

Comparison between the effect of commercially available chemical teeth whitening paste and teeth whitening paste containing ingredients of herbal origin on human enamel

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Abstract

Background: Dentistry plays a crucial role in shaping the esthetics of a person and thus boosts the self-esteem of an individual. Whitening of the teeth is the most popular procedure where surface and deep stain removal whitens the teeth. Teeth whitening is achieved by professional application of chemicals and can also be self-administered by numerous products available. The most popular product is teeth whitening paste which is simple in application and easily available. Recently, teeth whitening tooth paste is commercially available where natural ingredients or their derivatives are used instead of chemicals for teeth whitening. **Aims:** To investigate and compare the effect of commercially available chemical teeth whitening toothpaste and teeth whitening toothpaste containing ingredients of herbal origin on human enamel (at the Department of Oral and Maxillofacial Pathology, Royal Dental College, Kerala, India). **Materials and Methods:** An *in vitro* study with a duration of 14 days was conducted. **Settings and Design:** An *in vitro* study was conducted twenty samples were taken and assembled in to two groups of 10 each. Group A for teeth treated with conventional chemical toothpaste and group B for teeth treated with toothpaste containing ingredients of herbal origin. Premolars extracted for orthodontic purpose were checked for shade with Vita 3D shade guide and were observed under a stereomicroscope for surface morphology before the procedure. Each section was cleansed twice daily for 1 min with specified toothpaste and soft bristle toothbrush according to their groups and then cleansed with tap water and stored again in the same solution. After 14 days, the teeth were tested for the shade using vita 3D shade guide and surface morphology using stereomicroscope. **Statistical Analysis Used:** Student's unpaired *t*-test. **Results and Conclusion:** In this 14-day *in vitro* study, the chemical whitening toothpaste showed better whitening of teeth than toothpaste containing ingredient of herbal origin, whereas the surface irregularities was increased on the surface of the enamel with chemical whitening toothpaste when compared with toothpaste containing ingredients of herbal origin.

Keywords: Chemical whitening paste, herbal whitening paste, teeth whitening

Introduction

The simplest and most common oral hygiene measure is cleansing of the teeth using toothpaste and toothbrush.^[1,2] It offers basic protection from plaque and dental caries.^[3] Dentifrices carries the active therapeutic agent for basic protection from dental plaque and caries.^[4] In addition to this, whitening pastes have formulations with enhanced physical and chemical cleaning ability to remove as well as prevent extrinsic stains.^[5,6] Teeth whitening can be achieved either by professional application or can be self-administered by the use of commercially available products such as toothpaste, mouthwashes, whitening pens, whitening strips and whitening trays; among these, use of whitening toothpaste is the

most popular technique. Basically, conventional whitening toothpaste contains abrasives and bleaching agents such as silica, pyrophosphates, hydrogen peroxide or carbamide peroxide, which remove the extrinsic stains, thereby lightening the teeth color.^[1,2,7,8] The chemical ingredients in whitening toothpaste cause undesired harmful effects not only on the enamel but also on the soft tissues, resulting in mucosal irritation, ulceration and circumoral dermatitis. It has been

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noted that recently, the general population is leaning more toward herbal products as they propagate to be chemical free; hence, free of harmful side effects and their efficacy is due to their anti-inflammatory, antimicrobial, astringent, antidiabetic, antifungal, analgesics and antiseptic properties.^[9] This has resulted in a steep increase in various herbal products in the market including whitening toothpaste. Whitening ingredient in toothpaste containing ingredients of herbal origin is papaya (papain enzyme), menthol, meswak, clove, salt, citrus fruits etc. Thus, the study focused to investigate the effect of commercially available chemical teeth whitening toothpaste and teeth whitening toothpaste containing ingredients of herbal origin on the shade of human enamel as well as its surface morphology.

Materials and Methods

The current *in vitro* non randomized open labeled pilot study was carried out for 14 days. Ethical clearance was obtained from the institutional ethics committee. Premolars extracted for orthodontic purpose without any crack or decay were selected for this study. Whereas carious teeth, teeth extracted other than for orthodontic purpose and teeth other than premolars were excluded. Twenty samples were taken and grouped into two groups of 10 each. Teeth in group A were treated with conventional chemical toothpaste and teeth in group B (the ingredients of these paste are given in annexure 1 and 2 respectively) were treated with toothpaste containing ingredients of herbal origin. All the selected premolars in this study were checked for shade using Vita 3D shade guide and were observed under a stereomicroscope for surface morphology before the procedure. The preprocedure records obtained were tabulated. The teeth were stored in distilled water throughout the study. Each section was cleansed twice daily for 1 min with the specified toothpaste for both the groups with the help of soft bristle toothbrush, then cleansed with tap water and stored again in the same solution. This procedure was continued daily till the end of the study. After 14 days, the teeth were again examined for the shade and surface morphology using Vita 3D shade guide and stereo microscope and were tabulated [Figures 1-4]. Change in the tooth shade was scored on a scale from 0 to 1. Similarly, change in surface morphology was also scored on a scale from 0 to 1. The scores of each group were tabulated and compared.

Results

The changes in the surface morphology and shade of enamel in group A and group B were noted as 'yes' for the presence and 'no' for the absence and were scored numerically as 1 = yes and 0 = no. The scores obtained were entered into excel sheets and subjected for statistical analysis using student *t*-test SPSS package 18 (SPSS Inc. Released 2009, PASW statistics for windows, version 18.0. Chicago: SPSS Inc.).

Table 1 depicts the surface morphology of the 20 teeth in group A and group B. Group A showed more changes in

surface morphology than group B, i.e., 4/10 in group A and 2/10 in group B. Unpaired "*t*"-test was run and the *P* value was 0.3544 and results were not statistically significant as shown in Table 2. Table 3 shows pre and post-procedure

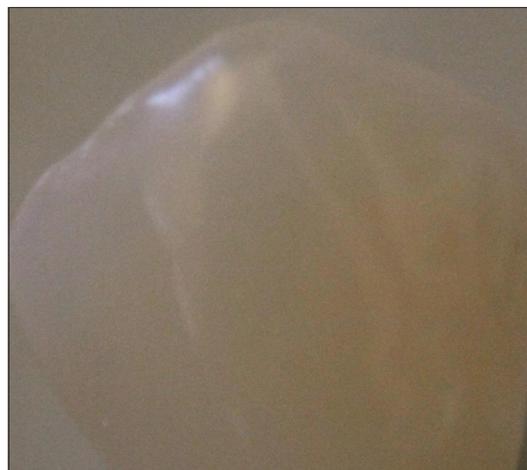


Figure 1: Surface of enamel morphology in Group A before the procedure



Figure 2: Surface of enamel morphology in Group A after the procedure



Figure 3: Shade of enamel surface in Group B before the procedure

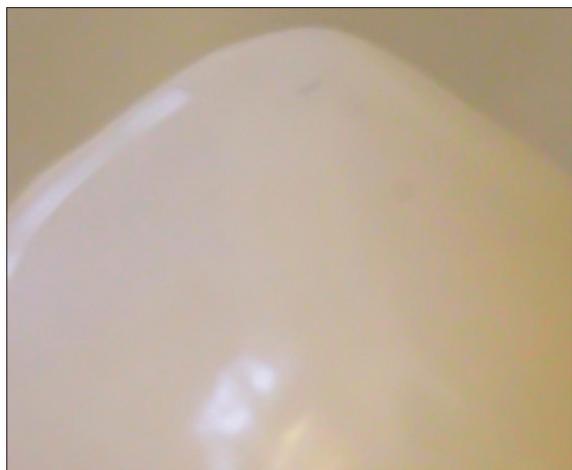


Figure 4: Shade of enamel surface in group B after the procedure

shades of each tooth. Of the 10 teeth, six teeth showed lightening of tooth in group A and only 4/10 in group B showed lightening. The *P* value was found as 0.1923, which was not statistically significant as shown in table 4. Conventional chemical whitening toothpaste showed better whitening of teeth than the toothpaste containing ingredients of herbal origin, whereas the surface irregularities increased on the surface of the enamel with chemical whitening toothpaste when compared with toothpaste containing ingredients of herbal origin.

Discussion

The universal method of cleansing teeth till date is achieved with the efficient use of dentifrice and toothbrush. Dentifrice contains various therapeutic agents and thus is the most common and simple method to maintain oral hygiene.^[8] The ingredients in dentifrice act on dental plaque thereby preventing dental caries and gingivitis.^[9] In addition to mechanical cleansing, whitening toothpaste offers removal of stain and discolorations. Its use in general population is gaining popularity as it can be self-administered and cost-effective, consumes less time and reduces visits to a dental clinic. Hence, there are varieties of commercially available whitening toothpaste available in the market. In 2005, Joiner *et al.* showed that whitening toothpaste makes no significant wear on the enamel and dentin.^[1] However, Zimmerman *et al.* reported that whitening treatments could change the mechanical properties of the enamel.^[1] Literature of Joiner and Terezhalmly shows conflicting results on the efficiency of whitening toothpaste. However, in 2007, Terezhalmly *et al.* concluded that there is no significant difference between the efficacies of different whitening toothpastes in terms of removal of extrinsic stain.^[1] However, the chemicals used in the commercial pastes have known to cause undesirable side effects such as irritation, allergies and mucosal ulceration.

Recently, there is an upsurge of herbal products for the treatment and prevention of various diseases including oral diseases. There is public perception that side effects are

Table 1: Surface morphology of enamel in group A and group B (pre- and post-procedure) score yes=1; no=0

Tooth number	Group A	Score	Group B	Score
1	Yes	1	No	0
2	Yes	1	No	0
3	No	0	No	0
4	Yes	1	Yes	1
5	No	0	No	0
6	No	0	Yes	1
7	No	0	No	0
8	No	0	No	0
9	Yes	1	No	0
10	No	0	No	0

Table 2: Unpaired student *t*-test for surface morphology of enamel

Group	Group A	Group B
Mean	0.4000	0.2000
SD	0.5160	0.4200
SEM	0.1631	0.1328
Sample size (<i>n</i>)	10	10

P=0.3544 (statistically not significant). SD: Standard deviation, SEM: Standard error of mean

Table 3: The shade of enamel in group A and group B (pre- and post-procedure) score yes=1; no=0

Tooth number	Group A		Score	Group B		Score
	Pre	Post		Pre	Post	
1	2M-3	2M-2	1	0M-2	0M-2	0
2	3L-2.5	3L-1.5	1	2R-2.5	2R-1.5	1
3	3L-2.5	3L-1.5	1	0M-2	0M-2	0
4	3L-2.5	3L-1.5	1	2M-3	2M-2	1
5	2M-2	2M-2	0	1M-1	1M-1	0
6	2R-1.5	2R-1.5	0	2R-2.5	2R-1.5	1
7	0M-1	0M-1	0	2R-2.5	2R-1.5	1
8	2M-2	2M-1	1	0M-2	0M-2	0
9	0M-3	0M-2	1	2R-2.5	2R-2.5	0
10	3M-3	3M-2	1	2M-3	2M-3	0

Table 4: Unpaired student *t*-test for comparison shade of enamel

Group	Group A	Group B
Mean	0.7000	0.4000
SD	0.4800	0.5100
SEM	0.1518	0.1613
Sample size (<i>n</i>)	10	10

P=0.1923 (statistically not significant). SD: Standard deviation, SEM: Standard error of mean

minimized or prevented totally when natural ingredients in herbal toothpaste are used in place of synthetic chemicals. This has resulted in increased preference for toothpaste containing herbal ingredients by general population leading to a variety of

toothpastes containing ingredients of herbal origin available in the market today. A study by George *et al.* in 2009 has shown that the efficacy of the herbal ingredients proprietary toothpaste is as effective as the conventionally formulated dentifrice in the control of plaque and gingivitis.^[10]

The chemicals used to achieve bleaching effects in toothpaste are hydrogen peroxide and carbamide peroxide in varying concentrations. However, their use is associated with roughening of enamel surface with cervical root resorption, leading to sensitivity.^[11]

These adverse effects of chemicals can be minimized or avoided when substituted with herbal products which offer teeth whitening without damage to the enamel.

Thus, present pilot study was an attempt to check the efficacy of tooth whitening toothpaste containing ingredients of herbal origin as against synthetic chemical whitening toothpaste.

Efficacy of the chemical whitening toothpaste and herbal whitening toothpaste by assessing the enamel shade using a vita-D shade guide and surface irregularities were evaluated using stereomicroscope before and after completion of the study.

In this study lightening of enamel shade was found to be increased in teeth which were treated with conventional chemical toothpaste than toothpaste containing ingredients of herbal origin. However, it was not statistically significant. Nevertheless the surface irregularities on enamel surface were also found more in teeth which were treated with chemical toothpaste than toothpaste containing herbal ingredients and there was no statistical significance along both groups. Brinda *et al.*, 2015 in the past have compared the efficacy of herbal based whitening toothpaste against professional prescribed bleaching agent and found the efficacy of the effects on enamel surface similar in both. They also emphasized that *in vitro* changes may differ from *in vivo* changes and thus contribute to changes in the micromorphology of enamel.^[11] This is true that as changes in the enamel *in vivo* is governed by the fact that salivary pH plays a major role in determining the movement of calcium and phosphorus ions in and out of the enamel surface. Khairnar *et al.* in 2017 noticed that salivary pH increased immediately after brushing with herbal toothpaste. They correlated the increase in salivary pH to increased salivary stimulation produced by salivary stimulants such as cinnamon, licorice, *Nimba* and *Pilu* etc., in toothpaste containing ingredients of herbal origin used in their study. It is a well-known fact that decrease in pH favors mineral loss from enamel surface leading to surface irregularities.^[12] However, in this study pH was not evaluated the as it was an *in vitro* study.

A variety of other herbal products offer whitening effect of teeth and are enumerated below with their mechanism of action:

- Strawberries and apples contain malic acid which is a natural enamel whitener. It also increases saliva production and thereby exerting the anticariogenic property.
- Celery, carrots and sesame seeds have high fiber content and act as mild abrasive which scrubs and removes surface stains effectively.
- Pineapple and orange contain an enzyme known as bromelain which removes superficial stains and also reduces plaque buildup.
- Papaya contains enzyme papain which is more like bromelain and removes superficial stains and reduces plaque buildup. Papain enzyme is found more in unripe papaya than ripe papaya.
- Dairy products such as milk, cheese and yogurt contain lactic acid which is a natural enamel whitener and also increases the production of saliva.
- Kiwifruit contains actinidin which removes surface stains on enamel.
- Lemon extract and peel contain citric acid which bleaches the stains on enamel. It also has antibacterial properties.
- Banana peel is rich in potassium, magnesium and manganese which are absorbed over teeth surface making them appear white.
- Rock salt acts as a mild abrasive and removes superficial stains. They increase the pH of the saliva thereby exerting antibacterial properties.
- Activated charcoal is negatively charged and binds to the positively charged plaque on tooth surface and is thus absorbed over tooth surface whitening it.

Conclusion

In this 14-day *in vitro* study, the toothpaste containing ingredients of herbal origin provided similar whitening effects to that of conventional chemical whitening toothpaste with less surface changes to the enamel. In spite of surge in availability of numerous proprietary herbal whitening toothpaste, there is dearth of data regarding their efficacy hence it was not possible to further assess and correlate the findings of the study. Increase in sample size, duration of the study and increase time of exposure may help achieve statistically significant results.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Khamverdi Z, Kasraie Sh, Rezaei-Soufi L, Jebeli S. Comparison of the effects of two whitening toothpastes on microhardness of the enamel and a microhybride composite resin: An *in vitro* study. *J Dent (Tehran)* 2010;7:139-45.
2. Nainan MT, Balan AK, Sharma R, Thomas SS, Deveerappa SB. The comparison of the effects of different whitening toothpastes on the micro hardness of a nano hybrid composite resin. *J Conserv Dent* 2014;17:550-4.
3. Watanabe MM, Rodrigues JA, Marchi GM, Ambrosano GM. *In vitro* cariostatic effect of whitening toothpastes in human dental enamel-microhardness evaluation. *Quintessence Int* 2005;36:467-73.
4. Alves KM, Pessan JP, Buzalaf MA, Delbem AC. Short communication:

- In vitro* evaluation of the abrasiveness of acidic dentifrices. Eur Arch Paediatr Dent 2009;10 Suppl 1:43-5.
5. Ferreira MC, Ramos-Jorge ML, Delbem AC, Vieirac Rde S. Effect of toothpastes with different abrasives on eroded human enamel: An *in situ/ex vivo* study. Open Dent J 2013;7:132-9.
 6. Joiner A, Luo W. Tooth colour and whiteness: A review. J Dent 2017;67S: S3-10.
 7. Tao D, Smith RN, Zhang Q, Sun JN, Philpotts CJ, Ricketts SR, *et al.* Tooth whitening evaluation of blue covarine containing toothpastes. J Dent 2017;67S: S20-4.
 8. Axelsson P, Odont D. Concept and practice of plaque-control. Pediatr Dent 1981;3:101-13.
 9. Khairnar MR, Dodamani AS, Karibasappa GN, Naik RG, Deshmukh MA. Efficacy of herbal toothpastes on salivary pH and salivary glucose – A preliminary study. J Ayurveda Integr Med 2017;8:3-6.
 10. George J, Hegde S, Rajesh KS, Kumar A. The efficacy of a herbal-based toothpaste in the control of plaque and gingivitis: A clinico-biochemical study. Indian J Dent Res 2009;20:480-2.
 11. Brinda B, Madan Kumar PD, Mohammed J. Effect of an indigenously available herbal tooth whitening system on human enamel microhardness and micromorphology-an *in-vitro* study. Sch J Dent Sci 2015;2:254-8.
 12. Benjakul P, Chuenarrom C. Association of dental enamel loss with the pH and titratable acidity of beverages. Journal of Dental Sciences (2011) 6, 129e133.

Annexure 1: Ingredients of commercially available chemical teeth whitening paste (Colgate Visible White Tooth paste)

Silica
Sorbitol
Glycerine
Polyethylene glycol
Sodium tripolyphosphate
Tetra potassium pyrophosphate
Sodium lauryl sulphate
Flavor
Cocamido propyl betadine
Sodium carboxy methyl cellulose
Sodium saccharin
Sodium fluoride
Xanthan
Sodium hydroxide
Blue poly 50
Titanium dioxide in aqueous base

Annexure 2: Ingredients of commercially available teeth whitening paste containing ingredients of herbal origin (Himalaya Sparkling white tooth paste)

Aqua
Bromelain (enzyme in pineapple juice)
Ceylanicum bark oil (Cinnamon)
Cinnamomum (Cinnamon)
Citric acid
Eugenia Caryophyllus bud oil (Clove oil)
Flavor
Glycerine
Hydrated silica
Menthol
Meswak
Papain (papaya proteinase)
Potassium benzoate
Potassium sorbate
Prunus Amygdalus Dulcis (almond) shell extract
Salvadora Persica stem extract (Meswak)
Silica
Sodium citrate
Sodium lauryl sulphate
Sodium saccharin
Sorbitol
Thymol
Titanium dioxide
Xanthan gum