

## EFFECT OF SIWAK EXTRACTS ON THE HARDNESS PROPERTY OF VINYL ADDITION CURED SILICONE MAXILLOFACIAL PROSTHETIC MATERIAL

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### ABSTRACT

**Aims:** The study aims to evaluate the hardness of the vinyl addition silicone maxillofacial material under the influence of disinfection and immersion time.

**Materials and Methods:** 40 samples of (20\*15\*3.5)mm were fabricated from the maxillofacial elastomer and divided into 4 groups of disinfection solutions (three concentrations of siwak extract: 1% , 2% and 5%), and Chlorhexidine was used as a commercial disinfectant , each group was subdivided into 2 immersion periods (15 and 30 hours), the hardness of the samples was measured before immersion and considered as self control and also the hardness was measured at the end of each immersion period by the use of Shore-A durometer.

**Results:** A significant difference was observed in hardness means after immersion and also there were significant differences between groups of disinfection in which siwak extract 1% observed the least value and chlorhexidine the highest one.

**Conclusions:** long immersion period 30 hours increased the hardness of the maxillofacial elastomer more than the shorter period 15 hours and the disinfection with the extracts of Siwak were better than chlorhexidine when the hardness is the factor.

**Keywords:** Hardness, maxillofacial elastomer, disinfection, Siwak extracts.

### INTRODUCTION

Maxillofacial materials are used to replace missing parts in the region of the face and maxilla, mainly due to trauma, disease or congenital deformities (Kiat-amnuay et al., 2005). Silicone is the most common material used to fabricate maxillofacial prosthesis because of its texture, strength, durability and patient comfort (Guiotti et al., 2010)

After a few months of use, the prosthesis becomes unpleasant, (Mancuso et al., 2009 and Goiato et al., 2009) and microorganisms colonizing the silicone may cause infection of surrounding tissue(Goiato et al., 2009 and Guiotti et al., 2010). Patients have to disinfect their maxillofacial prosthesis every day in order to maintain their hygiene (Hatamleh et al., 2011). Chemical disinfection can produce some properties alterations of the silicone used as a maxillofacial prosthesis.

Maxillofacial elastomers during their clinical life exhibit changes which affect their structure and surface characteristics (Eleni et al., 2013).

Surface changes such as hardness is often the main reason for changing the prosthesis since this alteration is that patient usually perceive and is eye detectable (Goiato et al., 2009) .

Salvadora persica (Siwak) is a medical plant which has been used for centuries as oral hygiene tool and its extract possess many biological properties like antibacterial, antifungal and anti-inflammatory as shown by many studies (Al-Otaibi, 2004; Sofrata,2010 and Al-Nidawi et al., 2010) . Whichever solution is chosen, disinfection should be a daily treatment lasting 3-5 minutes in which patient have to apply them on the prosthesis and wipe it out gently without brushing (Hatamleh et al., 2011) in order to avoid dissolving and removing some pigments from the external surface.

The aim of this study was to examine the disinfection with siwak extracts on the hardness of a maxillofacial silicone material under the influence of storage time.

## MATERIALS AND METHODS

### 1- Preparation of samples:

Forty samples of (20\*15\*3.5) mm length, width and thickness from maxillofacial vinyl addition cured silicon rubber material (polymerkit, wales) were fabricated in stone molds from wax specimens replica, samples were prepared by mixing the material manually according to the manufacturer's instruction 10:1 part A to part B, an intrinsic liquid pigment (pink) colored added 0.2% by weight, all samples were prepared by pouring the material in stone molds, clamped in their flasks and pressed by hydraulic pressing machine up to 150 psi to avoid air entrapment. The samples polymerized for 1 hour at 100°C according the manufacturer's instruction.

### 2-Disinfection procedures:

Salvadora Persica (Siwak) extract:- SalvadoraPersica chewing sticks (Saudi Arabia) were removed from their package and left to dry, they were cut to small pieces and ground to powder using a food blender. 120 ml of 60% ethanol were added to 40 gm of powder in a sterile container, left for 3 days at room temperature and then filtered using No.1 filter paper. The extract was autoclaved at 37°C until it became dry and it was stored in a sterile screw capped vials in the refrigerator ready for use and then freshly prepared in distilled water immediately before use (Al-Otaibi, 2004; Sofrata,2010 and Al-Nidawi et al., 2010). Three concentrations were used in this study: 1% (10mg/ml), (Hatim and Al-Jammal, 2013), 2% (20mg/ml) and 5% (50mg/ml). Chlorehexidine was used as a commercial disinfectant. Maxillofacial samples were distributed to disinfection groups and each group had two immersion periods, so each subgroup had

five samples. The immersion periods were 15 hours and 30 hours in disinfecting solutions. The examined period 15 hours simulated approximately 6 months and 30 hours simulated 1 year (360) days of service for a 5 minutes daily treatment (Ferreira et al.,2009)

### 3-Hardness measurement:

After curing, an initial Shore -A hardness test was performed on all samples using a digital durometer. At the end of immersion periods, all samples were tested for hardness again, this method is based on the penetration of the needle on the surface of the material with a constant load. The results from six readings were taken at six different points in the surface (5 mm apart) for each specimen were averaged. The samples before each disinfecting procedure were considered as self-controls.

### 4-Statistical analysis:

T-test was used to compare the hardness means before and after immersion of the maxillofacial material among disinfection groups. One-way analysis of variance followed by Duncan's multiple range tests were used to analyze the mean (standard deviation) of the hardness values of the maxillofacial elastomer. Statistical differences were defined at  $P \leq 0.05$  level of significance.

## RESULTS

Table (1) and Table (2) revealed a significant difference in mean hardness values of the maxillofacial elastomer before and after immersion at the two immersion periods (15 hrs. and 30 hrs.) among disinfection groups in which P-value was  $\leq 0.05$ .

**Table (1):** t-test of the mean hardness values of the maxillofacial material after 15 hours of disinfection

			Paired Samples Test				
	Group		Mean	SD	t	df	P-value
Siwak1%	Pair 1	before	20.125	.951	-4.683	3	.018
		after	22.531	.909			
Siwak2%	Pair 1	Before	19.750	.883	-5.564	3	.011
		after	23.531	.580			
Siwak5%	Pair 1	Before	18.875	.467	-18.509	3	.000
		after	23.90	.277			
CHX	Pair 1	Before	19.593	.5625	-6.847	3	.006
		after	24.156	.975			

**Table (2):** t-test of the mean hardness values of the maxillofacial material after 30 hours of disinfection

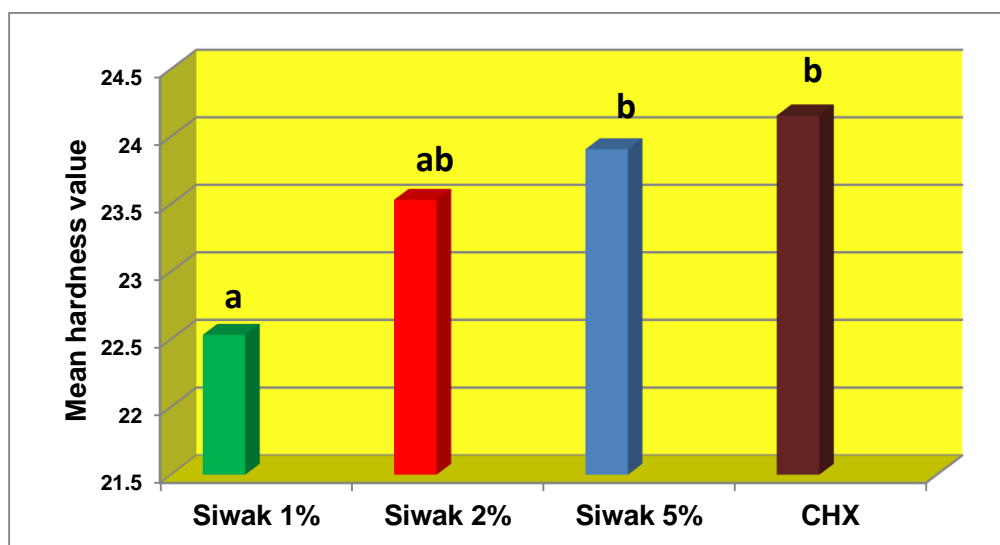
			<i>Paired Samples Test</i>				
	<i>Group</i>		<i>Mean</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>P-value</i>
<i>Siwak1%</i>	Pair 1	Before	19..125	1.103	-7.178	3	.006
		after	23.906	.672			
<i>Siwak2%</i>	Pair 1	Before	20.093	1.037	-4.320	3	.023
		after	24.25	.940			
<i>Siwak5%</i>	Pair 1	Before	20.937	.981	-6.582	3	.007
		after	24.5	.408			
<i>CHX</i>	Pair 1	Before	19.562	.314	-11.817	3	.001
		after	24.968	.695			

Table (3) ANOVA demonstrated a significant difference in mean hardness values of the maxillofacial material after (15 hrs.) of disinfection, but insignificance after (30 hrs.) among disinfection group.

**Table (3):** ANOVA of the mean hardness values of the maxillofacial material after disinfection

	<i>Time</i>	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
15 Hrs.	Between Groups	6.125	3	2.042	3.724	.042
	Within Groups	6.578	12	.548		
	Total	12.703	15			
30 Hrs.	Between Groups	2.398	3	.799	1.609	.239
	Within Groups	5.961	12	.497		
	Total	8.359	15			

Duncan's multiple range test, Figure (1) and Figure (2) showed that the increase in hardness means was as following: Siwak 1%, Siwak 2%, Siwak 5% and CHX respectively after both immersion periods.



**Fig. (1):** DMRT of the mean hardness values of the maxillofacial material after 15 hours of disinfection

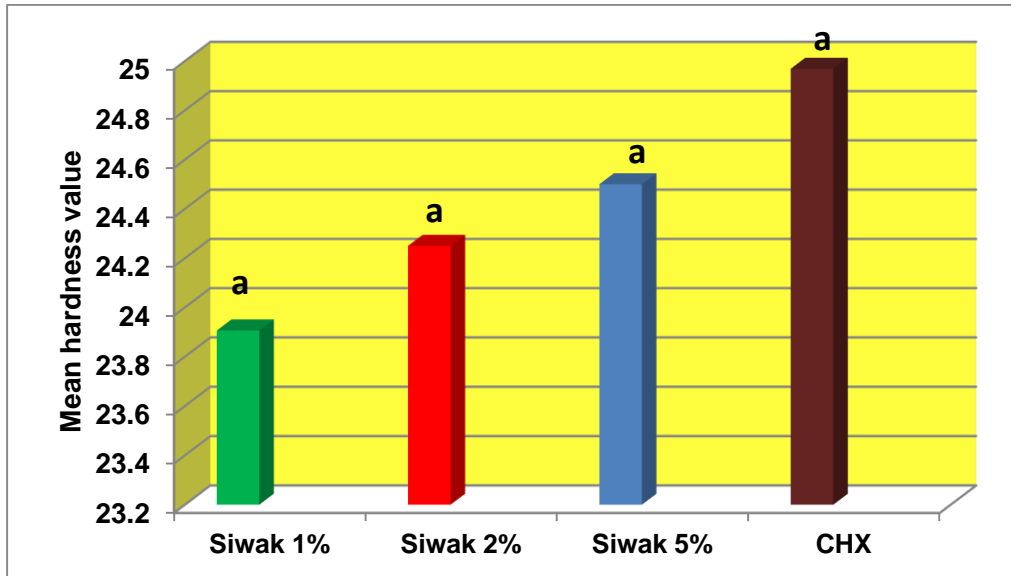


Fig.(2): DMRT of the mean hardness values of the maxillofacial material after 30 hours of disinfection

The difference in hardness between 15 hours and 30 hours of disinfection among disinfection groups was significant in Siwak 1% and Siwak 5% groups, but the difference was insignificant in Siwak 2% and CHX groups as shown in Table (4).

Figure (3) expressed that there was an increase in mean hardness values in all groups of disinfection after long immersion periods 30 hour over the shorter one 15 hours.

Table (4): t-test of the mean hardness values of the maxillofacial material between 15 hours and 30 hours of disinfection

group		Independent Samples Test				
		t-test for Equality of Means				
		Mean	SD	t	df	P-value
Siwak 1%	15 hrs	22.531	.909	-2.432	6	.051
	30 hrs	23.906	.672			
Siwak 2%	15 hrs	23.531	.580	-1.300	6	.241
	30 hrs	24.250	.940			
Siwak 5%	15 hrs	23.906	.2771	-2.407	6	.053
	30 hrs	24.5	.4082			
CHX	15 hrs	24.156	.975	-1.357	6	.224
	30 hrs	24.968	.695			

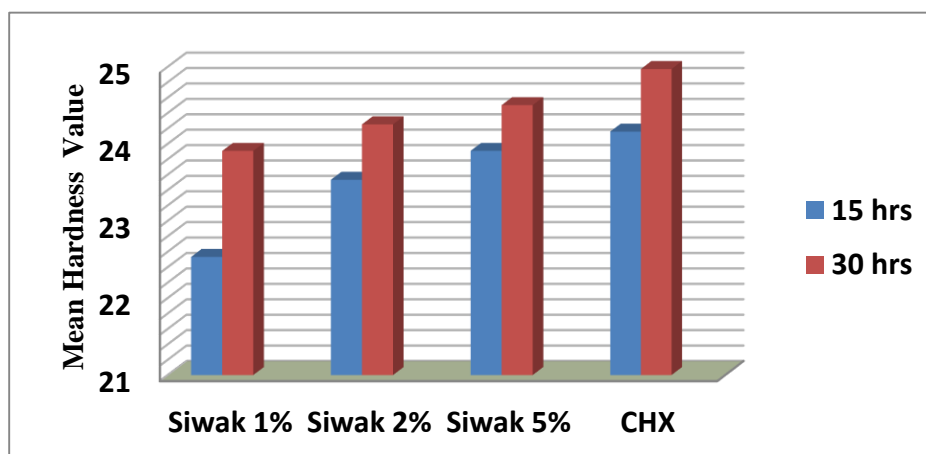


Fig. (3): Means of hardness values of the maxillofacial material at 15 hours and 30 hours of disinfection

## DISCUSSION

One of the desirable properties of a material used as a maxillofacial prosthetic material is low hardness. Shore-hardness is an indicative measure of a material's texture and flexibility.

Hardness measurements of maxillofacial material should remain within a range for their usage. The range is between 10-45 Shore-A which depends on the facial part replaced as each part differs in hardness and stiffness (Lewis and Castleberry, 1980). According to this range, all results in hardness values for the examined material considered as clinically acceptable.

In the present study, a significant increase in hardness values was observed in all groups of disinfection and after both periods of immersion (Table 1 and Table 2). The increase could be the result of continuous silicone polymerization with volatilization of formaldehyde which occurs during aging process ( Mancuso et al., 2009, Goiato et al., 2009, and Mancuso et al., 2009).

Table (3), Figure (1) and Figure (2) showed a significant change in hardness among disinfection groups after the shorter immersion and insignificance in the longer once. In both immersion periods, siwak extracts groups caused change in hardness less than Chlorhexidin group. Among the extracts themselves, as the concentration increases, the hardness increase in which 1% concentration had the least hardness and 5% the highest one. Siwak extract consists of (Trimethylamine, Salvadorine, Chloride, Silica, Fluoride, Sulphate, Vitamin C, Resin, Tannins, Nitrate and Thiocyanate (Darowt et al., 2000).

One reason for this change could be due to the components of the siwak extract when they are more concentrated, the extract becomes harder on the material and the hardness increases because the dilution of the extract become less. While when the extract is 1%, the absorption increases for the disinfection solution and a porous structure may have been formed ( Goiato et al., 2010).

The increase in hardness in Chlorhexidin group could cause damage to the material's physical properties, such as elevation in the solubility and absorption ( Goiato et al., 2009) and could be associated with change in surface characteristics of the polymer along with the movement of some compounds from the polymer matrix to disinfection solution or to the water ( Goiato et al., 2009 and Pesqueira et al., 2011).

Long-term storage increased hardness more than short-term storage as shown in Table (4) and Figure (3) because long-term storage in disinfection solutions can promote water absorption, and the degree of absorption depends on the filler material and the low adhesion between silicone polymers, this could be due to the continuous and ongoing polymerization of the maxillofacial elastomers in addition to the evaporation of acetic acid and formaldehyde.

Goiato et al., (2009) reported that the choice of the disinfectant agent for the prosthesis should be based not only on its antimicrobial properties, but also its compatibility, in order to preserve as much as possible the required properties of the material.

## CONCLUSION

All disinfection groups increased the hardness of the maxillofacial material in both immersion periods., the long period of immersion (30 hours) increased the hardness more than the shorter period (15 hours.).

Salvadora Persica extract affected the hardness of the maxillofacial material in higher concentration more than in lower once, and all the concentrations caused hardness less than chlorhexidine group.

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كارىگه رىا پوختى سىواكى لسه ر سالوخته تى ره قاتى تى يى قىنىلى زىده كرى چاكفه كه رى (معالج) ماده يى سليكونى.

#### پوخته

نارمانج: نه ف ليكولينه مه ره ما وى هه لسه نگاندا سه ختيا زىده كرنا قىنىلى يه مادى پيكيه نهر يى سليكونى لبن كارىگه رىا ماوى پاقرن و نقومكرنى.

كه ره سته و ريك: ٤٠ نمونين ( ٢٠ \* ١٥ \* ٣.٥ ) ملم يين هاتينه دروستكرن ژ متاتى (مگاگ) ده سترد و هاتينه دابه شكرن لسه ر ٤ گروپين شيكارى يين پاقرن. (٣ جىرى ژ پوختى سىواكى : ١٪ ، ٢٪ ، ٥٪ ) و (Chlorehexidine كلورهيكسوداين ) وه كو پاقرن كه ره كى بازگانى دهاته بكار نينان، هه ر گروپه ك دوباره هاته دابه شكرن بو دوو ماوى نقومكرنى ( ١٥ و ٣٠ كاتزيمير). ره قاتيا نمونا به رى نقومكرنى هاته نر خاندن ( پيقان ) و وه كى خوگرى (كوتترول لسه رخو كرن) هاته دانان و هه روه سا پشتى ماوى هه ر نقومكرنه كيژى ره قاتى هاته پيقان برىكا بكار نينانا. Shore - A durometer

نه نجام: ج ياوازيه كا گزنگ دياربو د ره قاتى دا پشتى نقومكرنى و گه له ك جياوازيين دژى هه بون دناف گروپين پاقرن كرندا كو تيدا پوختى سىواكى ١٪ كيترين بها وكلورهيكسوداين بلندترين بها دياركر . ده رنه نجام: ماوى نقومكرنا دريژ يا ٣٠ كاتزيمير ره قاتيا متاتى ده سترد زىده ترلى كر ژ ماوى ١٥ كاتزيميرا و پاقرن ب پوختى (دارى سىواكى *Salvadora persica*) باشتريو ژ Clorohixidine ده مى ره قاتى فاكته ربيت.

به يقين گزنگ: ره قاتى (سه ختى) ، ، maxillofacial مه متاتى ده سترد ، پاقرن كه ر ، (دارى سىواكى) *Salvadora persica*

#### تأثير مستخلصات السواك على خاصية الصلابة لمادة السيليكون من الفينيل المحضرتفاعل الاضافة والمستخدم في تعويضات الوجه والفكين

#### الخلاصة

**الهدف:** تهدف الدراسة الى تقييم خاصية الصلابة لمادة vinyl addition silicone maxillofacial material تحت تأثير التعقيم وعامل الوقت. **المواد وطرق العمل:** تم تحضير 40 عينة بأبعاد ( 15 \* 20 \* 3.5 ) ملم طول وعرض وارتفاع من مادة maxillofacial elastomer وقسمت الى أربع مجاميع من محاليل التعقيم (ثلاث تراكيز لمستخلص السواك: 1% ، 2% ، 5%) كذلك الكلوروهكسيدين كمعقم تجاري، لكل مجموعة فترتين من الغمر (15 ساعة و 30 ساعة). تم قياس خاصية الصلابة للمادة قبل غمرها واعتبرت هذه القراءات كقراءات قياسية، وتم كذلك قياس الصلابة بعد كل فترة غمر باستخدام جهاز (Shore – A).

**النتائج:** أظهرت النتائج إختلافاً معنوياً في قياس الصلابة بعد فترات الغمر وكذلك لوحظ إختلاف معنوي بين مجاميع المعقّمات بحيث أظهرت مجموعة مستخلص السواك بتركيز 1% المعدل الأقل بينما أظهرت مجموعة الكلوروهكسيدين المعدل الأعلى في قياس الصلابة.

**الاستنتاجات:** أظهرت فترة الغمر لمدة 30 ساعة زيادة في معدل الصلابة لمادة maxillofacial elastomer أكثر من فترة الغمر لمدة 15 ساعة، وإن استخدام مستخلصات السواك أظهرت نتائج أفضل من مجموعة الكلوروهكسيدين بالنسبة لقياس الصلابة.

**الكلمات المفتاحية:** الصلابة، maxillofacial elastomer، التعقيم، مستخلصات السواك.