



**EFFICACY OF HERBAL EXTRACTS IN TOOTHPASTES IN COMPARISON WITH CONVENTIONAL TOOTHPASTES IN CONTROL OF DENTAL DISEASES: A META-ANALYSIS**

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**ABSTRACT**

**Introduction:** Various studies have been conducted to assess the efficacy of commercially available herbal products to control dental diseases viz. dental caries, periodontal diseases and even reduce number of oral bacteria. Systematic reviews play an important role in aiding clinical decision making and help summarize the different results obtained in the all the various studies and reach a decisive conclusion.

**Objectives:** To evaluate the efficacy of herbal toothpastes and compare with conventional toothpastes in control of dental diseases.

**Methodology:** A literature review was performed using MeSH terms herbal tooth pastes, conventional toothpastes and comparative study. A total of 24 abstracts were found to be relevant out of which 9 were found to meet the inclusion criteria. These 9 randomized control studies were pooled in for the meta-analysis. The search was done from the Pub Med Central listed studies with the use of keywords with Boolean operators. The fixed effects model was used for analysis.

**Results:** This meta-analysis brings to light, the fact that a wide range of newer herbal products are now available but only a few have significant effect on dental health. This study found that six studies favour the use of herbal toothpastes and only three studies favour the use of conventional toothpastes, of the 9 studies that were analyzed.

**Conclusion:** Although it was found that the herbal toothpastes were more effective than the conventionally formulated toothpastes in the control of plaque and gingivitis, more studies are required under well controlled circumstances to prove that herbal products can equate or replace the conventionally used toothpastes compositions on a large scale basis.

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**INTRODUCTION**

Herbal extracts have been used in traditional medicine for several thousands of years. The knowledge on medicinal plants has been accumulated in the course of many centuries, based on different medicinal systems such as Ayurveda, Unani and Siddha. In India, it has been reported that traditional healers use 2,500 plant species and that 100 species of plants serve as regular sources of medicine. During the last few decades, there has been an increasing interest in the study of medicinal plants and their traditional use in different parts of the world<sup>1</sup>.

Natural herbs used either exclusively or in combination are proven to be safe and effective in the management of various oral health problems such as halitosis, bleeding gums, mouth ulcers, and dental caries. Herbal products have the dual advantage of minimal side effects and being alcohol and/or sugarfree, which are the two most common ingredients found in other over-the-counter products<sup>2</sup>.

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Various studies have been conducted to assess the efficacy of various commercially available herbal products to control dental diseases viz. dental caries, periodontal diseases and even reduce number of oral bacteria with contrasting results. There is a need to summarize the results obtained on a statistical scale to definitely declare if the herbal products are an effective replacement to the ones already existing. In contrast to classical narrative reviews, systematic reviews use an explicit and rigorous methodology. They start with a clearly stated set of clinically relevant questions and pre-defined criteria for study inclusion. The scientific literature is then systematically searched with the aim of identifying all potentially relevant studies. After application of eligibility criteria, the included studies are assessed for their internal validity, in particular the risk of bias. If possible, data are combined using meta-analytic methods. By statistically combining information from all or part of the included studies, meta-analyses can provide pooled estimates that are more precise than those derived from individual studies<sup>3</sup>.

Hence an attempt has been made to apply such meta-analytic review approach with an objective to compare the efficacy of

herbal toothpastes with conventional toothpastes in preventing oral diseases.

**MATERIALS AND METHODS**

**Study selection criteria:** A literature search was performed in PubMed using key words with Boolean operators during the month of July 2016 (viz. herbal tooth pastes, conventional toothpastes and comparative study). A total of 52 abstracts were found to be relevant out of which 9 were found to meet the inclusion criteria. These 9 randomized control studies were pooled in for the meta-analysis.

Original research studies including randomised control trials were selected which compared the efficacy of herbal toothpastes to conventional toothpastes in controlling dental diseases. The selected studies compared plaque scores and other periodontal parameters between herbal toothpastes and conventional toothpastes.

Review articles on herbal extracts in dentistry and other systematic reviews were excluded. In vitro studies on herbal extracts in toothpastes were excluded. Other studies of herbal extracts in mouth rinses and substances other than toothpastes were also excluded.

**Data analysis**

The meta-analysis of comparative efficacy between herbal toothpastes and conventional toothpastes in control of dental diseases was done using *Comprehensive Meta-Analysis software version 2.0*. The study findings were entered into the software viz. the mean and SD values and the associated p-values of plaque scores and other parameters measured were entered into the software.

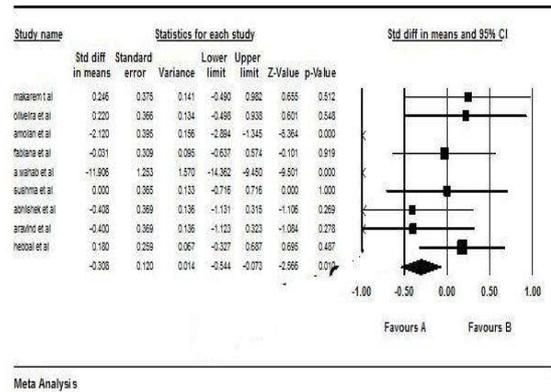
The fixed effects model was used for analysis when compared to the random effects model as the data was more heterogeneous. Chi square was used to compute heterogeneity based on the standard deviation and confidence levels of all the selected studies. The Meta-analysis results were depicted using a Forrest Plot. Mean difference of individual studies were reported as (+) for studies in favour of conventional toothpaste and (-) for studies in favour of herbal toothpastes. The cumulative mean difference of all the studies was depicted using a rhomboid mark on the Forrest plot.

**RESULTS**

Table-1 shows the Meta-analysis done by fixed effects model. It showed that out of 9 studies that were analyzed, only 3 studies favor the use of conventional toothpastes in comparison with 5 studies that favor the effect of herbal toothpastes.

**Table 1** Meta-Analysis showing comparison of efficacy of conventional and herbal toothpastes in control of dental disease

S.No	Author Name	Herbal Toothpastes			Conventional Toothpastes			Mean Difference	
		Mean	SD	No. of subjects	Mean	SD	No. of subjects		
1	Makarem et.al	1.545	0.5311	25	1.405	0.6605	10	0.246	
2	Oliveira et al	2.75	0.39	15	2.65	0.51	15	0.220	
3	Amoian et al	1.418	0.102	20	1.606	0.073	20	-2.120	
4	Ozaki Fabiana et al	2.11	0.68	20	2.13	0.60	22	-0.031	
5	A.wahab et al	1.015	0.065	32	1.77	0.06	16	-11.906	
6	Sushma et al	0.67	0.22	15	0.67	0.22	15	0.000	
7	Abhishek et al	0.66	0.19	15	0.76	0.29	15	-0.408	
8	Aravind et al	1.90	0.41	15	2.07	0.44	15	-0.400	
9	Hebbal et al	0.99	0.14	30	0.96	0.19	30	0.180	
Total				187				158	-0.308 (Cumulative Mean Difference)



**Figure 1** Forrest Plot representing Meta-analysis for comparison of efficacy of conventional and herbal toothpastes in control of dental disease

Only one study remains neutral to both types of toothpastes. Studies done by Makarem *et al*<sup>4</sup>, Oliveira *et al*<sup>5</sup> and Hebbal *et al*<sup>6</sup> were found to be in favour of conventional toothpastes while study by Sushma *et al*<sup>7</sup> was found to be neutral. A cumulative mean difference of -0.308 was derived indicating a slight inclination towards herbal toothpastes by the Meta-analysis.

Figure 1 shows the same analysis plotted on a Forrest plot where the Rhombus indicates the Cumulative mean difference also favouring the herbal toothpastes.

**DISCUSSION**

The current study compared the efficacy of herbal toothpastes with conventional toothpastes in control of dental disease using a Meta-analysis of 9 selected randomized controlled trials. In the recent times the use of herbal dentifrices is on the rise due to the spread in the awareness of the effect of complementary and alternative medicine. It is also due to the much stronger belief that the alternative therapy is with less side effects.

Very few studies were conducted to compare the efficacy of herbal and conventional toothpastes in controlling dental diseases. Even fewer numbers of systematic reviews were available in literature regarding the same. Among the studies selected for Meta-analysis in the present study, various herbal products were tested for their role in control of dental disease. Makarem *et al* used Barberry (*Berberis vulgaris*) extract in gel form in toothpastes among the test group along with placebo group and Colgate® toothpaste groups. The results showed barberry gel has reduced the Plaque scores by about 56%. This reduction was 18.5% for placebo and 44% for Colgate® antiplaque groups in the same study.

These results were similar to those recorded by Makarem *et al.* in a previous study on the efficacy of a dentifrice containing 3 herbal extracts (on dental plaque and gingivitis) in 12-13 year old boys; it was observed that both the plaque index and gingival index decreased significantly in test group compared to placebo group.

Oliveira *et al* used *Aloe vera* extracts in herbal toothpaste and compared the reduction of plaque and gingivitis with conventional toothpastes. The results showed that both herbal and conventional toothpastes were efficient on plaque reduction (23% in test herbal group and 19% in control group). This percent difference was not significant at the end of the trial. These results were similar to those of Villalobos *et al*<sup>8</sup>, who observed a significant reduction on plaque and gingivitis after a 30-day use of dentifrices containing *Aloe vera* associated to tooth-brushing. This study also showed an additional antiplaque and antigingivitis effect of this phytotherapeutic agent, which was not observed in this trial. Villalobos, *et al.* (2001) used a higher concentration of *Aloe vera* (50%), which could explain the better effect of this phytotherapeutic agent when compared to the findings of Oliviera *et al.*

Amoian *et al*<sup>9</sup> used *Calendula officinalis* extract toothpaste to reduce gingival inflammation and plaque formation. This extract was found to have a significantly higher reduction of plaque levels and gingivitis than the conventional toothpastes. It was supported by many studies like Cordova *et al.*<sup>10</sup>, De *et al*<sup>11</sup>, Larrondo *et al*<sup>12</sup> which stated that the anti-oxidant and antimicrobial properties of *Calendula* extract helped in reducing gingivitis and plaque formation.

Fabiana *et al*<sup>13</sup> & Abdul wahab *et al*<sup>14</sup> used Parodontax® dentifrice (containing *sodium bicarbonate*, *sodium fluoride* 1,400 ppm, *chamomile*, *echinacea*, *sage*, *rhatany*, *myrrh* and *peppermint oil*). The study results showed that there was no additional benefit of the test dentifrice over the positive control toothpaste although efficacy of herbal toothpaste was found to be slightly higher than that of normal fluoride toothpaste. These results were in contrast to Pannuti *et al*<sup>15</sup> where Parodontax toothpaste was unable to promote a significant reduction in PI and GI when compared to a standard dentifrice containing only fluoride. However a number of studies like Triratanaet *al*<sup>16</sup> and Lindhe *et al*<sup>17</sup> were in agreement that herbal toothpastes were an effective substitute for conventional toothpastes without the possible side effects.

Sushma *et al*<sup>7</sup> used commercially available herbal dentifrice containing 1000 ppm sodium monofluorophosphate, calcium carbonate, chamomile, eucalyptus, myrrh, sage. Though herbal dentifrice showed more effectiveness than the non-herbal dentifrice on the reduction of gingival scores, there was no statistically significant difference between the herbal and non herbal groups. These findings were agreement with studies by Saxer *et al.*<sup>18</sup> (1995) and Mullaly *et al.*<sup>19</sup> (1995) which showed there is significant reduction in both plaque and gingival indices within the group but no significant difference between the groups when herbal dentifrice were used. A study by Pannutiet *al.*<sup>15</sup> (2003) was unable to show a significant reduction in plaque and gingivitis when compared to a standard dentifrice.

Abhishek KN *et al*<sup>20</sup> used Neem containing toothpaste to evaluate control of plaque and gingivitis. Post intervention analyses showed a significant reduction of plaque and

gingivitis among test group as compared to control group. This study was supported by studies done by Saxeret *al.*<sup>18</sup> (1995) and Mullaly *et al.*<sup>19</sup> (1995) which yielded similar results.

Aravind *et al*<sup>21</sup> used an herbal dentifrice (Dabur Red®) containing *Pudinasatva* (menthol 50–55%, methyl acetate, menthone), *Tomarbeej* and *laungkatel* (70–90% eugenol 50–55%, 50% sesquiterpenes) in comparison with a conventional toothpaste. The study found herbal dentifrices to be as effective as the non-herbal ones in the reduction of gingivitis. This is in agreement with the report by Ozaki F *et al.*<sup>13</sup> (28.4% and 36.3% reduction, respectively). Also, it is similar to the findings of George *et al.*<sup>22</sup> and Mateu *et al.*<sup>23</sup> de Oliveira *et al.*<sup>5</sup>, who found slightly lower efficacy of herbal product on gingivitis and gingival bleeding compared to the conventional toothpastes.

Hebbal *et al*<sup>6</sup> used an herbal dentifrice (Himalaya Herbal HealthCare) containing Pomegranate extracts, Neem along with other ingredients for their study. They concluded that herbal toothpaste was as effective, but not significantly higher than the conventionally formulated dentifrice in controlling plaque and gingivitis.

Most of the studies used various ingredients that are scientifically proven to have beneficial effects on oral health. Among the various compounds tried the most common ingredients include *Aloe vera*, *Neem*, *Pomegranate extract*, *Barberry*, *Calendula*, *Eucalyptus*, *Chamomile*, *myrrh*, *Sage*, *Tulsi*, etc. to name a few. All these compounds are used individually or in combination with one another to create a cumulative beneficial effect.

Herbal medicines have been used for many years, and their history can be rooted from the ancient civilization, where their role as a primary source of medication has been evident. The herbal toothpastes have been proved to be an effective substitute to conventionally manufactured toothpastes in controlling dental diseases through this review. Although clinical trials and in vitro studies have been conducted by researchers, the long term benefits of using the herbal products are yet to be proven. Hence, longitudinal studies have to be conducted to prove the long term benefits and absence of side effects which occur due to the herbal products.

Although Systematic reviews are considered as a higher form of research, a few common limitations exist. There might be a publication bias as information available is only based on published data rather than crude data; there also might not be reports of non-significant data which might significantly affect the cumulative mean difference of the Meta-analysis; the comparison in Meta-analysis is based only on mean differences of individual studies rather than individual herbal products. However the results are still representative of the efficiency of herbal products to successfully replace the conventional toothpastes in maintaining a disease free oral cavity.

Therefore, to increase the strength of the Meta-analysis the following recommendations can be made: There is a need to include crude data (non-published data) in the statistical analysis because more the number of studies, stronger are the results of the analysis. It also eliminates any publication bias that might exist; *Need to report findings of non-significant data*: Usually, only the significant data is recognized in research while the non-significant data is lost in literature.

Hence, it is important to consider non-significant data in published research also for statistical analysis; *Need to conduct more longitudinal studies*: Although randomized controlled trials are of high strength, their results yield a short term efficiency of the dentifrices. Their long term effects can only be determined by conducting longitudinal studies in specific populations over an extended period of time. Hence, there is a need to encourage and implement more of long term research. From the present study we can conclude that the herbal toothpastes were found to be marginally more effective than the conventionally formulated toothpastes in the control of dental diseases. It is believed that the plants (Traditional Medicine) will be a major source of new compounds and raw materials for the pharmaceutical industry in near future. The *Materia medica of Ayurveda* and other similar repositories of knowledge from other cultures (*Unani, Siddha, Islamic hygienical Jurisprudence, etc.*) represent a valuable resource for development of medicinal preparations. They must be critically evaluated in terms of modern scientific parameters. It is important to carefully correlate the herbal products in use and their scope in replacing their conventional counterparts to maintain optimum oral and general health. Hence more studies are required under well controlled circumstances to prove that herbal products can equate or replace the conventionally used toothpastes compositions on a large scale basis.

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