

Efficacy of in-office and Home Bleaching Materials on Teeth Stained by Herbal Immune Boosters: *In-Vitro Study*

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Abstract

Aim: The purpose of this study is to evaluate and contrast the bleaching effectiveness of at-home and in-office bleaching methods on the most popular herbal items.

Method: In this investigation; human premolar teeth that had been removed were submerged in saline; lemon; orange; cinnamon; curcuma; myrrh; and ginger; among other liquids. Seventy removed premolars; 10 in each of the seven groups; were used in this in vitro investigation. With the exception of discolored and carious teeth; the samples utilized in this investigation were removed human premolar teeth with undamaged buccal or lingual/palatal surfaces. To ensure that all seven groups' teeth had the right coloring effect; the teeth were submerged for 14 days.

Results: Across the in-office bleaching group; the highest shade improvement was in Curcuma group with a mean change in shade of 8.4; while the lowest was in orange-stained group with a mean change of 1.4. The highest shade changes among both types of bleaching and across all types of stains was in Curcuma in office bleached group while the lowest was cinnamon home bleached group. Cycles 2 and 3 showed less shade improvement with a total change of 11.4 for each of the cycles.

Conclusion: The amount of color improvement differs depending on the type of stain; curcuma stains exhibit the most improvement because of their original blackness; whilst cinnamon stains were difficult to remove because of their little discolouration

Keywords: Efficacy; Bleaching Materials; Herbal Immune Boosters; *In-Vitro*

1. Introduction

Nowadays; dental esthetics is a major concern to a large number of the population; which can be affected by many factors such as teeth shade; shape and health (1;2). One factor that can be easily affected by patient practices is teeth shade. Lighter shades or higher teeth value are generally conceded more attractive. A study by Newton et al; found that

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social perceptions were consistently lowest for the least white dental condition and highest for the whitened condition; with the natural condition ranking in the middle (3).

Tooth color is affected by both its inherent shade and any external stains that can develop on the surface (4). One effective and minimally invasive method for whitening teeth is dental bleaching; which can be performed either in-office or at home using various concentrations of hydrogen peroxide or carbamide peroxide (5;6). Hydrogen peroxide acts as an oxidizing agent; generating reactive free radicals ($H_2O + O_2$) that are essential for the teeth whitening process (6). In an alkaline environment; it promotes the formation of the highly reactive perhydroxyl radical (HO_2); enhancing the bleaching effect (6). Additionally; carbamide peroxide decomposes into hydrogen peroxide and urea which contributes to the whitening action. This breakdown ensures that both compounds are effective options for dental bleaching treatment (7).

A controversy rises regarding bleaching techniques. Some researchers claim that home bleaching yields better results with less side effects than in-office treatments (8;9). On the other hand; other studies suggest that both methods achieve similar immediate and long-term effects (10;11)

Teeth shade can be affected by home remedies that are used to boost the immune system. It was found that almost 70% of the Saudi population have used herbal products during the period of December 2020 to April 2021 (12). The most commonly used herbal remedies were orange; lemon; curcuma; myrrh ginger and cinnamon (12). Alhazmi et al. conducted a study to measure the effects of such home remedies to teeth shade and found that curcuma; lemon and orange had the highest staining effect of teeth (13).

Since the use of herbal product is high in the Saudi population; this study aims to assess and compare the bleaching efficacy of in-office and home bleaching techniques on the most used herbal products.

2. Material and methods

This study was performed on extracted human premolar teeth immersed in different solutions; lemon; orange; cinnamon; curcuma; myrrh; ginger and saline. Research approval with reference number: NRC21R/153/03 by King Abdullah International Medical Research Center Institutional Review Board.

This in-vitro study was conducted using seventy extracted premolars divided into seven groups; ten teeth per group. The samples used in this study were extracted human premolar teeth with intact buccal or lingual/palatal surfaces; excluding discoloured and carious teeth. Immersion of teeth lasted for 14 days to achieve proper staining effect on teeth for all seven groups. Reading and recording of shade was taken after staining using VITA Easy shade Advance 4.0 as a baseline. Each group divided into two subgroups (N=5) to be bleached in office (WHITEsmile Light Whiteneing AC 32% HP) and home (WHITEsmile Home Whiteneing 35% CP) following manufacturer instructions. Bleaching of both techniques was done for 3 cycles and shade was measured after every cycle using VITA Easyshade Advance 4.0. The difference between readings was interpreted in VITA classical shade guide.

The collected data were arranged; organized and statistically analyzed using SPSS software (Statistical Package for the Social Sciences; version 26; SPSS Inc. Chicago; IL; USA). Comparison between more than two means of parametric data F-value of the ANOVA test was calculated; To detect the Significant used Post Hoc (Tukey HSD test). Significance was adopted at $P < 0.05$ for interpretation of results of tests of significance.

3. Results

Table 1 shows the mean of total change in shade of in-office and home bleaching groups after 3 cycles of bleaching. Across the in-office bleaching group; the highest shade improvement was in Curcuma group with a mean change in shade of 8.4; while the lowest was in orange-stained group with a mean change of 1.4

Looking at the home bleaching group; it can be noticed that the highest shade improvement was in the ginger group with shade change of 4. On the other hand; the lowest was in the cinnamon group with a change of 0.8

The highest shade changes among both types of bleaching and across all types of stains was in Curcuma in office bleached group while the lowest was cinnamon home bleached group.

Additionally; the table shows that most change in the shade was after cycle 1 for both in-office and home bleaching groups. Cycles 2 and 3 showed less shade improvement with a total change of 11.4 for each of the cycles. Looking at the cinnamon group; most shade change was noticed in cycle 3.

Table 1 Mean change in shade after each cycle for home and in office bleaching. H: Home. O: Office

	Cycle 1	Cycle 2	Cycle 3	Total
Orange H	1.4	0	0	1.4
Orange O	0.2	1	0.2	1.4
Lemon H	0.8	0.2	1.2	2.2
Lemon O	1.8	1.8	0	3.6
Curcuma H	0.6	0.2	0.6	2.4
Curcuma O	5.4	0.8	2.2	8.4
Myrrh H	2.4	0	0.4	2.8
Myrrh O	1.8	1.2	1.6	4.6
Ginger H	2.8	0	1.2	4
Ginger O	1	1.6	1.4	3.8
Cinnamon H	0	0	0.8	0.8
Cinnamon O	0.2	1.2	1.4	2.8
Control H	1.6	1.6	0	3.2
Control O	0.2	1.8	0.4	2.4
Total	20.2	11.4	11.4	43.8

Table 2 ANOVA test for total shade change among home and office bleaching with different types of stain. H: Home. O: Office

Group	P-value
<i>Orange H vs O</i>	0.513
<i>Lemon H vs O</i>	0.448
<i>Curcuma H vs O</i>	0.24
<i>Myrrh H vs O</i>	0.426
<i>Ginger H vs O</i>	0.668
<i>Cinnamon H vs O</i>	0.071
<i>Control H vs O</i>	0.361

ANOVA test was performed to test clinical significance between home and in-office bleaching. Among all types of stains; both home and office bleaching performed similarly after each cycle and as total shade change (Table 2).

4. Discussion

In recent years; there has been a growing demand for improved aesthetics; with dental aesthetics playing a significant role in overall appearance (1). Teeth bleaching is recognized as an effective and minimally invasive method for enhancing dental esthetics (11). However; a substantial portion of the Saudi population uses herbal products to boost

their immune systems; which can unfortunately lead to teeth staining (12;13). This experimental study aimed to evaluate and compare the effectiveness of in-office and at-home bleaching techniques in relation to the most commonly used herbal products. In this study; it was found that both home and in-office bleaching showed comparable bleaching effect. This finding comes in agreement with a systematic review and meta-analysis conducted by de Geus et al. which concluded that there was no difference between the two techniques (11). This can be explained by the fact that bleaching effectiveness is influenced by both the duration of application and the concentration of the bleaching agent; as longer exposure and higher concentrations typically enhance the whitening effect (14).

Another finding in this study was that the Curcuma-stained group demonstrated the most significant shade improvement across all stain types; likely due to starting with the darkest shade. This observation aligns with findings from Ermis et al.; who noted that the effectiveness of bleaching systems varies with the severity of discoloration (15). Their study indicated that darker teeth exhibit greater color changes; as reflected in the DE1 values. Darker teeth typically have lower L* values (indicating darkness) and higher a* and b* values (representing red and yellow tones); which enhances the contrast between the original and bleached color; making the changes more noticeable after treatment (15). The orange-stained group demonstrated one of the lowest mean values of color improvement; which can be attributed to the acidity of orange. This acidity may have altered the surface topography of the teeth; making it more challenging for the bleaching agents to effectively penetrate and achieve noticeable shade improvement. As a result; the structural changes to the enamel could hinder the bleaching process; limiting the overall effectiveness of the treatment for this type of stain (16).

The cinnamon-stained group exhibited the lowest color improvement after bleaching; which may be attributed to either minimal initial discoloration or the inherent difficulty in removing this particular type of stain; or possibly a combination of both factors. Additionally; there is a notable lack of literature addressing the specific challenges associated with cinnamon staining; highlighting a gap in our understanding of its bleaching efficacy.

While the results of this study offer valuable insights into the effects of bleaching on various types of stains; they may not fully reflect in vivo conditions; where saliva continuously interacts with tooth surfaces. Therefore; further research is essential to explore the implications of this interaction and to better understand how it influences the efficacy of bleaching treatments in a natural environment.

5. Conclusion

In conclusion; this study highlights the effectiveness of both in-office and home bleaching techniques in improving dental aesthetics; particularly in the context of commonly used herbal products that can cause staining. The findings indicate that the degree of color improvement varies by stain type; with Curcuma stains showing the most significant enhancement due to their initial darkness; while cinnamon stains presented challenges due to minimal discoloration and potential removal difficulties. Additionally; the acidity of orange may impede the bleaching process by altering enamel surface characteristics. Overall; the results underscore the importance of considering the type of stain when selecting a bleaching method and indicate a need for further research to better understand the challenges associated with specific stains; such as those from cinnamon. This knowledge will contribute to optimizing whitening strategies and improving outcomes for patients seeking enhanced dental aesthetics.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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