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Radish Oil Addition effect on some properties Of Heat Cure Acrylic resin

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Abstract

Background: Heat-cured acrylic resins are used most often for denture bases because they are the best in terms of their physical and chemical properties, are easy to handle, and are affordable. But the surface is not hard enough, and oral bacteria such as Candida albicans stick to the resin.
Objective: To assess how Radish oil affected heat-cured acrylic's impact strength and hardness.
Patients and Methods: The intention was to create a total of (60) specimens. Twenty samples were made without additives (Control), and 40 had made with radish oil added at two different amounts (2.5 per cent, 5 per cent).
Results: There was a Non-significant difference between the control and experimental groups in the impact strength test. In contrast, the hardness test showed a highly significant difference between the control and experimental groups. When radish oil had added, the impact strength and hardness had reduced in all concentrations.
Conclusion: Adding radish oil decreased the hardness and impact strength of the two experimental groups.
Keywords: Acrylic resin, polymethylmethacrylate, radish oil

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Introduction

PMMA, also known as poly (methyl methacrylate), has been a popular base material for dentures for many years. It benefits from simple processing and manipulation, low cost, pleasing look, and good colour stability [1, 2]. However, oral bacteria like Candida albicans, Pseudomonas aeruginosa, and Staphylococcus aureus are known to colonize denture base materials [3, 4,5]. These can lead to diseases of the mouth, particularly denture stomatitis, which is one of the main issues for those who wear dentures [6]. Recently helped decrease the dose-dependent adverse effects. Brassicaceae plants had shown to be a potential source of antibacterial chemicals after plant extracts and oils had been evaluated for antimicrobial activity [6]. Dental research has shown that adding radish oil to heat-cure acrylic has an anti-candida effect, which is thought to be a new therapeutic strategy for denture stomatitis [7] . Although adding radish oil to polymers has a beneficial antifungal effect, there isn't much information about what happens to the surface of PMMA denture base material after such an addition.

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This investigation intends to determine the effects of radish oil on a few mechanical and physical properties of heat-cured acrylic resin.

Patients and Methods

Specimens preparation

Impact strength test: According to ISO 179 [8], the designs were created with dimensions of 80×10×4 mm (length, width, and thickness, respectively), as shown in Figure (1). Ten specimens for the impact strength test had made for the control group and twenty specimens for each experimental group.

Surface hardness test: The acrylic resin specimens had the following dimensions: 65 mm in length, 10 mm in width, and 2.5 mm in thickness [2].

Ten specimens for the surface hardness test had made for the control group and twenty specimens for each experimental group.

Mold preparation

The plastic patterns (for transverse strength and impact strength) were coated with separating material to prepare the stone mould. The dental stone had placed in the lowest part of the metal flask. The flask's upper half was filled with stone and vibrated before the cover was put on and allowed to set. The plastic designs were then inserted to about one-half of their depth. After the stone has been set, the two halves are separated, the plastic patterns have taken out to make room for the acrylic specimen mould, the separating media is added, and once it has dried, the flask had prepared for packing the acrylic specimen.

Specimens fabrication

Used twenty samples from the heat-cure acrylic resin (Super acryl, Czech Republic) to make the control group specimens utilising the manufacturer's recommended 44gm/0.2/20ml (powder/liquid) ratio.

In contrast, the experiment groups (40 specimens) were made from the same acrylic resin and mixed with various amounts of radish oil that was 100 per cent pure (from Hemani, Pakistan) of different concentrations (2.5 per cent, 5 per cent).

The necessary quantity of Radish essential oil was measured with a micropipette, deducted from the volume of the monomer, and then combined with the monomer for one minute in a dry, clean glass beaker using a small electric hand mixer.

Following the addition of this combination to the acrylic powder, which was then well blended, followed the manufacturer's recommended curing procedure.

Mechanical and physical tests

All specimens were in distilled water at 37°C for 48 hours before evaluation for both tests [9].

A. Impact strength test

Charpy impact testing equipment had used to conduct the impact strength test. Using the following formula, the Charpy-impacted strength of specimens without notches had determined:

E: represents the fracture's absorbed energy in joules .

B: is the samples' width in millimetres.

D: is the samples' thickness in millimetres.

The specimen was held horizontally and struck with a free-swinging pendulum with an impact energy reading on the scale of 5 joules.

B. Surface hardness test: As indicated in Figure (3), the test had carried out using a

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durometer hardness tester (TH 210, CHINA) (shore D hardness).

The standard procedure was to quickly and firmly press down on the indenter while recording the highest reading. For each specimen, three measurements were taken at various locations, and the average of those readings had recorded.

Statistical Analysis

The data analysis was performed using descriptive statistics, including Mean, Std. Deviation, Std. Error, minimum, and maximum. Comparisons were made using one way anova test. The results were reported with ($p > 0.05$ or $p < 0.01$) as the accepted level of significance accordingly.

Results

Impact strength test

Table (1) displays the impact strength's descriptive statistical data (1). Compared to the control group, the mean values of the experimental groups at the two different radish oil concentrations (2.5 per cent and 5 per cent) exhibited no significant differences. As shown in Table (2), the analysis of variance (ANOVA) test revealed no significant differences between the control and treatment groups at ($p>0.05$).

Hardness test

Table (3) provided descriptive information about the test groups. The control group's mean value is higher than the experimental group's. The hardness test results revealed a highly significant difference between the groups (P-value 0.000), as indicated in Table (4); therefore, Tukey HSD of multiple comparisons among the analyzed groups was performed (5).

A high significant difference ($P = 0.000$) between the control group and the two concentrations treated with radish oil. Descriptive statistics of impact strength test in (KJ/m2).

Table (1): Impact strength's descriptive statistical data

	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Control	10	13.0820	.59911	.18945	12.17	13.83
2.5% Radish	10	12.9090	.60217	.19042	12.12	13.96
5% Radish	10	12.7320	.55661	.17602	12.16	13.73
Total	30	12.9077	.58412	.10665	12.12	13.96

Table (2): One-way ANOVA of Impact strength test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.613	2	.306	.891	. NS
Within Groups	9.282	27	.344		
Total	9.895	29			

Table (3): Descriptive statistics of surface hardness test in (N /mm2)

	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Control	10	86.8900	.69194	.21881	85.50	87.60
2.5% Radish	10	86.1000	.60185	.19032	85.10	86.90
5% Radish	10	85.1700	.56970	.18015	84.30	86.10
Total	30	86.0533	.93430	.17058	84.30	87.60

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Table (4): One way ANOVA of hardness test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.825	2	7.412	19.078	.000HS
Within Groups	10.490	27	.389		
Total	25.315	29			

Table (5): Tukey - HSD

(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Control	2.5%	-14.81200*	.95119	.000	-17.1704	-12.4536
	2%	-10.15500*	.95119	.000	-12.5134	-7.7966
2.5%	5%	4.65700*	.95119	.000	2.2986	7.0154

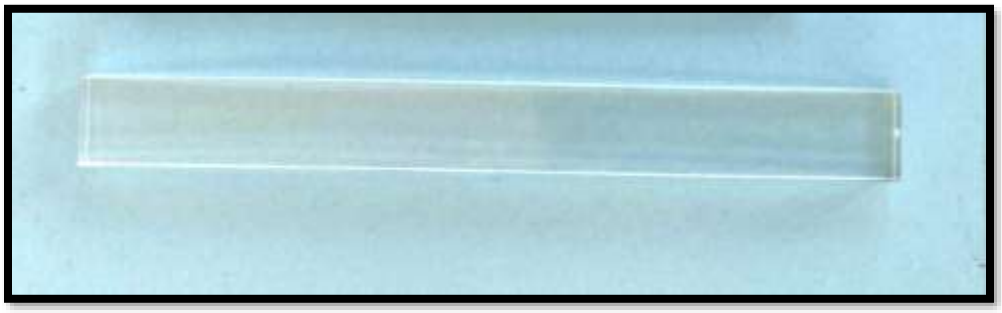

Figure (1): pattern of impact strength test

Figure (2): Digital Vernier: used to measure specimen dimension after finishing and polishing of hardness test specimens

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Figure (3): Durometer hardness tester

Discussion

Impact strength tests

Impact strength refers to the force needed to break the denture when it is subjected to extra oral sudden strikes, especially when it falls from the hand [10].

Compared to the control group (0 per cent radish), the impact strength values for the (2.5 per cent and 5 per cent) radish oil incorporation in this investigation decreased. The concentration of additional oil, which serves as an elastomer for PMMA acrylic resin, may be responsible for these results. It had explained by oil elastomer, which acts as a plastifying agent and decreases the glass transition temperature and elasticity module of resin matrix when added, resulting in a less stiff material at ambient temperature [11, 12]. This low elasticity module generates a larger resilience module, increasing the material's capacity to absorb energy and the deflexion force applied [13,14]. However, the non-significant difference in impact strength values of this study can be attributed to the small proportion of oil elastomer because the added oil elastomer concentration was directly proportional to the resistance to impact strength of the denture base material. As we've seen, adding oil elastomer improved the material's absorption of energy and made it less likely that the resin would crack, resulting in the prosthetic device being more resistant to mechanical failure [15]. That concurs with [16], who added tea tree oil and demonstrated no variation in the impact strength at all concentrations.

Hardness tests

Hardness is a regularly employed method to investigate elements that affect the degree of resin conversion. Hardness is a material's resistance and capacity to abrade opposing dental structures.

Characterizing a polymer's mechanical properties is possible due to the ease of the process. Also, to have the tools needed for specimen preparation and test process availability [17]. The shore durometer hardness tester, suitable for evaluating the hardness of denture bases, was utilized in this investigation. Due to its design, the Shore durometer type (D) hardness tester does away with the issue of elastic recovery. It uses a technique that accurately counts the number of loaded indentions on a screen while

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measuring their depth [18]. This study showed that the hardness of acrylic resin decreased as Radish oil concentration increased. This drop may cause by coating polymer particles with oil, which slows the transformation of monomer to polymer and leaves a lot of monomers. Through a plasticizing effect, the latter has a negative impact on the mechanical properties [19].

The increase in sample flexibility, especially at concentrations of 5%, which results in a decrease in hardness, is another potential explanation for this decline. Al-Nema research's findings don't match up with these findings, which might be a consequence of the essential oil used in the study or the different oil concentrations used [20].

Conclusions

Within the constraints of this investigation, we can say that adding radish oil to heat-cured acrylic resin in either concentration (2.5 per cent weight or 5 per cent weight) resulted in a high-significant decrease in hardness test results but a non-significant decrease in impact strength.

Recommendations

Results of the study revealed no significant change in the physical and mechanical properties of acrylic denture base material, it is safe to use the radish oil as disinfectant material.

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Ethical clearance: Ethical approval was obtained from the College of Medicine / University of Diyala ethical committee for this study.

Conflict of interest: Nil

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تأثير إضافة زيت الفجل على بعض خواص راتنج أكريليك المعالجة بالحرارة

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الملخص

خلفية الدراسة: تستخدم راتنجات الأكريليك المعالجة بالحرارة في أغلب الاحيان لقواعد أطقم الاسنان لأنها الأفضل من حيث خصائصها الفيزيائية والكيميائية، ويسهل التعامل معها، كما انها ميسورة التكلفة. لكن السطح ليس صلبا لدرجة كافية، وتلتصق بكتريا الفم مثل المبيضات البيضاء بالراتنج.

اهداف الدراسة: لتقييم كيفية تأثير زيت الفجل على قوة تأثير الأكريليك المعالج بالحرارة وصلابتة.

المرضى والطرائق: تمت عن طريق عمل ٦٠ عينة من الراتنج الأكريليك، ٢٠ عينة بدون اضافات و ٤٠ عينة مخلوطة مع زيت الفجل المضاف بكميتين مختلفتين (٢,٥% و ٥%).

النتائج: وجود فروق غير ملحوظة بين المجموعتين الضابطة والتجريبية في اختبار قوة التأثير. بالمقابل اظهر اختبار الصلابة فرقا ملحوظا للغاية بين المجموعتين الضابطة والتجريبية. عندما تمت اضافة زيت الفجل، انحفضت قوة التأثير والصلابة في جميع التراكيز.

الاستنتاجات: اضافة زيت الفجل قلل من الصلابة وقوة التأثير للمجموعتين التجريبيتين.

الكلمات المفتاحية: راتنج أكريليك ، بولي مثيل ميثاكريلات ، زيت الفجل

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