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Original Research Article

Effectiveness of *Terminalia chebula* on halitosis among 18-25 years old adults: a randomized controlled trial

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ABSTRACT

Background: Halitosis, commonly known as bad breath, is a dental condition characterized by an unpleasant and offensive odour from the oral cavity. Pathological halitosis is mainly caused by Gram-negative bacteria in the oral cavity that produce volatile sulphur compounds (VSC). Chlorhexidine mouthwash has been used for decades; however, it remains contraindicated due to its side effects. On the other hand, the anti-bacterial properties of plant-derived compounds are well documented. The study aims to assess the effectiveness of *Terminalia chebula* as an oral rinse against VSC in halitosis patients.

Methods: The study sample was selected from patients attending the regular outpatient Department of Public Health Dentistry, Karpaga Vinayaga Institute of Dental Sciences and consisting of 30 adults (both males and females) ranging between 18-25 years of age. The sample was selected from people who present with halitosis. The subjects were randomly divided into groups A and B with 15 adults in each group. Group A was assigned to *Terminalia chebula* mouthwash and group B to chlorhexidine mouthwash.

Results: The study demonstrated a significant reduction in halitosis scores and oral hygiene index (OHI) scores post-intervention in both groups, with group A showing a greater improvement. Statistically significant differences were observed between the groups after the intervention for halitosis and OHI scores, while no significant differences were noted at baseline.

Conclusions: *Terminalia chebula* can suitably be used as an oral rinse for halitosis and does not have any side effects such as erosion and staining.

Keywords: *Terminalia chebula*, Volatile sulphur compound, Malodour, Chlorhexidine, Halitosis

INTRODUCTION

Halitosis, commonly known as bad breath, is a dental condition characterized by an unpleasant and offensive odour from the oral cavity. Halitosis is highly prevalent, that includes physiological or pathological halitosis. The latter can be classified further into oral or extra-oral halitosis, depending on the source of the odour. Pathological halitosis is mainly caused by the presence of Gram-negative bacteria in the oral cavity that produces VSC such as hydrogen sulphide (H_2S), methyl mercaptan (CH_3SH), and dimethyl sulphide (C_2H_6S).[1] Poor oral hygiene, tongue biofilm, food effects, gum disease, dental abscesses, dry mouth, oral ulcers, respiratory infections, and other oral or systemic illnesses are additional causes that contribute to halitosis. Halitosis can be treated by using mouthwashes that are antimicrobial, improving oral hygiene, and utilization of antimicrobial mouthwash.

Traditional medicine is used by many people worldwide, especially in developing countries, to cure a variety of ailments. Some developed Western countries employ medicinal plants to inform and improve their entire way of life, drawing on ancient Eastern culture. According to the world health organization, traditional medicine is used by 80% of people worldwide, and a large percentage of these treatments employ plant extracts or their active constituents.[2] Plants or plant materials utilized in traditional dental procedures or recommended in Unani, homoeopathic, or Ayurvedic treatments have recently come to attention.[3]

Terminalia chebula possess multiple pharmacological and medicinal activities, such as antioxidant, antimicrobial, anti-inflammatory, antimutagenic, antiproliferative, antidiabetic, hepatoprotective, radioprotective, cardioprotective, antiarthritic and also prevents dental caries, spongy and bleeding gums, gingivitis and stomatitis.[4]

Terminalia chebula, which exhibited a number of medicinal activities due to the presence of different types of phytoconstituents. *T. chebula* has become a modern medical marvel due to its widespread use in Ayurvedic, Unani, and homoeopathic treatments. The observed health benefits may be credited to the presence of various phytochemicals like polyphenols, terpenes, anthocyanins, flavonoids, tannins, alkaloids and glycosides.

Tannins have a non-competitive inhibitory effect on the activity of the enzyme glucosyltransferase (GTF) which causes adherence of cariogenic bacteria to the tooth. [5] It has been discovered that polyphenolic chemicals are crucial in the management of halitosis. These substances have antibacterial qualities and can help suppress the bacteria that cause the offensive odour. They are found naturally in fruits, vegetables, and medicinal plants.[6] Their antioxidant properties are believed to play a role. Halitosis and other oral health issues are known to be exacerbated by oxidative stress and dangerous free radicals, which polyphenols can counteract.[7] These substances may also impair the production of VSC and interfere with bacterial metabolism.

Tannins are an effective component that promotes the process of wound healing, in addition to their direct anti-bacterial effect, they can also decrease the permeability of capillaries in the wound and alleviate tissue oedema and exudation, resulting in rapid scab formation.[8] Dental plaque bacteria-lipopolysaccharide-induced osteoclast formation and bone resorption were also significantly abolished by the ethanol extract of *Terminalia chebula* treatment.

Some studies have been done in support of investigating the effectiveness of T. chebula, however, not many studies have been performed in regard to checking the efficacy of *T. chebula* with that of chlorhexidine as an oral rinse in preventing halitosis, therefore, the present study is aimed to assess the effectiveness of *Terminalia chebula* as oral rinse against VSC in halitosis patient.

Objectives

Objectives were to evaluate the effectiveness of *Terminalia chebula* as an oral mouthwash against volatile Sulphur compounds in halitosis patients. at baseline and after 1-month post-intervention using a halitometer, to evaluate the effectiveness of chlorhexidine as an oral mouthwash against volatile Sulphur compounds in halitosis patients. at baseline and after 1-month post-intervention using a halitometer and to compare and evaluate the amount of VSC score between the groups at baseline and 1-month post-intervention using a halitometer.

METHODS

Study design and study setting

This randomized control trial was carried out in the clinical setting of the outpatient department in Karpaga Vinayaga Institute of Dental Sciences, Chengalpattu from April 1st 2024 to August 30th 2024. The description of the study protocol was submitted to the institutional ethics committee (IEC), and approval was granted. Before enrolment, written informed consent was obtained from participants.

Sample size calculation and sampling method

The sample size was calculated by using G power software, with an effect size of 0.70, and power of 80% (Ripin Garewal et al), the final sample was estimated to be 30. Based on the simple random sampling methods; by using the coin-toss method of randomization, participants will be allocated into two groups.

A total of 30 adults aged between 18 to 25 years old who came to the outpatient department in Karpaga Vinayaga Institute of Dental Sciences were included in this study.

Inclusion criteria

Those patients with a mean age ranging from 18 to 25 who live in Chengalpattu were included in the study.

Exclusion criteria

Those with orthodontic brackets, systemic diseases and GERD patients, those who are allergic are excluded from the study, those who were medically compromised and on medication were excluded from the study group and those who did not provide consent were not included in the study.

Data collection methodology

Preparation of *Terminalia chebula* aqueous extract:[9,10] The dried ripe fruit of *Terminalia chebula* is taken. It was mixed with 10 times its quantity of sterile distilled water in a round-bottomed flask and the suspension was kept at 4°C for 72 h. The aqueous extract was decanted, clarified

by filtration through a muslin cloth, and evaporated in a flat-bottomed porcelain dish at 40°C. Dried extract was again suspended in polyethylene glycol (20% v/v) and distilled water was evaporated to get final concentrate. This concentrate was then diluted with sterile distilled water to get mouth rinse of 10% (w/v) concentration.

The subjects were tested with the halitometer and their readings were noted. The subjects were asked to use the mouth rinse twice a day for one month (morning and night). Consent was obtained after the protocol had been clearly explained to the patients. All subjects were asked not to consume anything at least one hour before the study. After a month they were tested with the halitometer and the readings were noted and compared.

The OHI-simplified (OHI-S) by Greene and Vermillion was used to assess oral hygiene. Six index teeth (16, 26, 36, 46, 11, 31) were examined for debris and calculus using a mouth mirror and probe. Debris and calculus were scored separately (0-3), and the average OHI-S score was calculated to classify oral hygiene as good (0-1.2), fair (1.3-3.0), or poor (3.1-6.0).

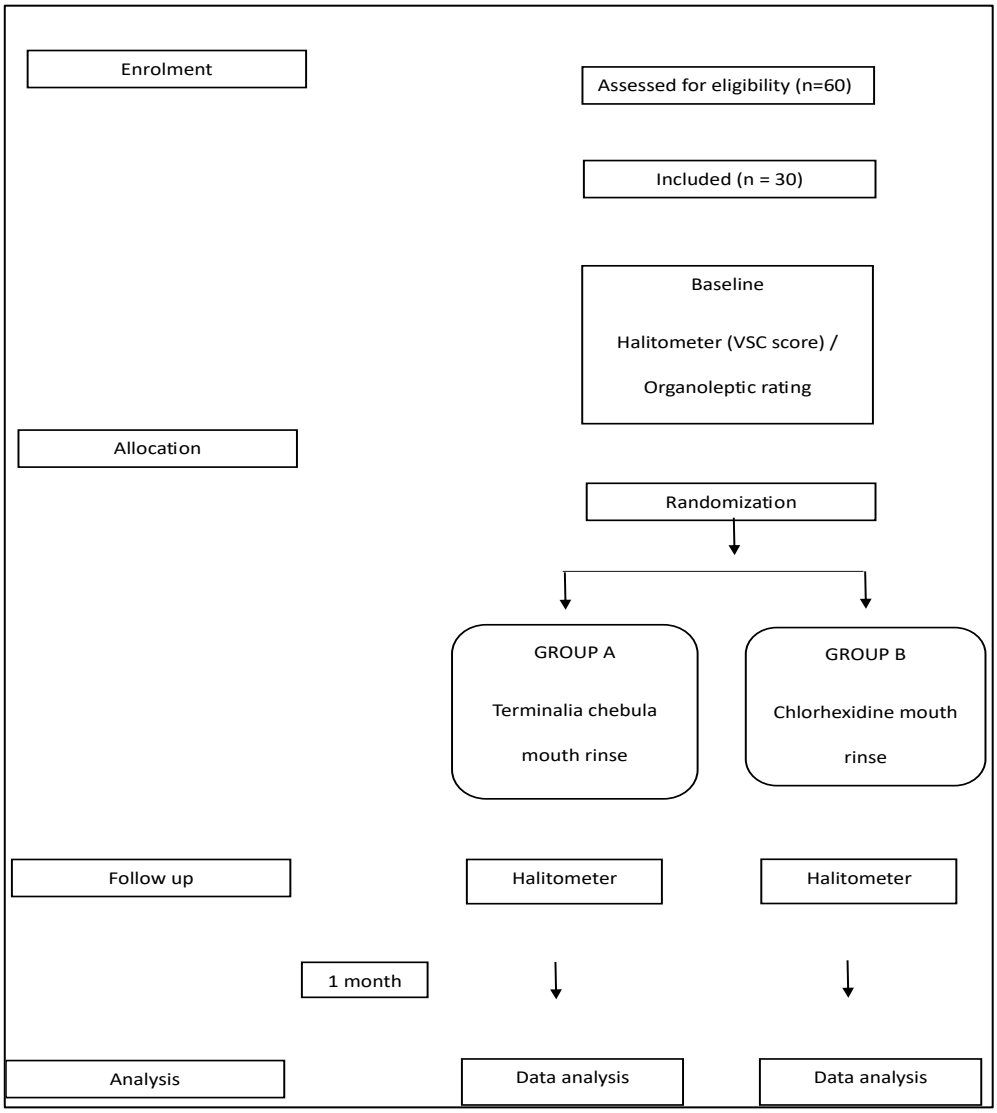

Figure 1: Flow chart illustrating methodology of this study.

Calibration of instrument

Odour intensity can be categorized on a scale ranging from 0 to 5. A rating of 0 indicates that the odour cannot be detected, while a rating of 1 corresponds to a questionable malodour that is barely detectable. A rating of 2 signifies a slight malodour that exceeds the threshold of recognition. At a rating of 3, the malodour is detected, whereas a rating of 4 indicates a strong malodour. Finally, a rating of 5 represents a very strong malodour.

Statistical analysis

A Microsoft excel sheet was used for all data management, and SPSS software version 22 (International Business Machines Corp. Armonk, NY,

USA) was used for data analysis. The data will be checked for normality and an appropriate test will be used; p<0.05 set as statistically significant.

RESULTS

Table 1 depicts the demographic characteristics of the study participants. The mean age of the participants was 20±3.4. A majority of the participants were male 52%, and regarding the socioeconomic status, most of the participants belonged to the upper lower class 30.

Table 2 depict the mean comparison of halitosis scores within groups. Before intervention mean halitosis score in group A was 3.33±0.48 reduced to 1.73±0.70 after intervention. The mean halitosis score in group B before intervention was 3.24±0.54 which was reduced to 1.93±0.59 after intervention.

Table 3 depict the mean halitosis score between the two groups. There was no statistically significant difference between the two groups at the baseline (p=0.654). But at the post-intervention, there was a statistically significant difference in the halitosis score (p=0.407).

Table 4 denotes the comparison of mean OHI scores at pre- and post-intervention within two groups. Before intervention the mean OHI score of group A was 2.90±0.79 reduced to 1.28±0.82 after intervention. The mean OHI score before intervention was 2.84±0.82 and reduced to 1.41±0.90 after intervention.

Table 5 denotes the comparison of the mean OHI score between two groups pre- and post-intervention**.** there was no statistically significant difference between the two groups at the baseline (p=0.858). But at the post-intervention, there was a statistically significant difference in the mean OHI score (p=0.677).

Table 1: Distribution details of the participants.

Variables	N
Age (in years)	20±3
Gender	
Male	17
Female	13
Socioeconomic status	
Upper middle	5
Lower middle	9
Upper lower	10
Lower	5
Location	
Urban	7
Rural	23

Table 2: Mean comparison of halitosis scores at pre- and post-intervention between the two groups.

Groups	Time interval	Mean±SD	Standard error of mean	T value	P value
Group A CHEBULA	Pre-intervention	3.33±0.48	0.125	9.798	0.000*
	Post intervention	1.73±0.70	0.181		
Group B CHX	Pre-intervention	3.24±0.54	0.129	10.693	0.000*
	Post intervention	1.93±0.59	0.153		

*P<0.05, Statistically significant, Paired t-test.

Table 3: Mean halitosis score between the two groups.

Time interval	Groups	Mean±SD	Standard error of mean	T value	P value
Pre-interval	Group A CHEBULA	3.33±0.48	0.125	1.233	0.654
	Group B CHX	3.24±0.54	0.129		
Post interval	Group A CHEBULA	1.73±0.70	0.181	-0.841	0.407
	Group B CHX	1.93±0.59	0.153		

*P<0.05, Statistically significant, Unpaired t-test.

Table 4: Comparison of mean OHI scores at pre- and post-intervention between the two groups.

Time Interval	Groups	Mean±SD	Standard error of mean	T value	P value
Pre-interval	Group A CHEBULA	2.90±0.79	0.125	0.181	0.858
	Group B CHX	2.84±0.82	0.129		
Post interval	Group A CHEBULA	1.28±0.82	0.181	-0.421	0.677
	Group B CHX	1.41±0.90	0.153		

*P<0.05, statistically significant, Paired t test

Table 5: Comparison of the mean OHI score between two groups at pre- and post-intervention.

Groups	Time interval	Mean±SD	Standard error of mean	T value	P value
Group A CHEBULA	Pre-intervention	2.90±0.79	0.790	4.565	0.000*
	Post intervention	1.28±0.82	0.824		
Group B CHX	Pre-intervention	2.84±0.82	0.822	5.675	0.000*
	Post intervention	1.41±0.90	0.909		

*P<0.05, Statistically significant, Unpaired t-test.

DISCUSSION

The present study aimed to evaluate the efficacy of chebula mouthwash in managing halitosis. Our findings demonstrated a significant reduction in oral malodour among participants using the mouthwash, supporting its potential as an effective intervention.

Chlorhexidine mouthwash has been used for decades but due to its some side effects like alteration in taste, production of brown stains, chromogenic and carcinogenic properties its uses are not advisable in many conditions. The alcohol content of this oral rinse also contraindicates and restricts its use in individuals of lower age groups.[11-13]

So, the current priority is to commercially develop an oral mouthwash with broad spectrum coverage and fewer side effects.

The present study shows that the *Terminalia chebula* has an effect on halitosis which is due to the presence of the tannins and the polyphenols. Tannins which form a major constituent of *Terminalia chebula* (20-40%) are well recognized for their microbial nature, bacteriostatic and bactericidal properties against Gram-positive and Gram-negative pathogens. Tannins have a non-competitive inhibitory effect on the activity of the enzyme glucosyltransferase (GTF) which causes adherence of cariogenic bacteria to the tooth.[9] Polyphenols have the property to inhibit the growth of the bacteria and neutralize the harmful free radicles and also reduce the VSC formation thus addressing the root cause of halitosis.[14]

In present study results showed that there is no significant difference in the VSC score at baseline for the chebula group and chlorhexidine group and after the intervention, there is a significant difference in the chebula group and chlorhexidine group (Table 3).

The results indicate that both groups showed a significant improvement in oral hygiene after the intervention, as evidenced by the reduction in mean OHI scores. Although there was no significant difference between the groups at baseline (p=0.858), post-intervention, group A demonstrated a greater improvement, leading to a statistically significant difference in mean OHI scores (p=0.677). This suggests that the intervention used in group A was more effective in enhancing oral hygiene outcomes (Table 4 and 5).

A study by Garewal et al showed that *Terminalia chebula* can suitably be used as an oral rinse and does not have any side effects such as erosion and staining.[9]

According to Lee et al *Terminalia chebula* ethanol extract (EETC) inhibited matrix damage, eliminated PGE2 and COX-2 production, decreased the generation of inflammatory cytokines and proteases, and inhibited the growth of oral bacteria. EETC prevented bone resorption by inhibiting the production of osteoclasts in osteoclast precursors and the expression of RANKL in osteoblasts by inducing the DPB-derived lipopolysaccharides. EETC might be a useful dietary supplement to help stop periodontal disease caused by DPB.[15]

According to a related study by Liu et al thinned-young apple polyphenols (YAP) have antibacterial properties by breaking down the cell membrane of bacteria linked to halitosis, such as *P. gingivalis*, *P. intermedia*, and *F. nucleatum*.[16]

Strength and limitations

The strength of study is that this is first study on halitosis using *Terminalia chebula* as mouthwash. The limitation is that it is professionally prescribed but self-use only the only loophole that arises in using an aqueous extract of *Terminalia chebula* as an oral rinse is its bitter taste.

CONCLUSION

Based on the study findings Terminalia Chebula mouth rinse reducing the halitosis and improving the oral hygiene status. Also There was no significant difference was established between T.chebula and chlorhexidine mouthrinse in mean halitosis score and oral hygiene status.

Recommendations

Further research is highly encouraged to identify and isolate the active component of *Terminalia chebula* and to conduct essential phytopharmaceutical investigations. Needed for a wider population.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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