Dentika Dental Journal
Journal homepage: https://talenta.usu.ac.id/dentika

The Effect of Red Ginger Drink Immersion on Surface Roughness of Acrylic Artificial Teeth

Veronica Angelia[1], Nuraisha Surraya[2], Nusima Mohamed[3]

[1]*Department of Prosthodontics, Faculty of Dentistry, Universitas Sumatera Utara, 20155, Indonesia*
[2] *Undergraduate Student, Faculty of Dentistry, Universitas Sumatera Utara, 20155, Indonesia*
[3]*Department of Conservative Dentistry and Prosthodontics, Faculty of Dentistry, Universiti Sains Islam Malaysia, 55100, Kuala Lumpur, Malaysia*

Corresponding Author: veronica_angelia@usu.ac.id

ARTICLE INFO

Article history:
Received 19 January 2026
Revised 7 June 2026
Accepted 22 July 2026 Available July 2026

E-ISSN: 2615-854X
P-ISSN: 1693-671X

How to cite:
Angelia V, Surraya N. The Effect of Red Ginger Drink Immersion on Surface Roughness of Acrylic Artificial Teeth. Indonesian Dentika Dental Journal 2026; 29(1): 28-35

http://doi.org/10.32734/dentika.v29i1.24547

ABSTRACT

Acrylic resin denture elements are popular due to their good aesthetics and economic value. However, their hydrophilic nature causes water absorption which can affect surface roughness. Red ginger drink contains phenolic compounds and is acidic. These compounds can diffuse into the acrylic resin matrix and break the polymer chain, potentially triggering surface damage. The purpose of this study was to determine the effect of the duration of immersion of conventional and intrahomogeneous polymer acrylic resin denture elements in red ginger drink for 3, 5, and 7 days on surface roughness. The laboratory experimental study used conventional and intrahomogeneous polymer acrylic denture elements samples (n = 40). The samples were divided into 4 treatment groups (each n = 10). The control group was immersed in artificial saliva, while the treatment group was immersed in red ginger drink. Surface roughness measurements were performed using a profilometer. Data were analyzed statistically using the Generalized Linear Model Repeated Measures (GLM-RM) test. The results showed a significant effect of the duration of immersion of acrylic denture elements in red ginger drink for 3, 5, and 7 days on the increase in surface roughness of both types of materials ($p < 0.001$). Conventional acrylic dentures showed a greater level of surface roughness compared to intra-homogeneous polymers, both in the control group and after immersion in the red ginger drink solution.

Keyword: Acrylic Artificial Teeth, Red Ginger Drink, Surface Roughness

ABSTRAK

Anasir gigi tiruan resin akrilik populer digunakan karena estetika yang baik dan ekonomis. Namun, sifatnya yang hidrofilik menyebabkan penyerapan air yang dapat memengaruhi kekasaran permukaan. Minuman jahe merah mengandung senyawa fenolik dan bersifat asam. Senyawa ini dapat berdifusi ke dalam matriks resin akrilik dan memutus rantai polimer, sehingga berpotensi memicu kerusakan permukaan. Tujuan penelitian ini mengetahui pengaruh durasi perendaman anasir gigi tiruan resin akrilik jenis *conventional* dan *intrahomogeneous polymer* dalam minuman jahe merah selama 3, 5, dan 7 hari terhadap kekasaran permukaan. Penelitian eksperimental laboratoris menggunakan sampel anasir gigi tiruan akrilik *conventional* dan *intrahomogeneous polymer* (n = 40). Sampel dibagi menjadi 4 kelompok perlakuan (masing-masing n = 10). Kelompok kontrol direndam dalam saliva buatan, sedangkan kelompok perlakuan direndam dalam minuman jahe merah .Pengukuran kekasaran permukaan dilakukan menggunakan *profilometer*. Data dianalisis secara statistik menggunakan uji *Generalized Linear Model Repeated Measures* (GLM-RM). Hasil penelitian menunjukkan terdapat pengaruh signifikan dari durasi perendaman anasir gigi tiruan akrilik dalam minuman jahe merah selama 3, 5, dan 7 hari terhadap peningkatan kekasaran permukaan pada kedua jenis material ($p < 0{,}001$). Gigi tiruan akrilik konvensional menunjukkan tingkat kekasaran permukaan yang lebih besar dibandingkan dengan polimer intra-homogen, baik pada kelompok kontrol maupun setelah direndam dalam larutan minuman jahe merah.

Kata kunci: Anasir Gigi Tiruan Akrilik, Minuman Jahe Merah, Kekasaran Permukaan

1. Introduction

Dentures are carefully designed prosthetic dental devices developed to replace one or more missing teeth along with the supporting oral tissues, such as the gums and underlying bone structure. The primary purpose is to restore essential oral functions, including chewing and biting, allowing the patient to maintain proper nutrition and digestion. In addition to functional restoration, dentures help improve and preserve the patient's facial aesthetics by supporting the lips and cheeks, contributing to a natural appearance. These prosthetics also aid in speech by providing the structural support necessary for proper pronunciation, playing an important role in maintaining oral health by preventing excessive movement of remaining teeth and reducing the risk of further oral complications [1]. In Indonesia, only about 5.5% of the population wears these prosthetics, showing relatively low use. However, this figure does not accurately reflect the true prevalence of tooth loss, as a significant number of people who have lost one or more teeth do not use dentures. Several factors contribute to the gap between tooth loss and denture use. The most frequently reported reason is the discomfort or difficulty experienced when wearing dentures. Other considerations include cost, accessibility, lack of awareness, or personal preference, all of which can influence an individual's decision to forgo prosthetic dental treatment [2].

Although dentures are highly valuable in mitigating the functional and aesthetic effects of tooth loss, such as restoring proper chewing ability, improving speech clarity, and supporting the facial muscles to maintain natural contours, many individuals who have lost teeth do not view obtaining dentures as an urgent necessity. Even though the treatment of dentures can significantly enhance oral function, appearance, and quality of life, a large number of individuals tend to postpone or place low priority on pursuing this type of dental care. This condition is caused by factors such as a lack of awareness about the benefits, perceived discomfort, financial constraints, or the belief that missing teeth do not immediately impact daily life [3]. A denture is a removable dental prosthesis made up of two main components, namely a base and a set of artificial teeth. The artificial teeth are designed to closely resemble the shape, size, and function of the natural teeth that have been lost, helping to restore appearance and chewing ability. The base, which is typically crafted to fit comfortably over the gums and underlying oral tissues, acts as the supporting structure that holds the artificial teeth securely in place [4].

Artificial teeth are commonly made from acrylic resin or porcelain. In comparison to porcelain teeth, acrylic resin artificial teeth bond chemically with the denture base, allowing easier adjustment and a comfortable fit, contributing to higher patient satisfaction in clinical practice. Furthermore, acrylic resin teeth are lighter and cause less trauma to the denture-bearing tissues, ensuring suitability for a wide range of patients. Although porcelain teeth offer better wear resistance and aesthetics, acrylic resin remains popular due to its favourable combination of ease of processing, cost-effectiveness, and flexibility in clinical use, specifically in complete denture rehabilitation [5]. Choosing the appropriate material for artificial teeth plays a significant role in the long-term success and durability of a denture. Among the available options, acrylic resin is frequently selected due to its relatively easy adjustment, polishing, and modification, allowing clinicians to achieve a precise fit and make chairside corrections when needed. It is also lightweight and generally provides a comfortable experience for patients. Although acrylic resin tends to wear down more quickly over time compared with some alternative materials, the practical advantages in terms of handling, adaptability, and patient comfort make the prosthetic a widely preferred choice for both dental professionals and the individuals who wear dentures [6].

Acrylic resin teeth are commonly preferred for denture fabrication because of the wide availability of shapes, sizes, and shades, facilitating clinical use. Compatibility with acrylic denture-based materials allows easy incorporation during laboratory processing without requiring a complex method. In addition, acrylic resin teeth can be readily adjusted, reshaped, and polished during clinical and laboratory procedures, enabling accurate occlusal correction and a smooth surface finish. A key advantage is the capacity to closely replicate the visual characteristics of natural teeth. This includes matching the natural colour and the subtle variations in translucency, as well as the shape and surface texture of real teeth. By accurately reproducing these features, the dentures achieve a highly realistic and visually pleasing appearance, which enhances the patient's smile and contributes to a more natural and aesthetically satisfying result [7]. Acrylic artificial teeth can be classified into several distinct categories based on composition and manufacturing characteristics. These include conventional acrylic teeth made from standard polymethyl methacrylate (PMMA) and cross-linked type containing additional chemical bonds between polymer chains to improve strength and wear resistance. Other types include intra-homogeneous polymer teeth designed with a more uniform internal structure to enhance durability and resin-filled composite teeth incorporating reinforcing fillers within the resin matrix to improve mechanical properties and overall performance [8].

In Indonesia, a significant clinical challenge arises from the widespread cultural habit of consuming traditional herbal beverages, particularly red ginger (*Zingiber officinale*). Data shows a high consumption rate of red ginger drinks among the elderly (the primary demographic for denture wearers) who use its anti-inflammatory and antioxidant properties for systemic health [9,10]. Although biologically beneficial for the body, the chemical interaction between red ginger and Polymethyl Methacrylate (PMMA) poses a potential risk to prosthetic longevity. Red ginger contains high concentrations of gingerol and acidic phenolic compounds [11,12]. Based on a material science perspective, phenols act as carbolic acid, which can function as a potent chemical solvent for acrylic resins [13]. This acidic challenge may penetrate the polymer matrix, causing the leaching of plasticizers and the disruption of polymer chains [14,15].

Phenol has the ability to chemically interact with acrylic resins, leading to degradation and deterioration of the resin's surface structure. This reaction alters the surface integrity of the acrylic material, leading to chemical damage and potential weakening of its physical properties [16,17]. Acidic compounds can diffuse into acrylic plates and penetrate the internal structure of the material, where they disrupt and break down the long polymer chains of the acrylic resin. This disruption weakens the polymer network, leading to physical deterioration manifested as increased surface roughness and reduced colour stability [18,19]. Therefore, this study aimed to assess the surface roughness of acrylic artificial teeth soaked in red ginger drink for three, five, and seven days.

2. Materials and Methods

This study was approved by the Ethics Committee Universitas Sumatera Utara, Medan, Indonesia, with ethical clearance number No. 443/KEPK/USU/2024. An experimental study was conducted with a pre-test and post-test, using the control group design. The samples were divided into four treatment groups with 10 samples each. The four different groups included A1, which comprised a conventional type of acrylic artificial teeth immersed in artificial saliva as the control group. Group A2 consisted of a conventional type of acrylic artificial teeth immersed in red ginger drink. Group B1 included an intra-homogeneous polymer type of acrylic artificial teeth immersed in artificial saliva as the control group. Group B2 consisted of intra-homogeneous polymer type of acrylic artificial teeth immersed in red ginger drink. Before immersion in any solution, each acrylic artificial tooth sample was carefully labelled with a unique identification number to ensure proper tracking throughout the experiment. Initial surface roughness measurements were then carried out on all samples using a contact profilometer (Mitutoyo, Japan). The immersion durations for each group were three, five, and seven days. These durations were selected based on previous *in vitro* studies that evaluated time-dependent changes in acrylic resin materials exposed to various solutions [20–22]. The intervals were intended to simulate the cumulative exposure of a denture to daily beverage consumption over an extended period. Measurements were taken three times on the surface of the sample.

The surface roughness of acrylic artificial teeth was accurately assessed using a contact profilometer, a precision instrument designed to quantify microscopic irregularities on a material's surface. In this procedure, a diamond-tipped stylus was gently placed on the selected area of the acrylic tooth, and a light, constant force was applied to ensure accurate measurement without causing any damage to the surface. The stylus was then moved horizontally along a predetermined path, typically a few millimetres in length, following the microscopic peaks and valleys of the surface. During movement across the surface, the instrument electronically detected vertical displacements of the stylus caused by surface irregularities and converted the displacements into digital signals representing the surface profile. To obtain reliable data, the measurements were recorded three times to account for variations in texture across the surface. After recording the surface profile, the profilometer calculated standard roughness parameters, with the most common being the arithmetic mean roughness (Ra). The Ra value represented the average deviation of the surface profile from an ideal mean line and was expressed in micrometres (μm). This method allowed the analysts and clinicians to quantitatively evaluate the smoothness or roughness of acrylic teeth, which was important for assessing several factors, including wear resistance and plaque accumulation potential, as well as the longevity and hygiene of denture materials. The measurements of acrylic artificial teeth after immersion in red ginger drink for three, five, and seven days were obtained using a profilometer and the mean value in micrometres (μm) was calculated. The data in this study were analysed using several methods. These included (1) Univariate analysis to determine the mean and standard deviation of the surface roughness values for each group, (2) Generalized Linear Model Repeated Measures (GLM-RM) test to evaluate the effect of immersing acrylic dentures in red ginger drink for three, five, and seven days on surface roughness.

3. Results

The surface roughness of acrylic artificial teeth was evaluated after immersion in red ginger drink for 3, 5, and 7 days. Measurements were performed using a profilometer, a precision instrument that detects and records microscopic peaks and valleys on the tooth surface. For each immersion period, the profilometer traced the surface profile of the teeth, and the vertical deviations were electronically captured to quantify the roughness. The average surface roughness values (Ra) were calculated and expressed in micrometres (µm), providing a standardized measure of how the acrylic teeth's surface texture changed over time due to exposure to the red ginger solution.

The surface roughness of acrylic artificial teeth increased progressively with longer immersion times in red ginger drink. After three days of exposure, a moderate increase in mean surface roughness (Ra) was observed compared with baseline values, suggesting initial changes to the acrylic surface. By day five, the Ra values showed a more pronounced increase, suggesting that prolonged contact with the solution worsened surface irregularities. After seven days, the acrylic teeth exhibited the highest mean surface roughness, showing a time-dependent effect of the red ginger drink on the surface integrity of the material. These results were consistent across all measurement points, and the profilometric data showed that conventional acrylic teeth experienced greater increases in roughness compared with intra-homogeneous polymer teeth at each immersion period. This result showed both the material-dependent and immersion time-dependent effects on the surface texture of acrylic artificial teeth when exposed to a phytochemical-containing beverage. The alterations in surface roughness were clinically relevant, as increased roughness could enhance plaque accumulation and affect long-term hygiene and durability. Table 1 shows the surface roughness values of conventional and intra-homogeneous polymer acrylic artificial teeth before and after immersion for three, five, and seven days.

Table 1. Surface roughness values of acrylic artificial teeth immersed in red ginger drink for 3, 5, and 7 days

Acrylic Artificial Teeth	Artificial Saliva (Control) (μm)				Red Ginger Drink (μm)			
	0 day	3 days	5 days	7 days	0 day	3 days	5 days	7 days
Conventional	1.112	1.16	1.233	1.314	1.141	1.353	2.007**	2.564
	1.197	1.273	1.323	1.418	1.176	1.395	1.983	2.667**
	1.117	1.201	1.252	1.377	1.140	1.307	1.824	2.595
	1.160	1.207	1.261	1.371	1.158	1.377	1.828	2.506
	1.198**	1.282**	1.327**	1.429**	1.145	1.317	1.981	2.505*
	1.185	1.233	1.315	1.443	1.107*	1.275*	1.821*	2.57
	1.128	1.199	1.248	1.361	1.189**	1.414**	1.84	2.632
	1.100	1.143	1.237	1.334	1.165	1.352	1.904	2.52
	1.000*	1.088	1.117*	1.224*	1.133	1.299	1.912	2.611
	1.023	1.061*	1.161	1.288	1.159	1.363	1.898	2.509
x̄ ±SD	1.122± 0.068	1.185± 0.073	1.247± 0.068	1.356± 0.068	1.151± 0.023	1.345± 0.045	1.9± 0.071	2.568± 0.058
Intra-Homogeneous Polymer	0.889	0.935	0.95	1.067	0.898**	1.013	1.329**	1.907**
	0.859	0.929	0.944	1.012	0.822	0.972	1.248	1.744
	0.800	0.862	0.89	0.968	0.847	0.962	1.25	1.728
	0.892	0.933	0.946	1.05	0.897	1.03**	1.303	1.766
	0.911	0.972	0.983	1.103	0.726	0.855*	1.15*	1.617
	0.750*	0.796*	0.838*	0.913*	0.726	0.859	1.164	1.475
	0.902	0.916	0.956	1.092	0.705*	0.855*	1.175	1.463*
	0.920	0.984	1.003	1.117**	0.806	0.947	1.208	1.667
	0.857	0.918	0.949	1.04	0.754	0.89	1.199	1.581
	0.948**	0.979**	1.009**	1.117**	0.818	0.971	1.247	1.8
x̄ ±SD	0.864± 0.064	0.917± 0.062	0.941± 0.056	1.036± 0.07	0.8± 0.061	0.934± 0.058	1.224± 0.057	1.69± 0.135

Description: *Smallest value, **Largest value

Roughness values were statistically analysed by generalized linear model repeated measures (GLM-RM) (solution and time). The results showed that the mean surface roughness of conventional acrylic artificial teeth was significantly greater than the intra-homogeneous polymer type of acrylic artificial teeth. This difference was confirmed through statistical analysis of both the solution and immersion time tests, which showed highly significant results ($p < 0.001$). Furthermore, the duration of immersion in red ginger drink was found to have a statistically significant effect on the surface roughness of both types of acrylic artificial teeth, as evident by a p-value < 0.001. These results suggested that both the type of material and the length of exposure to the red ginger solution played important roles in influencing surface roughness, as shown in Table 2.

Table 2. Effect of immersion time of acrylic artificial teeth in red ginger drink for 3, 5, and 7 days on surface roughness

Group	Immersion Time	$\bar{x} \pm SD$	p
Conventional	0 day – 3 days	(1.137±0.052) - (1.265±0.101)	<0.001*
	3 days – 5 days	(1.265±0.101) - (1.574±0.341)	<0.001*
	5 days – 7 days	(1.574±0.341) - (1.962±0.625)	<0.001*
Intra-homogeneous polymer	0 day – 3 days	(0.832±0.069) - (0.925±0.059)	<0.001*
	3 days – 5 days	(0.925±0.059) - (1.083±1.156)	<0.001*
	5 days – 7 days	(1.083±1.156) - (1.363±0.354)	<0.001*

*Significant (p<0.05)

4. Discussion

The results of this study showed that the average surface roughness of the conventional type acrylic artificial teeth ranged from 1.122 μm (0 day) to 2.568 μm (day 7) with an increase of 56%. Meanwhile, the intra-homogeneous polymer type acrylic artificial teeth average surface roughness ranged from 0.864 μm (0 day) to 1.69 μm (day 7), with an average increase of 49% in Table 1. The conventional acrylic artificial teeth had a significantly greater and progressively increasing surface roughness compared with the intra-homogeneous polymer type. This increase in roughness was consistently observed after immersion in all tested solutions, including the control solution (artificial saliva). Therefore, the conventional acrylic material was more susceptible to surface alterations over time, regardless of the type of solution. The intra-homogeneous polymer teeth maintained a comparatively smoother and more stable surface under the same conditions.

The conventional type of acrylic artificial teeth tends to be more susceptible to the formation of surface porosity and irregularities when exposed to liquids. This increased vulnerability is significantly due to the less densely cross-linked polymer structure of conventional acrylic, which allows fluids to penetrate more readily into the material. As these liquids infiltrate the acrylic matrix, surface integrity is disrupted, leading to measurable changes over time. These effects include an increase in surface roughness, slight dimensional changes, and modifications to the mechanical and physical properties of the teeth, potentially impacting the durability, wear resistance, and clinical performance. The alterations were particularly evident during prolonged or repeated exposure to beverages or solutions, showing the importance of material composition in determining the long-term stability of acrylic prosthetic teeth.

The intra-homogeneous polymer type of acrylic artificial teeth features a more sophisticated two-layer structural design, comprising an outer enamel layer and an inner base layer. The outer enamel layer was formulated using α-CH polymer chemistry, which was distinguished by a densely polymerized core and a highly cross-linked network. This tightly packed and interconnected molecular architecture significantly enhanced the hardness and wear resistance of the material, facilitating the retention of a smooth and uniform surface even under stress or exposure to liquids. The extensive cross-linking within the polymer network limits the material's water absorption, thereby reducing the risk of swelling, porosity, or surface degradation. Consequently, the intra-homogeneous polymer teeth exhibit minimal alterations in the physical and mechanical properties after immersion in solutions, maintaining the surface integrity, dimensional stability, and durability over time compared with conventional acrylic teeth.

Assessing the surface roughness of acrylic artificial teeth is a critical step in ensuring the long-term durability and performance. Surface roughness influences how the teeth interact with the environment, affecting multiple aspects of oral health and prosthetic function. A smoother surface reduces the tendency of staining from food, beverages, or other substances, helping the teeth retain aesthetic appearance over time. It also limits the adhesion of microorganisms, such as bacteria and fungi, which accumulate on rough surfaces and contribute to oral infections, bad breath, or prosthetic complications. Surface texture plays a role in maintaining healthy oral tissues by minimizing irritation to the surrounding gums and mucosa. Based on the patient's perspective, a properly finished and smooth surface enhances comfort during chewing, speaking, and general oral function. Therefore, careful evaluation and control of surface roughness are vital for the functional performance of the prosthesis, as well as the oral health and satisfaction of the patient.

The results of this study showed that immersion in the red ginger drink group led to high surface roughness values compared to the artificial saliva-immersed group (control) for three, five, and seven days. The immersion intervals were designed to represent an increased aging model of daily red ginger consumption. Assuming a patient consumes one serving of the beverage for approximately 15 minutes per day, a 24-hour continuous immersion cycle in this study simulates 96 days of actual clinical exposure. Consequently, the three-, five-, and seven-day intervals represent one, one and a half, and two years of regular daily consumption. The time-dependent evaluation is critical in prosthodontics to observe the cumulative degradation of the PMMA matrix. This is because the prolonged acidic challenge from phenolic compounds leads to the leaching of plasticizers and the subsequent increase in surface roughness over the projected lifespan of the denture [18-20].

The surface roughness values varied due to several factors, such as the length of immersion or the nature of water absorption. This process leads to the disruption and separation of polymer chains, further weakening the chemical structure of the acrylic resin and causing porosity that promotes the development of surface roughness. The result is also consistent with a report by Rachmadi et al (2020) that water absorption allows solvent molecules to enter the spaces between polymer chains, causing disruption and separation. This further leads to an increase in the surface roughness of acrylic resins [18]. The observed increase in surface roughness of acrylic artificial teeth after being immersed in red ginger drink is primarily associated with the chemical activity of the drink’s components. Red ginger contains bioactive compounds, particularly gingerol and other phenolic derivatives known to interact with proteins. Contact between the acrylic surface and these substances can induce protein coagulation, leading to changes to the material’s surface structure. This interaction causes the formation of micro-irregularities and a rougher texture on the surface. Over time, the surface alterations affect the appearance of the artificial teeth, as well as the susceptibility to staining, microbial adhesion, and wear resistance. Therefore, the chemical properties of red ginger drink play a significant role in modifying the surface characteristics of acrylic prosthetic teeth during immersion [20]. These results are consistent with the study conducted by Motayagheni R et al (2020), which showed a change from immersion of three different brands of acrylic artificial teeth in carrot juice, orange juice and tea to colour change [4].

The normality test results have a significance value of $p>0.05$, suggesting a normal data distribution. Furthermore, statistical tests obtained a significance level of $p<0.001$ ($p<0.05$), that immersion duration in red ginger drink affected the surface roughness of acrylic artificial teeth, as shown in Table 2. Gingerol, the primary active compound in red ginger drinks, interacts with polymer bonds, leading to the release of some resin monomers. This release increases the empty spaces within the matrix, resulting in greater surface roughness.

Selecting the most suitable type of artificial teeth plays a significant role in achieving both functional and aesthetic benefits for denture wearers. The right selection can greatly enhance the appearance of the prosthesis by providing a more natural look that matches the patient’s oral and facial features. In addition to aesthetics, selecting high-quality artificial teeth helps in maintaining oral hygiene more effectively, as certain materials and surface structures resist plaque buildup and are easier to clean. Reduced plaque accumulation minimizes the risk of oral infections and gum irritation, as well as prevents bad breath and other hygiene-related issues. Selecting teeth with superior material properties and durability contributes to the longevity of the denture restorations, reducing the frequency of repairs or replacements and ensuring sustained functionality over time. In general, careful selection of artificial teeth directly supports improved aesthetics, better oral health, and extended prosthesis lifespan [21].

In this study, the conventional type of acrylic artificial teeth showed a relatively smaller change in microhardness compared to others, suggesting that the hardness remained more stable under typical use conditions. Meanwhile, the enamel layer of intra-homogeneous polymer acrylic teeth, which incorporated a cross-linked structure, had several superior properties. These teeth exhibited high impact strength, making the material more resistant to fracture and chipping during chewing. The material also showed excellent wear resistance, allowing retention of shape and functionality over time despite repeated use. Additionally, this type of acrylic teeth showed minimal discoloration and strong resistance to staining, which helps preserve the aesthetic appearance. Beyond durability and resistance to damage, there were favourable optical properties, with excellent light transmission and diffusion that contribute to a natural, lifelike appearance. In general, intra-homogeneous polymer enamel layers combine mechanical strength, longevity, and aesthetic qualities, ensuring long-term use in dentures [22].

The conventional type of acrylic artificial teeth has a larger polymer chain network size than the cross-linked type. Therefore, there is more space between the polymer chains in the conventional type of acrylic artificial teeth. The monomers of the auto-polymerized acrylic resin can diffuse more into the conventional acrylic denture, leading to increased polymerization [23]. The duration of immersion has a direct impact on the amount of water that the material absorbs. When acrylic or polymer-based materials are submerged, water gradually penetrates the material structure, and prolonged immersion increases water uptake within the material. The absorption continues until the material reaches its saturation point, at which it can no longer absorb additional water. Consequently, prolonged immersion leads to a greater increase in the material's mass. This process is important because excessive water uptake can influence the physical properties of the material, such as dimensional stability, hardness, and surface integrity [24]. Soaking duration directly influences the extent of liquid infiltration into the microporous spaces on the material surface. The longer the artificial teeth remain immersed, the more the solution is able to penetrate tiny pores and irregularities. This infiltration leads to alterations in the surface texture, gradually increasing surface roughness over time. Essentially, prolonged exposure allows the liquid to interact more deeply with the material's microstructure, potentially affecting its physical properties, aesthetic appearance, and resistance to wear or microbial adhesion. This result was consistent with the study results, in which intra-homogeneous polymer-type acrylic artificial teeth showed smaller changes in surface roughness compared with the conventional type after immersion in red ginger drink for three, five, and seven days.

5. Conclusions

In conclusion, the results of this study show a significant effect of the duration of immersion of acrylic artificial teeth in red ginger drink for three, five, and seven days on the increase in surface roughness of both types of materials ($p<0.001$). Conventional acrylic artificial teeth have a greater degree of surface roughness compared with the intra-homogeneous polymer type, both in the control group and after immersion in red ginger drink solution. These results suggest that selecting appropriate artificial tooth materials, such as conventional or intra-homogeneous types, based on patient dietary habits is important for minimizing surface roughness and reducing biofilm adhesion. Proper oral hygiene education regarding turmeric consumption is also crucial to optimize long-term denture prognosis.

6. Acknowledgement

The authors are grateful to drg Damayanti Siregar, M.K.M., as the statistics consultant for this study.

7. Conflict of interest

The authors declare no conflicts of interest.

References

[1] Anindita A. Aesthetic and retention denture improvement using precision attachment retained removable partial denture. J Wiyata: Penelit Sains Kesehat 2023; 10(2): 177–85.

[2] Campbell SD, Cooper L, Craddock H, Hyde TP, Nattress B, Pavitt SH. Removable partial dentures: The clinical need for innovation. J Prosthet Dent 2017; 118(3): 273–80.

[3] Chairunnisa R, Sihombing RJ. The association between the number of tooth loss, tooth loss quadrants, and occlusal support with temporomandibular disorders in partially edentulous patients. In: Faculty of Dentistry Universitas Sumatera Utara. Proceedings of the International Dental Conference of Sumatera Utara. Medan, 2017.

[4] Motayagheni R, Adhami ZE, Motlagh SMT, Mehrara F, Nabavi Y. Color changes of three different brands of acrylic teeth in removable denture in three different beverages: An in vitro study. J Dent Res Dent Clin Dent Prospects 2020; 14(3): 159–65.

[5] Kodama A. Effects of composite resin teeth versus porcelain teeth in complete dentures. Dent J 2026; 14(2): 88.

[6] Sharma R, Tiwari H, Modi R. Comparative study of different artificial teeth materials in complete dentures. J Chem Health Risks 2023; 13(2): 438–43.

[7] Garg K, Kaur I, Vala AP, Deepashree C, Nair VVR, John N. Investigation of the surface roughness and hardness of different denture teeth materials. J Pharm Bioallied Sci 2024; 16(Suppl. 1): 427–30.

[8] Grimm M. Adhesion of conventional, 3D printed and milled artificial teeth to resin substrates for complete dentures: A narrative review. Article 2488. 2023;15(11). doi:10.3390/polym15112488

[9] Zhang M, Kou S, Zhao X, Mak H. Zingiber officinale var. rubrum: Red ginger's medicinal uses. Molecules 2022; 27(3): 775.

[10] Estiasih T, Maligan JM, Witoyo JE. Indonesian traditional herbal drinks: Diversity, processing, and health benefits. J Ethn Foods 2025; 12(1): 1–24.
[11] Edy S, Ajo A. Pengolahan jahe instan sebagai minuman herbal di masa pandemik COVID-19. Intelektiva 2020; 2(3): 83–177.
[12] Gao Y, Lu Y, Zhang N, Udenigwe CC, Zhang Y, Fu Y. Preparation, pungency and bioactivity of gingerols from ginger (Zingiber officinale Roscoe): A review. Crit Rev Food Sci Nutr 2024; 64(9): 2708–33.
[13] Widiastuti D, Pramestuti N. Uji antimikroba ekstrak jahe merah (Zingiber officinale) terhadap Staphylococcus aureus. J Penelit Kesehat 2018; 5(2): 43–9.
[14] Wang S, Zhang C, Yang G, Yang Y. Bioactive compounds and bioactivities of ginger (Zingiber officinale Roscoe. Foods 2019; 8(6): 185.
[15] Thresh JC. Gingerol: Discovery, biosynthesis, properties and antioxidant mechanisms. Metabolites 2021;12(12): 1274.
[16] Hanifa M, Saputera D, Wijayanti TF. Perbandingan ekstrak jahe putih kecil 70% dan alkaline peroxide terhadap nilai perubahan warna basis akrilik. Dentin 2018; 2(1):19–25.
[17] Kristiana D, Parnaadji R. Impact strength of heat-cured acrylic resin after immersion in tobacco leaf (Nicotiana tabacum L.) effervescent tablets: An experimental study. J Int Oral Health 2024; 16(2): 110–6.
[18] Rachmadi P, Firadaus WAK, Sukmana BI. The effect of immersion of 12.5% basil leaves and 25% mauli banana stem mixture extracts on surface hardness, surface roughness and discoloration of acrylic resin. Sys Rev Pharm 2020; 11(5): 281–7.
[19] Sofya PA, Rahmayani L, Purnama R. Effect of soft drink on heat-cured acrylic artificial teeth base surface roughness. Padjajaran J Dent 2017; 29(1): 58–63.
[20] Sofya PA, Ningsih DS, Octaviani Y. Pengaruh kuah masam keueng terhadap kekasaran permukaan basis gigi tiruan resin akrilik heat cured. Dentika 2016; 19(1): 52–5.
[21] Neppelenbroek KH. Analysis of the surface roughness of different denture teeth materials: A quantitative in-vitro study. J Pharm Bioallied Sci 2024; 16(8): 2494–6.
[22] Irfan D, Dian N, Afifatul M. Applications of whey extract and CPP-ACP on enamel surface hardness after extracoronal bleaching. JKG 2019; 6(2): 93–8.
[23] Rizki GA, Rais SW, Mozartha M. Effect of alcoholic beverages on surface roughness of acrylic artificial teeth base material. SONDE 2020; 5(1): 36–43.
[24] Vuksic J, Pilipovic A, Poklepovic Pericic T, Kranjcic J. Water sorption and water solubility of digitally fabricated denture base materials. Materials (Basel) 2025; 18(13): 5343.