chronic periodontitis.
- Subjects having minimum 20 functional teeth in the oral cavity.
- Cooperative patients willing to participate in the study.

#### Exclusion criteria:

- Subjects suffering from other systemic diseases other than DM.
- Subjects who are on active treatment of antibiotics and corticosteroids
- Pregnant and lactating females.
- Smoking and alcohol consumption
- History of periodontal treatment within the past 3 months.
- Subjects who have been using herbal products and dentifrices.
- Subjects with history or present condition of allergic response to any pharmaceutical products, toiletries or its components or ingredients in the test product.

The study was approved by the institutional ethical committee and review board. The following two herbal toothpastes were used in the randomized crossover clinical study – Colgate Diabetics Advanced AyurvedicSolution( Colgate Palmolive, India) containing YashadaBhasma, Surya Kshar and extracts of Madhunashini, Amalaki, Nimba and Jamun. The second paste was Complete Care Herbal Toothpaste (Himalaya, India) containing Pomegranate extract, Neem extract, Miswak extract, Babool extract, Triphala, Five-leaved Chaste Tree, Bishop's weed, Black pepper.

#### Patient selection

The sample size for the present study was estimated to be minimum of 25 subjects in each group using formula

$$n=(r+1)/r SD^2(Z\beta-Z\alpha)^2/(d)^2$$

Where n= number of samples

$$\begin{aligned} r &= 1 \\ (r+1)/r &= 2 \\ SD &= 0.1 \end{aligned}$$

$$Z\beta=0.84$$

$$Z\alpha=1.96$$

$$d=0.25$$

A ratio of 1:1 of sample size was selected for the present study.

#### Study design

This crossover randomized single- blinded study was conducted for a period of 6 weeks. A sample size of 50 diabetic patients meeting the inclusion criteria were selected. Randomization was done by drawing lots into either Test group A Colgate Diabetics Advanced Ayurvedic Solution toothpaste( Colgate Palmolive, India) or Test group B Complete Care Herbal Toothpaste ( Himalaya, India). After being assigned to their respective groups, the participants were blinded. On the first (baseline) day of the study, all the individuals were subjected to an oral examination. No prophylaxis was undertaken prior to commencement of the study, and no attempt was made to modify the participant's oral hygiene habits. Patients were advised to get their HbA1C levels checked and those fulfilling the inclusion criteria were selected. Then they were given a dentifrice that had been labeled and tagged with a number. They were asked to brush twice daily with a 1 cm line of paste in respective brushes for two minutes,using modified bass technique. The participants were given soft toothbrushes and the brushing technique was demonstrated and an image of the technique was provided to the participants.

Patients were divided into two groups:

#### In Phase 1,

**Test Group A-** those intervened with Colgate Diabetics Advanced Ayurvedic Solution toothpaste( Colgate Palmolive, India) for 2 weeks

**Test Group B-** those intervened with Complete Care Herbal Toothpaste( Himalaya, India) for 2 weeks.

- Plaque Index (Silness J and Loe H, 1964)
- Gingival Index (Loe H and Silness J, 1963) and
- Bleeding on Probing by Sulcus bleeding Index (Muhlemann HR and Son. S, 1971)

were recorded on day 0( baseline), Day 7 and Day 14.

On Day 14, all the subjects in both the test groups were given a questionnaire form, evaluating patient satisfaction and experience after using herbal toothpastes.

After the end of Phase 1, the toothpastes were switched over between the groups after a washout period of 15 days to reduce the possibility of a "carry- over impact". During the washout period subjects were advised to brush with water alone. No changes in their brushing habits were made.

#### In phase 2,

**Test Group A-** those intervened with Complete Care Herbal Toothpaste ( Himalaya, India) for another 2 weeks.

**Test Group B-** those intervened with Colgate Diabetics Advanced Ayurvedic Solution toothpaste( Colgate Palmolive, India) for another 2 weeks

- Plaque Index (Silness J and Loe H, 1964)

- Gingival Index (Loe H and Silness J, 1963) and

- Bleeding on Probing by Sulcus bleeding Index (Muhlemann HR and Son. S, 1971)

were recorded on day 0( baseline), Day 7 and Day 14.

On Day 14, all the subjects in both the test groups were given a questionnaire form, evaluating patient satisfaction and experience after using herbal toothpastes.

#### Questionnaire

Q1- Did the toothpaste give a feeling of freshness of breath?

- A. Yes
- B. No

Q2- Did the toothpaste produce foam?

- A. Yes
- B. No

Q3- Did you like the flavor of the toothpaste?

- A. Yes
- B. No

Q4- After how long does the flavor of toothpaste recede from your mouth?

- A. Less than 5 minutes
- B. More than 5 minutes
- C. After having food/water
- D. After gargling

Q5- Did the toothpaste delay bad breath?

- A. Yes
- B. No

Q6- Did the toothpaste reduce gum swelling, redness and gum bleeding?

- A. Yes
- B. No

Q7- Did the toothpaste reduce gum swelling, dry mouth and ulcers?

- A. Yes
- B. No

Q8- Are you satisfied using the given toothpaste?

- A. Yes
- B. No

#### STATISTICAL ANALYSIS

The raw data collected was then typed in Microsoft Excel in the form of tables. SPSS software was used for statistical analysis (Version 22, IBM Corp, Armonk, NY, USA). The normality of the data was evaluated using statistical tests. Paired t test was used for intragroup analysis (from baseline, day 7 and day 14) and unpaired t test for intergroup comparison. Intergroup comparison was done between-

Phase 1 group A and Phase 2 group A

Phase 1 group B and phase 2 group B

#### Results

Intragroup comparison

Mean values of PI, GI and BOP index recorded from baseline to day 7 and day 14 when compared for group A and group B in both the phase 1 and phase 2 showed statistically significant reductions ( $p < 0.05$ ) in scores of plaque index, gingival index and BOP index. Both the herbal toothpastes resulted in improvements of oral hygiene parameters.

Intergroup comparison

Comparison done between

Phase 1 group A and Phase 2 group A

Phase 1 group B and phase 2 group B

Was found to be statistically non-significant for all the oral hygiene parameters i.e., PI, GI and BOP.

- **PLAQUE INDEX**

Percentage reductions in scores of plaque index in phase 1 group A was 14.5% (baseline till day 14) as compared to phase 2 group A which showed a reduction of 16.7% (baseline till day 14)

Percentage reductions in scores of plaque index in phase 1 group B was 11.3% (baseline till day 14) as compared to phase 2 group B which showed a reduction of 13.7% (baseline till day 14)

- **GINGIVAL INDEX**

Percentage reductions in scores of gingival index in phase 1 group A was 15.5% (baseline till day 14) as compared to phase 2 group A which showed a reduction of 14.1% (baseline till day 14)

Percentage reductions in scores of gingival index in phase 1 group B was 15.5% (baseline till day 14) as compared to phase 2 group B which showed a reduction of 16% (baseline till day 14)

- **BLEEDING ON PROBING INDEX**

Percentage reductions in scores of bleeding on probing index in phase 1 group A was 11.5% (baseline till day 14) as compared to phase 2 group A which showed a reduction of 13.1% (baseline till day 14)

Percentage reductions in scores of bleeding on probing index in phase 1 group B was 9.7% (baseline till day 14) as compared to phase 2 group B which showed a reduction of 19.1% (baseline till day 14)

All the 50 participants completed the questionnaire and submitted the forms. On evaluation the results revealed, 70% of diabetic patients using Colgate Advanced Ayurvedic Solution experienced long lasting freshness of breath, refreshing flavors and improvements in problems like dry mouth and oral ulcers as compared to Himalaya Complete Care Herbal Toothpaste in which 50% of the patients experienced overall satisfaction using the toothpaste.

The results revealed that Colgate Advanced Ayurvedic Solution led to overall improvement in "well being" of the patients after using the toothpaste.

## Discussion

Gram negative bacteria found in dental plaque cause the chronic infection known as periodontal disease. The degree of tissue damage is significantly influenced by the balance between a localised infection and an excessive host inflammatory response. According to recent research, periodontal disease may not only affect the oral cavity but may also have systemic effects, resulting in a mild inflammatory response [11].

It has been demonstrated that diabetics have significantly higher rates of periodontal disease than do non-diabetics in terms of incidence, prevalence, severity, and progression. According to the theory, both conditions have a "two-way relationship" in which patients with periodontitis are more likely to develop diabetes mellitus and people with diabetes are more likely to have both conditions.

As a result, it's critical to be aware of the potential coexistence of hyperglycemia and periodontitis since both conditions adversely affect one another. As a result, maintaining good oral hygiene in diabetic patients becomes absolutely essential. Effective periodontal therapy has been shown in numerous studies to lower hyperglycemia and lower the risk of many of the complications associated with uncontrolled diabetes in patients [12].

The most popular type of dental care done at home is brushing your teeth with dentifrices. The use of therapeutic ingredients in toothpastes aids in the reduction of biofilm, thereby enhancing gingival health. Nowadays, herbal toothpastes provide a useful substitution for regular dentifrice formulations. The trend of "going natural" has fueled an increase in consumer demand for these goods, with many people reportedly choosing them because they are not tested on animals, have no side effects, don't use animal products, are vegan-friendly, don't contain any additional artificial colors or flavors, and are preferred for cultural reasons. Herbal products sometimes outsell toothpastes with fluoride in some areas. By using in vitro, in vivo, and animal studies, many herbal or plant extracts have been touted as having anti-inflammatory, antipyretic, analgesic, antibacterial, antiviral, anticarcinogenic, and antioxidant activities [13,14].

The goal of the current study was to compare how well two commercially available herbal toothpastes performed on various oral hygiene measures in a diabetic population. According to the study's findings, both herbal dentifrices helped diabetic patients with plaque accumulation, gingival inflammation, and bleeding upon probing. [15,16]

This could be attributed to the effects of various ingredients present in both of the herbal toothpastes- Colgate Diabetics Advanced Ayurvedic Solution toothpaste

Gymnemasylvestre (Madhunashini): wound healing herb, possessing antidiabetic, anti-inflammatory, antimicrobial and antioxidant properties

Emblicoefficialis (Amalaki): antioxidant properties

Azadirachtaindica (Neem): anti-germ action

*Eugenia jambolana* (Jamun): well known astringent

Hiora Complete Care Herbal Toothpaste

*Punicagranatum* (Pomegranate): Topical applications have been found to be particularly effective for controlling oral inflammation, as well as bacterial and fungal counts in periodontal disease. Numerous in vitro studies demonstrate the antimicrobial activity of pomegranate extracts.

*Terminaliachebula* (Triphala): has potent antioxidant and antimicrobial activity

*Vitexnegundo* (Chastetree): Anti- microbial and anti-inflammatory activity.

*Azadirachtaindica* (Neem): antimicrobial property, which may be used in oral care preparations.

When compared to Complete Care Herbal Toothpaste, Colgate Diabetics Advanced Ayurvedic Solution toothpaste showed overall greater reductions in plaque index, gingival index, and bleeding on probing index. The study also showed that using Colgate Diabetics Advanced Ayurvedic Solution toothpaste helped patients feel more "well-being" overall. After using the toothpaste, the majority of them reported that it left their mouths feeling fresh and tasting good. Additionally, it helped diabetic patients with their xerostomia and oral stomatitis. This might be because the toothpaste contains the *Madhunashini* herb (*G. sylvestre*), which has been clinically proven to treat diabetes. Its traditional antidiabetic formulation also demonstrated hypoglycemic potential by increasing insulin secretion, which in turn promotes islet cell regeneration and increases glucose utilisation. Gymnemic acid molecules saturate the receptor site in the absorptive upper coverings of the bowels, inhibiting the absorption of sugars by the intestine and lowering blood sugar levels as a result. This action demonstrates the enormous anti-diabetic potential of gymnemic acid. [17]

G. Gymnemic acid molecules share an atomic structure with glucose molecules. These molecules block the taste buds' receptor sites from being activated by sugar molecules in food, which reduces the desire for sweets[18]. *Gymnema* leaf extract, particularly the peptide "Gurmarin," has been found to obstruct the tongue's ability to taste sweet and bitterflavours. The same effect is produced by gymnemic acid. It is thought that by inhibiting the sweet tastesensation, those who take it will consume fewer sweet foods, which may account for some of its hypoglycemic effect [19].

*Sylvestre* leaves have been used in herbal medicine to treat adult-onset diabetes mellitus and have been shown to cause hypoglycemia in laboratory animals (NIDDM). When a diabetic patient takes *gymnema* leaf extract, the pancreas is stimulated, which results in an increase in insulin release [20].

In a randomized control clinical trial with two different herbal toothpaste formulations, Hosadurga R et al. enrolled 50 patients with established gingivitis and instructed them to use the pastes for 30 days. Both herbal-based dentifrices were discovered to lessen

plaque accumulation and gingival inflammation. This is further supported by our study, which found that both herbal toothpastes enhanced certain aspects of oral hygiene[21].

In a study comparing three toothpastes—regular fluoride toothpaste, ayurvedic toothpaste, and a positive control toothpaste—Utgikar J et al evaluated ayurvedic toothpastes in a diabetic population. The findings showed that diabetic subjects who used ayurvedic toothpaste had lower plaque and gingival indices[4].

In a 12-week randomised double-blind placebo-controlled study, Jayashankar S et al. found that using ayurvedic toothpaste significantly reduced plaque and bleeding on probing[10].

Complete Care Herbal Toothpaste was tested for effectiveness by Mazumdar M et al, who found that it significantly improved oral health overall and decreased GI, PI, and BOP indexes[22].

In our study, it was found that using both herbal toothpastes improved oral hygiene metrics like the plaque index, gingival index, and bleeding on probing index. Colgate Diabetics Advanced Ayurvedic Solution toothpaste, however, demonstrated greater improvements in the diabetic patients' general health, periodontal health, and gingival health. Improved oral hygiene standards following use of the herbal toothpastes may have improved the patients' diabetic status because diabetes mellitus and periodontitis have a "two-way" relationship.

Our study has some restrictions, including a small sample size and a brief study period. Since our focus was on how plaque index, gingival index, and bleeding on probing scores were affected in diabetic patients with generalised chronic periodontitis, we also did not use control groups to determine overall efficacy because it would be difficult. Furthermore, the only factor used to determine whether subjects used the herbal toothpastes given to them was their responses. In order to assess how well diabetic patients were controlled after receiving the toothpastes, we also neglected to check their HbA1C levels. Nevertheless, from the present study, both the herbal toothpastes are promising in their use in diabetic patients and could be considered as a potential adjunct alongwith non-surgical periodontal therapy.

### Conclusion

According to the study's findings, both herbal toothpastes significantly reduced plaque levels as well as gingival inflammation and bleeding upon probing. To assess the systemic and local effects of the study's toothpastes, extensive follow-up is needed. To support the findings of this study, additional research is needed to assess the treatment retention over the long term and to compare it to other commercially available dentifrices.

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