EVALUATION OF THE EFFECT OF SOME DENTURE CLEANSERS ON THE HARDNESS OF TWO DENTURE BASE MATERIALS

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ABSTRACT

Aim and background: The use of denture cleanser is mandatory in order to keep the denture hygienic and free of micro-organisms but should not have adverse effects on the properties of denture base material. This study aims to evaluate the effect of different cleansing solutions on hardness property of two denture base materials.

Materials and Methods: Seventy specimens have been prepared in dimensions(30*10*2.5)mm, length width and thickness respectively, from two denture base materials(heat-cured acrylic resin and flexible denture base materials). Each had thirty five specimens.

These specimens were divided into three groups of cleansers(thyme oil+soda, vinegar+soda and commercial cleanser Kinpro tablet) along with a forth solution as a control group(distilled water). Each group had two immersion periods(thirty minutes and eight hours) in which the cleansers were daily exchanged for a month, while control group had 24 hours immersion and exchanged daily for a month. prior to immersion, hardness property was measured for each sample and after the end of the month, hardness was measured again using Shore D hardness tester. T-test and One Way Analysis of Variance were used to analyze data and determine the significance between the groups at $P \leq 0.05$

Results: T-test analysis showed that there were insignificant differences between groups(before and after immersion) in all denture cleansers groups and in both denture base materials. Analysis of variance also showed insignificant differences between denture cleansers groups. In flexible denture base materials, the natural cleansers showed less hardness values than control group, while in heat-cured acrylic resin it was increased in relation to control group.

conclusion: From the results of this study it was concluded that no significant change in mean hardness was observed and that eight hours immersion period showed higher hardness means than 30 minutes period except for clear vinegar+soda in flexible denture base material.

Keywords: Denture cleanser, Hardness, Denture base materials.

INTRODUCTION

Poly methyl methacrylate(PMMA) is one of the most widely used denture base materials due to its many superior properties(Annusavice, 1996). However, the material has some poor mechanical properties like poor fatigue resistance, and weak transverse strength which leads to fractures(Yazadin et al., 1989). Also it can can be allergic for some wearers(Mabraden, 1988). In recent years nylon based denture base materials was introduced to overcome some of these challenges.

Flexible denture base material was first introduced in 1950s(Lowe et al., 2004). Flexible acrylic resin is a nylon based, very strong and hard to break thermoplastic material, usually pink color, and can be made very thin(Prashanti et al., 2010). The material offer more esthetic advantages, it goes well with the color of natural teeth and gum, the material also doesn't need visible metal clasps(Budtz et al., 2000). It is also more comfortable to the patient, as it flexes with the contours of patient's oral tissues and has a light weight(Yonus et al., 2005), (Negrutiu et al., 2005).

Daily use of the prosthesis will end up forming a thin layer of glycoprotein and immunoglobulins on surface of denture called Pellicle(Singh, 2011). This layer helps increasing bacterial aggregation and colonization, specially that the microporous nature of the denture base provide a suitable environment for such a process(Shay, 2000). This is very problematic for the wearer and has many consequences like denture stomatitis, halitosis, candidiasis, staining and appearance changes(Allis et al., 2012), thats why oral

hygiene and the use of denture cleanser daily is very important. The routine daily use of denture cleansers may have negative impact on denture physical and chemical properties(Petersen, 2005).

One of the important qualities of denture base material is its resistance to indentation, which is referred to as hardness and this property can be affected by daily cleansing routine(Salman et al., 2011).

An ideal denture cleanser should be non toxic, bactericidal, fungicidal and compatible with denture base (Sheen, 2000), i.e it must clean effectively without adversely affecting denture base material properties.

Denture cleansers can be classified according to their mode of action into chemical and mechanical, immersion in a chemical disinfectant is widely used among denture wearers(Craig et al., 1996).

This study aims to evaluate the effect of different cleansing solution on hardness property of flexible and heat- cured acrylic denture base materials.

MATERIALS AND METHODS
Specimens Preparations:
A-Number and dimensions:
Seventy specimens of (30*10*2.5)mm, (ADA, 1999) of two denture base materials were prepared, thirty five specimens from heat cured acrylic resins (Major Prodotti Dentari, Italy) and thirty five specimens of flexible denture base materials(Deflex Global, Spain) as shown in figure(2), samples were distributed evenly across cleansing solutions(10 for each solution divided on two periods of immersion evenly, control group had 5 samples).

B- Mould preparation:
Specimens replica of modeling wax were made according the required dimensions on a glass slab using a sharp wax knife as shown in figure(1). A dental stone type III was mixed with water in a ratio of 30 ml of water to 100 gm of stone (Craig et al., 1996) and was put in the flask. Wax specimens were cleaned, dried and placed over the stone in the flask to prevent air entrapment.

After the stone was set, it was painted with separating medium using a brush, and the upper half of the flask then was placed, poured and allowed to set before putting the flask in a boiled water for 10 minutes to eliminate the wax.

C-Packing and Curing:
1-Flexible
Flexible resin cartridges were inserted inside an electrical furnace to be plasticized at high temperature, according to manufacturer instructions, the device was set at 250°C for 20 minutes. Then the cartridges were removed and placed in the inlet of the flask and compressed using its lever in less than one minute, the pressure were maintained for 3-5 minutes, then the flask was put on bench to cool for 20 minutes (Paryizi et al., 2004). The sprue formers are cut with special type of knife and finishing is done with valcinate burs and green and pink mounted stones, usually used for porcelain finishing, using a rapid and light shaving motion. Then the specimens were polished using conventional polishing protocols.

2-Heat cured acrylic resin
According to the manufacturer instructions, powder/liquid ratio of 3:1 by volume of powder and liquid was mixed and left in a glass jar and covered until it reached dough stage, then it was inserted into the flask, and put under pressure for 5 minutes to ensure proper flow of material inside the flask. The flask was put then in a hot water at 74°C for 1.5 hours and then in a boiled water at 100°C for an hour(Craig et al., 1996). The flask was bench cooled for 20-30 minutes, after that the samples were retrieved from the flask. Then samples were finished and polished using stone bur at low speed and then by silicon carbide paper with continuous water cooling, and then the samples were polished with a rouge and wool brush on dental lathe(Hammoudi, 2006). A hole was made on each sample and labeled with numbers to identify them.

Cleansing Solutions
Three types of denture cleansers were used, two of them were prepared (thyme oil 3.57g + sodium bicarbonate 2g in 100 ml distilled water) and (clear vinegar 5 ml + sodium bicarbonate 7g in 100 ml distilled water) according to (Khalil, 2007), and one commercial cleanser (KinPro tablet in 100 ml of distilled water). Distilled water was used as a control group.

Hardness Measurement
Shore D(figure 3) device was used to record indentation hardness measurement. It is usually used for harder non metallic materials. The device has a stable platform on which samples are put to be held against the indenter which has a diameter of 1.25mm the distance between the sample and

the indenter is between 5-15mm. The samples were subjected to a minor load of 44.5 N and contact continued for 1 second according to manufacturer instructions.

Three different readings across the length of the sample were measured one on the center and two on each side of the sample, the mean was taken as a final record for each sample.

Immersion Procedure

After specimens were prepared, sampled were stored at 37°C for conditioning (Annusavice, 1996). Hardness measurement was recorded prior to immersion in denture cleansers for comparison purposes. Samples were divided according to the cleansers and duration of immersion, 70 glass containers were used to contain cleansing solution, each was labeled with a sticker on which the number of the sample was written. Each container contained one sample hanged with a string to ensure that all surfaces are properly exposed by preventing it from settling in the base of the container.

Each material (flexible and heat cured acrylic) had 35 samples, five samples immersed in distilled water as a control group, and fifteen samples were immersed for 8 hours a day and the other fifteen samples were immersed for 30 minutes a day. After that duration samples were removed from their cleansing solution and washed under distilled water, dried and collected in a distilled water container in which they were stored for the rest of the 24 hours. The procedure was repeated daily for 30 days. After the end of 30 days of immersion, hardness measurements were recorded again to compare the two readings (before and after immersion).

Statistical Analysis

Statistical analysis were done using student t-test to determine the comparative significant difference between two groups (before and after immersion) in denture cleansers. One-way analysis of variance was also used to determine the significance between groups at P-value ≤ 0.05.

Fig. (1): showing waxed samples

Fig. (2): showing final sample

Fig. (3): showing Shore D device

RESULTS

Results for this study for flexible denture base materials revealed that there were insignificant differences between the two groups (before and after) immersion in all denture cleansers at eight hours and thirty minutes as shown in tables(1,2,3,4), also for heat cured acrylic resin denture base material, there was insignificant differences between groups in all denture cleansers except for (vinegar+soda) group at 30 minutes immersion period.

Table (1): student's t-test of hardness measurements after 8 hours immersion in denture cleansers for flexible denture base materials:

		N	Mean	T	std	Sig.(2-tailed) T-test(less than P value of 0.05 is significant)
Pair 1	Before thyme + soda	5	88.000	2.250	3.2403	0.088
	After thyme + soda	5	86.200		3.56371	
Pair 2	Before vinegar + soda	5	84.000	0.930	4.06202	0.405
	After vinegar + soda	5	83.200		3.34666	
Pair 3	Before d water	5	86.200	0.343	2.1679	0.749
	After d water	5	86.000		1.41421	
Pair 4	Before kinPro	5	87.800	0.408	1.92354	0.704
	After kinPro	5	87.400		2.70185	

Table (2): student's t-test of hardness measurements after 30 minutes immersion in denture cleansers for flexible denture base materials:

		N	Mean	T		Std	Sig.(2-tailed) T-test(less than P value of 0.05 is significant)
Pair 1 +soda	Before thyme	5	84.600		1.238	5.079937	0.284
	After thyme+ soda	5	83.400			3.04959	
Pair 2 +soda	Before vinegar	5	86.2500		1.698	3.30404	0.188
	After vinegar+soda	5	84.5000			1.29099	
Pair 3	Before d water	5	86.200		0.0	2.1679	0.749
	After d water	5	86.000			1.4142	
Pair 4	Before kinPro	5	87.400		0.0	4.335	0.189
	After kinPro	5	86.400			3.577	

Table(3): student's t-test of hardness measurements after 8 hours immersion in denture cleansers for heat cured acrylic base materials:

Paired sample test		N	Mean	T	Std	Sig.(2-tailed) T-test(less than P value of 0.05 is significant)
Pair 1	Before thyme +soda	5	82.600	1.58	2.50998	0.189
	After thyme+ soda	5	81.600	1	3.36155	
Pair 2	Before vinegar +soda	5	83.200	1.50	2.049	0.208
	After vinegar+soda	5	82.600	0	1.516	
Pair 3	Before d water	5	78.000	0.40	6.906	0.704
	After d water	5	77.800	8	6.220	
Pair 4	Before kinPro	5	83.000	2.13	1.581	0.099
	After kinPro	5	82.200	8	1.095	

Table(4): student's t-test of hardness measurements after 30 minutes immersion in denture cleansers for heat cured acrylic denture base material denture base materials:

Paired sample test		N	Mean	T	Std	Sig.(2-tailed) T-test(less than P value of 0.05 is significant)
Pair 1	Before thyme +soda	5	81.800	2.058	4.323	0.109
	After thyme+soda	5	80.600		3.361	
Pair 2	Before vinegar +soda	5	81.600	3.087	3.847	0.037
	After vinegar+soda	5	79.800		2.774	
Pair 3	Before d water	5	78.000	-0.784	6.906	0.704
	After d water	5	77.800		6.220	
Pair 4	Before kinPro	5	81.2000	-0.784	2.949	0.477
	After kinPro	5	81.6000		1.949	

Analysis of variance showed non significant differences between groups in both denture base materials in all types of denture cleansers at two immersion periods, as observed in table(5, 6).

Mean values of hardness measurements in flexible denture base material revealed that commercial denture cleanser had the highest mean hardness at both periods of immersion in comparison to control group(distilled water) and thirty minutes immersion caused less hardness changes than eight hours immersion groups except for (vinegar+soda) group which showed higher changes after thirty minutes immersion than after eight hours immersion.

Mean hardness values for heat cured acrylic resin denture base(figure 4, 5) revealed that all cleansers groups had hardness values more than control group in both immersion periods and that the longer the period of immersion (eight hours) showed higher hardness mean than the short period(thirty minutes).

Table(5): Analysis of variance of hardness measurement after immersion in denture cleansers for flexible denture base material.

Immersion period		Sum of squares	DF	mean square	F	Sig.
30 Minutes	Between gps	22.957	2	11.479	1.352	0.299
	Within gps	93.400	11	8.491		
	Total	116.357	13			
8 Hours	Between gps	54.060	3	18.020	1.825	0.173
	Within gps	207.300	21	9.871		
	Total	261.360	24			

Table(6): Analysis of variance of hardness measurement after immersion in denture cleansers for heat cured acrylic denture base material.

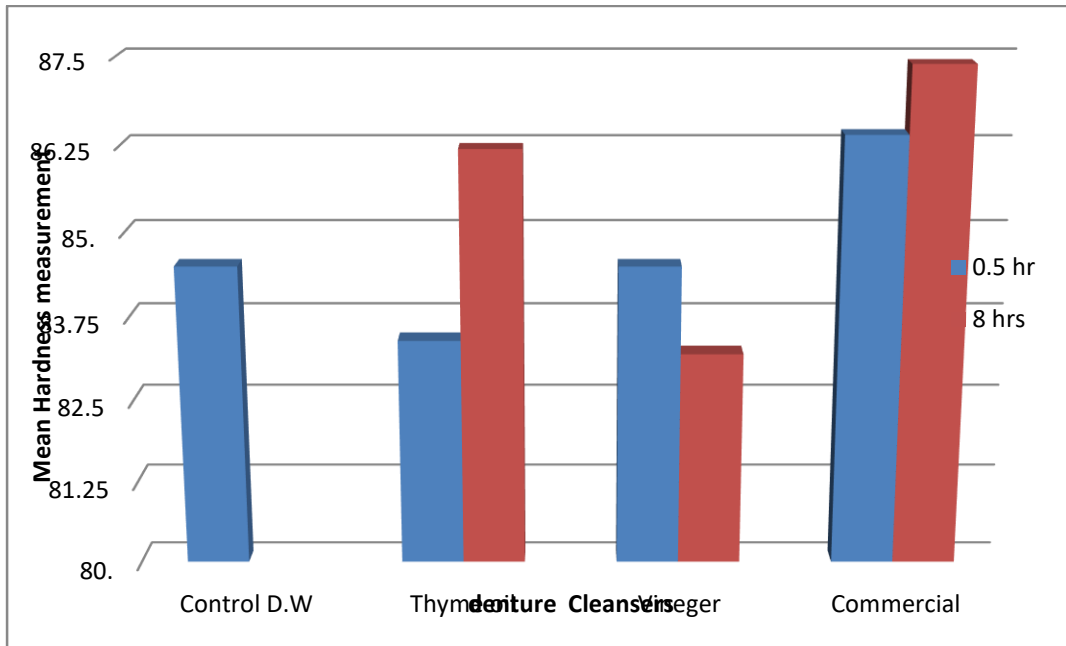| Immersion period		Sum of squares	DF	mean square	F	Sig.
30 Minutes	Between gps	105.040	3	35.013	2.474	0.090
	Within gps	297.200	21	14.152		
	Total	402.240	24			
8 Hours	Between gps	8.133	2	4.067	0.535	0.599
	Within gps	91.200	12	7.600		
	Total	99.333	14			

Fig.(4): Mean hadrness measurement of flexible denture base material after two period's immersion in denture cleansers.
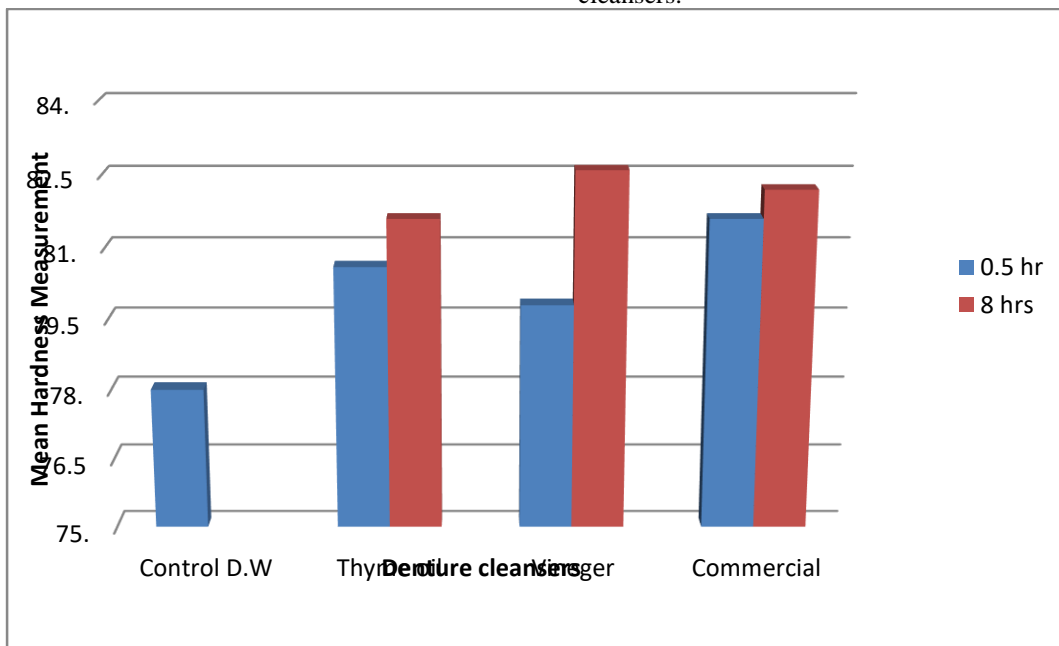

Fig. (5): Mean hardness measurement of heat cured acrylic resin denture base material after two period's immersion in denture cleansers.

DISCUSSION

The results of this study(table 1,2,3,4) showed insignificant differences hardness measurement in both materials across all solutions. In flexible denture base material there was a none significant decrease in surface hardness in (thyme oil +soda) and in (vinegar+soda) in 30 minutes, this agrees with(Neppelenbroek et al., 2005), who concluded that there is a decrease in surface hardness of denture base material after immersion in a disinfectants no matter the material used for construction of denture base. It also agrees with (Salman et al., 2011) who stated that indentation hardness did not have a significant change for nylon specimens.

The biggest change in hardness in flexible among two periods flexible samples were of those

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immersed in thyme oil+soda, and samples immersed for 8 hours had higher changes in hardness values than those immersed for 30 minutes, this can be related to the slow absorption of disinfection solution in relation to water, this can increase elasticity and decrease hardness(Neppelenbroek et al., 2005). This decrease in hardness is higher in specimens immersed for 8 hours than those for 30 minutes which shows that time plays a role.

Clear vinegar+soda group in both immersion periods showed hardness means less than control(distilled water) and commercial groups this could be due to the chelating properties of sodium citrate which results from the reaction citric acid and sodium bicarbonate, this increases the rate of removal of organic and inorganic components. Acetic acid has a low PH which is less favorable than neutral PH, this leads to softening of the surface layer of resins (Machado – Silvereio et al., 2004) though acetic acid is considered a weak acid. This agrees with(Khalil et al., 2007).

Kin pro tablets caused higher hardness means than other groups both(thyme+soda) and (vinegar+soda) and distilled water, which may be due to its action resulted from the oxidizing ability of the peroxide decomposition and the effervescing action of evolved oxygen(Khalil, 2007).

For heat cured acrylic denture base specimens hardness measurements were higher than control group(distilled water) in both immersion periods and this was in agreement with (Hatim et al., 2012). who stated that the hardness of resin can be increased by immersion in same natural disinfectants. Distilled water causes a decrease in hardness in different denture base materials after 90 days of immersion. (Pavarina et al., 2003).

CONCLUSION

relying on the results of this study it was concluded that :
• insignificant change in hardness between pre and post immersion was observed in both denture base materials and in all groups of cleansers
• the longer period of immersion increased hardness more than the shorter one(30 minutes) except vinegar+soda group in flexible denture base
• Natural cleansers caused hardness changes less than commercial one.

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الخلاصة

الهدف: أن استخدام منظفات طقم الأسنان ضرورية للحفاظ على نظافة الطقم وجعله خالي من الميكروبات ولكن بنفس الوقت يجب أن لاتوثر هذه المنظفات سلباً على خصائص قاعدة طقم الأسنان تهدف الدراسة إلى تقييم تأثير مختلف منظفات الاطقم على خاصية الصلابة لمادتين من قاعدة   طقم   الأسنان

المواد وطرق العمل: تم تحضير70 عينة بإبعاد(30*10*2.5) ملم (طول و عرض و سمك على التوالي) من مادتين لقاعدة طقم الأسنان(المرنة والمطبوخة حرارياً) لكل مادة 35 عينة تم تقسيم هذه العينات إلى ثلاث مجموعات من منظفات الاطقم (زيت الزعتر +الصودا ، الخل +الصودا ، قرص التنظيف من نوع kin) ومجموعة الماء المقطر هي مجموعة السيطرة. كل نوع من المنظفات له فترتين غمس للعينات ٣٠دقيقة ، ٨ساعات حيث تم تغير المحاليل يوميا لمدة شهر انا مجموعة الماء فقد تغير الماء يوميا كل ٢٤ساعة لمدة شهر كامل . ثم قياس خاصية الصلابة قبل غمس العينات في محاليل المنظفات وبعد انتهاء مدة الغمس ايضا تم قياس الخاصية لكل عينة باستخدام جهاز Shor_D . تم استخدام تحاليل t-test وتحاليل ANOVA لتحديد الاختلاف بين المجاميع   حيث   أن   0.05≥   p

النتائج: أظهر تحليل t-test عدم وجود اختلاف معنوي بين المجاميع (قبل وبعد الغمس) في مجاميع المنظفات ولكلا المادتين قاعدة طقم الاسنان كذالك اظهر تحليل ANOVA عدم وجود اختلاف معنوي بين مجاميع المنظفات وقد أظهرت المنظفات الطبيعية صلابة اقل من مجموعة السيطرة في فترة ٣٠دقيقة بينما إظهرت كل المنظفات زيادة في خاصية الصلابة بالمقارنة مع مجموعة السيطرة.

الاستنتاجات: حسب نتائج هذه الدراسة تم استنتاج الاتي: عدم وجود تغير معنوي في مقدار الصلابة لكلا المادتين ان فترة الغمس ٨ ساعات أظهرت زيادة في معدل الصلابة مقارنة مع فترة ٣٠ دقيقة باستثناء مجموعة (الخل+الصودا) في مادة قاعدة طقم الأسنان المرنة.

الكلمات المفتاحية: منظفات الاطقم ،الصلابة ، مواد قاعدة طقم الأسنان

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ئارمانج : بكارئينانا ڤاقژكەرێن تاغما ددانا يا پێدڤييە بۆ پاراستنا ددانا ژ ميكرۆبيان و د هەمان دەمدا پێدڤييە ئەڤ ڤاقژكەرە كارتێكرنا نەرێنەى لسەر تايبەتمەندييێن بنياتا تاخما ددانا نەكەت , ئارمانجين

ڤێ ڤەکولینێ ئەوە کو هەلسەنگاندنێ دناڤبەرا وان جورین پاقژکەرا بکەت ئەقێن بۆ پاقژکرنا تاغمێن ددانا دهێته بکارئینان لسەر تایبەتمەندییا رەقاتیا وان هەر دوو ماددێن ژ تاغما ددانا .

مادده و رێکێن بکارێین بکارێینانێ : 70 سەمپڵ ب دوراتیا (30 × 10 ×2,5) ملم هاتینه ئامادەکرن ژ دوو ماددێن بنیاتا تاغمه ددانا (نرم و هاتنه چێکرن ب گەرمیێ) بۆ هەر ماددەکێ 35 سەمپل ئەڤ سەمپله هاتینه دابەشکرن بو سێ گروپیان ژ پاقژکەرێن ددانا (زەیتا زعترێ , سوودا , سیهك , پیلێ , پاقژکرنێ ژ جورێ kin) و گروپێ ئاڤا سازکار. ئەوژی گروپێ کونترولکریه , بو هەر جورەکێ پاقژکەرا دوو ماوەیێن هەین تێهەلاندنا سەمیلان 30 خولەکان , 8 دەمژمێران , کو گێراوە روژانه هاتینه گوهورین. بو ماوەیێ هەیڤەکێ سەبارەت گروپێ ئاڤێ کو روژانه هاتینه گوهورین د 24 دەمژمێرادا بو ماوەیێ هەیڤەکێ ب تمامی . سەخلەتێن رەقاتیێن هاتینه پیڤان بەری تێهەلاندنا سەمیلان د گێراویێن پاقژکران , پشتی ب دوماهیك هاتنا ماوێ تێهەلاندنێ دیسان سەخلەت هاتینه پیڤان. بو هەر سەمپلەکێ ب بکارئینانا ئامیرێ shore D , تاقیکرنا t – test و تاقیکرنا ANOVA هاتینه بکارئینان بو دەستنیشانکرنا جوداهیێن دناڤبەرا گروپاندا کو p>0.05   ئەنجام : تاقیکرنا t- test دیاربوو کو چ جوداهیێن بەرچاڤ نینه دناڤبەرا گروپان (بەری و پشتی تێهەلاندنێ) بو گروپیێن پاقژکەران و بو هەردوو ماددێن بنیات یێن تاغما ددانا هەروەسا تاقیکرنا ANOVA دیاربوو کو چ جوداهیێن بەرچاڤ نینن دناڤبەرا گروپیێن پاقژکرنێدا . پاقژکەرێن سروشتیدیارکر رەقاتیا کێمتر ژ گروپێ کونترولکرنێ د ماوەیێ 30 خولەکان , بەلێ یا هەمی پاقژکەرێن دیتر سەخلەتێن قایمیێن بشێوەکێ زێدەتر دیارکر بەراوردکرنێ دگەل گروپێ کونترولکرنێ .

دەرئەنجام :ل دویڤ گوهورینەکا بەرچاڤدرێژا رەقاتییێدا بۆ هەر دوو ماددان ماوێ تێهەلاندنا 8 رێژەکا زێدەتر ژ رەقاتیێ دیارکر بەرامبەری دگەل تێهەلاندنا ماوێ 30 خولەکان ژبلی گروپێ (سیهك + سوودا) د ماوێ بنیاتا تاغما ددانائێن نەرم .

پەیڤین فەکرنێ : پاقژکەرێن تاغمان , رەقاتیا ماددێن بنیاتا تاغما ددانا