



Comparative Effect of Ginger, Myrtus, and Chamomile Disinfectant Plant Extracts on the Color Stability of Acrylic Denture Base

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Received: 2024-11-17/ Accepted: 2025-01-26 / First publication date: 2025-09-11

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Abstract

Background: Various chemical solutions have been suggested for disinfecting dentures. However, the dipping method may influence the properties of the acrylic denture base, such as strength and color. This study aimed to compare and evaluate the color change of the heat-cured acrylic denture base subjected to the dipping method using antimicrobial extracts of ginger, myrtus, and chamomile plants.

Materials and Methods: This laboratory experimental study involved the preparation of 80 acrylic denture base samples, each measuring $3.3 \times 10 \times 65$ mm. The samples were divided into four groups ($n=20$). Pure extracts of ginger, myrtle, and chamomile were prepared. A colorimetric test was initially conducted on all samples. The specimens were then immersed in their assigned solutions or in distilled water as a control for a duration of 10 days, with each day consisting of three immersions, each lasting for 15 minutes. Following the 10-day treatment period, a subsequent colorimetric test was performed. The colorimetric measurements were performed utilizing a spectrophotometric device, in accordance with the CIELAB color system. Data were analyzed by one-way ANOVA test ($\alpha = 0.05$).

Results: The four groups under study exhibited no significant difference in the mean discoloration value of the acrylic denture base ($p=0.200$).

Conclusion: Results of our study showed extracts of ginger, myrtus, and chamomile did not alter the color of the denture material within the given time.

Keywords: Zingiber officinale; Myrtus; Chamomile; Color; Dentures

Introduction

Complete denture wearers encounter a variety of problems. Some of these problems are temporary and are thus overlooked by patients, while some others are

severe enough to make patients feel uncomfortable and unable to tolerate their dentures. Some patients exhibit poor *denture hygiene*. In general, denture wearers often neglect to clean their dentures, demonstrating inadequate oral hygiene, which leads to the formation and accumulation of oral biofilm and is associated with an increased risk of developing denture stomatitis (1). Hygiene plays a major role in the effective use of dentures. In long-time denture wearers, the materials used in the denture base can become a ground for harmful microorganisms to grow.

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Maintaining the cleanliness of dentures is crucial for preventing various oral and dental diseases, as well as for treating denture stomatitis in edentulous patients. Usually, a combination of mechanical and chemical methods is recommended for denture cleaning (2).

A variety of chemical solutions have been recommended for denture disinfection, and the effect of dipping dentures in these solutions on various properties of acrylic dentures has also been discussed. Several chemical solutions have been recommended for denture disinfection, and considerable attention has been given to the effects of denture immersion in these agents on the physical and mechanical properties of denture acrylics. An ideal denture cleanser should be biocompatible, bactericidal, fungicidal, harmless, and non-toxic to the denture structure; effectively remove organic and inorganic deposits; and be easy to use (2).

Chemical denture cleansers are not as effective in clinical use as in the laboratory method. An important point to note is that natural products can be used as alternatives to synthetic chemicals, and there has been an increasing interest in the use of medicinal plants as a source of antimicrobial agents. Natural products, including essential oils and extracts, are promising therapeutic options for treating oral infections. These products are a complex mixture of plant-derived volatile compounds with antioxidant and antimicrobial properties against a wide range of pathogens, including *Candida albicans* and dermatophytes (2).

Certain plants used for this purpose have shown an inhibitory effect on various microorganisms, including bacteria, fungi, and yeasts. These products showed a low toxicity level to mammals with lower environmental impact and more widespread public acceptance (3).

The medicinal plants of ginger (4), myrtus (5), and chamomile (6) have been proposed as plants with

antimicrobial properties and are widely used in many medicinal compounds.

Chamomile is a member of the Asteraceae family. Its anti-inflammatory, wound-protecting, antispasmodic, and antibacterial effects have been proven many times, which is why it has been included in many pharmacopoeias (7). Gingers are obtained from a yellow plant with purple veins. In *laboratory animals*, the *gingerols* increase the motility of the *gastrointestinal tract* and have analgesic, sedative, antipyretic, and antibacterial properties, as well as the contraction effect of the digestive tube (8). Myrtus, the common myrtle, is a member of the myrtle family Myrtaceae. It has antibacterial, antifungal, anti-inflammatory, and pain-relieving properties and is known as an antioxidant. In higher concentrations, it also exhibits bacteriostatic properties (8).

Over time, the chemical and physical properties of dental dentures change, which can include color alterations as well. These color changes can result from extrinsic factors (time and eating habits such as consumption of tea, stained soft drinks and coffee) (9, 10) or intrinsic factors (absorption and adhesion of colors due to surface roughness, accumulation of waste materials and infective organisms such as *Candida albicans*). The discoloration of *materials used* in the fabrication of *these removable* prostheses *can lead* to an *unfavorable appearance* and *patient dissatisfaction*. This can also compromise the quality of the prostheses (11).

It has been found that the discoloration level also depends on patients' maintenance of oral and dental hygiene and the frequency use of cleansing materials (12).

In a study performed by Keyf et al. (13), the antibacterial effect of chamomile and ginger on *Escherichia coli*, *Bacillus subtilis* and *Salmonella typhi* has been shown. Kandil et al. (14) found that dentures coated with olives and grapes showed a

decrease in the optical density when compared to the uncoated group. They concluded that the use of coating materials on the acrylic denture base surface can be beneficial, but it will cause a significant change in the color of the acrylic denture base. In the study of Gonçalves et al. (15), dipping the *acrylic resin* dentures in the *Chenopodium ambrosioides* plant extract was *effective* in the *reduction* of *Candida albicans* and *Candida glabrata* biofilms without any evidence of changes in roughness and color.

Considering the general tendency to use plant-based materials in daily life and the importance of the effect of materials on acrylic properties for color stability and cosmetic considerations, it is important to find disinfectant plants that do not change or just minimally change the acrylic properties. The aim of this study was to compare and evaluate the discoloration of heat-cured acrylic denture base by the dipping method in the antimicrobial extract of ginger, myrtus and chamomile plants.

Materials and Methods

In this experimental laboratory study, 80 wax models (Modelling Wax, Polywax, Turkey) from heat-cured polymethyl methacrylate (PMMA) resins with dimensions of 3.3 x 10 x 65 mm (according to ISO/FDIS 1567 standard) were prepared and flaked. In the next step, the heat-cured acrylic denture base (Acrosun Heat-cure Denture Base Resin, BetaDent, Iran) was packed inside the plaster mold and the denture flasks were pressed and their excess was removed. Then, the flask was placed under pressure in a water bath with controlled temperature and time (74°C for 8 hours) to be ready for polymerization. After the polymerization was completed, the specimens were removed from the flask and separated and polished using a milling machine and micromotor. A total of 22 flasks were cast and 88 specimens were produced, of which 8 specimens were excluded from

the study due to distortion and failure and 80 suitable specimens were included in the study.

For the experiment, three herbal extracts of ginger, chamomile, and myrtus were required. As we were not sure about the purity and percentage of the solutions available in the market, we produced these extracts in the laboratory (16-18).

The 80 produced acrylic pieces were divided into four groups (n=20). The groups were named according to the intervention performed as follows:

- Group 1: to be dipped in ginger extract
- Group 2: to be dipped in myrtus extract
- Group 3: to be dipped in chamomile extract
- Group 4: to be dipped in distilled water (control)

Each group of 20 specimens was sent to the laboratory for spectrophotometric testing. After they were delivered and the results were recorded, the acrylic pieces of each group were immersed in the respective solution extract container.

To test the colorimetry of the immersed acrylic pieces before and after dipping, we used a spectrophotometric device for colorimetry (Avantes spectrometer, Avantes, Netherlands) in the 200-1100 nm range.

For each acrylic piece in the CIELAB color system, the laboratory sent three indicators, L*, a* and b*, indicating color intensity, color position between green and red, and color position between blue and yellow, respectively. The color difference with these three indicators was determined by statistical calculations (Figure 1).

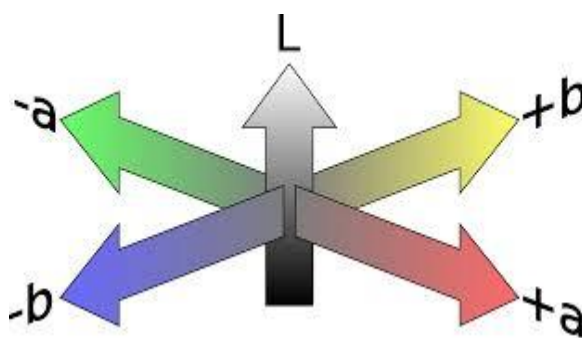


Figure 1. Color indicators in the CIELAB system

After controlling the normality default using the Kolmogorov-Smirnov test, the Data were analyzed using the statistical tests of one-way ANOVA by SPSS version 27. The significance level was set to 5%.

Results

Table 1. The mean discoloration value of acrylic dentures in the groups under study

Group	N	Mean $\pm$ SD (MPa)	Min.	Max.	P value
Ginger	20	67.01 $\pm$ 6.74	49.51	74.75	0.200
Myrtus	20	64.26 $\pm$ 4.70	49.48	72.84	
Chamomile	20	65.56 $\pm$ 4.54	55.74	73.21	
Control	20	63.49 $\pm$ 5.72	44.62	72.52	

Discussion

This study evaluated the effects of the herbal extracts of ginger, myrtus, and chamomile on the discoloration of heat-cured acrylic denture base resin. Dentures are in constant contact with oral fluids. But for maintaining the hygiene of the dentures, they are in close contact with water and other denture cleansers for 15 to 20 minutes

There has been an increasing demand for cosmetic dentistry and the rapid advancement of new restorative materials for cosmetic procedures. Failure or success in the beauty of dental products, such as dentures or cosmetic procedures, depends on the color stability of the product or cosmetic and restorative material. Discoloration can be evaluated visually or by instrumental techniques. Visual color detection is based on the visual comparison of an object with color standards. This method is the most commonly used in dentistry. However, since visual assessment leads to subjective and inconsistent results, color-measuring instruments are preferred. The CIELAB colorimetric system is suitable for studying the relationship between the measured discoloration values. Mutlu-Sagesen (19) found that instrumental and "objective" color evaluation is becoming an important technological tool for the analysis of colored objects,

According to the results of one-way ANOVA, the studied groups (ginger extract, myrtus extract, chamomile extract and distilled water) showed no significant difference in the mean discoloration level of acrylic denture ($p=0.200$) (Table 1).

and it is a widely used method in dentistry. The CIELAB system, with its associated color difference criteria, was specifically designed to improve the visual interpretation of colorimetric data and it is rapidly becoming a useful standardized technique for the accurate evaluation of color values. In the dental industry, color monitoring and evaluation can be performed using a spectrophotometer.

Discoloration can occur due to extrinsic or intrinsic factors (20, 21). Extrinsic factors include internal and surface absorption (21). *Other factors are also related to color change, such as stain dehydration, water absorption, leakage, rough surfaces, chemical and aging degradation*, oxidation, and permanent formation of pigments (20).

According to the results of the present study, the groups exhibited no significant difference in the mean discoloration value of acrylic dentures. Similar results were achieved by Pisani et al. (22) in an evaluation of the color alteration of acrylic denture base in an exposure to an experimental solution of *Ricinus communis* (RC). Gonçalves et al. (15) investigated the effect of *Anacardium occidentale* on the discoloration of acrylic dentures. According to them, despite the variety of color difference values obtained, all these values were insignificant. Banu et al. (11) found that

coffee and cola beverages had little impact on acrylic denture discoloration, which is consistent with the results of the present study.

Hong et al. (22) investigated the impact of commercial denture cleansing solutions on the discoloration of acrylic dentures and reported their discoloration. Kandil et al. (14) also investigated the effect of acrylic resin coating "monopoly", olive oil and grape seed oil on the *Candida albicans* growth, and on the color of a heat-cured acrylic resin denture base, observing a significant change in the color of the acrylic denture base.

Discoloration may occur depending on the quality of the bond between the monomers and the amount of water absorbed. The intrinsic discoloration in the polymer substrate of more colorful materials is partially hidden and thus less noticeable due to the high ratio of color pigments. Uchida et al. (23) reported that higher discoloration may result from one of the following two factors:

(a) Color change through environmental breakdown of the polymer, which results in the release of monomers and color change from the cured resin to the monomers.

(b) Environmental effects on the retention and/or stability of pigments and other additives in polymer formulations

The color stability of the acrylic pieces shows that the lack of brightness of the denture color causes less discoloration. Moreover, the acrylic polymerization was carried out well and the environment of the solutions was suitable and did not cause the release of monomers.

Coelho et al. (24) investigated the effect of dipping in disinfectants on the color stability of denture base resins, concluding that the duration of dipping influenced the discoloration of the denture base resins regardless of the disinfectant solution.

Conclusion

Extracts of ginger, myrtus, and chamomile can be used to clean dentures without affecting their color. The best outcome regarding the color stability of the acrylic denture base was achieved by the myrtus extract. A comparison of the effects of ginger, myrtus and chamomile extracts on acrylic denture discoloration showed that the chamomile extract caused less discoloration. Thanks to their antimicrobial and antioxidant properties, as well as their ability to maintain the color, ginger, Myrtus, and Chamomile extracts can meet some of the needs of an ideal denture cleanser.

Conflict of Interests:

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial, or non-financial in this article

Ethic C

References

1. Frenkel H, Harvey I, Newcombe RG. Oral health care among nursing home residents in Avon. *Gerodontology*. 2000;17(1):33-38
2. Anjum R, Dhaded SV, Joshi S, Sajjan CS, Konin P, Reddy Y. Effect of plant extract denture cleansing on heat-cured acrylic denture base resin: An in vitro study. *J Indian Prosthodont Soc*. 2017;17(4):401-405.
3. Lee SO, Choi GJ, Jang KS, Lim HK, Cho KY, Kim JC. Antifungal activity of five plant essential oils as fumigant against postharvest and soilborne plant pathogenic fungi. *Plant Pathol J*. 2007; 23(2):97-102.
4. Nemati Z, Moradi Z, Alirezalu K, Besharati M, Raposo A. Impact of Ginger Root Powder Dietary Supplement on Productive Performance, Egg Quality, Antioxidant Status and Blood Parameters in Laying Japanese Quails. *Int J Environ Res Public Health*. 2021;18(6):2995
5. Mir MA, Bashir N, Alfaify A, Oteef MDY. GC-MS analysis of *Myrtus communis* extract and its antibacterial activity against Gram-positive bacteria. *BMC Complement Med Ther*. 2020; 20(1):86.
6. Roby MHH, Sarhan MA, Selim KA, Khalel KAH. Antioxidant and antimicrobial activities of essential oil and extracts of fennel (*Foeniculum vulgare* L.) and

- chamomile (*Matricaria chamomilla* L.). Industrial crops and products. 2013; 44:437-45.
7. Cinco M, Banfi E, Tubaro A, Loggia RD. A microbiological survey on the activity of a hydroalcoholic extract of camomile. . Int J Drug Res. 1983;21(4):145–51
8. Feisst C, Franke L, Appendino G, Werz O. Identification of molecular targets of the oligomeric nonprenylated acylphloroglucinols from *Myrtus communis* and their implication as anti-inflammatory compounds. J Pharmacol Exp Ther. 2005;315(1):389-396.
9. Koksall T, Dikbas I. Color stability of different denture teeth materials against various staining agents. Dent Mater J. 2008;27(1):139-144
10. Hipólito AC, Barão VA, Faverani LP, Ferreira MB, Assunção WG. Color degradation of acrylic resin denture teeth as a function of liquid diet: ultraviolet-visible reflection analysis. J Biomed Opt. 2013; 18(10):105005.
11. Banu F, Jeyapalan K, V AK, Modi K. Comparison of Colour Stability Between Various Denture Base Resins on Staining and Denture Cleansing Using Commercially Available Denture Cleansers. Cureus. 2020; 12(1): e6698.
12. Keyf F, Etikan I. Evaluation of gloss changes of two denture acrylic resin materials in four different beverages. Dent Mater. 2004; 20(3): 244-251.
13. Azu NC, Onyeagba RA. Antimicrobial properties of extracts of *Allium cepa* and *Zingiber officinale* (ginger) on *Escherichia coli*, *Salmonella typhi* and *Bacillus subtilis*. Internet J Trop Med. 2006; 3(2): 11056
14. Kandil MMN, Jaffer NT, Shehab EY. The effect of three coating materials on the candidal growth, on the surface and color of a heat-cure acrylic resin denture base. Al-Rafidain Dent J. 2009; 9(1): 279-
15. Gonçalves LM, Madeira PLB, Diniz RS, Nonato RF, de Siqueira FSF, de Sousa EM, Farias DCS, et al. Effect of *Terminalia catappa* Linn. on Biofilms of *Candida albicans* and *Candida glabrata* and on Changes in Color and Roughness of Acrylic Resin. Evid Based Complement Alternat Med. 2019; 2019: 7481341.
16. Azadpour M, Azadpour N, Bahmani M, Hassanzadazar H, Rafieian-Kopaei M, Naghdi N. Antimicrobial effect of Ginger (*Zingiber officinale*) and mallow (*Malva sylvestris*) hydroalcoholic extracts on four pathogen bacteria. Der Pharmacia Lettre. 2016; 8(1):181-187.
17. Taheri A, Seyfan A, Jalalinezhad S, Nasery F. Antibacterial effect of *Myrtus communis* hydroalcoholic extract on pathogenic bacteria. Zahedan J Res Med Sci.2012; 15(6):e92954.
18. Mutlu-Sagesen L, Ergün G, Ozkan Y, Semiz M. Color stability of a dental composite after immersion in various media. Dent Mater J. 2005; 24(3): 382-390.
19. Anıl N, Hekimoglu C, Büyükbaz N, Ercan MT. Microleakage study of various soft denture liners by autoradiography: effect of accelerated aging. J Prosthet Dent. 2000; 84(4):394-399.
20. Jin C, Nikawa H, Makihira S, Hamada T, Furukawa M, Murata H. Changes in surface roughness and colour stability of soft denture lining materials caused by denture cleansers. J Oral Rehabil. 2003;30(2):125-130
21. Pisani MX, Macedo AP, Paranhos Hde F, Silva CH. Effect of experimental *Ricinus communis* solution for denture cleaning on the properties of acrylic resin teeth. Braz Dent J. 2012; 23(1):15-21.
22. Hong G, Murata H, Li Y, Sadamori S, Hamada T. Influence of denture cleansers on the color stability of three types of denture base acrylic resin. J Prosthet Dent. 2009; 101(3):205-213.
23. Uchida H, Vaidyanathan J, Viswanadhan T, Vaidyanathan TK. Color stability of dental composites as a function of shade. J Prosthet Dent. 1998; 79(4):372-377.
24. Coelho SRG, da Silva MDD, Nunes TSBS, Viotto HEC, Marin DOM, Pero AC. Effect of immersion in disinfectants on the color stability of denture base resins and artificial teeth obtained by 3D printing. J Prosthodont. 2024;33(2):157-163