The Saudi Journal for Dental Research (2015) 6, 41–47

King Saud University

The Saudi Journal for Dental Research

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ORIGINAL ARTICLE

# Chromatic stability of light-activated resin and heat-cure acrylic resin submitted to accelerated aging

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Received 8 May 2014; revised 8 June 2014; accepted 8 June 2014
Available online 27 June 2014

**KEYWORDS**

Color stability;
Light-activated resin;
Heat-cure acrylic resin

**Abstract** *Statement of the problem:* Several denture base resins providing easier/or faster processing have recently been introduced. Even though these materials have improved physical properties, their color stability is also of vital interest.
*Objective:* The purpose of this study was to determine quantitatively the effect of different colorant solutions on the color stability of Eclipse (visible-light-activated resin) in comparison to Lucitone-199 (heat-cure acrylic resin).
*Materials and methods:* Twenty one specimens from two tested materials, Eclipse (visible-light-activated resin) and Lucitone-199 (heat-cure acrylic resin) were prepared and stored for 24 h at 37 °C in distilled water. In a dimmed atmosphere, seven specimens of each tested material were stored in different colorant solutions (strawberry, coffee, and tea). Using a computer-controlled spectrophotometer, color measurements among the specimens were done before and after 252, 504, and 1008 h of immersion in the colorant solutions. Data were statistically analyzed.
*Results:* Ranova test showed significant differences ($p < 0.05$) between the color change mean values for Eclipse and Lucitone-199 at 252, 504, and 1008 h of accelerated aging. While paired $t$-test showed no significant difference of means in the color changes between the measuring intervals of each colorant solution with Eclipse. Lucitone-199 showed significant differences especially with coffee and tea colorant solutions.

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Peer review under responsibility of King Saud University.

ELSEVIER Production and hosting by Elsevier


http://dx.doi.org/10.1016/j.sjdr.2014.06.003

*Conclusions:* Eclipse denture base material is significantly more color stable than the Lucitone-199. Tea has the highest discoloration effect on Eclipse, but within the acceptable clinical levels. On the other hand, coffee has more discoloration effect on Lucitone-199, while, the least staining effect was caused by strawberry colorant solution on both Eclipse and Lucitone-199.



## 1. Introduction

Despite the fact that most complete dentures are manufactured from heat-cure acrylic resin (PMMA), it seems that it is not the ultimate denture base material in some aspects. Several denture base resins that provide easier and faster processing have recently been introduced. The use of visible-light-polymerized urethane dimethacrylate (UDMA) was launched in the 1980s, and Triad was the initial light-polymerized denture base polymer attainable in the market.[1] Eclipse Prosthetic Resin System (UDMA) was the most recent addition of denture base polymer, where three types of resins (baseplate, setup and contour resins) are supplied for the construction of the denture.[2,3] Studies showed that Eclipse exhibits dramatically higher surface hardness, flexural strength, and flexural modulus, transverse strength, and shear bond strength of IPN denture teeth to denture base resins than PMMA denture base polymers.[2,4] Despite these materials having improved physical properties, their color stability is also of special importance. Esthetic outcome is a problem that can be encountered from discoloration of acrylic resin.

Smooth translucent surface with good esthetics matching the natural soft tissue appearance is an exclusive property of an ideal denture base polymer. The serviceability of these materials is dramatically affected by the color stability standards.[5] As the majority of these materials utilized for construction of dental prosthesis are subjected to sorption; a process of absorption and adsorption of liquids relies on environmental conditions. If the contacting solution is colored, discoloration is likely to occur.[6,7] Many studies have been reported on discoloration features of resin-based dental prosthodontic materials during exposure to oral fluids, and denture cleaners.[8–15] There is proof that colored drinks such as tea, coffee, and soft drinks dramatically augment the development of enamel and acrylic resin discoloration as well.[16] Accelerated aging is a test that uses aggravated conditions to expedite the normal aging procedures of the tested materials, to help determine the long-standing outcome at anticipated levels of stress within a shorter time. It is utilized usually in a laboratory by controlled standard test methods.

To quantify the color changes of dental materials, comprehension of color science and differential colorimetry is needed. Current photometric and colorimetric instruments are reliable to measure the color of acrylic resin specimens[5,15], and to demonstrate it in terms of three coordinate values ($L^*$, $a^*$, $b^*$), that situate the object's color within the CIELAB color space.[17] The $L^*$ match symbolizes the color intensity of an object, the $a^*$ value corresponds to the red or green chroma, and the $b^*$ value represents the yellow or blue chroma. Numeric description of color allows precise definition of the magnitude of the color difference between objects. The equation utilized for calculating color differences in this system is[17,18]

$$\Delta E = \left[(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2\right]^{1/2}$$

where $\Delta E$ is the color difference of the two objects that can be determined by comparing the differences between individual values for each object.

Varied adequacy and perceptibility values for color variances in dental materials were reported by former researches.[19] The detection of color discrepancy depends on human perception of color. Formerly, studies reported that color differences greater than 1 $\Delta E$ unit are 50% visually detectable. Besides, under uncontrolled clinical conditions, such minor changes in color would be invisible, as average color differences below 3.7 are rated a "match" in clinical conditions.[20]

According to national and international standards, color stability of denture base resins is a required characteristic provide important information on the serviceability of the materials.[5,7] The purpose of this research was to quantitatively find out the effect of accelerated aging on the color stability of visible-light-polymerized urethane dimethacrylate (Eclipse) in comparison with heat-cure polymethyl methacrylate acrylic resin (Lucitone-199).

## 2. Materials and methods

Forty-two disk-shaped specimens of Eclipse and Lucitone-199 were equally divided into two groups. The specimens were prepared by utilizing a metal mold 15 mm in diameter and 2 mm in thickness (according to ADA specification no. 17) modified by the author with knock-out plate at the base Fig. 1(a and b).

Wax disks were formed by pouring molten inlay wax into the metal mold. After cooling, the excess wax, it was trimmed with a scalpel blade #11 to ensure a flat surface. The wax disks were removed from the metal mold by pushing the knock-out plate at the base of the mold. The Lucitone-199 specimens were prepared by investing the wax disks in dental stone using a denture flask Fig. 2. After wax elimination, Lucitone-199 acrylic resin specimens were constructed in a conventional manner according to manufacturer's recommendations. Eclipse specimens were prepared after retrieving the stone mold from the denture flask, application of a separating agent (Dentsply Int.), and conditioning the stone mold in a conditioning oven (Dentsply Int.) to 55 °C for 2 min. Using finger pressure, a section of 1 mm Eclipse baseplate resin was then applied into the mold. Air Barrier Coating (ABC) (Dentsply Int.) was applied and the specimens were cured in the Eclipse VLC processing unit for 10 min (Fig. 3). After bench cooling to room temperature and washing them out of the ABC coating, 1 mm of the Eclipse contour resin was applied onto the cured baseplate resin specimen. A new coat of ABC was applied, and the specimens were recurred.

All specimens were submitted to finishing for 1 min with Buehler abrasive disks no. 320, 400 (AKE, Illinois, USA),