International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Effect of Tea, Coffee and Turmeric Solutions on the Color Stability of Heat Polymerized Polymethyl Methacrylate Resin Denture Base Modified with Five Percent Low Molecular Weight Chitosan Microparticles: An in Vitro Study

Dr. Rushabh Bafna

Postgraduate Student, Department of Prosthodontics and Crown and Bridge, K. M. Shah Dental College and Hospital, Sumandeep Vidyapeeth, Piparia, Vadodara, Gujarat, India

Abstract

Background: Polymethyl methacrylate is extensively used as a denture base material; however, its susceptibility to discoloration compromises long-term esthetics. Chitosan, a naturally derived biopolymer, has been incorporated into PMMA to enhance its functional properties. This in vitro investigation assessed the influence of tea, coffee, and turmeric solutions on the color stability of heat-polymerized PMMA modified with five percent low molecular weight chitosan microparticles.
Materials And Methods: Seventy-five chitosan-modified PMMA specimens were fabricated and allocated to three groups according to staining media. Color measurements were recorded at baseline and after ten, twenty, and thirty days using a spectrophotometer following the CIELAB color system. Color differences were calculated as ΔE values. Statistical analysis included Friedman and Wilcoxon signed-rank tests with Bonferroni correction.
Results: A progressive increase in discoloration was observed with increasing immersion periods for all staining agents. Turmeric caused the greatest color alteration, followed by coffee and tea. All intergroup and intragroup comparisons showed statistically significant differences ($p < 0.001$).
Conclusion: Five percent chitosan-modified PMMA exhibited time-dependent discoloration when exposed to common dietary chromogens, with turmeric producing clinically unacceptable color changes.

Keywords: Chitosan Microparticles, PMMA, Denture Base Resin, Color Stability, Tea, Coffee, Turmeric

Introduction

Color stability is a critical determinant of the clinical longevity and esthetic acceptance of denture base materials. Polymethyl methacrylate remains the material of choice owing to its favorable handling properties and cost-effectiveness; however, prolonged exposure to dietary chromogens often results in

visible discoloration. Factors such as water sorption, surface irregularities, and pigment adsorption contribute to this phenomenon.

Chitosan has attracted interest in dental material research due to its biocompatibility, antimicrobial activity, and reinforcing potential. Although previous studies have demonstrated improvements in mechanical performance following chitosan incorporation, evidence regarding its effect on color stability remains limited. This study was therefore undertaken to evaluate the color stability of chitosan-modified PMMA following exposure to commonly consumed staining beverages.

Materials And Methods

An in vitro experimental design was adopted. Heat-polymerized PMMA resin was modified by incorporating five percent low molecular weight chitosan microparticles using ball milling. Seventy-five specimens measuring twenty by twenty by three millimeters were fabricated and finished uniformly. Specimens were divided into three groups corresponding to tea, coffee, and turmeric solutions. Staining solutions were freshly prepared and specimens were immersed at thirty-seven degrees Celsius. Color measurements were obtained at baseline and after ten, twenty, and thirty days. Color differences were calculated using the CIELAB ΔE formula. Non-parametric statistical tests were employed due to non-normal data distribution.

Results

All specimens demonstrated increasing ΔE values with prolonged immersion. Turmeric produced marked discoloration exceeding clinically acceptable thresholds, whereas tea and coffee caused comparatively lower yet significant color changes. Statistical analysis revealed significant differences across time intervals and between staining solutions ($p < 0.001$).

Discussion

The pronounced discoloration observed with turmeric immersion can be attributed to curcumin's strong chromogenic nature and affinity for polymer matrices. Coffee-induced discoloration was greater than that caused by tea, likely due to higher tannin content. Although chitosan enhances mechanical and antimicrobial properties of PMMA, its incorporation did not mitigate color instability. The in vitro nature of this investigation limits direct clinical extrapolation, as oral factors such as salivary flow, mechanical cleaning, and thermal cycling were not simulated.

Conclusion

Within the limitations of this study, five percent chitosan-modified PMMA demonstrated significant time-dependent discoloration following exposure to tea, coffee, and turmeric. Turmeric produced the greatest color change, followed by coffee and tea. Dietary counseling and maintenance protocols are recommended for patients receiving such prostheses.