

BOND STRENGTH OF TISSUE CONDITIONER TO ACRYLIC RESIN AFTER IMMERSION IN PLANT EXTRACT DENTURE CLEANSER CONTAINING CINNAMALDEHYDE

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ABSTRACT

Bond strength of tissue conditioner (temporary soft denture liner material) on an acrylic denture base could be affected on the adhesion between these two materials by water solution such as chemical denture cleanser. Cinnamaldehyde contained in cinnamon plant extract (*Cinnamomum burmani*) is one of the natural agents that can be recommended as a denture cleanser and expected to have a smaller impact on the mechanical properties of material. The aim of this study was to determine the influence of immersion time in plant extract denture cleanser containing cinnamaldehyde on the bond strength of tissue conditioner to acrylic resin. Twenty-four rectangular acrylic soft denture liner samples (64 mm x 10 mm x 2,5 mm (ISO 1567:1988)) were divided into 4 groups: group I and II, 1.5 % cinnamon extract immersions (for 7 days and 14 days); group III and IV, aquadest immersions (for 7 days and 14 days). The measurements of samples's bond strength were done using the Universal Testing Machine on the last day of each group after immersion. The results were submitted to one-way ANOVA and post hoc Bonferroni. There was a significant difference between all groups ($p < 0.05$). The highest average of sample's bond strength was shown by group III and IV followed by group I and II, respectively. There was effect of immersion time in cinnamon extract denture cleanser on the bond strength of tissue conditioner to acrylic resin

Keywords: tissue conditioner, denture cleanser, cinnamaldehyde

1. INTRODUCTION

Immersion of tissue conditioner (soft denture liner material as a temporary cushion for protection of traumatized ridge mucosa) which is covered in acrylic denture base in daily chemical denture cleanser can affect the mechanical properties of material, such as the bond strength between these two materials. The impact of these is release of the tissue conditioner material apart from the denture base that the functional ability of material can be decreased.¹⁻³ Aiemezza et al. stated that the bond strength between the surface of the tissue conditioner and the heat polymerized acrylic resin base was low, after soaking chemical

denture cleanser solution (alkaline peroxide) for 30 days. The ability of this solution to penetrate deep enough in both materials causes the release of bonds between acrylic polymers and hydrolysis of molecules in the tissue conditioner material. Water molecules are scattered at the bonding site of these two materials, causing failure of adhesion between them.⁴

This could be anticipated by the selecting of denture cleanser alternative, which is very important to reduce their effects by using plant extract based on cinnamaldehyde

such as cinnamon extract (*Cinnamomum burmanian*).⁵

The cinnamataldehyde content of this extract has antifungal and antibacterial effects. In addition, based on previous research, the 1.5% cinnamaldehyd in cinnamon extract immersion could be affected on mechanical properties material, such as the hardness of the soft liner material, but this study, it showed low hardness value in this immersion.⁶

This study aims to determine the influence of immersion time in plant extract denture cleanser containing cinnamaldehyde on the bond strength of tissue conditioner to acrylic resin. This is expected to provide an alternative base for denture cleanser that has strong antifungal effect with minimal influence on the bond strength of tissue conditioner to acrylic resin denture base.

2. METHOD

This study was an experimental laboratory study with *post test only control group design* approach.²¹ The sample size is based on the following Federer formula:⁷⁻⁹

$$\begin{aligned}(t-1)(r-1) &> 15 \\ (4-1)(r-1) &> 15 \\ (3r-3) &> 15 \\ 3r &> 18 \\ r &> 6\end{aligned}$$

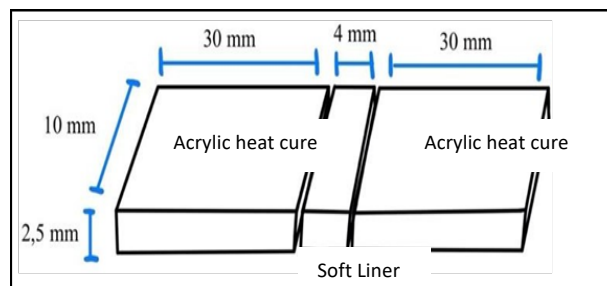
Description:

t = Sample size

r = Sample size for each group

In this study, the number of samples were 6 subjects for each groups, the total samples were 24 subjects.

Twenty four samples of rectangular were made by sticking soft denture liner (4 mm x 10 mm x 2,5 mm) (reviver, Medicept, UK) and heat-cured acrylic (64 mm x 10 mm x 2,5 mm (ISO 1567:1988)) (Figure 1).¹⁰



Samples were divided into 4 groups : group I and II, 1.5 % cinnamon extract immersion; group III and IV, aquadest immersions. Samples were immersed in each group for 7 days (groups I and III) and 14 days (groups II and IV). Every 24 hours, the immersions were replaced. The samples were rinsed first with distilled water before immersing the new solution. After the last immersion, the samples were rinsed with distilled water to clean from the soaking solution.¹¹⁻¹⁴

Furthermore, all groups were tested for the bond strength on day 7 (groups I and III) and day 14 (groups II and IV) using the Universal Testing Machine (Gunt, Germany). Tensile test was carried out with a cross head speed of 5 mm/minute until a crack occurred. The value that appeared for the first crack occurred was the maximum load value of the sample. It was calculated in N/mm² or Mpa.¹¹⁻¹⁴

Formula of bond strength:

$$\text{Bond strength} = \frac{\text{Maximum load (N)}}{\text{Cross sectional area (mm}^2\text{)}}$$

3. RESULTS

The results of this study showed that the highest average bond strength of acrylic tissue conditioner was identified in group III (aquades, for 7 days) and the lowest was identified in group II (cinnamon, for 14 days). Data normality test were used the Shapiro-Wilk test with the results of normally distributed data ($p > 0.05$).

Levene's test were used and the results of homogeneous data were obtained ($p > 0.05$). The data was forwarded to the one way ANOVA test (Table 1).

Table 1. Results of the one-way ANOVA test for bond strength between groups

| Group | n | $\bar{X} \pm Sb$ (MPa) | | P |
|----------|----|------------------------|------------------|---------|
| | | 7 hari | 14 hari | |
| I & II | 12 | 1,26 \pm 0,043 | 1,14 \pm 0,044 | < 0,001 |
| III & IV | 12 | 1,44 \pm 0,051 | 1,30 \pm 0,018 | |

Based on table 1, the results of the study showed differences between the groups ($p < 0.05$). Bonferroni's post hoc test showed that there were significant differences on the bond strength of acrylic tissue conditioner between groups ($p < 0.05$). (Table 2).

Table 2. Results of the post hoc test for bond strength between groups

| Group | I | II | III | IV |
|-------|----------|----------|----------|----|
| I | - | | | |
| II | < 0,001* | - | | |
| III | < 0,001* | < 0,001* | - | |
| IV | | < 0,001* | < 0,001* | - |

3. DISCUSSION

Tissue conditioner has elasticity properties in the span of 2 weeks to several months.^{2,35} Over time, the adhesion of this material to the denture base is decreased by routine immersion in a denture cleanser solution that avoids bacterial colonization and fungi.^{15,16} Tissue conditioner material requires an adhesive/primary material to adhere to the acrylic denture base, with the composition of ethyl acetate as a solvent and the active components of monomer poly methyl

methacrylate and polyorganosiloxane. Ethyl acetate could dissolve acrylic resin materials and produce a rough surface, wets and cleans the surface, the polymethyl methacrylate ester monomer penetrates and adheres to the acrylic resin base and polyorganosiloxane adheres to the tissue conditioner.¹⁷⁻²⁰

Based on this study, there were significant differences in the bond strength between groups (groups 1 and 2, 1 and 3, groups 2 and 3, 2 and 4, 3 and 4.). The researcher observed that the surface of the tissue conditioner sample swelled from the initial shape of the sample after soaking between groups. The materials could absorb the solution, then swelled, be stiff, and cause stress and external loads that were concentrated on the surface between the tissue conditioner material and the acrylic denture base material that adhesion of both materials were reduced until they were released.^{15,21}

Immersion in the solution could be affected on the adhesive/primary material, the solution penetrated into the adhesive material and hydrolyzed polymethyl methacrylate ester monomer into carboxylic acid and alcohol. The adhesive material became unstable, the loss of this monomer component could reduce the bond strength between tissue conditioner and acrylic resin. Aimeeza et al. stated that the bond strength between tissue conditioner and acrylic resin was decreased after 30 days in denture cleanser immersion.^{4, 22}

The results of this study showed a decrease on the bond strength of tissue conditioner and acrylic resin, these was proportional to the duration of aquades and cinnamon immersions. Maghdalena et al., S. Alaa et al., and A. Mese et al. stated that if the immersion duration of both materials was getting more in aquadest, their bond strength would also be lower.^{15,22,23} Tissue conditioner material immersed in aquadest would cause the same hydrolysis mechanism that affected its bond strength. However, the value of these was higher than the cinnamon extract immersion. Aquades is neutral solution, and the rate of

hydrolysis occurs more slowly at a neutral pH.²⁴

Cinnamon contains cinnamaldehyde and eugenol components. Eugenol belongs to the phenolic acidic compounds. Cinnamon extract has pH of 4.0-6.5 which is classified as acidic.^{25,26} The 1.5% cinnamon extract was used in this study has pH of 5.3. Acidic conditions could increase the hydrolysis rate of the polymethyl methacrylate ester monomer, the monomers in the primer/adhesive material was lost, the adhesive material became unstable and the bond strength between the tissue conditioners and acrylic resin was decreased. Yanikogtlu et al. proved that these case was same when soaked for 30 days in a tea solution that also contained phenol as its main ingredient.^{25,26,27} The bond strength of materials in 1.5% cinnamon extract had lower value than aquades immersion in this study.

The standard of the clinically value of tissue conditioner bond strength is more than or equal to 0.45 MPa.²⁰ The results of this study indicated that the bond strength of tissue conditioner and acrylic resin material for 7 and 14 days in 1.5% cinnamon extract immersion could be reduced. However, these values were still greater than 0.45 MPa, which were 1.26 MPa and 1.14 MPa that classified as clinically acceptable. However, in this study, there was no sample group without treatment that was tested for bond strength, so its initial value was not obtained to be compared with the value after immersion.

4. CONCLUSIONS

There was an effect of immersion time in cinnamon extract denture cleanser on the bond strength of tissue conditioner to acrylic resin. Further study is needed on the measurement of the selected concentration of cinnamon extract against the growth of bacteria and fungi with minimal effect on the mechanical/physical properties such as the bond strength of tissue conditioner to acrylic denture base materials.

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