

Anticarious efficiency and effectiveness of Terminalia Chebula and Chlorhexidine as an oral rinse in children - An In-Vivo Study

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Abstract:

Background: Chlorhexidine mouth wash has been used for decades, however, it remains contraindicated in children and teenagers. On the other hand, the anti-microbial properties of plant derived compounds are well documented.

Aim: To compare, in vivo the efficacy and effectiveness of aqueous fruit extract of Terminalia chebula and Chlorhexidine oral rinse as an anti caries agent in children.

Materials and Methods: 30 children in the age groups of 13 - 19 years were randomly selected for the study. The efficacy of the two agents (Terminalia Chebula and Chlorhexidine) as anti caries agents was assessed by evaluating the salivary pH and the salivary buffering capacity. The values obtained were subjected to statistical analysis.

Results: A percentage improvement in buffering capacity was noted with Terminalia chebula when compared to Chlorhexidine mouthwash which indicated potential long term effects. The pH of both Terminalia chebula and Chlorhexidine did not show any significant difference.

Conclusion: Terminalia chebula can suitably be used as an anti-caries oral rinse and does not have any side effects such as erosion and staining.

Keywords: Chlorhexidine, Dental caries, Medicinal plants, Terminalia chebula

Introduction

Tooth decay is caused by specific types of acid-producing bacteria that cause damage in the presence of fermentable carbohydrates such as sucrose, fructose, and glucose if exposed for a specific time period. The mineral content of teeth is sensitive to increase in acidity from the production of lactic acid. When the pH at the surface of the tooth drops below 5.5, demineralization proceeds faster than remineralization i.e., there is a net loss of mineral structure on the tooth's surface.¹ This results in the ensuing decay.

A number of steps in the management of dental diseases include a) identifying the risk group for a disease; b) remineralising the non-cavitated carious lesions without surgical intervention and c) preventing the occurrence/recurrence of disease in an individual. However, the work of a dentist lies in providing treatment to adolescents, with preventive regimen in order to develop an eco friendly environment in the oral mucosa, to help the individual to maintain cariostatic pH and buffer values in order to prevent initiation of dental caries. Fluoride, till date has been understood to be the most

widely used preventive material due to its ability to remineralize the tooth and make it acid resistant. However, professionally applied topical fluoride require patient compliance and can lead to excess intake, due to non availability of specified data in regard to dietary fluoride supplements or community water fluoridation of the children subjected to fluoride. An oral rinse, Chlorhexidine, has been recognized as yet another useful, widely used preventive measure, but its use is restricted among children and teenagers, due to its alcoholic base and that it causes numerous side effects such as staining, mucosal erosion, desquamation and altered taste sensation.²

A large portion of the world's population, especially in developing countries depends on the traditional system of medicine for a variety of diseases. Some developed western countries are depending on ancient Eastern culture for ways to improve and invigorate their entire lifestyle by use of some medicinal plants. The World Health Organization reported that 80% of the world's population rely chiefly on traditional medicine and a major part of the traditional therapies involve the use of plant extracts or their active constituents.² Recently the focus is on plants or plant products used in folk dental practices or prescribed in Unani, homeopathic or Ayurvedic remedies.³

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On examining the list of plants recommended for a particular dental therapeutic purpose, it is evident that the ripe fruit of Terminalia chebula can prove to be valuable in the prevention and treatment of several diseases of the mouth such as dental caries, spongy and bleeding gums, gingivitis and stomatitis.⁴ Some studies have been done in support to 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 dental caries.^{5, 6} Therefore, the present study was designed to compare the efficacy of the extract of Terminalia Chebula with chlorhexidine when used as an anti-cariogenic mouth wash in children.

Materials and Methods

Subject Selection

The study sample was selected from patients attending the regular Outpatient department of Mai Bhago Ayurvedic Medical College, Muksar and consisting of 30 children (both males and females) ranging between 13-19 years of age who were chosen using the criteria of carious risk assessment. The sample was selected from high caries susceptible patients. Individuals with caries prevalence of 2 carious teeth per quadrant were considered as highly caries susceptible and included in the study. The subjects were randomly divided into two groups as group A and B with 15 children in each group. The group A was assigned for herbal extract mouthwash and group B for Chlorhexidine mouth wash.

The Ethical Committee of Mai Bhago Ayurvedic Medical College approved the study before the start. 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 prior to the study.

Methodology

Preparation of Terminalia Chebula aqueous extract:

The extract was prepared as given by Jagtap and Karkera.⁶ The dried ripe fruit of Terminalia chebula was ground into a fine powder. 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. The dried extract was again suspended in polyethylene glycol (20% v/v) and distilled water evaporated to get the final concentrate. This concentrate was then diluted with sterile distilled water to get a mouth rinse of 10% (w/v) concentration (Fig. 1).

In group B, Chlorhexidine used was Clohex® (Dr. Reddy's Pharmaceuticals Ltd, Mumbai).

In group A, The subjects were made to rinse orally, a 10% concentrated extract of the Terminalia Chebula and made to retain it in the mouth for 40 seconds before expectorating it. They were not allowed to rinse with water or to consume anything orally for 90 min following the test. The pH and buffer test were repeated at 30 and 60 minute intervals.



Fig. 1. Aqueous extract of Terminalia Chebula

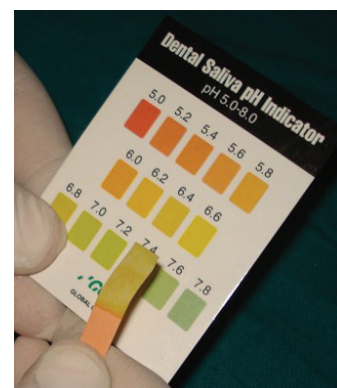


Fig. 2. Salivary pH analysis

Salivary pH analysis

Saliva samples from the 15 subjects were taken and the pH was analyzed using GC saliva check. Strict user guidelines were followed to maintain the authenticity of results.⁷

Unstimulated saliva was allowed to collect in the floor of the mouth and then transferred to the collecting jar. The pH test paper was dipped in the sample for at least 10 seconds and the color changes were compared with the chart provided by the manufacturer (Fig. 2). The values were recorded.

Salivary buffering capacity analysis

The salivary buffer was assessed using GC saliva check. Following strict user guidelines, buffer test were done on stimulated saliva.⁷ The patient was instructed to chew on a piece of paraffin wax for 30 seconds. The first saliva that was secreted was discarded and the subsequently secreted saliva was collected for testing (Fig. 3). Using the pipette provided, one drop of saliva was placed on each test pad (Fig. 4). After 2 minutes, the color of the strip was compared with the chart provided by the manufacturer, and the values were recorded. The same procedure was carried out in Group A.

The values obtained from the pH analysis, buffering analysis (from two groups) were tabulated and the means and standard deviations were calculated. Statistical analysis was done using the paired 't' test and ANOVA test.

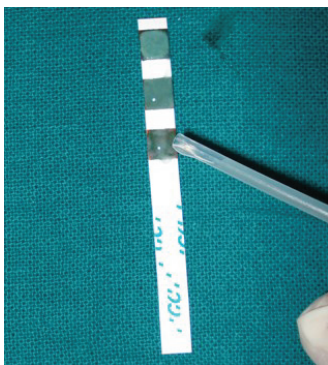


Fig. 3. Collection of Saliva



Fig. 4. Salivary buffering capacity analysis

pH analysis

Following user guidelines and result interpretation table given by the manufacturer for pH were taken into considerations:

- 5.0-5.9 - highly acidic
- 6.0-6.7 - moderately acidic
- 6.8-7.8 - healthy saliva

1. Chlorhexidine

It was seen in patients subjected to Chlorhexidine, the pH increased to a peak value of 6.9 at 60 min from baseline value of 5.1.

2. Terminalia Chebula

In patients subjected to Terminalia chebula, the pH increased to a peak value of 7 at 60 min from baseline value of 5.1.

The paired 't' test revealed that no significant difference was observed for pH values between Group A (Chlorhexidine) and Group B (Terminalia chebula) at 1% level of significance, i.e., $p = 0.125$ thus proving that children subjected to Group B (Terminalia chebula) showed no significant difference over time as well as stabilization in pH values which was same in case of Chlorhexidine [Table 1]. However, for evaluation of difference in pH values at regular intervals of 30 and 60 minutes within groups, one way ANOVA was used and it was observed that there was significant difference at all intervals both in Group A (Chlorhexidine) and Group B (T. chebula). Thus the results of the present study prove that T. chebula as well as Chlorhexidine showed equivalent and comparable stabilization for longer duration and found to be equally efficient in terms of pH [Table 2 and 3].

Table 1. Salivary pH analysis between two groups

Groups	Mean Values	Mean Difference	t value	p value
A (Chlorhexidine)	6.392 ± 0.52	-0.073		0.125
B (Terminalia chebula)	6.465 ± 0.563		1.5622	

Table 2: One way ANNOVA test for pH in children subjected to Chlorhexidine

	Sum of Squares	Degree of Freedom	Mean Squares	F	p Val
Between	10.615	3	3.538	74.065	<0.001**
Within	2.102	44	0.048		
Total	12.717	47			

Table 3: One way ANNOVA test for pH in children subjected to Terminalia Chebula

	Sum of Squares	Degree of Freedom	Mean Squares	F	p Val
Between	12.528	3	4.176	77.771	<0.001**
Within	2.363	44	0.054		
Total	14.891	47			

Salivary Buffer analysis

Following user guidelines and result interpretation table given by the manufacturer for Salivary Buffering ability were taken into considerations:

- 0-5 - very low buffering ability
- 6-9 - low buffering ability
- 10-12 - normal/ high buffering ability

1. Chlorhexidine

The buffering capacity in Chlorhexidine increased to a peak value of 8 at 30 minutes from baseline value of 6 and did not maintain it until 60 minutes.

2. Terminalia Chebula

The salivary buffer capacity in Terminalia chebula, raised to a peak value of 10 at 30 minutes from a base line value of 6 and maintained the same at 60 minutes. The paired 't' test revealed that no significant difference was observed for salivary buffer values from base line to 30 minutes in Group A (Chlorhexidine), i.e., $p > 0.0012$, however a high significant difference was observed in Group B (T. chebula) at 1% level of significance, i.e., $p < 0.012$ showing that teenagers subjected to Terminalia chebula maintained highest efficacy in Salivary Buffer values, than that of Chlorhexidine [Table 4].

For evaluation of difference in salivary buffering capacity values at regular intervals of 30 and 60 min, one way ANOVA suggested significant difference within Group A (Chlorhexidine) and Group B (Terminalia chebula) though the values in Terminalia

Chebula remained constant and higher when compared to that of Chlorhexidine [Table 5 and 6]. The results hence proved that Terminalia chebula was more efficient than Chlorhexidine in terms of salivary buffering capacity.

Table 4: Evaluation of salivary buffering capacity between two groups

Groups	Mean Values	Mean Difference	t value	p value
A (Chlorhexidine)	6.88 ± 1.04	-0.67	3.4413	0.0012
B (Terminalia chebula)	7.54 ±1.25			

Table 5: One way ANNOVA test for salivary buffering capacity in children subjected to Chlorhexidine

	Sum of Squares	Degree of Freedom	Mean Squares	F	p Val
Between	21.741	3	7.247	10.810	<0.001**
Within	29.499	44	0.670		
Total	51.240	47			

Table 6: One way ANNOVA test for salivary buffering capacity in children subjected to Terminalia Chebula

	Sum of Squares	Degree of Freedom	Mean Squares	F	p Val
Between	49.582	3	16.527	29.888	<0.001**
Within	24.331	44	0.553		
Total	73.913	47			

Discussion

Prevalence of oral diseases is a rapidly emerging problem especially among teenagers in India. These chronic ailments interfere with normal nutrition intake, speech and daily routine activities as in a teenager suffering from caries pain, may adversely affect his or her food intake and self esteem. Fluoride containing oral rinses, a widely used oral rinse known for its preventive capabilities against dental caries, when used on regular basis, can also cause excess intake of fluoride ions. Chlorhexidine oral rinse has also been most widely used for decades, however, its alteration in taste sensation, production of brown stains in teeth⁸ and its chromogenic and carcinogenic potential⁹ makes it not advisable in some instances. The alcohol content of this oral rinse also contraindicates and restricts its use in individuals of lower age groups.¹⁰ So, the need of the hour is to commercially manufacture a preventive oral rinse with broad spectrum coverage and least negative attributes aimed to be used in children and adolescents.

We prevail the use of Ayurveda in our daily life without even knowing its significance. For management of dental diseases as well, many therapeutic agents from natural sources are being tested and tried. In Ayurvedic literature, Terminalia Chebula has been documented to be a potent anti inflammatory, anti bacterial, antiseptic, anti enzymatic, anti fungal, antihelminthic and a powerful astringent agent.¹¹ 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.¹² Tannins have non-competitive inhibitory effect on the activity of enzyme glucosyltransferase (GTF) which causes adherence of cariogenic bacteria to the tooth. These are also easily absorbed by its large phenolic groups to the hydroxyapatite of the teeth thereby preventing the binding of salivary mucins on the tooth surface with the bacterial antigens. Priority has been aimed at preventing periodontal diseases; however, not much has been done to prevent dental caries. The only loop hole that arises in using aqueous extract of Terminalia Chebula as an oral rinse is its bitter taste that makes it less palatable for consumption by children. This can be improved by providing a suitable flavoured base to the oral rinse. This study was aimed to check the efficacy of commercially marketed Chlorhexidine oral rinse with that of an aqueous extract of Terminalia Chebula as an anticaries agent.

For pH values, the paired 't' test indicated that teenagers subjected to Terminalia chebula showed a significant difference in pH values over time and also maintained stability. This was also recorded in case of Chlorhexidine [Table 1]. ANOVA test for the same indicted increased stabilization of pH both in Terminalia chebula and Chlorhexidine [Table 2]. This was found similar to other studies.^{7,12}

However, for salivary buffer values, the paired 't' test indicated that teenagers subjected to Terminalia chebula maintained highest efficacy, than that of Chlorhexidine [Table 1]. The results of ANOVA for the same directed that Terminalia chebula was more efficient than Chlorhexidine in terms of salivary buffering capacity [Table 3]. This was in agreement with other studies.^{7,12} Terminalia Chebula comes with only one drawback as an oral rinse is that of its bitter taste those makes it less palatable for use by individuals. However, we potentiate that if the agent is consumed on a regular basis, the same will have an edge over the traditional Chlorhexidine in terms of percentile improvement both in pH and buffer analysis.

It is a well known fact that salivary buffering capacity of an individual plays a key role in caries prevention, as individuals with high buffer capacity are considered to have healthy saliva. Hence, efforts may be made to overcome the problem of non-palatability of Terminalia Chebula by the addition of a suitable flavored base.

Further research work is strongly recommended to locate and isolate the active principle of T. Chebula and also to carry out the necessary phyto-pharmaceutical studies. Research into the effects of local medicinal plants is expected to boost the use of these plants in the therapy against disease caused by the test bacterial species and other microorganisms. The detailed results of this investigation also appears to indicate that Terminalia Chebula has a high potential for use as an anticaries and antiplaque agent and can suitably replace currently commercially available mouth rinses.

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