

# The Influence of Different Whitening Toothpastes on Tooth Colour



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## Abstract

*1. Background/Objectives:* Nowadays, when aesthetic appeal holds unprecedented significance, a paramount aspect is a radiant, healthy smile. The purpose of the study was to demonstrate the influence of different whitening toothpastes on tooth-colour. *2. Methods:* 25 caries-free premolars, extracted for periodontal reasons, after signing informed consent, were randomly divided in 5 groups after soaking them into. Using a spectrophotometer the cervical tooth colour was measured. Each group was soaked into espresso coffee, for 72 hours. Each group was underwent a cleaning procedure using 3 different kinds of whitening toothpastes, professional airflow and sodium bicarbonate powder. *3. Results:* All sample teeth lightened up by at least one nuance. Group 1 has stained from the initial color 2 shades up. After brushing with Colgate Advanced white the color has improved one shade down. Group 2 was brushed with Colgate Max. improving the initial color by 1 shade. Group 3 has gained approximately its initial color with the Splat extreme white toothpaste. Groups 4 and 5 were not treated with conventional toothpaste but with sodium bicarbonate and airflow. Group 4 stained up 2 shades and improved one shade after brushing with sodium bicarbonate. *4. Conclusion:* All whitening substances had a direct whitening effect on the tooth color.

**Keywords:** tooth-whitening, airbrushing, airflow, enamel, spectrophotometer

## INTRODUCTION

Nowadays, in an era where aesthetic appeal holds unprecedented significance, a paramount aspect is a radiant, healthy smile. It frequently stands out as the initial point of attention during conversations. A luminous smile plays a pivotal role in crafting a favourable first impression, thereby exerting a profound influence on one's social interactions. The outward appearance serves as a symbolic introduction to society. Numerous methods can be employed to fulfil this desire. Among the most prevalent options are whitening toothpastes, which aid in brightening the shade of teeth and eliminating discolouration. Their popularity stems from their widespread availability, user-friendly nature, easy accessibility, and affordability. [1] Most of the whitening toothpastes make use of mild abrasive particles that help to polish the enamel surface. [2] They remove surface stains caused by highly pigmented food and drinks like red wine or tea. Habits such as smoking or chewing tobacco can tarnish teeth with frequent use. The fine particles in whitening toothpaste are more delicate compared to those in regular toothpaste, allowing for a gentle removal of surface stains without causing harm to the tooth enamel.

Enamel being the outermost layer of the tooth, serves as a barrier and is a protective component. It is the strongest tissue in the human body, but it is incapable of regenerating. So once it's lost, it cannot rebuild.

Whitening toothpastes have several ways of reacting. As already mentioned, one of the most used processes is the use of abrasives (mechanical mechanism). [2] These small particles work by physically polishing the tooth surface to remove extrinsic stains that make it appear in a brighter shade. [1;2]

Another technique makes use of chemical agents or enzymes that help to break down and dissolve surface stains. Also, some pastes help to prevent stain build-up. The ingredients work by creating a protective barrier on the tooth surface which makes it more difficult for new stains to adhere to the enamel [3].

Tooth whitening through toothpaste is not compatible with everybody and can even worsen the situation. The appearance of the tooth color has multiple factors. It depends on the thickness and the translucency of the enamel, in the case of having thin enamel and then brushing your teeth with abrasive whitening toothpastes, the enamel thins even more through abrasion [3]. The teeth can get even more yellowish and teeth can start to develop sensitivity. Other important factors that influence the color of teeth are genetics, age, lifestyle and general dental health.

### *Aim and objectives*

People from all over the world consider white healthy teeth are desirable and beautiful, making it an important international topic. White teeth are a sign of health and youthfulness and reflect attractiveness. In this study different whitening tooth paste are compared as well as the professional air flow system and the home remedy sodium bicarbonate to see which method has the greatest impact on the tooth appearance.

The purpose of the study is to demonstrate the influence of different whitening toothpastes on the color of extracted teeth.

## MATERIAL AND METHODS

The experimental study shows a comparison between the effectiveness of different whitening tooth pastes and between professional dental hygiene performed by airflow versus the popular home remedy baking powder. The results were evaluated using a

spectrophotometer under natural light. For this study 25 extracted premolars were randomly divided in 5 groups. These caries free teeth were extracted from patients who had to undergo dental extraction due to severe periodontitis and previously gave the informed consent to use the teeth for research purposes. With the help of the spectrophotometer the tooth color was measured on the cervical part of the tooth. The teeth were cut along the long axis with a diamond-coated conical bur, from coronal to apical between the cusps. Both halves of each tooth were placed in espresso coffee (Julius Meinl) for a time of 72 hours. After being stained in coffee, the color was measured again with the spectrophotometer. One half of each stained tooth was selected to conduct the brushing experiment. The contra-angle hand-piece was used for brushing the samples for 30 seconds with the respective whitening medium. Finally, a new measurement was taken with the spectrophotometer under natural light. The teeth have been treated with 3 different kinds of whitening toothpastes (Colgate, splat), professional airflow and sodium bicarbonate powder. Each product was tested on 4 extracted teeth that were previously soaked in espresso coffee, for 72 hours, followed by brushing for 30 seconds. The following products were used for whitening:

1. Colgate Advanced White. Promises whiter teeth in 10 days, (fluoride content 1450ppm). Ingredients: Aqua, hydrated silica, sorbitol, PEG-12, Aroma, Sodium Lauryl sulfate, xanthan gum, potassium hydroxide, cellulose gum, tetrasodium pyrophosphate, phosphoric acid, sodium fluoride, benzyl alcohol, sodium saccharin, sodium bicarbonate, volcanic ash, charcoal powder, limonene, CI 74160

2. Colgate Max White purple reveal (fluoride content 1450ppm). Promises to instantly correct yellow tones effect is temporary. Ingredients: Aqua, Sorbitol, Hydrated Silica, PEG-12, Sodium Lauryl Sulfate, Aroma, Cellulose Gum, Potassium Hydroxide, Tetrasodium, Pyrophosphate, Phosphoric acid, cocamidopropyl betaine, Sodium fluoride, Sodium Saccharin, Xanthan Gum, Hydroxypropyl Methylcellulose, Eugenol, CI 17200, CI 42090, CI 73360, CI 74160.

3. Splat special - extreme white. Promises intensive teeth whitening, protection against tooth decay and effective cleaning and polishing (fluoride content 600ppm). Ingredients: Aqua, Hydrogenated starch hydrolysate, Hydrated silica, Dicalium Phosphate Dihydrate, PEG-8, Sodium Lauryl sulfate, Hydrogenated palm oil, aroma, xanthan gum, zinc citrate, PEG - 200, Sodium methyparaben, Sodium Saccharin, Tetrasodium Glutamate Diacetate, Urea peroxide, Lecithin, PVP, CI 77891, sodium fluoride, CI 73360, Sodium hydroxide, Ananas Sativus Fruit extract, Maltodextrin, Limonene, CI 16255.

4. Sodium Bicarbonate (baking powder). Sodium Bicarbonate ( $\text{NaHCO}_3$ ) is commonly known as baking powder. It has a high solubility, which means an easy penetration through the dental biofilm and can neutralize acids. Additionally, it is known for its abrasiveness which makes it not recommendable.

5. Airflow - the KaVo PROPHYfelx 4. The Kavo Prophyflex is known for its balanced and ergonomically designed handle and its efficiency. The product evenly distributes the airflow powder on the tooth surface, which makes it effective but at the same time is gentle to the enamel, being non-aggressive and protective. Different heads are available on the market for different treatment purposes.

The "before and after" color measurements were compared with a spectrophotometer under natural light. A spectrophotometer is a digital device that establishes colours and shades. In this study the VITA Easyshade V by the German company VITA Zahnfabrik is used. It can be used on natural teeth but also on ceramic restorations. The producer claims that the determination of the tooth shade is precise, reliable and reproducible due to the LED technology. It has an OLED color touch display and offers wireless communication via Bluetooth and using VITA Assist PC software. It is an efficient and easy-to-use device with an

ergonomic design which makes working with this spectrophotometer very enjoyable. (4) The color shade was established with VITA Easyshade V on the dry cervical surface of the tooth.

## RESULTS

After taking into consideration the initial, before and after brushing color results (Table 1), the results can be seen in table 1. All sample teeth lightened up by at least one nuance.

Table 1. Comparison of shades between the procedures

GROUP	INITIAL	STAINED COLOR	BRUSHED
1	A1; A2; A1; B2; B1	A3,5; A4; A3,5; B4; A3,5	A2; A3; A2; B2; B2
2	A3; A2; A4; A3; A3	A3,5; A3; A3,5; A4; A3,5	A2; A1; A3; A2; A1
3	A1; A2; B1; A2; A2; A3	B3; B2; B3; A3; A3,5	A1; A1; A2; A2; A2
4	B2; B1; B2; A2; A3	B3; C4; C4; B3; A3,5	C3; B2; C3; B2; C3
5	B1; A2; B1; B2; A1	B2; A3; B2; C3; A3	A1; A1; A2; B1; A1

Group 1 has stained from the initial color 2 shades up. After brushing with Colgate Advanced white the color has improved one shade down. The toothpaste was not able to regain the initial color. Group 2 was brushed with Colgate Max. white. This toothpaste was able to whiten the initial color by 1 shade. Group 3 has gained approximately its initial color with the Splat extreme white toothpaste.

Groups 4 and 5 were not treated with conventional toothpaste but with sodium bicarbonate and airflow. Group 4 stained up 2 shades and improved one shade after brushing with sodium bicarbonate. This shows how big the impact of coloured food and beverages is, that it is possible to affect the base tooth color in just as little time in which the teeth were kept in coffee. Sodium bicarbonate has been known for many years to be a useful home remedy to whiten teeth, but at the same time, it has a significant impact on tooth health, specifically on its enamel surface. It can lead to tooth hypersensitivity induced by the abrasive particles, which scratch the enamel and open dentinal tubules, making the tooth sensitive. New stains will stick more easily to the surface and make the tooth appear darker. Group 5 was treated with the professional airflow that is used in the dental office. After airbrushing the shades improved one number.

## DISCUSSIONS

A more aesthetically pleasing smile has long been a common aspiration for many patients seeking dental procedures. The color of the teeth is widely regarded as a key determinant of dental attractiveness, especially in the front portion of the upper set of teeth. Tooth discolouration can stem from either extrinsic or intrinsic sources. Intrinsic discolourations arise from endogenous chromogens present within the enamel and dentin, whereas extrinsic discolourations are the result of exogenous chromogens binding to the enamel surfaces [5].

Different techniques have been proposed for the removal of discolourations, including micro-abrasion, macro-abrasion, and bleaching. An optimal whitening solution should effectively eliminate surface deposits and stains while minimizing any adverse effects on the integrity of tooth enamel and restorations. However, studies have shown that toothpastes containing whitening agents and abrasives may lead to elevated levels of calcium release rates and morphological lesions on enamel [6,7]. Furthermore, dental hypersensitivity and enamel demineralization resulting from the low pH of certain bleaching agents have been documented as prevalent side effects of tooth whitening procedures [8-12].

The present study refers only to the tooth color and does not give any information on the abrasiveness. The impact and how much the tooth surface is affected cannot be determined by visual appearance. The Vita Easyshade spectrophotometer utilized in this investigation proves to be a dependable, consistent, and quantitative instrument for evaluating modifications in tooth discoloration under both controlled laboratory settings and real-life scenarios [13]. The magnitude of  $\Delta E$  signifies the comprehensive alteration in color, with thresholds of at least 3.3 being acknowledged as visually discernible and clinically identifiable by the human eye [13].

It is essential to note that the tooth shade does not definitively reflect its actual health and condition. A brighter color does not necessarily equate to better health. Moreover, this study only focuses on specific teeth selected for analysis, making it challenging to evaluate certain parameters due to variations in their initial tooth color, thus presenting a limitation.

Sodium bicarbonate ( $\text{NaHCO}_3$ ) or baking soda is commonly incorporated in toothpaste due to its abrasive properties, which aid in removing stains. Sodium bicarbonate, in the form of a white powder with a pH value of approximately 8, has been found to be effective in whitening teeth. Some researchers suggest that abrasives like silica and sodium bicarbonate can eliminate surface stains but may not penetrate deeper intrinsic stains [14] and other studies noted a visible reduction of inherent discolorations following the utilization of sodium bicarbonate-infused toothpastes during mechanical brushing [5]. It is postulated that the utilization of CPP-ACP toothpastes mitigates the deleterious effects of whitening agents on tooth structure [15-20]. Some investigations posit that mineral compounds containing calcium and phosphate ions are more preferable than fluoride-containing compounds for use in bleaching products. This is due to the fact that fluoride ions tend to precipitate on the enamel surface, thereby obstructing further ion penetration into the subsurface lesion, consequently restricting deeper remineralization [15,21,22]. Interestingly, de Vasconcelos et al. [17] suggested that the gel containing "CPP-ACP" alone demonstrated efficacy in eliminating tooth discoloration. They posited that the remineralizing properties of CPP-ACP result in enhanced lustre and translucency of enamel, thereby contributing to a subtle enhancement in tooth color [17].

## CONCLUSIONS

Within the limitations of the present study, the conclusion that can be drawn is that all whitening substances that have been used have a direct whitening effect on the tooth color. Summarizing, the whitening effect of the toothpastes is only a change in the superficial outer layer of the tooth, which is achieved by mechanical abrasion of stains.

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### *Conflicts of Interest*

The authors declare no conflict of interest.

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