Optical and mechanical effects of different bleaching regimens on enamel surface

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Abstract: Purpose: This study was designed to assess the effect of 3 different bleaching regimens on color and microhardness of enamel. **Materials and Methods**: Ninety bovine upper central incisors were divided into three main groups according to the bleaching regimen used; chemically activated (Viva Style Paint on Plus), photo activated (Zoom 2), and laser activate (Opalescence X-Boost) bleaching agents. Each group was stained with (tea, carbonated beverage or a combination of both tea and carbonated beverage for 1 day or 6 days. Color was assessed using computerized image analysis in terms of grey scale, while Vickers microhardness tester was used to assess change in enamel microhardness. **Results:** Computerized image analysis revealed statistically significant decrease in the mean grey scale value of all teeth immersed in the three staining solutions used. The results also revealed that color change become intense as the immersion time increased. After bleaching with the three bleaching regimens the results revealed increase in the mean grey scale value of all the three bleaching regimens used with statistically significant increase in the mean grey scale value of both photo and laser activated bleaching agents than did chemical activated bleaching agent. Microhardness results revealed that there was statistically significant decrease in enamel microhardness after immersion in the three solutions, where the carbonated beverage group showed the lowest mean microhardness value than did the tea and the combination solutions. After bleaching with the three bleaching regimens enamel revealed a significant decrease in its microhardness. For all groups, no correlation was found between color change of enamel surface and its microhardness. **Conclusion**: Tea and Carbonated beverages have the ability to discolor teeth and alter their microhardness. Different bleaching regimens are lightening the color of discolored teeth but adversely affect enamel microhardnes.

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Introduction

Nowadays, esthetic of dentition is of great concern for many individuals seeking dental treatment due to the increase of the patient's awareness of the ability to improve their smile by lightening discolored teeth through few visits to dentists.

Bleaching is considered the most conservative approach to obtain esthetic than aggressive methods such as veneering, crowning or bonding ***(Matis at el, 2000).*** Therefore aesthetic dentistry has turned its attention to develop a series of bleaching techniques and materials to offer the patient a successful pain-free bleaching of both intrinsic and extrinsic stains. These techniques include peroxide based, light-activated, laser-activated or combination therapies. A broad range of peroxide based treatments are currently available including those that are professionally administered (in-office), professionally dispensed (custom-tray based system) and self-directed (over the counter) ***(Zanin et al, 2004).***

Power bleaching is an in-office whitening technique developed to bleach teeth in single office visit with a combination of a whitening agent such as peroxide and an auxiliary light. It has the advantage that all the smile-line teeth are whitened simultaneously ***(Tavares et al, 2003).*** There are several different available types of light sources to accelerate the in office bleaching procedure. The techniques that use coherent or incoherent light sources, have the advantage of being quick and convenient ***(Wetter et al, 2004).***

The mechanism by which teeth are bleached by H2O2 is not completely understood; it is thought that, as the peroxide diffuses into the tooth structure, it may react with organic colored materials found within the tooth structure leading to reduction in color ***(Luk et al, 2004).*** Unfortunately improvement in tooth color may, however, be at the expense of tooth strength.

Thus it was thought that a study aiming at evaluating the effect of different bleaching regimens on the color change and micro-hardness of enamel surface might be of value.

2. Materials and methods:

2.1. MATERIALS:

2.1.1. TEETH SELECTION AND GROUPING:

Ninety recently extracted sound bovine upper central incisors were selected and stored in isotonic saline (0.2% sodium azide NaN_3) at room temperature until use to avoid bacterial growth and dehydration. The ninety teeth specimens were divided into three main groups of 30 teeth each, according to the bleaching regimen used (B). Where B1 referred to Viva Style paint on plus bleaching agent **(**IvoclarVivadentAG, FL-949schaan/ Liechenstein) B2 referred to photo activated bleaching agent Zoom2 bleaching system (Discus Dental, Inc. Culver City, CA 90232 USA) and B3 referred to Opalescence X-tra Boost + laser activation bleaching gel (Ultradent products, South Jordan, UT, USA).. Each main group was further subdivided into two subgroups, 15 teeth each, according to time of immersion in the staining solutions (T). T1 referred to 1 day and T2 referred to 6 days immersion time in the staining solutions. One day staining was equivalent to one month of three times drinking tea cups or carbonated beverage daily, while six days was equivalent to six month ***(Guler et al, 2005).*** Each subgroup was further subdivided into three classes according to the staining solution (S), where S1 represented tea, S2 represented carbonated beverage and S3 represented a combination of both tea and carbonated beverage one by one respectively.

2.2. Methods:

2.2.1. BLEACHING TREATMENT:

2.2.1.1. Paint on plus bleaching agent 6% hydrogen peroxide (HP):

A thin layer of Viva Style paint on plus bleaching agent was applied to the labial tooth surface using a brush. According to the manufacturer's instructions, this layer was washed out after 10 minutes with water and toothbrush. That procedure was repeated 14 times according to the manufacturer's instructions. Then the specimens were stored in saline till testing.

2.2.1.2. ZOOM 2 photo-activated bleaching agent 25% HP:

The gel was spread on the labial teeth surfaces with the supplied brush for three 15-minutes sessions with the zoom light (short-arc metal halide bulb -wavelength of 365-500 nm). At the end of the treatment the teeth were rinsed with water and each subgroup was stored in a separate bottle filled with normal saline till testing.

2.2.1.3. palescence X-tra Boost 38%HP+laser activation:

The Opalescence X-tra Boost laser activated bleaching agent was applied on the labial surfaces of the teeth for 15 minutes according to the manufactures instructions then the gel was rinsed with water and the teeth was dried with gauze. The bleaching agent was again applied on the labial surface of the teeth and activated with diode laser (wave length 904nm, power 6Wfrequency 500MZ) for 1 minute time exposure. (The diode laser exposure was done in laser technology services center, Cairo University). At the end of laser bleaching the teeth were rinsed with water and each sub-group was stored in a labeled bottle filled with normal saline till testing.

2.2.2. COLOR CHANGE ASSESSMENT:

Each bovine tooth was mounted vertically in a mould of self-cured acrylic resins using Teflon ring with dimension of 2x2cm. Color assessment was made at baseline (control before staining), post-staining and post-bleaching using the grey scale image analyzer software (soft ware image ware, J-13, microsoft, USA). Each tooth was photomicrographed using zoom stereomicroscope (Olympus-SZ-PT,Japan) with charged couple device digital camera(Olympus-DP10,Japan). Four points were randomly selected and measured for each specimen where the mean values of the four points were calculated.

2.2.3. MICRO-HARDNESS MEASUREMENT:

Each bovine tooth was mounted horizontally in a mould of self-cured acrylic resins using Teflon ring with dimension of 3x3cm.The micro-hardness test of enamel surface was made at baseline (control before staining,) after staining and after bleaching. The micro-hardness values of the specimens were determined using a Vickers micro-hardness tester. Three indentations were made with a static load of 200 grams for 20 seconds dwell time. The indentation dimensions were registered. The mean VHN values of the three indentations were calculated.

2.2.4. TATISTICAL ANALYSIS

The recorded data for color change and micro-hardness assessment were collected, tabulated and statistically analyzed using ANOVA and Tukey's tests. Pearson's correlation coefficient was used to determine significant correlation between mean percentage changes in color and microhardness after bleaching with the three different bleaching agents.

3. RESULTS:

3.1. COLOR MEASUREMENTS

3.1.1. Color measurements before (control) and after staining with the staining solutions and after bleaching with the different bleaching gels (Table 1):

Table 1. Mean, standard deviation values, results of ANOVA and Tukey's tests for the effect of the three staining solutions on color and the color change after bleaching with the three bleaching gels:

Bleaching agent	Control		Storage time	Solution / Measurement	Tea		Carbonated beverages		combination		p-value
	Mean	SD			Mean	SD	Mean	SD	Mean	SD	
Paint - on Plus	141.8 [a]	4.5	1 day	After staining	129.5 [b]	1.6	134 [b]	1.9	130.9 [b]	2.3	**<0.001***
	141.8 [a]	4.5		After bleaching	133.4 [c]	2	138.2 [b]	2.6	136.5 [b]	3.4	**0.007***
	141.8 [a]	4.5	6 days	After staining	119.4 [c]	3.2	121.9 [b]	3.3	124.8 [b]	2.6	**<0.001***
	141.8 [a]	4.5		After bleaching	128.4 [b]	4.5	132.4 [b]	3.6	133 [b]	2.3	**<0.001***
Zoom 2+ Photo activation	141.8 [a]	4.5	1 day	After staining	129.1 [c]	1.7	133 [b]	2.9	132.4 [b]	1.9	**<0.001***
	141.8	4.5		After bleaching	138.5	1.7	141.3	0.8	142.6	2.7	**0.148**
	141.8 [a]	4.5	6 days	After staining	116.3 [c]	3.5	121.2 [b]	2	124.1 [b]	3.7	**<0.001***
	141.8	4.5		After bleaching	139.3	4.7	139.1	1.6	139.6	1.9	**0.590**
Opalecence Xtra- boost + laser activation	141.8 [a]	4.5	1day	After staining	128.7 [c]	2	133.4 [b]	3.5	131.1 [b]	1.4	**<0.001***
	141.8	4.5		After bleaching	139.8	0.6	141.7	2.2	141.3	2.2	**0.626**
	141.8 [a]	4.5	6 days	After staining	118.9 [c]	3	122.5 [b]	1.8	124.1 [b]	3.3	**<0.001***
	141.8	4.5		After bleaching	137.9	2.2	137	2.8	139.4	1.9	**0.104**

SD: Standard Deviation, *: Significant at P ≤ 0.05, Means with different letters are statistically significantly different according to Tukey's test.

3.1.1.1. For Paint on plus:

-1 day storage:

After staining,

Control group showed the statistically significantly highest mean color measurement.

There was no statistically significant difference between staining with tea, carbonated beverage and combination which showed the statistically significantly lowest means.

After bleaching,

Control group showed the statistically significantly highest mean color measurement.

There was no statistically significant difference between staining with tea, carbonated beverage and combination which showed the statistically significantly lowest means.

3.1.1.2. For Zoom2 bleaching:

-1 day storage:

After staining, Control group showed the statistically significantly highest mean color measurement. There was no statistically significant difference between staining with carbonated beverage and combination which showed lower mean values.

Staining with tea showed the statistically significantly lowest mean.

After bleaching, there was no statistically significant difference between the four groups.

-6 days storage:

After staining,

Control group showed the statistically significantly highest mean color measurement.

There was no statistically significant difference between staining with carbonated beverage and combination which showed lower mean values.

Staining with tea showed the statistically significantly lowest mean. After bleaching, there was no statistically significant difference between the four groups.

3.1.1.3. For opalesence extra-boost+ laser-activation bleaching:

-1 day storage:

After staining,

Control group showed the statistically significantly highest mean color measurement.

There was no statistically significant difference between staining with carbonated beverage and combination which showed lower mean values.

Staining with tea showed the statistically significantly lowest mean. After bleaching, there was no statistically significant difference between the four groups.

-6 days storage:

After staining,

Control groupshowed the statistically significantly highest mean color measurement.

There was no statistically significant difference between staining with carbonated beverage and combination which showed lower mean values.

Staining with tea showed the statistically significantly lowest mean. After bleaching, there was no statistically significant difference between the four groups.

3.2. MICROHARDNESS RESULTS:

3.2.1. Microhardness measurements before (control) and after staining with the three staining solutions and after bleaching with the three different bleaching gels (Table 2):

Table 2. Mean, standard deviation values, results of ANOVA and Tukey's tests for the microhardness measurments.

bleaching agent	Control		Storage ti	Solution / Measurement	Tea		Carbonated beverages		combination		p-value
	Mean	SD			Mean	SD	Mean	SD	Mean	SD	
Paint on Plus.	135 ^{a}	7.6	1 day	After staining	132.2 ^{b}	9.6	124 ^{c}	7.6	130.6 ^{b}	5.8	**0.023***
	135 ^{a}	7.6		After bleaching	115.8 ^{b}	9.6	111.2 ^{b}	5.3	108.6 ^{b}	7	**<0.001***
	135 ^{a}	7.6	6 days	After staining	131.6 ^{b}	7.2	121.4 ^{c}	7.5	128.7 ^{b}	6.1	**0.034***
	135 ^{a}	7.6		After bleaching	118.4 ^{b}	5.9	111.6 ^{c}	8.2	109.7 ^{c}	6.3	**<0.001***
Zoom2+ Photo activation	135 ^{a}	7.6	1 day	After staining	133.1 ^{a}	4.9	126 ^{b}	6.6	132.3 ^{a}	7.5	**<0.001***
	135 ^{a}	7.6		After bleaching	116.6 ^{b}	7	89.6 ^{c}	6	110.6 ^{b}	5	**0.148**
	135 ^{a}	7.6	6 days	After staining	131.2 ^{a}	7.9	125.1 ^{b}	4.7	131 ^{a}	8.2	**<0.001***
	135 ^{a}	7.6		After bleaching	117.4 ^{b}	5.8	104.2 ^{c}	5.1	111.4 ^{b}	7.1	**0.590**
Opalescence Xtra-boost.	135 ^{a}	7.6	1day	After staining	133.9 ^{a}	7.2	122.6 ^{b}	7	131 ^{a}	6.4	**0.001***
	135 ^{a}	7.6		After bleaching	120 ^{b}	5.7	112.8 ^{c}	6.6	105.1 ^{c}	7.2	**<0.001***
	135 ^{a}	7.6	6 days	After staining	133.5 ^{a}	2.9	120.4 ^{b}	6.6	130.4 ^{a}	9.3	**<0.001***
	135 ^{a}	7.6		After bleaching	119 ^{b}	7.2	111.7 ^{c}	7.3	108.2 ^{c}	9.4	**<0.001***

SD: Standard Deviation, *: Significant at $P \leq 0.05$, Means with different letters are statistically significantly different according to Tukey's test.

3.2.1.1.Paint on plus:

1 day storage:

After staining, the highest mean microhardness both tea group (132.2) and combination group (130.6) which showed no statistically significantly difference between them which showed lower mean. The lowest mean microhardness was for carbonated beverage group (124). **After bleaching**, the highest mean microhardness was the control group (135), followed by the other 3 groups, tea group (115.8), carbonated beverage group (111.2) and combination group (108.6) which showed no statistically significantly difference between them which showed lower mean.

6 days storage:

After staining, the highest mean microhardness was the control group (135), followed by both tea group (131.6) and combination group (128.7) which showed no statistically significantly difference between them which showed lower mean. The lowest mean microhardness was for carbonated beverage group (121.4). **After bleaching,** the highest mean microhardness was the control group (135), followed by both tea group (118.4) and combination group (109.7) which showed no statistically significantly difference between them. The lowest mean was for carbonated beverage group (111.6).

3.2.1.2.Zoom2 gel+ photo activation.

1 day storage:

After staining, the highest mean microhardness was the control (135), tea group (133.1) and combination group (132.3) which showed no statistically significantly difference between them. The lowest mean value was for carbonated beverage group (126).

After bleaching,the highest mean microhardness was the control group (135), followed by both tea group (116.6) and combination group (110.6) which showed no statistically significantly difference between them which showed lower mean. The lowest mean microhardness was for carbonated beverage group (89.6).

6 days storage:

After staining, the highest mean microhardness was the control group (135), followed by both tea group (131.2) and combination group (131) which showed no statistically significantly difference between them The lowest mean was for carbonated beverage group (125.1). **After bleaching**, the highest mean microhardness was the control group (135), followed by both tea group (117.4) and combination group (111.4) which showed no statistically significantly difference between them which showed lower mean. The lowest mean microhardness was for carbonated beverage group (104.2).

3.2.1.3.Alesencextra-boost+Laser activation.

1 day storage:

After staining, the highest mean microhardness was the control group (135), followed by both tea group (133.9) and combination group (131) which showed no statistically significantly difference between them The lowest mean was for carbonated beverage group (122.6).

After bleaching, the highest mean microhardness was the control group (135), followed by tea group (120). Both carbonated beverage (112.8) and combination groups (105.1) showed the lowest mean with no statistically significant difference between them.

6 days storage:

After staining, the highest mean microhardness was the control group (135), tea group (133.5) and combination group (130.4) which showed no statistically significantly difference between them. The lowest mean was for carbonated beverage group (120.4).

After bleaching, the highest mean microhardness was the control group (135), followed by tea group (119). Both carbonated beverage (111.7) and combination groups (108.2) showed the lowest mean with no statistically significant difference between them.

4. DISCUSION

Since the last decade, methods to improve the esthetics of the dentition by tooth whitening were of interest to dentists, their patients and the public. Thus, dental bleaching has become an alternative to change the color of discolored teeth.

In the current study bovine teeth were used as it was practical and suitable because of its large labial surface area and its validity in a sound, non carious form. Bovine teeth were also used in previous studies according to **Adeyemi et al, 2006; Al Salehi et al, 2007**. The results and observations in studies by **Titley et al, 1991 & 1993** utilized human teeth generally support the results and observations recorded for bovine teeth.

In this study, the effects of tea and carbonated beverages on enamel surface were investigated, as they are the most commonly used by the population. Moreover carbonated beverage was chosen as it continues to replace milk and other nutrient-dense foods and beverages in which patients consider it harmless, **Jain et al, 2007; Owens and Kitchens, 2007.**

Three peroxide based bleaching regimens were used in this study. As peroxide based products are effective in achieving a wide range of shade enhancement and are available by professional application in-office or through professional dispensing for daily use (Custem-tray based system) and self-directed (over the counter)**; Bernie et al, 2003; Zanin et al, 2004.**

In this study, chemical activated bleaching agent was tested as it is the most commonly used and available bleaching regimen, **Sulieman et al, 2006; Luo et al, 2007.** In addition photo and laser activated bleaching agents were also tested to accelerate lightening of discolored teeth during chair side treatments, where immediate whitening occurs. This was in accordance with previous studies by **Wetter et al in 2004 and Buchalla and Attin in 2007;** who used Light and laser for the activation of the bleaching agents. In the current study color change and microhardness were measured to assess the effect of the three bleaching regimens used on enamel surface.

Color changes could be assessed visually using shade guide systems and digital photographic means or digitally using colorimeter, spectrophotometer and digital analysis; **Sulieman et al, 2006; Braun et al, 2007; Luo et al, 2007.** However each system has its own limitation. In this study Color change was assessed using computerized image analysis in term of grey scale (ranging from 0= black and 255= white) as it is one of the objective measuring procedure that eliminates the potential for human variability. Microhardness was assessed using Vickers hardness tester as it was used in previous studies by **Unlu et al in 2004 and Al-Salehi et al in 2007**.

Results of computerized image analysis revealed statistically significant decrease in the mean grey scale value of all the teeth immersed in the three solutions used. As the normal color of the teeth is determined by the blue, green and pink tints of the enamel and is reinforced by the yellow through to brown shades of dentine beneath. Direct staining has multifactorial etiology with chromogens derived from dietary sources or habitually placed in the mouth. These organic chromogens are taken up by the enamel pellicle and color imparted is determined by the natural color of the chromogen as stated by

Watts and Addy in 2001. Moreover the chromogens diffuse rapidly into the dentine to saturate binding sites. The diffusion occurs mainly through the dentinal tubule system, although diffusion through inter-tubular dentine is possible and must occur to produce staining in the body of the dentine which is the main cause of showing the translucent enamel discolored. Teeth immersed in tea showed the lowest mean grey scale value this result was in agreement with **Sulieman et al in 2003 and 2005** where they revealed considerable colour changes in all L*a*b* values with the most marked value change in L* indicating tooth darkening. The change in a* and b* were of interest since these moved in the direction of red and yellow, this could be attributed to the polyphenolic chromogens found in tea namely, the theorubigins and theoflavins, which are red and yellow, respectively. As well as results revealed that as the immersion time increased the color change become intense.

After bleaching with the three bleaching regimens results revealed increase in the mean grey scale value of all the three bleaching regimens used. This result is in agreement with **Bartlett, 2001; Reinhard et al, 1993; Matis et al, 2002 & 2003; Zekonis et al, 2003; Joiner et al, 2004; Duschner et al, 2006 and Sulieman et al 2006.** This could be attributed to the fact that when hydrogen peroxide interacts with a tooth, it decomposes into hydroxyl radicals or into water and oxygen molecules, depending on the mechanism of hydrogen peroxide decomposition. The free radicals released are unstable and immediately seek an available target with which they may react. The reaction may decompose organic materials, including stains on enamel, from larger-chained, darker-colored molecules into smaller, shorter-chained, light- colored molecules. In the course of decomposition, a color change occurs on the enamel surface and the decomposed organic materials are dissolved in the hydrogen peroxide solution.

Moreover results of computerized image analysis revealed statistically significant increase in the mean grey scale value of both photo and laser activated bleaching agents than did chemical activated bleaching agent.

This could be attributed to the difference in hydrogen peroxide concentrations between the bleaching agents used where the chemical activated bleaching agent has 6% H_2O_2 while the photo and laser activated bleaching agents have 25% and 38% H_2O_2 respectively. These results indicate that bleaching efficiency might be concentration dependant. This result is in agreement with the results of **Matis et al in 2000 and Braun et al in 2007.**

Moreover this may be also attributed to under photo-chemically initiated reactions using light or laser, the formation of hydroxyl radicals from hydrogen peroxide has been shown to increase, by a rise in temperature according to the following equation: H_2O_2+211 KJ/mol---- 2HO. This is in accordance with increase in speed of decomposition of a factor of 2.2 for each temperature rise of 10ºc. Due to the increased release of hydroxyl-radicals (thermocatalysis), an increase in efficacy is conceivable. If light is projected onto a bleaching gel a small fraction is absorbed and its energy is converted into heat. Most likely,

this is the main mechanism of action of all light activated bleaching procedures. Moreover the bleaching process is a chemical reaction composed of different factors that determine the rate of the chemical reaction and the increase of the temperature. Concentration of the reactants and intensity of light in a photo-chemical reaction are all proportional to the rate of chemical reaction of the tooth whitening. Similar results have been suggested by **Sun et al in 2000; Luk et al in 2004; Perdigo et al in 2004 and Buchalla et al, 2007.**

However the results suggested by **Zekonis et al in 2003 and Sulieman et al in 2006** were contradicting. This might be to significant variations in the bleaching agents, time of application and color assessment methods used.

Microhardness results revealed that there was statistically significant decrease in enamel microhardness after immersion in the three solutions, where the carbonated beverage group showed the lowest mean microhardness value than did the tea and the combination solutions. This is in agreement with the results of previous studies by **Kim et al in 2001; Willershausen and Dobrick in 2004; Jain et al in 2007; Owens and Kitchens in 2007.** This may be due to the acidic nature of the carbonated beverages that may result in enamel erosion. In addition, there are many other factors affecting the rate of enamel erosion and dissolution, which are the total exposure time that would depend on the actual amount of beverage consumed, the frequency of consumption (that is, if small sips are taken at frequent intervals or the entire can/bottle is consumed quickly), if the consumer uses a straw to drink these beverages (reducing the enamel's exposure as a result), and so forth. This explanation matches that of **Willershausen and Dobrick in 2004; Joiner et al in 2004 and Jain et al in 2007.**

Moreover, microhardness results after bleaching with the three bleaching regimens revealed a significant decrease in enamel microhardness. This is with agreement with

Park et al, 2004; Pinto et al, 2004; Unlu et al, 2004; Junior et al, 1996; Rotstein et al, 1996. This may be attributed to surface degradation, resulting from the complicated oxidation process of free radicals. Since the organic materials (proteins, lipids or dental staining substance) are distributed mainly in the inter-zone of inorganic structures, the removal of such organic materials makes the surface uneven. Hydrogen peroxide can also interact with inorganic materials and dissolves the enamel surface gradually by removing the mineral elements. As the main building block of enamel is hydroxy-apitite crystal that is composed of calcium and phosphorus. Therefore changes in ca/p ratio indicate alteration in the microhardness, since microhardness directly related to the mineral content of enamel.

However, the results suggested by **Joiner et al in 2004; Duschner et al in 2006 and Ferreira et al in 2006;** were contradicting. This can be due to variations in the methodology applied, such as time of exposure, pH of the immersion solution, type of teeth and mainly the storage environment. When the specimens are stored in artificial saliva or exposed to oral environment in situ, no change in the superficial hardness of enamel is observed, considering that saliva presents a large remineralization potential. The enamel contact with the bleaching solution slightly below the critical pH for a short period followed by the contact for a longer period with a hypermineralized solution of artificial saliva seems to be unable to result in demineralization.

For all groups, no correlation was found between color change of enamel surface and its microhardness. This is in agreement with **Basting et al, 2003 and Joiner et al, 2004**. However, other study by **Rodrigues et al in 2005** have shown that the increase in the concentration, duration and frequency of exposure of tooth structure to hydrogen peroxide is directly proportional to the increase in the bleaching action and the associated sequelae such as effect on enamel microhardness.

Nevertheless, in vitro procedures are not necessarily representative of the in vivo situation. By the lack of the positive outward pressure along the dentinal tubules, which in vivo might retard the penetration of any bleaching agent clinically with vital teeth. The use of extracted teeth that were devoid of dentinal fluid also probably allowed the agent to penetrate the tooth more quickly than would be the case clinically as stated by **Sulieman et al, 2003.**

Conclusion:

1. Tea and carbonated beveraves have the ability to discolor teeth and alter their microhardness. Different bleaching regimens are lightening the color of discolored teeth but adversely affect enamel microhardness.

2. Enamel microhardness is directly proportional with hydrogen peroxide concentratin in the bleaching agent**.**

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