ISSN: 1812–1217

The Effect of Different Denture Cleansers on Different Color Properties of Permanent Soft Liner

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الخلاصة

أهداف البحث: يهدف البحث الى تحديد تأثير منظفات طقوم الأسنان على خواص الألوان وهي نوعية اللون، وبريق اللون، وتشبع اللون لمادة تبطين طقم الأسنان من النوع السلكوني الدائم ولفترات غمر مختلفة .**المواد وطرائق العمل**:غمرت عينات المادة المبطنة للطقم في أربعة منظفات وهي : مزيج حامض الليمون مع الصودا، والمادة الثانية هي محلول ملح الطعام، والمادة الثالثة هي مزيج حل التفاح مع الصودا والمادة الأخيرة هي محلول الشب، ولفترات زمنية عديدة هي: (يوم واحد وثلاثة أيام وسبعة أيام وأربعة عشر يوما). تم استعمال جهاز مطياف رقمي لتحديد اختلاف صفة اللون قبل وبعد كل فترة غمر لكل محلول على حدة . **النتائج**: أظهرت النتائج أن كل من حامض الليمون وملح الطعام أدى إلى نقصان قيمة البريق والتشبع والنوعية. بينما لم يؤثر حل التفاح على أي من الصفات. وأدى الشب إلى نقصان قيمة البريق والتشبع بينما لم يؤثر على نوعية اللون. **الاستنتاجات**: يختلف تأثير منظفات الطقوم المختلفة على الصفات المختلفة للون المادة المبطنة للطقوم. كما يختلف تأثير فترات الغمر على الصفات المختلفة للون المادة المبطنة.

الكلمات المفتاحية: منظفات الطقوم، اللون، المادة المبطنة للطقم

ABSTRACT

AIMS: To determine the effect of different denture cleansers on hue, value, and chroma of permanent silicone soft liner at different immersion periods. **MATERIALS AND METHODS:** Soft liner specimens were immersed in four denture cleansers ("citric acid + soda", salt, "apple vinegar + soda", and alum) for periods of 1, 3, 7, and 14 days. A digital spectrophotometer was used to access color differences of soft liner before and after each storage period in each solution. **RESULTS:** The citric acid and salt cleansers decrease the value, chroma, and hue. The apple vinegar cleanser does not affect significantly any color property. The alum cleanser decrease value and chroma, but does not affect hue of soft liner. **CONCLUSIONS:** The effects of different denture cleansers tested on different color properties of soft liner were different. The effect of the immersion period on the different color properties tested was different for each denture cleanser.

Key Words: denture cleanser, color, soft liner.

Al–Ali AA. The Effect of Different Denture Cleansers on Different Color Properties of Permanent Soft Liner. *Al–Rafidain Dent J*. 2011; 11(1):78-87.
Received: 16/7/2009 ***Sent to Referees:*** 16/7/2009 ***Accepted for Publication:*** 27/10/2009

INTRODUCTION

The use of soft denture liners has become increasingly popular for providing comfort for denture wearers. Soft denture liners are often used for patients who cannot tolerate a conventional denture base.(1)

The denture cleanliness is an essential component of oral health to prevent malodor, poor esthetic and accumulation of plaque and calculus with its deleterious effect on oral mucosal tissue.(2)

A chemical soaking technique is primarily the method of choice for geriatric patients and for those with poor motor capacity.(3,4)

Denture cleaners can cause significant deterioration of soft liners because they can cause loss of soluble components and plasticizers, or absorption of water or saliva by the soft liners. Thus the selection of denture cleanser should be considered to avoid or minimize changes in the properties of soft liners.(3,4)

There is some knowledge about the changes in color stability of soft denture lining materials caused by denture cleansers.(5,6)

Many researchers attempt to use natural, locally available materials as denture cleansers. Of the important materials used are citric acid, sodium chloride, vinegar, and alum. (2,7-9)

The color stability criteria may provide an important information on the serviceability of the dental materials.(10)

Color is a three-dimensional phenomenon. The three dimensions are hue, value, and chroma. Hue is the quality that

distinguishes one family of colors from another. It is specified as the dominant range of wavelengths in the visible spectrum that yields the perceived color, even though the exact wavelength of the perceived color may not be present because in fact hue is an interpretation of a sum of wavelengths. Value, or brightness, is the amount of light returned from an object. Munsell described value as a white to-black gray scale. Bright objects have lower amounts of gray, and low-value objects have larger amounts of gray and will appear darker. Lowering value means diminished light returns from the object illuminated; more light is being absorbed, scattered elsewhere, or transmitted through. Chroma is the saturation, intensity, or strength of the color.[11]

The aim of this research is to determine the effect of four denture cleansers (which are "citric acid + soda", salt, "apple vinegar + soda", and alum) on the three dimensions of color (which are hue, value, and chroma) of permanent silicone soft liner at different immersion periods.

MATERIALS AND METHODS

Permanently soft polyvinyl siloxane reline material (Mucopren soft, Germany) was processed following the manufacturers instructions to produce circular specimens with a diameter of 30mm and a thickness of 1mm.[3]

Four natural, locally available denture cleansers were used[2]:

1- Citric acid(4.57g)+soda(sodium bicarbonate)(2g)+water(100ml).
2- Salt(40g)+water(100ml).
3-Apple vinegar(acetic acid) (5ml)+soda (7g)+water(100ml).
4- Alum(5g)+water(100ml).

For each denture cleanser, ten specimens were prepared to be evaluated.

The specimens were immersed in distilled water for 7 days for conditioning. During the storage of specimens in water and subsequently during their immersion in the denture cleansers, the specimens were suspended in the solutions by a stainless steel dental wire passing through the center. This will hold the specimens in a vertical position and prevent the contact between the specimens during their immersion in the tested solutions, so each specimen was in contact only with the immersing solutions.[10,2]

After the specimens were taken out, initial color measurements were taken.[12]

A digital spectrophotometer (Easyshade, Vita, Germany) was used to measure the color properties of soft liner specimens including the value, chroma, and hue which displayed digitally on the device (Figure 1). Easyshade spectrophotometer contain a color analyzer with its own light source that has accompanying software for the downloading, evaluation, and transmission of the relevant color data recorded. It standardize the measurements of hue, value, and chroma.

Figure(1):The Vita Easyshade digital spectrophotometer

The color distribution of Easyshade was more ordered (in the value, chroma, and hue scale) than previously reported color distributions of other, traditional shade guides.[13]

The Easyshade spectrophotometer was the most reliable instrument in both in vitro and in vivo circumstances.[14]

The individual white color index of the instrument was used as a color control.[12,15]

The specimens were immersed in denture cleanser solutions for 1, 3, 7, and 14 days.[16]

Specimens placed in water served as controls. Color differences before and after each storage period in each solution were assessed.[16,12]

Mean values for the effect of type of denture cleanser on three properties of the color tested at each immersion period were compared using ANOVA followed by Duncan multiple range test to determine the significant difference at $P<0.05$ level.

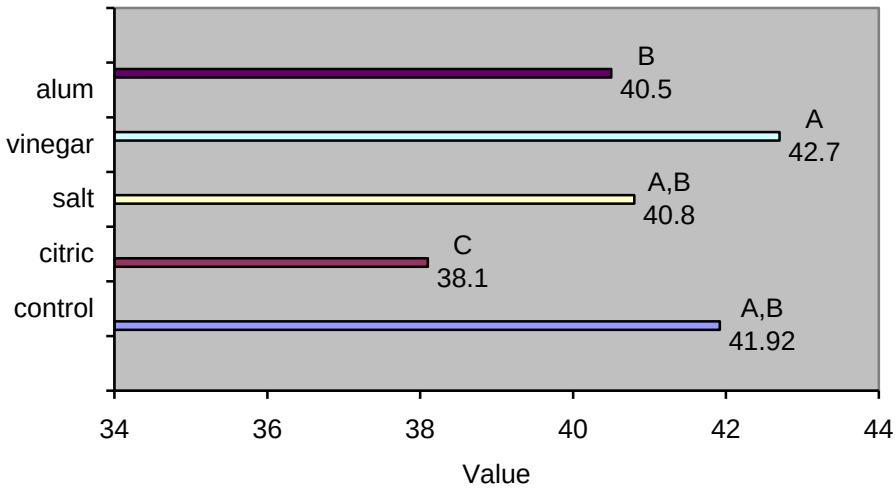
RESULTS

The effect of the immersion period on the different color properties tested was different for each denture cleanser.

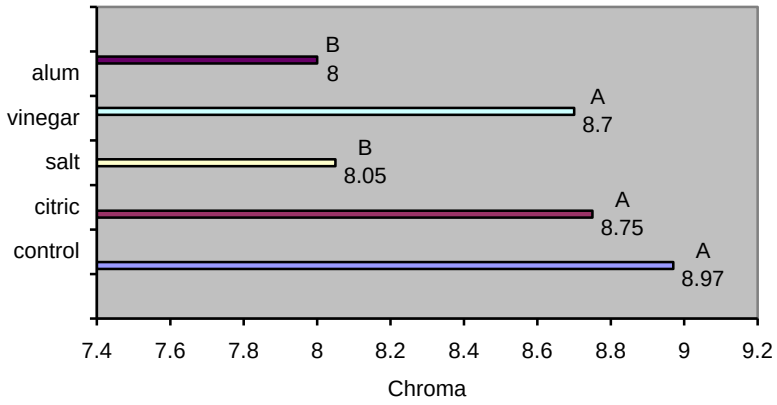
At the first day, the effects of different denture cleansers on the value of permanent soft liner were significant($P=0.000$)(Table 1); with the citric acid cleanser significantly decrease value, and the effects of other cleansers are shown on(Figure 2).The effects on chroma were also significant($P=0.000$)(Table 1); with the salt and alum cleansers significantly decrease chroma, while the citric acid and vinegar cleansers do not (Figure 3).The effects on hue were not significant when compared with the control group(Table 1, Figure 4).

Table(1):ANOVA test of denture cleansers and control at the first day

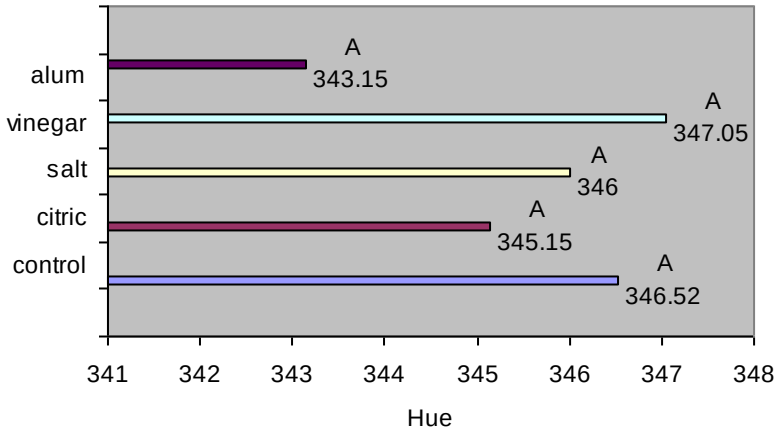
		Sum of Squares	df	Mean Square	F	Sig.
Value	Between Groups	122.443	4	30.611	6.210	0.000
	Within Groups	221.816	45	4.929		
	Total	344.259	49			
Chroma	Between Groups	7.757	4	1.939	9.273	0.000
	Within Groups	9.411	45	0.209		
	Total	17.168	49			
Hue	Between Groups	93.105	4	23.276	1.491	0.221
	Within Groups	702.411	45	15.609		
	Total	795.516	49			



Figure(2):Duncan Multiple Rang Test for value at the first day



Figure(3):Duncan Multiple Rang Test for Chroma at the first day

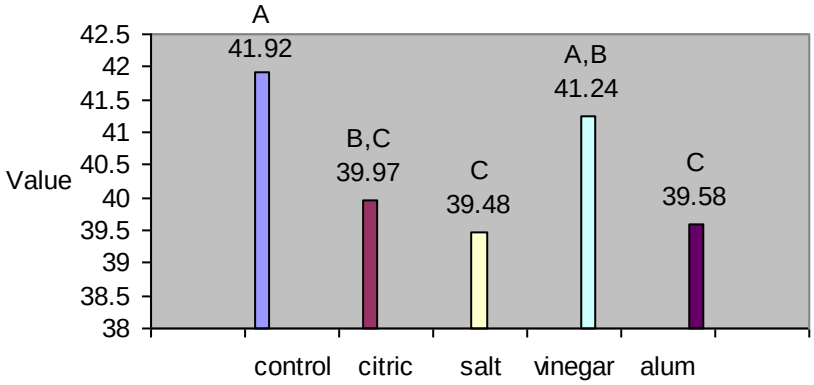


Figure(4):Duncan Multiple Rang Test for Hue at the first day

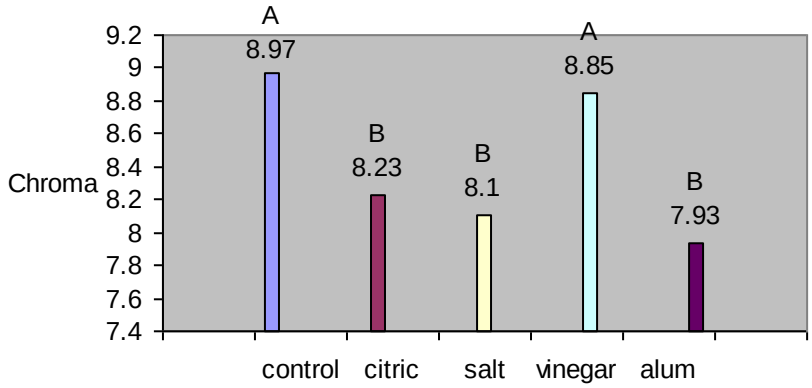
At the third day, the effects of denture cleansers on value were significant (P=0.008) (Table 2); with the citric acid, salt, and alum cleansers significantly decrease value; the results are more illustrated in(Figure 5). The effects on chroma were significant(P=0.002)(Table 2); with the citric acid, salt, and alum cleansers significantly decrease chroma while vinegar cleanser does not(Figure 6). The effects on hue were significant(P=0.002) (Table 2); with the citric acid and salt cleansers significantly decrease hue while the vinegar and alum cleansers do not(Figure7).

Table(2):ANOVA test of denture cleansers and control at the third day

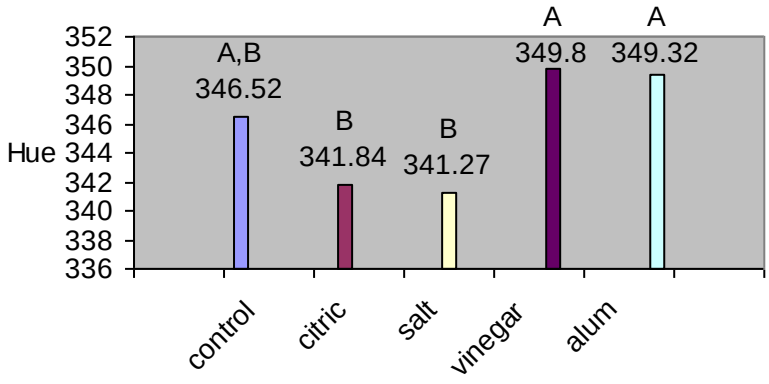
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Value	Between Groups	47.125	4	11.781	3.975	0.008
	Within Groups	133.373	45	2.964		
	Total	180.498	49			
Chroma	Between Groups	8.659	4	2.165	5.141	0.002
	Within Groups	18.948	45	0.421		
	Total	27.607	49			
Hue	Between Groups	650.988	4	162.747	5.095	0.002
	Within Groups	1437.397	45	31.942		
	Total	2088.385	49			



Figure(5):Duncan Multiple Rang Test for value at the third day



Figure(6):Duncan Multiple Rang Test for Chroma at the third day

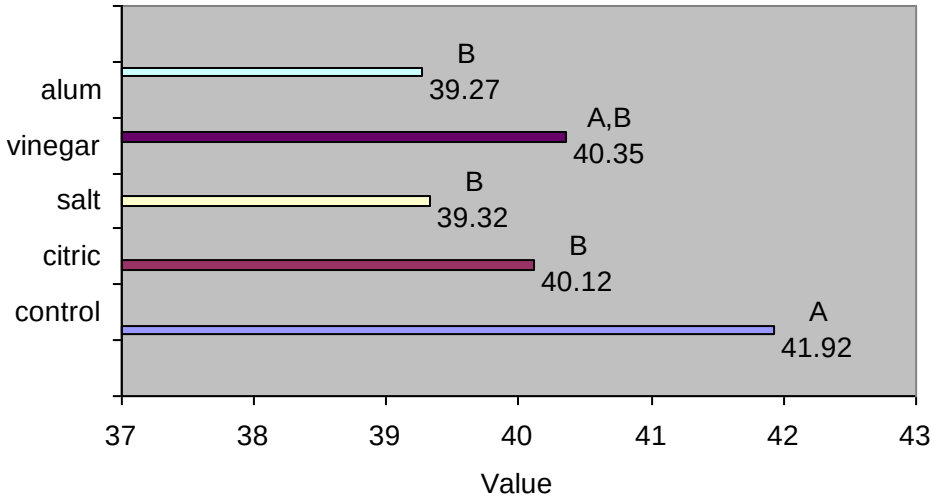


Figure(7):Duncan Multiple Rang Test for Hue at the third day

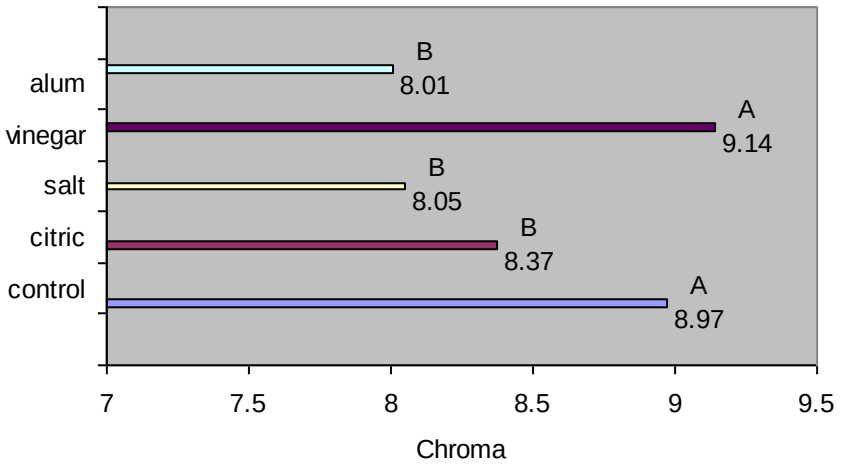
At the seventh day, the effects on value were significant(P=0.010)(Table 3); with the citric acid, salt, and alum cleansers significantly decrease value. The results are more specified in(Figure 8). The effects on chroma were significant (P=0.000) (Table 3); with the citric acid, salt, and alum cleansers significantly decrease chroma while the vinegar cleanser does not(Figure 9).The effects on hue were significant(P=0.041)(Table 3); with the citric acid cleanser decrease hue and the other results are shown on(Figure 10).

Table(3):ANOVA test of denture cleansers and control at the seventh day

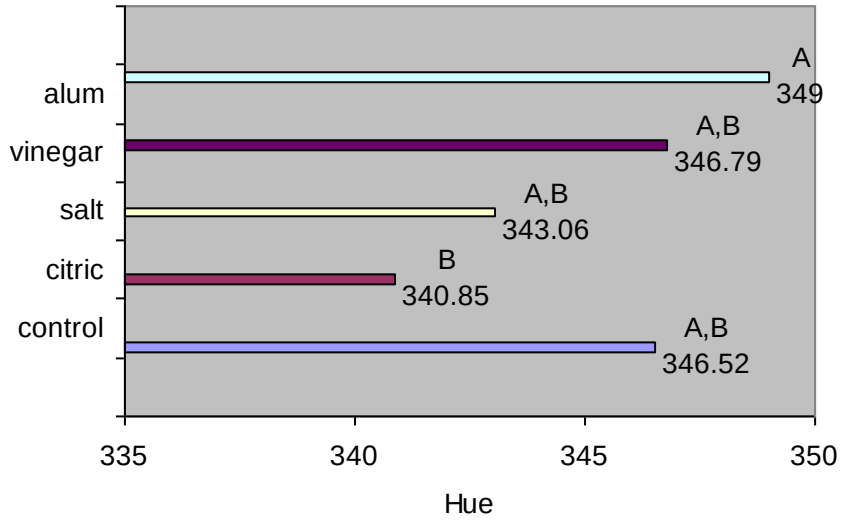
		Sum of Squares	df	Mean Square	F	Sig.
Value	Between Groups	46.265	4	11.566	3.739	0.010
	Within Groups	139.214	45	3.094		
	Total	185.479	49			
Chroma	Between Groups	10.897	4	2.724	6.425	0.000
	Within Groups	19.080	45	0.424		
	Total	29.977	49			
Hue	Between Groups	422.029	4	105.507	2.726	0.041
	Within Groups	1741.754	45	38.706		
	Total	2163.783	49			



Figure(8):Duncan Multiple Rang Test for value at the seventh day



Figure(9):Duncan Multiple Rang Test for Chroma at the seventh day

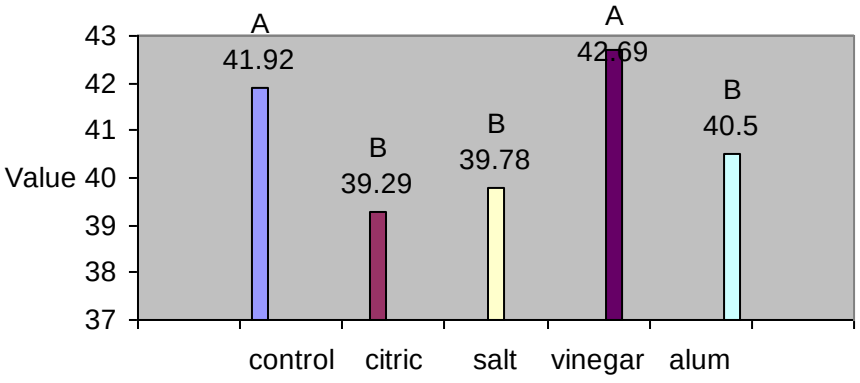


Figure(10):Duncan Multiple Rang Test for Hue at the seventh day

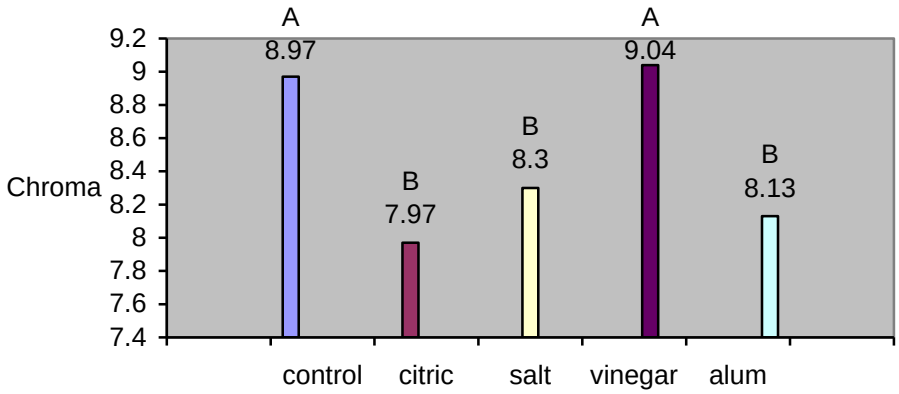
At the fourteenth day, the effects on value were significant(P=0.000) (Table 4); with the citric acid, salt, and alum cleansers significantly decrease value and the vinegar cleanser does not(Figure 11). The effects on chroma were significant (P=0.000)(Table 4); with the citric acid, salt, and alum cleansers significantly decrease chroma while the vinegar cleanser does not (Figure 12). The effect on hue were significant (P=0.001)(Table 4); with the citric acid and salt cleansers significantly decrease hue while the vinegar and alum cleansers do not(Figure 13).

Table(4):ANOVA test of denture cleansers and control at the fourteenth day

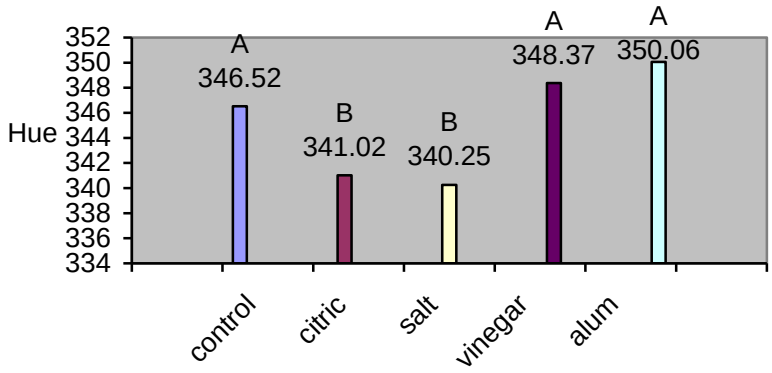
		Sum of Squares	df	Mean Square	F	Sig.
Value	Between Groups	82.305	4	20.576	8.961	0.000
	Within Groups	103.330	45	2.296		
	Total	185.635	49			
Chroma	Between Groups	9.687	4	2.422	6.378	0.000
	Within Groups	17.087	45	0.380		
	Total	26.774	49			
Hue	Between Groups	773.761	4	193.440	5.406	0.001
	Within Groups	1610.342	45	35.785		
	Total	2384.103	49			



Figure(11):Duncan Multiple Rang Test for value at the fourteenth day



Figure(12):Duncan Multiple Rang Test for Chroma at the fourteenth day



Figure(13):Duncan Multiple Rang Test for Hue at the fourteenth day

DISCUSSION

It has been reported that denture cleansers can cause loss of soluble components and plasticizers, or absorption of water or saliva by the soft lining materials.[17]

The mechanism of color change cannot be known exactly, but it can be estimated.[18]

The color change of the denture base polymer may be also caused by penetration of the colored substance through the process of sorption. Therefore, if the contacting solutions are pigmented, discoloration will be possible.[10]

The color changes of soft denture liners are attributed to changes in the colorants used, a change in color of the elastomer, or both. Some colorants or elastomers may be affected by high humidity.[19]

"Citric acid+ soda" produced a significant decrease in the value, chroma, and hue of the soft liner specimens and this decrease may be due to the chelating property of the sodium citrate that is produced from the reaction between the citric acid and soda(sodium bicarbonate). This can be illustrated as sodium citrate solution has pH value close to the neutral which makes it more effective in chelation (removal of the organic and inorganic components of the deposit). The chelating process will involve removal of colorant substances of material.[20,8] These findings are in agreement with Al–Aubadi.[2]

"Apple vinegar+ soda"(Acidic denture cleanser) was shown to affect insignificantly the value, chroma, and hue of the soft liner specimens. These findings are in agreement with Al-Abbas and Asmussen who found that the reduction of the pH of the storage water had only little effect on the color of acrylic resin materials.[10,21]

Alum (potassium Aluminum sulphate) produced a significant decrease in the value and chroma of the soft liner specimens. This may be due to the fact that when the non-aqueous solution of the

aluminum salt dissolved in the water the eighth surfaces aluminum ion formed [AL $(H_2O)_6]^{+3}$. It will then hydrolyze to form $(H_3O)^+$ that gives acidity to the solution.

$2KAL(SO_4)2 + 12\ H_2O \rightarrow 2[AL(H_2O)_6]^{+3} + K_2SO_4$

The very high acidity of the solution (pH=3.27) leads to an increase in water sorption.(2)

CONCLUSIONS

The effects of different denture cleansers tested on different color properties of permanent soft liner tested were different. The effect of the immersion period on the different color properties tested was different for each denture cleanser. The citric acid solution cleanser decrease value, chroma, and hue. The salt solution cleanser decrease value, chroma, and hue. The citric acid and salt solution cleansers differ in their effect in relation to the amount of decrease in all color properties tested and the time required for such change. The apple vinegar solution cleanser does not affect significantly any of the color properties tested. The alum solution cleanser decrease value and chroma, but does not affect hue.

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