

Assessment of color alteration of heat polymerized resin by visual inspection and spectrophotometer after immersion in chemical denture cleanser.

Israa Mohummed Hummudi MSc, Ala'a Ezzat Abdul Majeed MSc.

Abstract

Background: Denture cleanser should be designed to remove and prevent re accumulation of microbial plaque. Cleaning the denture by chemical immersion have several advantages that solutions reach all areas of the denture and results in complete cleaning. One problem associated with their use has been bleach and discoloration the surface layer of acrylic dentures.

Objective: to assess the color alteration of heat polymerized acrylic resin after immersed in different types of chemical denture cleanser.

Method: forty five rectangular specimens (50x3.5x3mm) (length-width-thickness) of heat activated acrylic resin were divided in three denture cleansers groups (sodium hypochlorite NaOCl 0.5%) and vinegar (acetic acid 6%) and control group (immersed in distal water). Soaking trial 8 hours simulated 30 days of use. Color alterations were assessed by

visual examination of photographs and by spectrophotometer testing device.

Results: the results of spectrophotometer testing device did not show any interaction between different type of chemical cleansers and acrylic resin during 30 days 8 simulated use, also visual examination did not detect any color alteration.

Conclusion: denture clearers, when used according to the manufacturer's instructions, did not cause any mechanical or visual alterations in the heat polymerized acrylic resin.

Keywords: Acrylic resin – denture cleanser-color changes.

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Introduction

Acrylic resins have been used to produce dentures for more than 60 years. Heat activated acrylic resin is the most common type used for construction of denture base⁽¹⁾. Dentures can be cleaned mechanically, chemically or by the combination of both methods. Mechanical methods are the most common way for bio film removed from denture surfaces⁽²⁾. The use of chemical cleansers is usually associated to its efficacy in removing stains and bio film formation on the dentures⁽³⁾. The most commonly used cleansers are represented by the group of alkaline hypochlorite.

NaOCl solutions have been used for along times as denture cleansers and several regimes have been proposed^(4, 5).

Nevertheless, the effect of those solutions on the properties of denture base acrylic resins can be influenced by some factors which were not still evaluated. Several studies assessed NaOCl as a disinfecting agent for dental clinics to reduce cross contamination of dentures, and used high concentrations during short times⁽⁶⁻⁸⁾.

The use of vinegar (acetic acid) solution was evaluated by (Bassoon et al, 1992)⁽⁹⁾, who found it effective at killing adherent micro organisms although less effective than bleach solution.

One advantage of vinegar over bleach is that in adequate rinsing after soaking in vinegar dose not result in mucosal damage⁽¹⁰⁾.

College of Health and Medical Technology.
Address Correspondence to: Israa Mohummed Hummudi,
E- mail: tualin 1112006@yahoo.com
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Factors like water temperature and immersion period are considered critical when complete denture cleansers are used, sometimes, the prostheses need to replace due to the patients abuse of hygienic methods^(4, 6, 11, 12).

Denture base materials can be damaged if the cleaning agents are not used according to the manufacturer's instructions^(12, 13).

The importance of following the manufactures instructions is emphasized because the transverse strength of acrylic resins depends on several factors such as polymer bead size⁽¹⁴⁾, amount of cross linking agents⁽¹⁵⁾, type of polishing and action of chemical agents⁽¹⁶⁾.

One of the problems frequently reported by chemical cleanser users is a whitening effect on the denture. Denture base polymers are susceptible to color changes if the cleaning solutions are not used correctly⁽⁶⁾. The whitening effect is related to the high temperature of water used in the solution^(11, 13).

When peroxide based cleansers are used in a warm water solution as recommended by the manufacturer, no deleterious effects on correctly processed denture acrylic have been found⁽¹⁷⁾.

It is of clinical importance to determine whether chemical solutions or denture cleansers alter the acrylic resins color when dentures are cleaned repeatedly and for various amounts of time⁽⁴⁾. Therefore the aim of this study was to evaluate whether soaking of heat polymerized acrylic resins in chemical solution (NaOCl, vinegar) may affect the resin color when subjected to the recommended instructions of the use for a simulated period of 30 days.

Materials and methods

Specimen's preparation

Heat cures acrylic specimen's preparation:

Wax plate 50x3.5x3 mm in dimensions was prepared and fixed into flat glass plate. Stone slurry was prepared (33ml water/100gm powder) and poured in the lower half of flask before the stone in the lower half of the flask was harden, the glass plate, which is larger than the surface area of the flask, was loaded and wax plate placed over the stone, so that the level of the wax plate would be with level of the stone. When the stone reached its initial set, it was coated with the separating medium (cold mold seal), than the upper half of the flask was positioned on the lower half and a second mix of dental stone was poured into the flask and kept under the hydraulic press, after completing the setting of the stone, wax elimination, was done by immersing the flask in the boiling water for 4 minutes, then the flask was opened, washed with boiled water to remove the remaining wax. Then it was allowed to cool, the flask opened again and the surface of the mold was coated with the separating medium.

Heat cure acrylic powder was mixed with the liquid in a proper polymer-monomer ratio of 3:1 (v: v) for 45 second at room temperature, the container was left until it reached the dough stage. The mixture was packed into the stone mold, covered with polyethylene sheet, the two halves of the flask were closed together, and then the flask assembly was placed into the hydraulic press 20 bars to allow the resin dough to flow evenly throughout mold, the flask was opened, the flow material and the polyethylene separating sheet was removed. Then the halves of the flask were finally closed together, press metal to metal contact and held for 5 minutes before

clamping was done. The flask was transferred to a thermostatically controlled water bath for curing the acrylic denture base resin. The fast technique involves processing the resin at 74C° for 1.5 hours and then increases the temperature of the water bath to boiling for an additional 1 hour⁽¹⁾. Following the completion of polymerization cycles, the flask was removed from the water bath and left on the bench to cool for 30 minutes subsequently; the flask should be immersed in cool tap water for 15 minutes.

Finishing of the acrylic resin specimens:

The acrylic plates were then removed from the flask and trimmed with tungsten bur then finished using progressively finer grades of silicon carbide paper (grades 120 to 40 um), pumice and rouge were used for final polishing. All specimens were stored in water at 50C° for 1 hour to remove the excess of residual monomer and then stored at room temperature until the time of the soaking trials.

Specimens grouping:

Forty five samples were divided into three groups:-

Group one: 15 specimens immersed in distilled water (control)

Group two: 15 specimens immersed in sodium hypochlorite 0.5%

Group three: 15 specimens immersed in vinegar (acetic acid) 6%

Soaking trials

Fifteen specimens of each resin were subjected to the soaking trials⁽¹⁸⁾:-

8-hour intervals for up to a total 240h , changing the solution every 8 hours, to correspond 30 over right soaking periods. The control specimens were stored in distilled water at room temperature, changing the water every 8 hours.

Analysis of treated specimens

The study specimens were analyzed by fourier transform infrared spectrophotometer (FTIR) Shimadzu-Japan. (Figure 1).

Spectrophotometric analysis of color of acrylic denture base material, before and after time of immersion in different denture cleanser was conducted. All specimens were dried, then treated with potassium bromide in a percentage of 1:100 then grinded as a powder and converted to a disk like by press. Each disk was fixed on the flat plate to become ready for scanning. The mode of action of this device is by reading the chemical composition of each specimen at specific area and the solution in which it was immersed. the reading appears as a diagram and each number in diagram was represented by peak.

Visual inspection:-

The control specimens stored in distilled water and specimens immersed in two denture cleansers, using daily soaking times 8 hours for a period of 30 days were put side by side and photographed camera (SONY DCR-SR 46E, 40GB, 40optical zoom, Tokyo-Japan)

Film was processed and visual inspection of photographs of the specimens was carried out independently by three examiners blinded to the resins, denture cleansers and immersion to assess the occurrence of alteration in the resins. Each examiner received an initial photograph of the non-treated resin specimens (used as control and compared to the photograph of the treated specimens.

Yes or no answers were given depending on the presence or absence of color change. (Figure 2, 3)



Figure 1: Spectrophotometer testing device



Figure 2: Photographs of specimens Immersed in distilled water and NaOCl



Figure 3: Photographs of specimens Immersed in distilled water and Vinegar

Results

The results of this study are qualitative which depends on the reading of each diagram. Spectrophotometer device did not show any differences between each diagram after matching with each other.

There were no changes between e readings of Figure (4) (specimens

before time of immersion) and Figure (5) (specimens immersed in distilled water). Also there is no differences between Figure (5) with Figure (6) (specimens immersed in NaOCl) and Figure (7) (specimens immersed in vinegar).

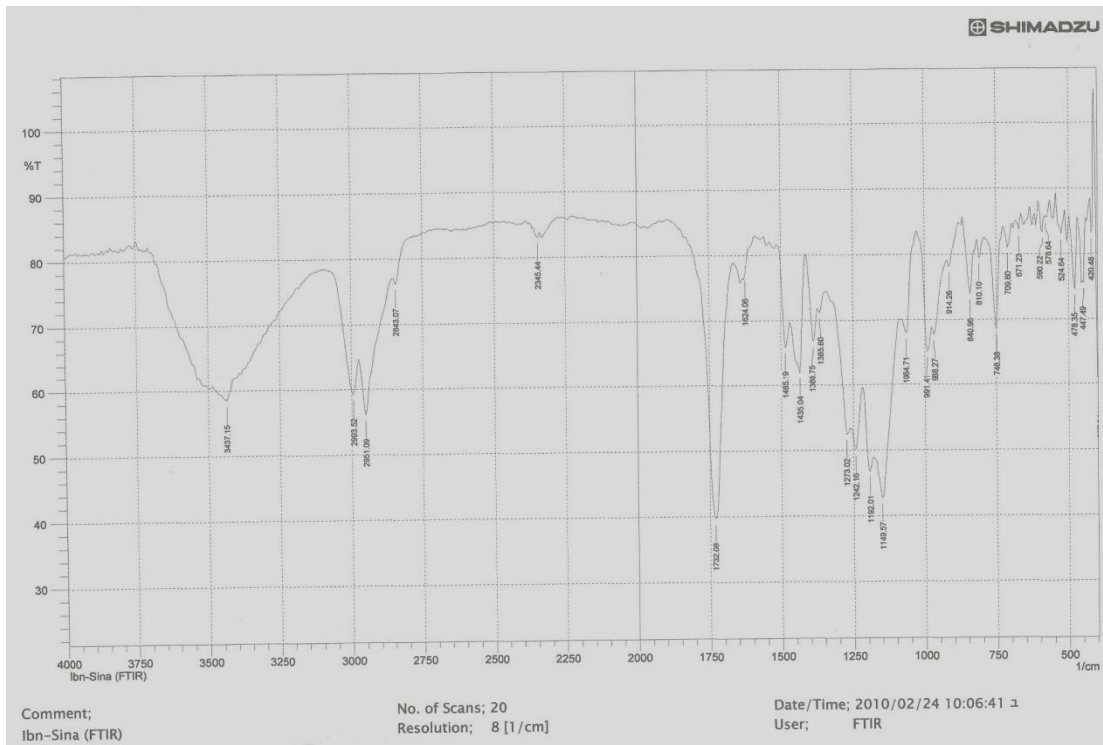


Figure 4: Diagram of specimen before time of immersion

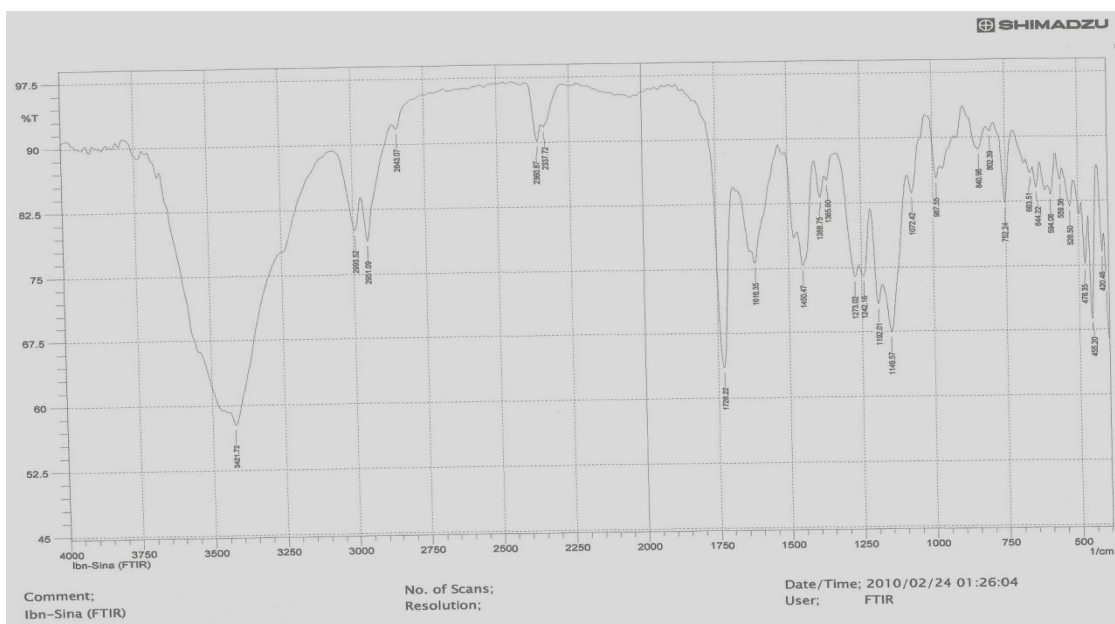


Figure 5: Diagram of specimen immersed in distilled water

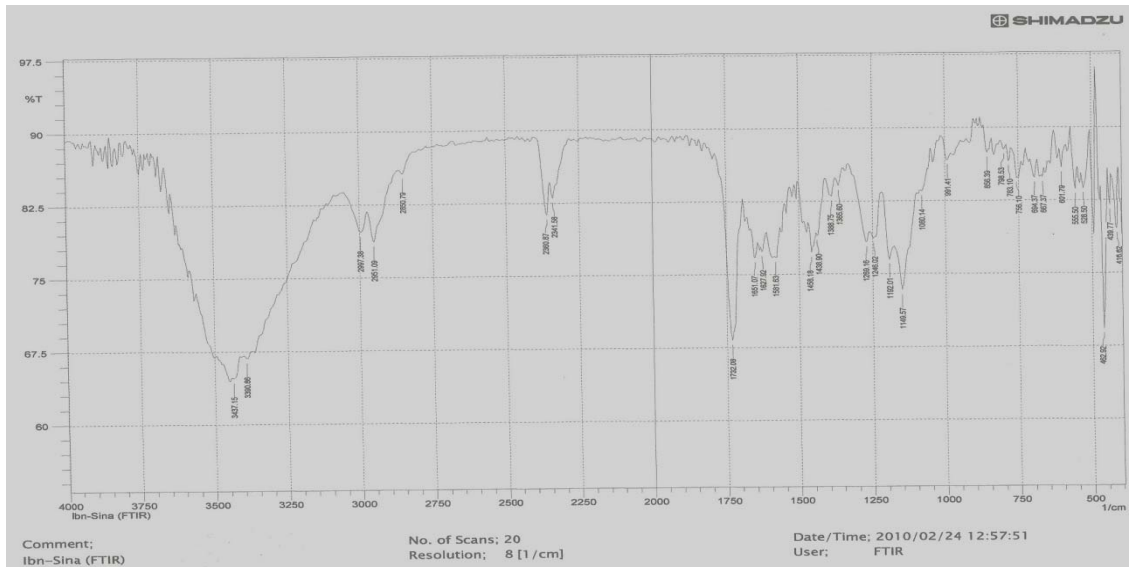


Figure 6: Diagram of specimen immersed in NaOCl

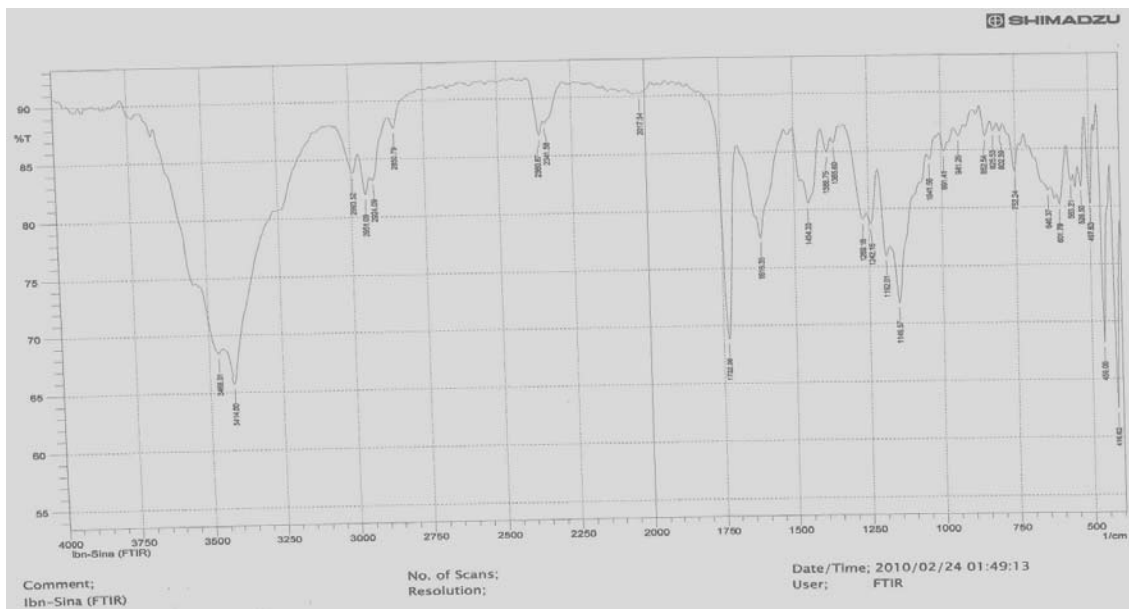


Figure 7: Diagram of specimen immersed in vinegar

The vertical line of diagram represents the transmission (T%) and the horizontal line represents the range (cm^{-1}) Comparison between diagrams in figs. 5,6,and 7shows that there was no differences in the readings , means no interaction between chemical solution and acrylic in specimen as shown in a diagram: (each reading susceptible to ± 10 degree) .

No clinically significant color alterations were observed on examination of the photographs.

Discussion

It has been shown that brushing alone is not sufficient for good denture biofilm control and hence chemical cleaning is usually associated to mechanical cleansing to complement denture hygiene, moreover denture immersion in chemical products aims to provide cleaning and decontamination. It is important to analyze the efficacy of the cleaning product and how it acts on the denture materials⁽¹⁹⁾.

The daily immersion of the removable prostheses in commercial

bleaching agents is indicated for domestic use because it is an inexpensive and simple hygiene method⁽²⁰⁾ combining NaOCl solutions with a water softener solution is recommended for daily hygiene of complete dentures^(21,22).

The rationale for adding a water softener is the improvement in the removal of heavier deposits or stains by means of chelating action⁽²¹⁾.

Factors that may contribute to the change in color of materials include stain accumulation, dehydration and oxidation of the reacted carbon-carbon double bonds that produces colored peroxide compounds and continuing formation of the colored degradation products⁽²³⁾.

Previous investigations have emphasized that the correct use of chemical cleansers is not associated to alteration in the mechanical and chemical properties of the materials for denture bases.^(11,12,13) However, another factor to be taken into account is the immersion time, as extended immersion can damage certain materials used to manufacture the prostheses⁽²⁴⁾. 8 hour periods (extended or overnight immersion-during sleep period) were established to simulate the orientations patients received for the daily cleaning of total prostheses. The results showed that, even within an 8 hour period, no alteration occurred in the analyzed characteristics.

In this study color alteration can be measured by two methods spectrophotometer and visual inspection. The results of spectrophotometer showed that no color changes of that polymerized specimens immersed in sodium hypochlorite. This may be weak concentration solution 0.5% so that the liberated oxygen did not cause oxidation of tertiary amine accelerator. This result is in agreement with

McNeme et al and Polyzois et al⁽⁴⁾. Both studies did not find color changes in the acrylic resin after the use of NaOCl but disagreed with Kazangi and Ahmad⁽²⁵⁾.

Acidic denture clearers (vinegar) did not show color changes of heat cure acrylic denture base resin. This finding was disagreeing with the results of Kazangi and Ahmed⁽²⁵⁾.

The results of visual examination did not show any noticeable color change with the use of NaOCl and vinegar after a soaking of 30 days. The denture cleanser tested in this study were used according to the manufactures instruction did not cause the whitening effect observed in some dentures soaked in chemical solution. These findings are in consistent with the previous investigations which attributed the whitening effect on chemically cleansed acrylic resin denture bases to the excessively high temperature of the water rather than to the denture cleanser itself^(17,18).

It may be concluded that, when used according manufactures specification, denture cleansers did not cause alteration or color changes in heat polymerized acrylic resin after 30 days of simulated use.

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