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Effect of denture cleanser on the color stability of artificial denture teeth

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الخلاصة

اهداف البحث:تهدف الدراسة الى تقييم تأثير ثلاثة أنواع من منظفات طقم الأسنان على تغير اللون الحاصل في ثلاثة أنواع من الأسنان الاصطناعية الخاصة باطقم الأسنان. **المواد و طرائق البحث:** تم تحضير ستون نموذج من الثلاثة أنواع من الأسنان الاصطناعية وتم غمرها لمدة ثماني ساعات يوميا بالأنواع الثلاثة من منظفات الأطقم لفترات مختلفة (أسبوع وأسبوعين وارع أسابيع) ثم تم قياس تغير اللون بواسطة المطياف. **النتائج:** اظهرت النتائج ان قيم a*b من مجموعة السراميك وقيمة L* من مجموعة RHM تغيرا معنويا بعد الغمس في منظفات الاطقم الثلاثة لمدة اسبوعين وان التحليلات الإحصائية أوجدت إن قيم L*a*b* لأسنان البورسلين و RHM كانت إحصائية مختلفة عن acry-rock بعد أربعة أسابيع من الغمر بمنظفات الأطقم .ان تغير اللون (ΔE) لمنظفات الاطقم الثلاثة ولفترات الغمس الثلاثة كان مقبولا من الناحية السريرية **الاستنتاجات:** أظهرت الدراسة ان غمر الاسنان لمدة طويلة في منظفات طقم الاسنان يؤدي الى تغير في قيم L*a*b* لكن وجد ان هذا التغير ضمن القيم المقبولة سريريا.

ABSTRACT

Aims: To evaluate the effect of three different cleanser on the color stability of three different types of artificial teeth. **Materials and methods:** sixty samples of artificial anterior teeth were prepared which are Acry-Rock, RMH teeth and Porcelain teeth and immersed in three types of denture cleanser(Bony plus, Protefix and soda+ vinegar) for 8 hours and the color of the teeth was measured by Easyshade's spectrophotometer at 3 intervals(1,2and4weeks). **Results:** Showed that the a'b values of ceramic teeth and L value of RHM teeth were significantly differencent after 2 week of immersion in three type of denture cleanser. Analysis of variance demonstrated that L'a'b value for ceramic teeth and RHN teeth were statistically significant after 4 week immersion in three type of denture cleanser, The result of color change (ΔE) for three denture cleansers of three periods of immersion were clinically accepted. **Conclusion:** Long period of immersion of artificial teeth in denture cleanser cause significant color change for L*a*b* values but they were clinically accepted.

Key wards: Artificial teeth ,Denture cleanser, Spectrophotometer.

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INTRODUCTION

Acrylic resins and porcelains have been used for the fabrication of artificial teeth; however, neither type completely accomplishes the requirements of an ideal prosthetic tooth. For this reason, acrylic resin teeth have been modified to overcome the disadvantages of acrylic resin by using interpenetrating cross-linking agents, different monomers, and the addition of nanofillers[1-3]

Color stability is one of the most important physical properties that affect the aesthetic of restorative and prosthetic dental materials [4,5].

Color change is an indicator of aging or damage to dental materials and can be assessed by colorimetry, which is based on the digital expression of the color perceived from the object[6].

In dentistry, the HSB (Hue, Saturation or Chroma, Brightness or Value) system is

most commonly used for color communication [7,8].

Chroma is the purity of color, *hue* is referred as the basic color, value the quality by which a light color is distinguished from a dark color[9].

The rate at which the deposits accumulate on the denture may vary between individual [10].

It is well established that the use of denture cleansers helps to control or reduce the amount of plaque residing on denture surface [11].

Denture cleanliness is essential to prevent malodor, poor esthetic and accumulation of plaque and important for long–term success of prosthodontic treatment. The most common commercial denture cleansers use immersion technique which is the suitable method for many elderly patients in long–term care hospital because of disease and poor dexterity [12].

Chemical denture cleaner solution includes: oxidizing type, diluted acids, disinfectant solutions and enzymes [13,14].

There are large number of solutions, tablets and powders available for cleaning dentures. An ideal denture cleanser should be non toxic, bactericidal, fungicidal and compatible with denture base [11].

Denture cleanser must clean effectively without adversely affecting denture base material properties especially roughness because rough surface is unfavorable and may affect plaque formation or inhibit its removal[15,16].

Khalil [17] prepared anew formulas of compound as a denture cleanser and concluded that the safest prepared solutions is sodium bicarbonate +clear commercial vinegar.

The aims of this study is to evaluate the effect of three different cleanser on the color stability of there different types of artificial teeth.

MATERIALS AND METHODS

Three types of artificial anterior teeth of shade (A_2) were used in this study: Acry-Rock (acrylic resin teeth, Italy), RMH teeth (cross-linked, China) and Porcelain teeth (Alloy pin porcelain, China). For each type, twenty models were made by positioning the tooth in the centre of a polyvinyl chloride tube (20X20mm) previously filled with autopolymerizing acrylic resin (Respal, Italy). The lingual surface of the tooth was embedded within the autopolymerizing resin ,until the polymerization reaction was completed, while the labial surface of the tooth was exposed.

Denture cleansers that were used in this study are of three types: two commercial:Bony plus tablet (Switzerland) and Protefix tablet (Germany) and one cleanser solution was prepared by mixing sodium bicarbonate (China) 9.52 gm and clear commercial vinegar (UAE) 16 ml in 100 ml of distilled water [17], the control group was distilled water. Twenty samples were prepared for each type of artificial teeth, those were divided in such away that each cleanser had five samples and five samples inside distilled water as a control. All the artificial teeth were underwent color measurement technique by using Easyshade's spectrophotometer before their immersion in the disinfectant solutions. The samples were immersed in their cleansers in plastic containers at room temperature for one month simulating one month usage by a patient, the immersion time was eight hours /day in which the cleansers were changed daily throughout one month, while distilled water was changed every twenty four hours [17]. The color of the samples were measured after 1 week, 2weeks and 4 weeks of immersion by using Easyshade's spectrophotometer to obtain delta information about color represented by parameters individually (hue/ chroma/ value) [18].

The data convert from (H C V system) to L*a*b system by using commercial graphic software program (Adobe Photoshop 9.0).

Where L is measurement of lightness, a* value represent poisons on red- green axis, the b* value represent poison on yellow –blue.

Color change $\Delta E = [(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2]^{1/2}$

$\Delta E=[(L^*2-L^*1)^2+(a^*2-a^*1)^2+(b^*2-b^*1)^2]^{1/2}$ [19, 20]

Data of the study were analyzed statistically by Analysis of Variance (ANOVA) followed by Duncan's multiple range test to determine the significance level.

RESULT

The result showed that there was no significant differences of L'a'b* values of ceramic teeth , and RHM teeth and a' value for Acry-rock teeth after 1 week of denture cleanser immersion, while there was a significant difference for L'b* value of Acry-rock teeth types (Table 1).

Table (1): ANOVA of the effect of one week immersion in denture cleansers on L'a'b of thee artificial teeth.

Artificial teeth		groups	Sum of squares	df	Mean of squares	f	Sig.
		Between group	44.8	3	14.93	0.264	0.85
	L	With in groups	90.4	16	5.65		
		Total	135.2	19			
		Between group	3.75	3	1.25	1.11	0.37
Ceramic	**A**	With in groups	18	16	1.12		
		Total	21.75	19			
		Between group	6.55	3	2.18	0.97	0.43
	B	With in groups	36	16	2.25		
		Total	42.55	19			
		Between group	35.35	3	10.45	1.93	0.16
	L	With in groups	86.4	16	5.4		
		Total	117.75	19			
		Between group	14.6	3	4.86	2.94	0.06
RHM	**A**	With in groups	26.4	16	1.65		
		Total	41	19			
		Between group	41.6	3	13.86	0.13	0.66
	B	With in groups	53.6	16	3.35		
		Total	95.2	19			
		Between group	25.2	3	8.4	4.09	**0.02**
	L	With in groups	32.8	16	2.05		
		Total	58	19			
		Between group	8.15	3	2.71	2.93	0.06
Acry-rock	**A**	With in groups	14.8	16	0.92		
		total	22.95	19			
		Between group	24.2	3	8.06	3.7	**0.03**
	B	With in groups	34.8	16	2.17		
		Total	59	19			

Table (2) showed that the a'b values of ceramic teeth and L value of RHM teeth were significantly differencent ($p \leq 0.05$) after 2 week of immersion in three type of denture cleanser.

Analysis of variance (Table 3) demonstrated that L'a'b value for ceramic teeth and RHN teeth were statistically significant after 4 week immersion in the three types of denture cleanser.

Duncan's multiple range test showed that L value of Acry-rock teeth after 1 week immersion of Soda + vinegar had significant differences than that for control and the other two denture cleansers.

While there was a significant differences of L value of RHM teeth immersed for 2 week in soda + vinegar, and Bony plus denture cleanser than other cleanser. Whereas after 4week immersion the L value of ceramic and RHN teeth were statistically significant after immersion in the three types of denture cleanser (Figure 1).

Figure (2) revealed that a' value of ceramic teeth which immersed in Bony plus for 2 week was significantly different from that immersed in protifex and soda + vinegar.

Table (2): ANOVA of the effect of two week immersion in denture cleansers on L'a'b of thee artificial teeth.

Artificial teeth		groups	Sum of squares	df	Mean of squares	f	Sig.
Ceramic	L	Between group	2.95	3	0.98	0.27	0.84
		With in groups	56.8	16	3.55		
		Total	59.75	19			
	a	Between group	13.8	3	4.6	5.11	**0.01**
		With in groups	14.4	16	0.9		
		Total	28.2	19			
	b	Between group	32.55	3	10.85	6.11	**0.00**
		With in groups	28.4	16	1.77		
		Total	60.95	19			
RHM	L	Between group	65.75	3	21.91	6.17	**0.00**
		With in groups	56.8	16	3.55		
		Total	122.55	19			
	a	Between group	10.8	3	3.6	2.4	0.1
		With in groups	24	16	1.5		
		Total	34.8	19			
	b	Between group	13.6	3	4.53	1.67	0.21
		With in groups	43.2	16	2.7		
		Total	56.8	19			
Acry-rock	L	Between group	17.35	3	5.78	2.78	0.07
		With in groups	33.2	16	2.07		
		Total	50.55	19			
	a	Between group	1	3	0.33	0.49	0.69
		With in groups	10.8	16	0.67		
		total	11.8	19			
	b	Between group	3.8	3	1.26	0.76	0.52
		With in groups	26.4	16	1.65		
		Total	30.2	19			

Table (3): ANOVA of the effect of four weeks immersion in denture cleansers on L'a'b of thr types of artificial teeth.

Artificial teeth		groups	Sum of squares	df	Mean of squares	F	Sig.
Ceramic	L	Between group	48.8	3	16.26	6.5	**0.00**
		With in groups	40	16	2.5		
		Total	88.8	19			
	a	Between group	11.35	3	3.78	5.82	**0.00**
		With in groups	10.4	16	0.65		
		Total	21.75	19			
	b	Between group	23.53	3	7.78	5.87	**0.00**
		With in groups	21.2	16	1.32		
		Total	44.55	19			
RHM	L	Between group	235.8	3	78.6	17.37	**0.00**
		With in groups	72.4	16	4.52		
		Total	308.2	19			
	a	Between group	45.2	3	15.06	4.67	**0.01**
		With in groups	51.6	16	3.22		
		Total	96.8	19			
	b	Between group	95.35	3	31.78	5.96	**0.00**
		With in groups	85.2	16	5.32		
		Total	180.55	19			
Acry-rock	L	Between group	5.35	3	1.78	0.51	0.67
		With in groups	55.6	16	3.47		
		Total	60.95	19			
	a	Between group	3.75	3	1.25	1	0.41
		With in groups	20	16	1.25		
		Total	23.75	19			
	b	Between group	12.95	3	4.31	2.18	0.13
		With in groups	31.6	16	1.97		
		Total	44.55	19			

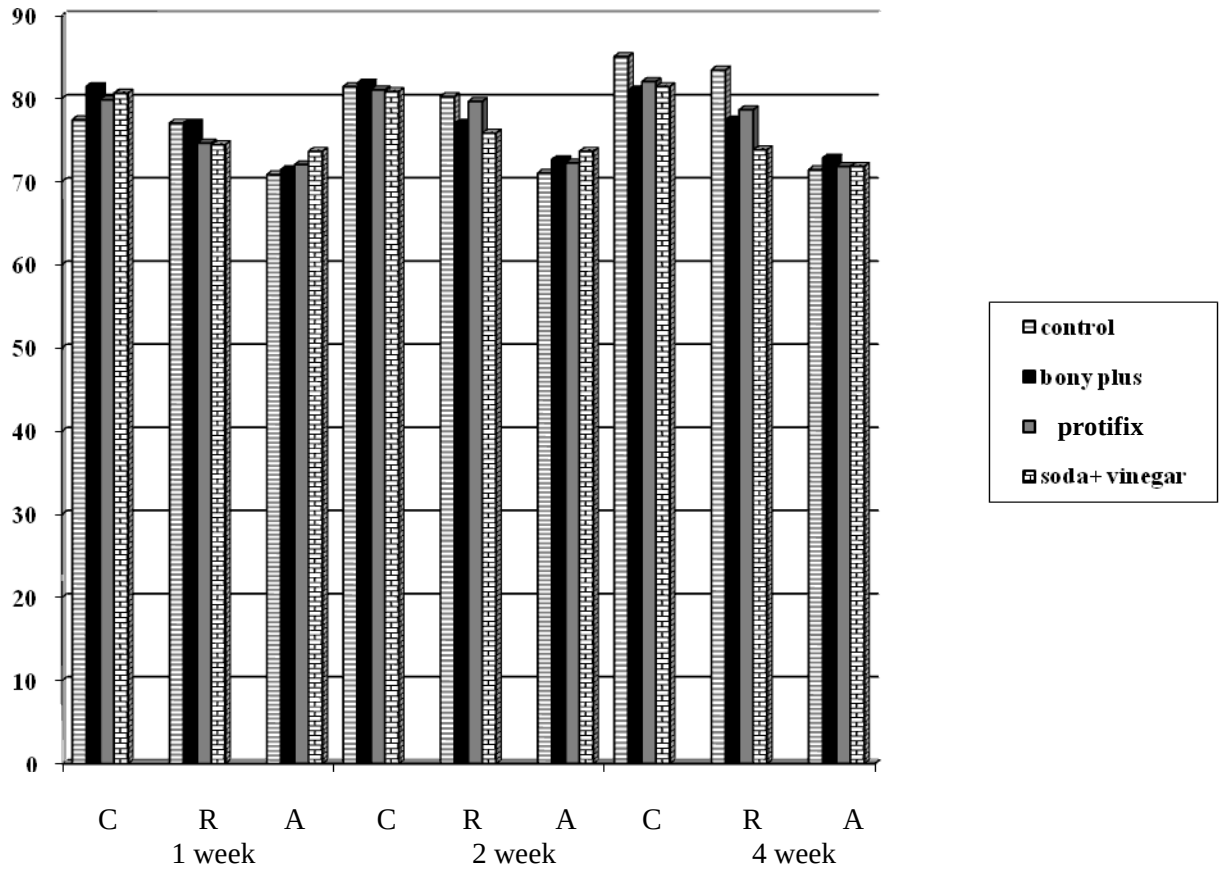
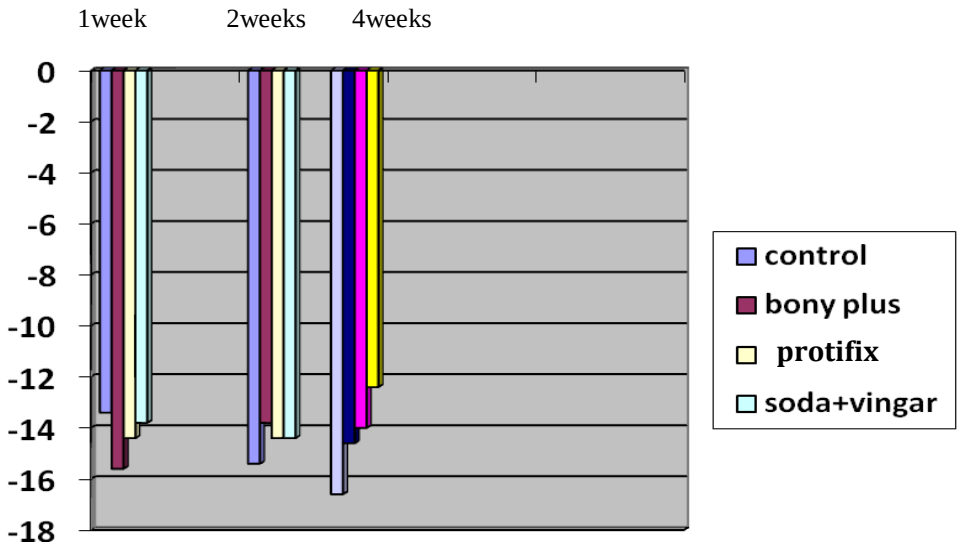
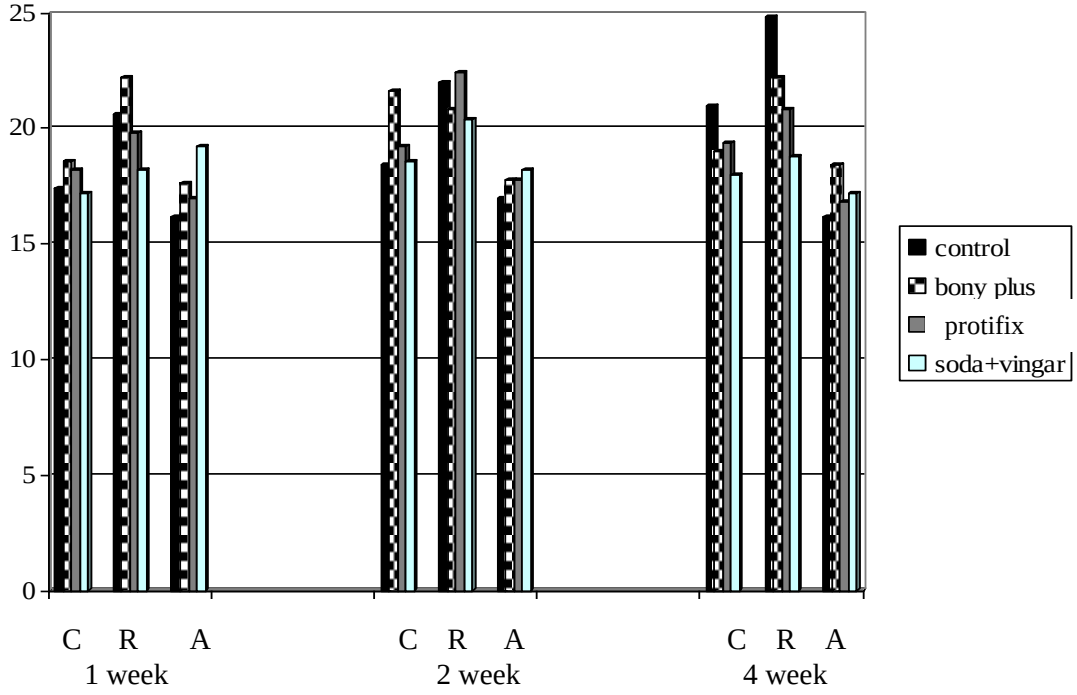


Figure (1): Duncan's multiple range test and mean of L of different immersion time of denture cleansers on three artificial teeth.
C:ceramic,R:RHM,A:Acry-rock.



Figure(2) Duncan's multiple range test and mean of a* value of different immersion time of denture cleansers on the artificial teeth.

Figure (3) demonstrated than soda + vinegar was affecting significantly the b' value of Acry-rock teeth after 1 week of immersion, while bony plus significantly affect the b' value of ceramic teeth after 2 week of immersion. The three denture cleanser significantly affected the color of ceramic teeth after immersion for 4 week compared to the control . At the same time the color of RHM teeth immersed in protifex, and soda + vinegar was significantly differed from the control.



Figure(3) Duncan's multiple range test and mean of b of different immersion time of denture cleansers on three types of artificial teeth.
Where C:ceramic,R:RHM,A:Acry-rock.

Table(4) show the rate of acceptance of the color change in relation to ΔE value , if the value of variables ≤ 3.7 was considered clinically accepted in vitro study, while if the value was ≤ 6.8 considered accepted in vivo. The result of color change (ΔE) for three denture cleansers of three periods of immersion were clinically accepted [19,20]

DISCUSSION

Factors that may contribute to the change in the color of materials include stain accumulation, dehydration and oxidation of the reacted carbon-carbon double bonds that produces colored peroxide compounds, and continuing formation of the colored degradation products[21].

As shown in Table (1) and Figures (1, 2 and3) the lightness value (L*) and hue (b*) value of Acry-rock artificial teeth was significantly increased after 1 week immersion in soda+ vinegar cleanser which had acidic pH (73.8 and 19.2 respectively) in respect to distilled water immersion (70.8 and 16.2) this result may be due to the fact that a denture cleansing composition for dissolution in water to form a cleansing bath with a initial acidic pH [22] this decrease in pH of solution lead to increase in water sorption of acrylic denture teeth which lead to penetration of colorants constituents of solution [21,23].

Table (4) ΔE of the effect of immersion time on the action of denture cleanser for three teeth types.

Type of teeth	Comparison	Type of cleanser	ΔE
Ceramic	Before immersion verses after 4weeks	Bony plus	0.447
		Protefix	1.789
		Soda+ vinegar	0.489
RHM	Before immersion verses after 4weeks	Bony plus	1.8
		Protefix	1.661
		Soda+ vinegar	2.375
Acry-rock	Before immersion verses after 4weeks	Bony plus	1.969
		Protefix	0.2
		Soda+ vinegar	0.91

While after 2 week of artificial teeth immersion in denture cleanser Table(2) and Figures(1,2 and 3) the L*value of RHM teeth were decreased by the effect of Bony plus and soda+ vinegar cleansers (75.8, 77) in respect to distilled water (80.2). For a* (15.6) and b* (21.6)value was significantly increased for ceramic teeth immersed in Bony plus denture cleanser in contrast to control group. This result may be due to the fact that after two weeks of immersion in soda+ vinegar PH effect was increase on RHM teeth and the active oxidation effect of bony plus was increased which effect the ceramic teeth.[24]

After 4 week of immersion ceramic teeth and RHM teeth show significantly decrease in L*a*b values in contrast to Acry- rock teeth and control teeth. This result may be due to accumulating whitening effect (dehydration and oxidation) in ceramic teeth and RHM teeth after 30 days of simulated use of denture cleansers[24].

CONCLUSION

Soda+ vinegar and Bony plus denture cleanser cause color change of artificial teeth rather than protifex , cross linked teeth with nano fillers (Acry- rock) had color stability rather than ceramic teeth and RHM cross linked teeth. Long period of immersion of artificial teeth in denture cleanser cause significant color change for L*a*b* values but they were clinically accepted.

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