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RESEARCH ARTICLE

THE EFFECT OF TEETH WHITENING PRODUCED BY VARIOUS NATURAL FOOD SUBSTANCES: AN *IN-VITRO* STUDY

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ABSTRACT

Introduction: Process of removing the stains from tooth is termed as bleaching. Substance used for bleaching are termed as bleaching agents. Various bleaching agents (artificial and natural) are readily available in the market.

Aim: Present study was aimed in evaluating the efficacy of lemon, apple, carrot, baking soda in the whitening of the extracted natural teeth that are stained with tea decoction.

Material and method: Teeth were stained with tea decoction and bleaching was done using natural food substances (lemon, carrot, apple, baking soda) in two different methods (direct application, soaking).

Result: Bleaching efficacy of lemon was superior in both the methods when compared with baking soda, carrot and apple.

Conclusion: Because of superior bleaching property of lemon, it can be used as an active ingredient in day to day commodities like tooth paste or other tooth cleaning products after standardisation.

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INTRODUCTION

Whitening or bleaching of teeth is a procedure that removes the stains and the substances that bring about bleaching are known as bleaching agents. Bleaching is done to enhance the overall aesthetic look of the patient which eventually boosts their self-esteem. Social and psychological research has shown that appearance is one of the non-verbal communications that play an important role in determining the quality of our interactions with other person (Goldstein, 1993). The tooth whitening or bleaching has been grouped into 2 main categories: Professional and natural methods. The professional methods are in turn classified into: In office application (Professionally applied), professionally prescribed and over-the-counter bleaching. The professional methods of bleaching revolve around using peroxide based agents like hydrogen peroxide and carbamide peroxide (Craig and Supeene, 1999).

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Owing to the harmful effects of the chemical agents, the use and promotion of natural substances for teeth whitening are popular in the recent times. Effectiveness of the natural agents has been comparable to that of the professionally applied agents with the added advantage of being cost effective and biologically safe (Brinda *et al.,* 2015). Although the professionally applied bleaching agents have established to be effective, concerns regarding the safety of these have always remained doubtful. Hence, the natural agents get their upper hand and paves way for further research (Yeh *et al.,* 2005). The contemplation of this study is to see the efficacy of natural food products like fruits, vegetables in the bleaching of stained teeth.

MATERIALS AND METHODS

The objective of this in-vitro study was to evaluate the efficacy of lemon, apple, carrot, baking soda in the whitening of the extracted natural teeth that are stained with tea decoction. Permanent anterior teeth were collected for the study. Teeth

with dental caries, developmental anomaly, fracture and intra-coronal discolouration were excluded. 108 selected teeth were washed with 2% hydrogen peroxide followed by 2 days of soaking in normal saline and then it was stained with tea decoction. This staining was brought about by immersing the teeth in this beverage for 10 days. The tea extract was freshly prepared and changed every day (Figure 1). 6 teeth were soaked in hydrogen peroxide for 60 seconds and considered as positive control. 6 teeth were kept in Hank's balanced salt solution and considered as negative control. The remaining 96 teeth were divided into 4 groups, namely A, B, C and D, each containing 24 numbers. Each group (A, B, C, D) were treated with the four chosen variables lemon, apple, carrot and baking soda respectively. The 4 groups (24 teeth each) were in-turn divided into 2 sets, Set 1 (direct application) and Set 2 (soaking), containing 12 teeth in each set. Among the 2 sets, teeth from 1st set was directly rubbed with the respective variable for 60 seconds and the teeth from 2nd Set were soaked in the extract derived out of each variable respectively (Figure 2).

Figure 1. Staining of the teeth using tea decoction

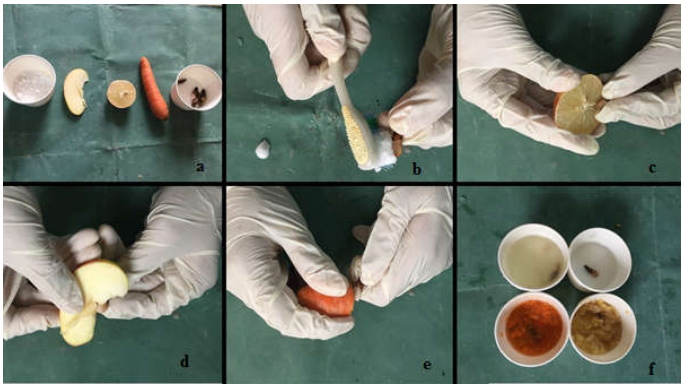

Figure 2. Different types of bleaching done (Direct b, c, d, e & soaking f)

The extract for 2nd set was standardized as follows:

- Lemon-each tooth was soaked in 5ml of 1:2 concentration of lemon juice for 6 hours.
- Apple - each tooth was soaked in 5ml of extract obtained from mashed apple for 6 hours.
- Carrot- each teeth was soaked in 5ml of extract obtained from mashed carrot for 6 hours.
- Baking soda- Each teeth were soaked into an extract derived out of 3 teaspoon of baking soda, 2 tea spoon of glycerine for 6 hours. (Figure 2) respectively.

The shade of the teeth was analysed using Digital shade analyser, before and after bleaching. The data was subjected to WILCOXON signed ranks test to find the significance of results.

RESULTS

The results revealed that lemon, apple, carrot and baking soda showed statistically significant results of bleaching when applied directly. Lemon and baking soda showed statistically significant results while soaking, whereas, apple and carrot showed insignificant results while soaking. Overall, lemon showed the highest significance followed by baking soda. Apple and carrot showed significance only when it is applied directly and was comparatively less significant than the former (Table 1).

Table 1. Efficacy of different bleaching variables using Wilcoxon signed rank test

Bleaching agent		N	Mean + standard deviation		Z value	P Value
			Before	After		
Lemon	Direct	12	10.28 ± 3.088	8.42± 2.999	-3.093	0.002
	Soaking	12	10.67± 3.114	7± 2.763	-3.071	0.002
Apple	Direct	12	9.2± 3.261	7.58± 3.630	-2.555	0.011
	Soaking	12	10.5± 2.236	10.0± 2.174	-1.857	0.063
Carrot	Direct	12	12.83± 1.992	11.67± 0.888	-2.070	0.038
	Soaking	12	12.42± 1.730	12.25± 1.357	-0.743	0.458
Baking soda	Direct	12	9.33± 3.939	6.83± 2.887	-2.953	0.003
	Soaking	12	10.00± 3.191	5.83± 2.525	-3.068	1.000

DISCUSSION

The touch of aesthetics into dentistry has grown to be one of the prime factors. Meeting up to the patients' expectations of a beautiful smile has pushed dentists to strive more to discover, learn and invent. One such important procedure in the ladder to a beautiful smile is teeth whitening. The colour of the teeth is influenced by various factors. It could be influenced from within the tooth (intrinsic) or from its external surface (extrinsic). The intrinsic stains are caused due to chromogenic substances produced or incorporated into the tooth commonly through the dental pulp before or after eruption. The extrinsic stains are those deposited on the outer surface of the tooth over time (Watts and Addy, 2001; Joiner, 2004). However, stains vary in extent, distribution, colour and tenacity. Identifying the cause of the stain is essential before proceeding with further treatment. Mild stains could be removed by scaling followed by pumice polishing. The tougher stains require bleaching (Hattab *et al.,* 1999). Professional bleaching is commonly done using peroxide based agents. There has been tremendous evolution of this material. Earlier, first generation materials used were in liquid form. Owing to its disadvantages of lower concentration, not remaining in trays for too long, the second generation of gel form was used. This increased the contact time with the tooth and lessens the chance of soft tissue contact. The third generation differed in vehicle and colour. The mechanism of action is that the oxidation of the stains breaks it down into smaller less noticeable molecules. To hasten up the process light activated systems have also been found (Mithra *et al.,* 2012). Although the peroxide based methods of bleaching have been commonly practiced and proven effective, investigators continue to report adverse

effects on hard tissue, soft tissue, and restorative materials (Attin *et al.,* 2004; Dahl and Pallesen, 2003). The common adverse effects of bleaching techniques are transient sensitivity and oral irritation or ulceration and sometimes even affects the vitality of the tooth. To overcome these adverse effects, the use of organic and natural products has been encouraged and of late there is an emerging trend towards its use at a larger scale. In our study, we divided the natural teeth equally among the natural bleaching products to be applied directly or indirectly. Apart from this we also had positive and negative controls. Keeping in mind, citric acid content in lime, tartaric acid present abundantly in apple, carotenoids in carrot and usage of baking soda widely for various reasons, this study was done to find out bleaching efficacy of the above variable. We found that lemon showed the highest significance in bleaching. This could be attributed mainly to its citric acid content. Lemon juice and lime juice are rich sources of citric acid, containing 1.44 and 1.38 g/oz, respectively. Lemon was the only variable which showed equal significance by direct application and soaking. The reason for this result could be because of the same consistency of being liquid. The diet derived citric acid contact with the tooth may also cause bleaching to some extent with respect to its concentration (Penniston *et al.,* 2008).

The variable that showed second highest significance was baking soda (direct application). But it did not show any significance while soaking. Baking Soda is a naturally occurring substance and is basic in nature. It helps in maintaining the pH balance and thus acts as a buffer. Baking Soda is made from soda ash, also known as sodium bicarbonate. The soda ash can be manufactured by passing carbon dioxide and ammonia through a concentrated solution of sodium chloride (table salt). Baking soda is commonly used in toothpastes for its abrasivity, which leads to stain removal. According to Kleber CJ et al, sodium bicarbonate can remove the extrinsic stains, but are not capable to clean deeper, intrinsic stains (Kleber, *et al.,* 1997). Baking soda has also been proven to be effective when used in combination with hydrogen peroxide. According to Bhenya Ottoni Toste *et al,* the decomposition of residual hydrogen peroxide was by enhanced by almost 6 folds by the presence of baking soda (Tostes *et al.,* 2013). From the present study we can come to a conclusion that efficacy of sodium bicarbonate is mainly because of its abrasive nature rather than its chemical composition. The variable to show the third highest significance was apple (direct application). Apple contains acids like tartaric acid, malic acid, folic acid. Like baking soda, apple showed significance only when applied directly. This again can be due to the added fibre content in apple which also acted like an abrasive. According to Zheng LW et al, apple vinegar is effective on in vitro tooth bleaching (Zheng *et al.,* 2014). Apple did not show significance on soaking. The reason may be because the mashed apple was not the right vehicle for the agents to bleach well. Proper extract can show positive results. The fourth variable to show significance was carrot (direct). Carrot contains nitrate, nitrite, glutamic acid, free amino acids and trace amounts of caffeic acid, lactic acid and glycolic acid. Which specific content of carrot brings about bleaching is not exactly known. But the efficacy of carrot could be because of its rich and varied acid content. However carrot on soaking showed least significance when compared to other 3 variables (Sharma *et al.,* 2012).

Conclusion

It was compared as to which food substance can be used to effectively whiten teeth. The hypothecation that food substances can be effective was proved to be right. Hence, these agents can be used as an active ingredient in day to day commodities like tooth paste or other tooth cleaning products after standardisation. This study can act as tool to promote the use of natural food substances for bleaching for a greener environment and can pave way for further research with various other agents.

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