



**COMPARING THE pH OF DIFFERENT TOOTH WHITENING PRODUCTS
RELATED TO THEIR EFFICACY AND SAFETY**

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ABSTRACT

Objective: The present study evaluated pH changes in Various Tooth-Whitening Products because of increasing demand for bleaching.

Methods: 8 commercially available tooth whitening products were chosen based on the availability in Iran and without the prior knowledge of their pH. The experiment has been done in laboratory of Chemistry College of Amirkabir University with the use of pH meter (MEMTROHM 744 Company) .

Results: The pH of all tooth whitening products tested ranged from 2.97 ± 0.02 (acidic) to 7.97 ± 0.01 (basic). The average pH from OTC products ranged from 6 ± 0.02 .the IOB products had mean pH of 5.47 ± 0.01 .The DSHB products had mean pH of 5.06 ± 0.01 and whitening toothpastes had mean pH of 6.92 ± 0.01 . One-way ANOVA showed that there was no significant difference between the 4 product categories. but there was a significant

difference between 8 tested products except the white smile home whitening pen & FGM whitness perfect take home .

Conclusion: It is evident from this in vitro study that polo in-office teeth whitening (SDI) is the most acidic (2.97) product and may cause the problem to teeth an oral tissues. In addition to Day white (Philips) with ph of 4.28 that is below the critical ph of enamel demineralization, may also change the teeth properties.

Dash In-office teeth whitening 30% hydrogen peroxide(discus dental) is the most basic (7.9)product followed by 3Dwhite tooth paste (crest) with ph of 7.1 .these two products that have a relatively neutral ph may minimize potential damage in contact with intraoral structures and may consider as safe products.

Keywords: Tooth Whitening Products, pH, Safety, Damage To Tooth

INTRODUCTION

Several esthetic procedures have been described in the literature to alter the appearance of smiles, including alterations in the form, texture, position, and color of teeth. The most conservative and noninvasive of these is vital bleaching (1-3).

The desire for whiter teeth has made tooth bleaching one of the most sought-after cosmetic procedures in dentistry. Available bleaching modalities include dentist-prescribed at-home bleaching and dentist-supervised in-office bleaching (4).

Tooth whitening or bleaching lightens the teeth and help to remove stains with chemical compounds. the natural color of teeth is influenced essentially by the light transmitting and reflecting properties of dental hard tissues (5) despite various potential toxicological side effects' peroxides have been used to treat

periodontal diseases (6) Peroxides usually in the form of hydrogen or carbamide peroxides are also the active ingredients in most tooth whitening agents. The safety effectiveness and various side effects of these products on the intra oral structures have been investigated, and Some products have been accepted by the American Dental Association for whitening teeth (7).

Although tooth bleaching has been considered a conservative technique (8-10) associated with ease of implementation and highly efficient performance, (11) there are concerns about the biologic safety of the procedure, referring to the indiscriminate use of highly concentrated peroxide products. Studies have shown that the diffusion of hydrogen peroxide through dental tissues may cause pulpal damage (12-14) and increased postoperative sensitivity (15,16).

The direct effect of pH on bleaching effectiveness was previously demonstrated in the industrial bleaching of cotton fibers or wood pulp. Hydrogen peroxide solutions with a higher pH are used to increase the efficacy of the process (17) In relation to dental bleaching gels, a large number of products present an acidic pH in order to increase the product's shelf life, since hydrogen peroxide is more stable in an acidic environment. However, this low pH can promote enamel demineralization. Several studies have shown that bleaching in acidic pH can produce changes in chemical composition and surface morphology, calcium loss, and reduction in hardness and fracture resistance (18-22). On the otherhand, studies of dental bleaching agents with alkaline pH have shown an increased bleaching efficacy,23 reducing its deleterious effects on enamel surface properties.24even though these clinical findings are relatively common, there is a little literature in relation to the difference of pH of bleaching products that help a clinician to balancing between safety and efficacy, therefore in this study we determining ph of 8 available tooth whitening products in iran and comparing efficacy and safety for suggestion to patients.

MATERIALS AND METHODS

8commercially available tooth whitening products were chosen based on the availability in Iran and without the prior knowledge of their pH. The experiment has been done in laboratory of Chemistry College of Amirkabir University of Tehran with the use of pH meter (MEMTROHM 744 Company) and an electrode (METROHM 744) for measuring the pH.

The products were divided into 4categories(table 1-4)OTC products which are available in drug store(N=2),in office bleaching (IOB) products (N=2),which are applied by professional as an in office treatment, dentists supervisedhome bleaching(DSHB)(N=2) which are dispensed by the dentists to be used by patients at home and 2 whitening tooth pastes.

The pH meter was initially standardized using Potassium Acid phthalate(HATCH EUROPE by Dr Bruno lange company)and was recalibrated before testing each new product. All products were tested in triplicated to obtain main pH values.

3mm of each products were placed in disposable cups and were stirred with the pH electrode to allow uniform contact with the electrode tips. Care was taken not to introduce air bubbles in to the products were in contact with the pH electrode for 10 minutes at room temperature $22C \pm 2C$ to allow the pH value to stabilize (error

max0.11 for electrode drift).the electrode was roughly washed between samples using stream of water to remove all traces

of previous sample. The electrode was then rinsed with distilled water and dried with a sterilized wipes.

Table 1 : OTC Products

Name of product	Manufacture	Composition	MEAN
home whitening pen 16% carbamide peroxide	White smile	16% carbamide peroxide,0.25 %sodium perborate(=5.7% hydrogen peroxide)	5.81±0.02
tooth whitening pen 10% carbamide peroxide	Yotuel	glycerine, 10% carbamideperoxide,xylitol,potasiumcitrate,carbomer,potassiumfluoride,sodiumsacharin	6.20±0.02

Table 2: IOB (in office bleaching) products

Name of product	Manufacture	Composition	mean
Dash In-office teeth whitening 30% hydrogen peroxide	Discus Dental	Water,hydrogenperoxide,acrylovido sodium glycerine,anhydronicacid,astanetpotassium,ammoniahydroxid,	7.97±0.01
Pola In-office teeth whitening 35% hydrogen peroxide	SDI Dental	4.5 gr 35%Hydrogen peroxide ,water, potassium nitrate,0.6 gr whitening powder,glycerine.	2.97±0.02

Table 3: DSHB (dentist supervised home bleachbleaching) products

Name of product	Manufacture	Composition	mean
Day white/ take home whitening kit 14% hydrogen peroxide	Philips,discus dental	Water,propylene,glycol,poloxomer407,hydrogen peroxide 14%,carbamide peroxide,dicetylphosphate,potassiumnitrate,silica,sodiumfluoride,xylitol,monosodiumphosphate,phosphoricacid,eugenoull hydroxypropylcellulose	4.28±0.02
Whiteness perfect 16 %carbamide peroxide	FGM	Water, 16% carbamideperoxide,naturalcarbapol,potassiumnitrat,sodium fluoride,glycol	5.84±0.01

Table4: Whitening toothpaste

Name of product	Manufacture	Composition	mean
3D white	Crest	Water,silica,sorbitol,disodiumpirop hosphat,sodiumlorylsulphate,sodiumhydroxid,sodiumsaccharin,sodium fluoride	7.10±0.01
Kobayashi activated charcoal toothpaste	Kobayashi	Water,phosphoricacid,sorbitol, glycerine,silica, sodium loryl sulphate,mint,carbon,ethanol,saccharin,3MG phosphate	6.74±0.02

RESULTS

The pH of all tooth whitening products(table 1-4) tested ranged from 2.97±0.02 (acidic) to 7.97±0.01 (basic).

The average pH from OTC products ranged from 6±0.02. the IOB products had mean pH of 5.47±0.01.The DSHB products had

mean pH of 5.06 ± 0.01 and whitening toothpastes had mean pH of 6.92 ± 0.01 .

the most basic and acidic pH of all products tested was IOB products. Dash in office tooth whitening products had the highest pH and Pola in office bleaching had the lowest pH among chosen products.

One-way ANOVA showed that there was no significant difference between the 4 product categories. but there was a significant difference between 8 tested products except the white smile home whitening pen & FGM whiteness perfect take home.

	N	Mean Std	Deviation Std.	Std. Error	Error 95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
OTC	6	6.0083	23345	.09530	5.7633	6.2533	5.70	6.28
IOB	6	5.4717	2.74503	1.12065	2.5909	8.3524	2.84	8.23
DSHB	6	5.0650	.85713	.34992	4.1655	5.9645	4.22	5.85
TP	6	6.9267	.20829	.0850	6.7081	7.1453	6.67	7.13
Total	24	5.8679	1.52505	.31130	5.2239	6.5119	2.84	8.23

DISCUSSION

In the present study The ph of whitening products ranged from 2.97 ± 0.02 (acidic) to 7.97 ± 0.01 (basic).this range in the pH was higher than the average pH which Tilekykc and his partner reported in 1992 25 .these researches search on the effect of carbamide peroxide gel on the shear bond strength of a microfilm resin to bovin enamel .statistical analysis of the results indicated that there was a highly significant reduction in shear bond strength to carbamide peroxide treated enamel as compared with that to saline treated . The effects of duration of peroxide treatment and pH, as well as the interaction term were not statistically significant.

several studies conducted related on different pH on the teeth. In the study

which Drriessence and his partner did shows that enamel demineralization occur in pH lower than 5.2 to 5.8. also other studies have shown that low pH can cause root resorption (26) .therefore, base on the findings in this research ,Day white product (Zoom company) from DSHB group, Pola in office (SDI dental company)from IOB group may cause problems and resorption in enamel and root.

In study of Gokay and his partners in 2004 reported that whitening strips containing 14%hydrogen peroxide had more penetration to pulp in comparison by whitening strips containing 6.5%hydrogen peroxide .therefore base on findings can conclude that Pola in office teeth whitening product of SDI dental that contain 35%

liquid hydrogen peroxide and whitening powder in comparison with day white containing 14% hydrogen peroxide product of Zoom can penetrate pulp and cause more damages (27).

In 2006 Betke H and his partners studied on the Influence of bleaching agents and desensitizing varnishes on the water content of dentin and concluded that bleaching agents can cause dehydration of dentin.(28) therefore products use in this research can cause dehydration in dentin because of peroxide compounds.

Suleiman and his partners (29) in 2004 had research on the effect of an in office bleaching system on the integrity of enamel and dentin and concluded that using one of the highest concentration of hydrogen peroxide for tooth bleaching procedures and maximum likely peroxide exposures, there was no evidence of deleterious effect on enamel and dentin. it must be assumed that studies which reported adverse effects on enamel or dentin of bleaches reflect not the bleach itself but the pH of the formulation used. in office teeth whitening product of SDI dental that contain 35% hydrogen peroxide and whitening powder has average pH of 2.97 .in which day white contain 14% hydrogen peroxide product of Zoom has average pH of 4.28. therefore this comparison confirms that the

higher the percentage of hydrogen peroxide the higher the acidity of product.

Joiner A in 2007 in a review article concluded that The majority of studies indicate that peroxide containing products and solutions have no significant deleterious effects on enamel and dentine surface morphology and chemistry, surface microhardness, subsurface enamel and dentine microhardness or ultrastructure (30).

other study showed that increasing erosion with decreasing pH and increasing acid concentration and vice versa for decreasing erosion.³¹so we could assume that polo in-office teeth whitening (SDI) is the most acidic (2.97) product and may cause the problem to teeth and change the properties of teeth.

Peroxides may also affect the properties of composite restorative materials, but it is known if this effect is related to the peroxide concentration or the pH of bleaching products .Cullen and others³² reported that the tensile strength of composite resins decreased when exposed to bleaching products containing 30% hydrogen peroxides, while the composites treated with 10% carbamide peroxide showed no significant decrease in tensile strength .Cooley and Burger³³ suggested that although exposure to 10 %carbide peroxide increase the surface roughness

and hardness of composite resin materials, these differences were probably clinically significant. So we may hypothesized that only tooth whitening pen, 10% carbamide peroxide (Yotuel) have low effect on mechanical properties of composite restorations.

Tooth whitening products may be in contact with intraoral structures for several hours or they may be used daily to whiten the teeth. Consequently, these products should have a relatively neutral pH to minimize potential damage. Therefore in methods in which we need to take use of bleaching trays in extended periods (as in Day white bleaching kit, product of Dicus dental company that contain 14% hydrogen peroxide and whiteness perfect 16% carbamide peroxide for FGM company and whitening toothpastes which can use daily such as 3D white and Kobayashi active charcoal toothpaste), low pH of tooth whitening can cause proportional increase problems and we should pay attention to it. The average pH from DSHB products is 0.01 ± 5.06 this average in study which Price and his partners³⁴ have done in 2000 was 6.48. The most important cause of this significant difference is the products that have been choose to examine on. In the other hand the pH meter in Price's research is different from our pH meter.

Although this study measured the pH of 8 tooth whitening products in vitro, there are many other tooth whitening products that were not tested. The wide range of whitening products needs further investigations. Additionally, the pH of the bleaching agent has been reported to change inside the oral cavity during the bleaching process as the carbamide peroxide breaks into hydrogen peroxide, in turn, breaks down into oxygen and water, and the urea degrades into ammonia and carbon dioxides. The release of ammonia and carbon dioxide elevates the pH of the bleaching agent in the oral cavity to a more basic environment within 15 minutes (35, 36).

Other study by Hourizade Ganjkar (37) have shown that using whitening strips of hydrogen peroxide 8.5% can significantly decrease the pH of saliva. This difference between the results of different studies is because of using different brands of tooth whitening also Hourizadeganjkar took use of hydrogen peroxide that is higher in acidity comparing to carbamide peroxide.

CONCLUSION

On the basis of these results and within the limitations of this in vitro study, it may be concluded that:

1-polo in-office teeth whitening (SDI) is the most acidic (2.97) product and may cause the problem to teeth and oral tissues.

In addition to Day white (Philips) with ph of 4.28 that is below the critical ph of enamel demineralization, may also change the teeth properties.

2-Dash In-office teeth whitening 30% hydrogen peroxide (discus dental) is the most basic (7.9) product followed by 3D white tooth paste (crest) with ph of 7.1. These two products that have a relatively neutral ph may minimize potential damage in contact with intraoral structures and may consider as safe products.

3- In addition, more studies need to determine the ph of other tooth whitening products for suggestion a dentist to prescribe for best efficacy and safety.

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