

Whitening efficacy of three over-the-counter oral rinses

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E Potgieter: Faculty of Dentistry, University of the Western Cape, Tygerberg, South Africa.
SR Grobler: Faculty of Dentistry, University of the Western Cape, Tygerberg, South Africa.

Corresponding author:

E Potgieter: Department of Oral Hygiene, Faculty of Dentistry, Private Bag X1, Tygerberg, 7505. Tel: 021 937 3124. Fax: 021 931 2287.
E-mail: epotgieter@uwc.ac.za.

ABSTRACT

Aim: The aim of the study was to determine the whitening efficacy of three different oral rinses.

Materials and methods: Eighty extracted teeth were randomly divided into four groups, cleaned with a slow-speed hand-piece with pumice and placed in a staining broth for 14 days. Measurements of tooth shades were measured with a spectrophotometer. Three groups (20 each) were then exposed to Colgate Plax Whitening Blancheur (A), White Glo 2 in 1 (B) and Plus White (C) for 21 days for 2 minutes a day and in between stored in artificial saliva. The other group acted as a control and was only stored in the artificial saliva.

Results: The Kruskal-Wallis and Tukey-Kramer analysis showed no statistical significant differences (on a 5% basis) for the differences between base-line and after treatment (21 days) for ΔL^* , Δa^* , Δb^* and ΔE^*ab median values amongst the control, Colgate Plax Whitening Blancheur, White Glo 2 in 1, and Plus White.

Conclusion: None of the 3 commercially available oral rinses resulted in any significant bleaching effect on the teeth over a 21 day treatment period.

INTRODUCTION

We undoubtedly live in appearance conscious times. The advertising media tells us that good looks start with a white smile. Lately patients are worrying more about the appearance of their teeth than their general oral health.¹ It remains difficult to meet our patients' needs while satisfying their demand. From a health professional's viewpoint improved oral health should be the preventive strategy.¹ In the past 20 years research on bleaching and other methods of removing tooth discolorations without restorative intervention has increased remarkably.² The increasing demand for a better appearance and 'whiter' smile has made vital tooth-bleaching (also referred to as tooth-whitening) a popular dental procedure. It has become one of the fastest growing areas of aesthetic dentistry.³ The appropriate use of tooth-whitening methods and products are dependent on correct diagnosis of the discoloration. Most methods include the use of peroxide bleaching agents.² Commonly used methods for tooth-whitening include in-office or power bleaching⁴, professionally-supervised home bleaching or nightguard vital bleaching⁵ and over-the-counter whitening products, available to the public for self-application.

Sales of over-the-counter (OTC) tooth-whitening products have escalated because of heightened consumer demand for aesthetic care and promotion by product manufacturers.⁶ The (OTC) products are available in pharmacies, department stores and online on the Internet and are marketed directly to consumers and cost less than professional whitening treatment from a dentist. Ideally products should be recommended by dental professionals⁷. With heightened consumer interest in whiter teeth, dentists and other dental professionals must become familiar with the (OTC) products to adequately advise patients and provide optimal treatment solutions towards improved oral health⁶. It should be noted that these over-the-counter products are not controlled in South Africa nor in many other countries. Furthermore, in South Africa there is no regulation of tooth-whitening products and many unknown products are available from supermarkets.

Many retail products have not undergone rigorous clinical testing and are inexpensive, convenient and easy to use and may be of questionable efficacy.⁶ When an oral health benefit is expected, it is important that sufficient scientific evidence exist to support such claims.⁸ Lately bleaching agents have also been included into (OTC) oral rinses available in the South African market. It needs to be investigated whether these rinses will in any way be a strategy to improve the aesthetic appearance of dentition.

AIM

The aim of the study was to determine the whitening efficacy of three commercial oral rinses in the South African market.

MATERIALS AND METHODS

Eighty extracted teeth, selected from discarded specimens obtained from the Department of Maxillofacial and Oral Surgery, University of the Western Cape, were randomly divided into 4 treatment groups of 20 each. Each tooth was cleaned with pumice paste for five seconds using a slow-speed hand-piece and stained for fourteen days in a staining broth (Table 1). A combination of anterior and posterior maxillary and mandibular teeth were used in this study.

Table 1: Staining broth.⁹

27g of finely divided instant coffee,
27g of finely ground instant tea,
20g of finely ground gastric mucin dissolved into 9L of sterilized trypticase soy broth,
6ml of FD&C Red 40 and 6ml of FD&C Yellow 5, along with 325mL of a 24-hour <i>Micrococcus luteus</i> culture, and 750ml of red wine.

A. Colgate Plax Whitening Blancheur pH = 3.74	Aqua, sorbitol, alcohol, 4% hydrogen peroxide, poloxamer 338, polysorbate 20, methyl salicylate, menthol, sodium saccharin.
B. White Glo 2 in 1 pH = 3.59	Purified water, ethanol 95SG, sorbitol, polysorbate 80, eucalyptol, methyl salicylate, menthol crystal, cetylpyridinium chloride, benzoic acid, sodium saccharin, caramel.
C. Plus White pH = 5.0	Water, glycerin, poloxamer 338, flavor, sodium saccharin, cetylpyridinium bromide, FD&C blue, tetrasodium EDTA, disodium EDTA, methylparaben.

Composition	g/l
Sodium carboxymethylcellulose	10.0
Sorbitol	30.0
Potassium chloride	1.2
Sodium chloride	0.844
Magnesium chloride	0.052
Calcium chloride	0.146
Potassium dihydrogen phosphate	0.342
pH	7.0

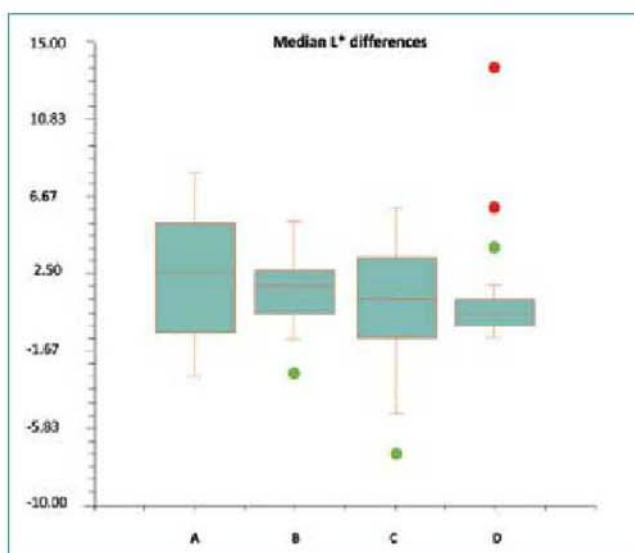


Figure 1: A Box and Whisker plot showing the maximum, minimum, 25 percentile, median and 75 percentile differences in the L* values between base-line (before treatment) and after treatment (21 days). A is Colgate Plax Whitening Blancheur, B White Glo 2 in 1, C Plus white and D the saliva control.

The intent of the staining of the four groups of teeth was to provide teeth that exhibit similar discoloration. Thus, when the 3 different oral rinses (A), (B) and (C) were applied daily in the mornings and evenings for one minute, there would be sufficient latitude for changes in shade. It was found that a minimum period of 14 days of staining is needed for maximum staining⁹.

After removal from the broth, the teeth were lightly brushed and rinsed with distilled water and again cleaned with pumice as performed before the staining. Sixty teeth were then exposed to the 3 different oral rinses (Table 2; viz. Colgate Plax Whitening Blancheur, White Glo 2 in 1 and Plus White.) twice daily (one minute at a time) for 21 days and in between stored in artificial

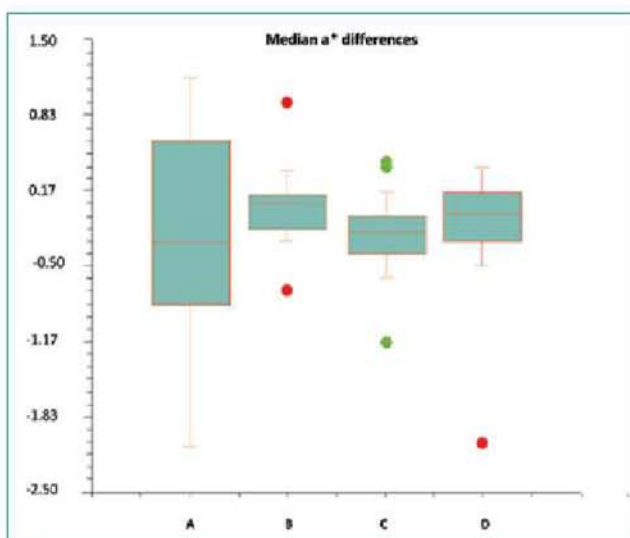


Figure 2: A Box and Whisker plot showing the maximum, minimum, 25 percentile, median and 75 percentile differences in the a* values between base-line (before treatment) and after treatment (21 days). A is Colgate Plax Whitening Blancheur, B White Glo 2 in 1, C Plus white and D the saliva control.

saliva (Table 3). The other 20 teeth acted as the control group and were only stored in the artificial saliva for 21 days.

Measurements of tooth shades were done on all 80 stained teeth just before exposure to the 3 oral rinses and again after the 21 day period of treatment with a Konica Minolta spectrophotometer. Before taking any measurements the spectrophotometer was calibrated, as suggested by the manufacturer (Model: CM-2600d, Konica Minolta Sensing, Inc., Japan).¹⁰ With the spectrophotometer tooth colour can be quantified by measuring it numerically in a three dimensional colour space (Figure 5; L* a* b*)¹¹ where L* indicates lightness/darkness and a* and b* are the chromaticity coordinates. ΔL^* , Δa^* and Δb^* would represent the changes which occurred in these components.

The pH values for the 3 oral rinses were also measured with a combination pH-glass electrode.

RESULTS

Figure 1 shows the Box and Whisker plot with the maximum, minimum, 25 percentile, median and 75 percentile differences in the L* (lightness and brightness) values between base-line (before treatment) and after treatment (21 days). A is Colgate Plax Whitening Blancheur, B White Glo 2 in 1, C Plus white and D the saliva control.

Figures 2-4 shows the same as above for Δa^* , Δb^* and ΔE^*ab .

Data analysis

For all three components (L*, a* and b*)¹² for the control, Colgate Plax Whitening Blancheur, White Glo 2 in 1, and Plus White statistical significant differences (p <0.05) between base-line values and the values obtained after treatment (21 days) were found (Wilcoxon Signed Rank Sum Test). However, the Kruskal-Wallis and Tukey-Kramer analysis showed no statistical significant differences (on a 5% basis) for the differences between base-line and after treatment (21 days) for ΔL^* , Δa^* , Δb^* and ΔE^*ab median values amongst the control, Colgate Plax Whitening Blancheur, White Glo 2 in 1, and Plus White. The

Kruskal-Wallis and Tukey-Kramer analyses was used because they are non-parametric in nature and have less assumptions compared to parametric ANOVA.

DISCUSSION

The best way to measure tooth colour is with the spectrophotometer where one can quantify colours by measuring it numerically in a three dimensional colour space

(Figure 5; $L^*a^*b^*$)¹¹ where the L^* indicates lightness/darkness and a^* and b^* are the chromaticity coordinates. The world of colour (Figure 5)¹¹ is a mixture of hue (green, red, blue, yellow), lightness (bright colours and dark colours) and saturation (vivid colours and dull colours). The a^* value varies from a negative side (more greenish) to the positive side (more reddish), while the b^* value varies from the more blue side (negative side) to the more yellow side (positive side) (Figure. 5).¹¹

Many previous studies used shade guides to measure tooth colours, which have more limitations. The spectrophotometer has many advantages over the shade guide. Apart from being a small computer it has its own built-in light source, constant illumination/viewing angles and constant "observer", which means observer conditions are uniform for all measurements.¹¹ The major disadvantage of the shade guide is that it can only measure one value for all the mentioned possible variations. It is also reported that evaluation of teeth with a shade guide is unreliable and that the intra-evaluator agreement can be as low as 60%¹².

Like the shade guide, the colour change measurements with the spectrophotometer can also be given by presenting only one value, namely the ΔE^*_{ab} ¹¹ where $\Delta E^*_{ab} = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]$ and ΔL^* , Δa^* and Δb^* the changes, which occurred in these components. Presenting only ΔE^*_{ab} results is a masking effect of what really happened in the separate components¹¹.

An interesting finding from this study is that the teeth kept in the saliva control solution also showed significant changes in L^* , a^* and b^* values between base-line and after 21 days. Thus, it can be seen that the colour of the teeth obtained through the colouring process is not stable in the saliva control solution

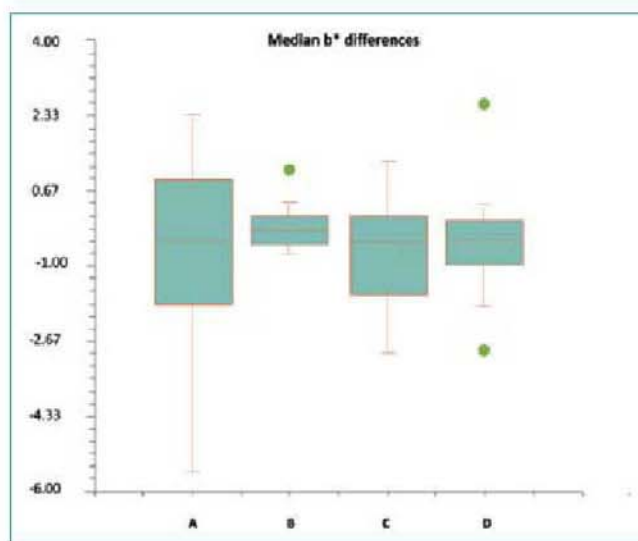


Figure 3: A Box and Whisker plot showing the maximum, minimum, 25 percentile, median and 75 percentile differences in the b^* values between base-line (before treatment) and after treatment (21 days). A is Colgate Plax Whitening Blancheur, B White Glo 2 in 1, C Plus white and D the saliva control.

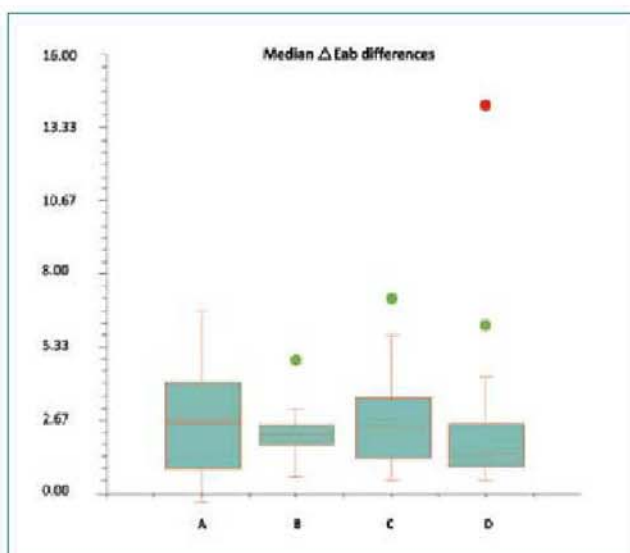


Figure 4: A Box and Whisker plot showing the maximum, minimum, 25 percentile, median and 75 percentile differences in the E^*_{ab} values between base-line (before treatment) and after treatment (21 days). A is Colgate Plax Whitening Blancheur, B White Glo 2 in 1, C Plus white and D the saliva control.

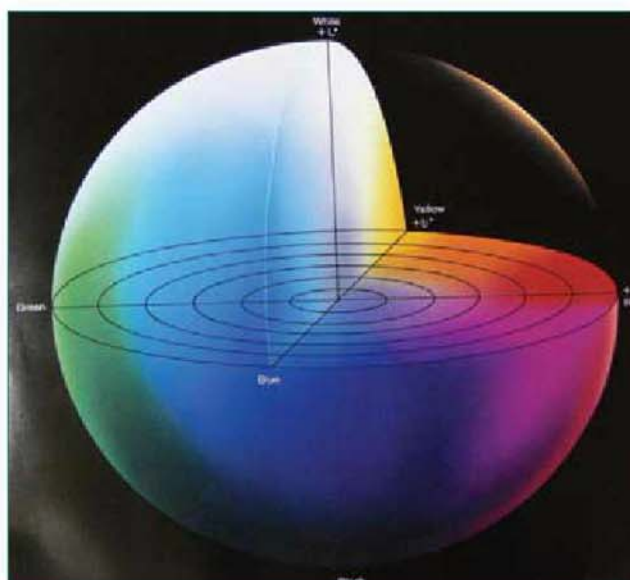


Figure 5: Representation of colour solid for $L^*a^*b^*$ colour space¹¹.

but changes backwards over time (21 days). This could have resulted in misleading interpretations of the results if not taken in consideration as the test groups of teeth were also kept in the artificial saliva between treatments. To correct for it, the differences between base-line and after treatment were statistically compared (Figures 1-4) amongst the control, Colgate Plax Whitening Blancheur, White Glo 2 in 1, and for Plus White (for all components ΔL^* , Δa^* , Δb^* and ΔE^*_{ab}). No significant differences ($p > 5\%$) were found between them. This means that none of the 3 commercially available oral rinses had any additional significant bleaching effect on the teeth but that only the exposure of the coloured teeth to the saliva control was responsible for the found changes.

The respective oral rinses were applied for 2 minutes (2x1 minute) daily over a period of 21 days (42 minutes in total) compared to in-office and home bleaching techniques (conventional systems) that require bleaching agents to effectively work over a

much longer period of time. For example, Opalescence PF 10%¹³ as a home bleaching product contains 10% carbamide peroxide which, according to the manufacturer, should be applied nightly (for ~6 hours per night) for a 14 day treatment period. This may result in on average up to 84 hours (14 x 6 hours) exposure. The short exposure times could therefore be a possible reason why these oral rinses were not effective bleaching products.

Furthermore, the low acidic pH values of the 3 products (3.74 for Colgate Plax Whitening Blancheur, 3.59 for White Glo 2 in 1, and 5.00 for Plus White) might etch the enamel. With such low pH values it can be expected that damage to enamel will take place at least as far as the hardness of enamel is concerned^{13,14}. To support this concern another study reported the damaging effect for 9 other bleaching products with low pH values¹⁴. From a health professional's viewpoint improved oral health should be the preventive strategy.

On the other hand, the 12 hour lap after the one minute treatment period should be advantageous to the remineralisation process.

CONCLUSION

The three evaluated commercially available oral rinses Colgate Plax Whitening Blancheur, White Glo 2 in 1, and Plus White showed no measurable bleaching effect over a 21-day application period.

Declaration: No conflict of interest.

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Additional references (7-14) are available on www.sada.co.za

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OBITUARY

HULDEBLIK: PROF PIETER GERMISHUYS

10.11.1926 – 27.11.2010

'n Stil, nederige en begaafde akademikus is nie meer met ons nie.

Prof Piet is na 'n kort skiekbed aan kanker oorlede en ons treur saam met sy familie en eer sy nagedagtes.

Gebore op 10 Novemer 1926. Hy was 'n Dux-leerling en behaal die B.Com-graad. Hy behaal ook die graad in Tandheelkunde in 1955 en praktiseer op Parys. Die Farmakologie was sy liefde en behaal hy 'n honneursgraad en MSc in Farmakologie.

Verder behaal hy ook 'n MDent-graad en 'n Diploma in Tersiere onderwys aan die Universiteit van Pretoria.

Sy akademiese loopbaan begin in 1975 aan die Fakulteit Tandheelkunde, Universiteit van Pretoria.

Hy eindig as Professor in die Departement Periodonsie en Mondgeneeskunde. Hy was 'n meester op die gebied van Mondgeneeskunde en het 28 nagraadse studente in Mondgeneeskunde opgelei.

Hy het 23 voor – en nagraadse studente met hulle navorsing begelei en was trots op IVTN prysweners.

Ek beskou hom as die een van die beste Mondgeneeskundiges in die land en het met groot passie sy kennis oorgdra. Statistiese formules en aktiwiteite was vir hom lekker.

Hy het op verskeie komitees van die Fakulteitsraad gediens en was konvenor van die Regulasiekomitee. Hy het op die Medisyne Beheerraad gediens. Hy verwerf die Elida Gibbs Navorsingstoekening in 1972 en 1978.

Hy was in die VSA en ook Verenigde Koningryk vir navorsingsaspekte van Mondgeneeskunde, onderrigmetodes en kurrrikula.

In 1988 word die Dekaan se Toekening vir voortreflike diens aan hom gemaak. Twaalf volledige artikels van hom in professionele artikels het verskyn en hy was by 5 mede-outeur. Allergieë vir lokaalanestetika was sy voorliefde.

As mens was hy geliefd onder almal wat sy pad gekruis het en was 'n voorbeeld van professionalisme en hoffikheid vir elke student en kollega. 'n Kenmerk was dat hy al die studente se name en vanne geken het, selfs lank na hulle afstudering.

Iets wat ek nooit sal vergeet nie is dat hy by meer as een geleentheid, tydens sy siekbed, vir my gesê het " Ek is tevrede en gelukkig, ek het 'n vol lewe gehad en is gereed om te gaan."

Sy goddelike roeping om 'n goeie man, pa, kollega, vriend en leermeester te wees het hy tenvolte uitgeleef.

Piet laat baie vriende agter wat hom nooit sal vergeet nie.

Hy laat sy vrou Juliana, seun Quintus ('n tandarts) en dogter Una agter.

Ons dank onse Heer vir Piet.

Prof Hannes Pretorius



Prof Pieter Germishuys