Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Spl Issue [2] 2022 : 167-173

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD

ORIGINAL ARTICLE **OPEN ACCESS**

Comparing Various Commercial and Household Denture Cleansing Agents for Their Efficacy – an *In Vitro* Study

Alisha Rewari[1]Reshu Sanan[2*], AbhishekNagpal[3], Bharti Raina[4] Sumit Phukela[5], Omkar Shetty[6]
[1-6] Department of Prosthodontics, Faculty of Dental Sciences, SGT University, Gurugram
*Corresponding Author- reshu.sanan@sgtuniversity.org

ABSTRACT

This study aimed to evaluate and compare various commercially available (Fittident, Clinsodent) and Household (Vinegar, Sodium bicarbonate) denture cleansing agents for their efficacy. The study was done to assess and verify the effectiveness of household denture cleansing agents because of their added advantage of being cost-effective.40 Heat cured acrylic resin specimens of standard dimensions were fabricated in the present study. The specimens were immersed in prepared staining solutions containing tea/turmeric and artificial salivary substitute at 37°C for 15 days. Samples were equally divided into 4 groups having 10 samples each. Stained samples were immersed in 4 different denture cleansing agents namely Clinsodent and Fittident (commercially available), Vinegar, and Sodium bicarbonate (Household). The reflectance values of the samples were calculated using the UV/VIS spectrophotometer and compared the efficacy of these denture cleansing materials in the removal of tea and turmeric stains. A statistically nonsignificant difference was found between the different denture cleansing materials used. Household products like vinegar and baking soda were found to be equally effective when used as denture cleansing agents, with the added advantage of being cost-effective and easy to availability. It was found that all the denture cleansing materials used in this study were effective in removing tea and turmeric stains. The household denture cleansing agents showed a similar mechanism of action as the commercially available ones, which makes them equally suitable for use.

Keywords- *Acrylic Resin, Cleansing Agents, Denture, Reflectance Value,*

Received 12.07.2022 Revised 08.08.2022 Accepted 18.10.2022

INTRODUCTION

Complete dentures significantly replace missing or naturally lost teeth and the structures that go along with them. But insufficient cleaning of removal dentures encourages biofilm buildup and adhesion, which not only causes failure of these prostheses but also constitutes a major predisposing factor for oral fungal infection, denture stomatitis, inflammatory papillary hyperplasia, etc [1].The rate at which deposits build up on dentures can vary from person to person and is influenced by things like salivary composition, dietary habits, the surface texture and porosity of the denture base material, the length of time that the wearer wears the dentures, and the denture cleaning routine that the wearer uses[2] Denture wearers may be more likely to inhale opportunistic microorganisms from their denture into their lungs because of how close a denture is to the respiratory tract [3]. Moreover, a major cosmetic concern of denture wearers is the staining of dentures. These stains result from various processes, like ingesting colored food stuffs, smoking, and drinking beverages such as coffee and tea.The tissue surface of acrylic resin dentures shows micro pits and micro porosities which harbor micro-organisms that are difficult to remove[3]Furthermore, denture wearers fear that the esthetic problems of denture malodor and staining may reveal denture wearing to others [4].

Thus, an ideal denture cleanser should fulfill many requirements, including the ability to remove both organic and inorganic deposits together with any associated extrinsic stain. Adequate cleaning of a well-polished denture with hand soap and a properly designed denture brush is the current denture cleansing method recommended by the American Dental Association[5] The brushing method requires manual dexterity and visual acuity which are usually compromised in elderly individuals. Paan, tea, coffee, and turmeric stains along with bacterial plaque accumulate on the dentures in an average Indian patient despite attempts to produce a self-cleansing design for dentures [6]. Proper cleaning and maintenance of denture prostheses is not only important for the oral health of patients but also to maintain the prosthesis stain-free and esthetic.

A plethora of denture cleansers is available, with claims for their various efficacies. Commercially they are available as alkaline peroxides, alkaline hypochlorite, dilute organic or inorganic acids, disinfectants, and enzymes[7]. But, some household products have also shown their efficacy for the same with the advantage of their easy procurement in the Indian market [8].
This study was undertaken to evaluate relative efficacy of two household denture cleansing agents namely, Vinegar & Sodium Bicarbonate and two popular commercially available denture cleansers namely Fittident® and Clinsodent®in removing the stains induced by tea and turmeric on the heat cured acrylic resin specimens. Fittydent is manufactured in India by Group Pharmaceuticals Limited ; marketed by Dr. Reddy's Laboratories Limited, under licence from Fittydent International GMBH &Clinsodent® is manufactured by Group Pharmaceuticals Limited; marketed by ICPA Health Products Limited. The study was done with an objective to assess and verify the effectiveness of household denture cleansing agents because of their added advantage of being cost effective and easy availability.

MATERIAL AND METHODS

The study was conducted in the Department of Prosthodontics, Crown & Bridge and Oral Implantology, Faculty of Dental Sciences, SGT University, Gurugram.
Sample preparation-
40 Heat cured acrylic resin (Meliodent®) specimens of standard dimensions of 1×1 inch with thickness of 1mm were fabricated in the present study. The wax patterns were flasked in dental flasks with dental stone. After wax elimination, packing was done with heat cure acrylic resin and after trial closure, the final closure was done. They were then bench cured for 30 minutes and then subjected to a curing cycle of one and half hours. The samples were then deflasked, trimmed and polished using progressive grits of sandpaper, finally ensuring that the standard dimensions were maintained.
Grouping of samples-
Based on the household denture cleansing agents and the commercially available denture cleansers, all samples were divided into 4 groups having 10 samples each-
Group A – Vinegar
Group B- Sodium bicarbonate
Group C- Clinsodent®
Group D- Fittydent®
Each group was further divided into 2 subgroups namely 1A & 2A, 1B & 2B, 1C & 2C, 1D & 2D. Each subgroup comprised of 5 samples. Tea solution was used to stain samples in group 1A, 1B, 1C & 1D. Turmeric solution was used to stain samples in group 2A, 2B, 2C & 2D.
4 groups were further divided into 8 subgroups having 5 samples each, according to solution they were immersed in and the denture cleanser they were intended to be treated with.
8 subgroups were 1A, 1B, 1C, 1D, 2A, 2B, 2C and 2D
Testing of samples-
The baseline reflectance value of each of the unstained samples was then determined using Lambda 35 UV/VIS Spectrophotometer (Fig 4) prior to staining for future comparison. The samples were then immersed in prepared staining solutions containing tea/turmeric and artificial salivary substitute at 37°C for 15 days to facilitate uptake of stain. 8gm of colorant in 400ml of water was used to prepare staining solutions:
Solution 1- 8gm of Tea leaves in 400ml of water
Solution 2- 8gm of Turmeric powder in 400ml of water
Cleansing of samples-
Subsequent to soaking, the tea and turmeric stained samples were cleansed with respective denture cleansing agents. Samples in Group A and B were immersed in Household denture cleansing agents; Vinegar and Sodium bicarbonate respectively . Samples in Group C and D were immersed in Commercially available denture cleansing agents; Clinsodent® solution and Fittydent® solution respectively . Post cleansing, spectrophotometric analysis was done to measure light reflectance of the specimens.

RESULTS AND DISCUSSION

The inter-group comparison of mean difference in reflectance value was done using the post-hoc bonferroni test. The intra group, mean difference in reflectance value from pre-cleansing to post cleansing was compared using the one-way ANOVA test.
SOLUTION 1 - TEA

The mean difference in reflectance value was compared between group 1A, 1B, 1C, 1D using the one-way ANOVA test. There was no significant difference in mean difference in reflectance value between group 1A, 1B, 1C AND 1D.(p = 0.178) (Figure 1)
The inter-group comparison of mean difference in reflectance value was done using the post-hoc bonferroni test. No significant difference was found for the inter-group comparisons of mean difference in reflectance value between the different groups (TABLE 1)
The comparison of pre and post cleansing reflectance value for GROUP 1A, 1B, 1C, 1D was done using the paired t-test. The reflectance value for all 4 groups decreased significantly from pre to post cleansing. (TABLE -1.2), (figure – 2)
SOLUTION 2 – TURMERIC
The mean difference in reflectance value was compared between group A,B,C& D using the one-way ANOVA test. There was no significant difference in mean difference in reflectance value between all 4 groups. (p=0.201) (figure 3). The inter-group comparison of mean difference in reflectance value was done using the post-hoc bonferroni test. No significant difference was found for the inter-group comparisons of mean difference in reflectance value between the different groups. (TABLE – 4). The comparison of pre and post cleansing reflectance value for GROUP 2A, 2B, 2C and 2D was done using the paired t-test. The reflectance value for all groups decreased significantly from pre to post cleansing. (TABLE – 2.2) , (figure 4)
Complete dentures are fabricated using heat cured acrylic resin because of its low cost, esthetic appearance and easy manipulation. Color stability is an important clinical property of dental materials. Various factors like accumulation of stains, dissolution of ingredients, degradation of intrinsic pigments, water sorption and surface roughness contribute to discoloration of dental prosthesis after long term usage. Moreover, beverages like tea , coffee and spices such as turmeric in food increase the discoloration of denture based polymers. Thus, regular and effective cleaning of dental prosthesis is important to reduce oral problems and maintain esthetics.
Literature is scanty in regard to the comparative effect of household cleansers like vinegar/baking soda with that of popular and widely used commercially available products like Clinsodent® powder and Fittydent®denture cleansing tablets, on cleaning efficacy of denture based resin.
According to Nakamoto *et al*.[9]chemical denture cleansers can be divided into five groups based on their maiNine chemical denture cleaners, according to Nakamoto *et al.,* categorized into five classes depending on their primary ingredients, which include alkaline peroxides, alkaline hypochlorites, acids, disinfectants, and enzymes. Alkaline peroxides are the most often used of these. In order to conduct this study, two alkaline peroxide cleansers—Clinsodent® (powder) and Fittydent® (tablets)—were chosen. When choosing a denture cleaner for elderly individuals, considerations like cost and accessibility are crucial. According to Anthony and Gibbons10, common household items like vinegar, which is both affordable and accessible, can be used as denture cleaners. So, sodium bicarbonate (common baking soda) and vinegar were chosen as the study's primary components.
When choosing a denture cleaner for elderly individuals, considerations like cost and accessibility are crucial. Anthony and Gibbons,10 have suggested that household products like vinegar, which is inexpensive and easily available, can be used as denture cleansers. Hence, vinegar and sodium bicarbonate (common baking soda) was selected for this study. An components as: Alkaline peroxides, alkaline hypochlorites, acids, disinfectants, and enzymes. Among these, alkaline peroxides are the most commonly used. Therefore, two alkaline peroxide cleansers namely Fittydent® (tablets) and Clinsodent® (powder) were chosen for this study.
For geriatric patients, cost and easy availability are important factors when selecting a denture cleanser. Anthony and Gibbons[10] have suggested that household products like vinegar, which is inexpensive and easily available, can be used as denture cleansers. Hence, vinegar and sodium bicarbonate (common baking soda) was selected for this study.
Fittydent® denture cleansing tablet is a commercial denture cleansing product containing sodium perborate as the main ingredient**.** Fittydent tablets when dissolved in water, readily decomposes to form Hydrogen Peroxide (H_2O_2) which when goes in aqueous solution, releases nascent oxygen (O) which in turn cleanses the surface debris and stains via effervescent action [11] Manufacturer's recommended immersion time for fittydent is 30 minutes.
Clinsodent® powder contains sodium perborate, sodium carbonate, trisodium phosphate, sodium lauryl sulfate.When dissolved in water, it forms a solution of hydrogen peroxide. This type of cleanser combines alkaline detergents to reduce surface tension and chemicals which release oxygen from the solution. The oxygen bubbles exert a mechanical cleansing effect [12] It is recommended to immerse the dentures in warm water and powder mix for 30 minutes.

Vinegar is regular household product which is easily available, inexpensive and has low toxicity as well. It is basically 6%-13% acetic acid. It is known to have antimicrobial potential along with cleansing action [13]. Basson, *et al*. [14-15]showed the effectiveness of undiluted vinegar solutions in killing adherent microorganisms when used as disinfection agent for denture cleansing. In vitro experiments have already shown that overnight soaking of dentures in 10% vinegar eventually gets all the stains off.

Baking soda, also known as sodium bicarbonate, is widely accessible, secure, and just mildly abrasive. According to reports, denture cleaners based on sodium bicarbonate are less harmful to resin surfaces and metal parts than cleaners based on perborate. When sodium bicarbonate dissolves in water, it ionises to produce HCO3 ions, which subsequently interact with the H+ ions from the acids. According to Kleber et al. in 2000[16] baking soda-containing teeth-whitening systems were more effective than systems without baking soda at removing intrinsic stains as well. The cleansing action of various cleansers depends on the rate of accumulation of deposits, dietary intake, surface texture of dentures, time duration for which the dentures are worn and the cleansing regimen adopted by the user. Further studies are needed to determine as to which type of cleansers are most effective and the time duration for which the household denture cleansing should be used.

From the results of the present study, it can be concluded that both the commercial and house hold products were effective in cleaning tea and turmeric stains. A statistically non significant difference with p=0.178 for samples in solution 1 , p=0.201 for samples in solution 2 was found between the different denture cleansing agents used. The study did not aim to compare the well documented efficacy of the commercially available denture cleansers. Within the limitations of the study, it was concluded that Fittydent® tablets and Clinsodent® powder have a significantly better stain removing abilities than Vinegar and Sodium Bicarbonate, but the difference being insignificant statistically.

Table 1- Shows mean difference in reflectance value between different groups

		Mean Difference	p-value
1A	1B	-0.08	1.000
1A	1C	1.26	0.081
1A	1D	1.49	0.071
1B	1C	1.34	0.078
1B	1D	1.57	0.070
1C	1D	0.23	1.000

TABLE 2 - Shows comparison of pre and post cleansing reflectance value for Group

		Mean	Std. Deviation	Mean difference	t-test value	p-value
1A (Vinegar)	Pre-cleansing reflectance value	26.07	2.79	23.98	152.909	< 0.001*
	Post-cleansing reflectance value	2.08	0.43			
1B (Baking soda)	Pre-cleansing reflectance value	26.40	1.87	24.06	126.759	< 0.001*
	Post-cleansing reflectance value	2.34	0.59			
1C (Clinsodent)	Pre-cleansing reflectance value	26.12	3.23	22.72	127.173	< 0.001*
	Post-cleansing reflectance value	3.63	0.97			
1D (Fittydent	Pre-cleansing reflectance value	26.27	3.14	22.49	135.233	< 0.001*
	Post-cleansing reflectance value	3.54	0.98			

Table 3 - Shows mean difference in reflectance value between different groups.

		Mean Difference	p-value
2A	2B	-0.22	1.000
2A	2C	0.49	0.166
2A	2D	0.56	0.103
2B	2C	0.71	0.089
2B	2D	0.78	0.100
2C	2D	0.07	1.000

Table 4- Shows comparison of pre and post cleansing reflectance value for Group 2A to 2D

		Mean	Std. Deviation	Mean difference	t-test value	p-value
2A vinegar	Pre-cleansing reflectance value	26.35	3.88	15.98	111.476	< 0.001*
	Post-cleansing reflectance value	10.37	1.14			
2B Baking soda	Pre-cleansing reflectance value	26.14	4.30	16.20	105.198	< 0.001*
	Post-cleansing reflectance value	9.94	1.55			
2C Clinsodent	Pre-cleansing reflectance value	26.27	2.89	15.49	66.955	< 0.001*
	Post-cleansing reflectance value	10.77	2.25			
2D Fittydent	Pre-cleansing reflectance value	26.20	3.97	15.42	99.628	< 0.001*
	Post-cleansing reflectance value	10.78	1.01			

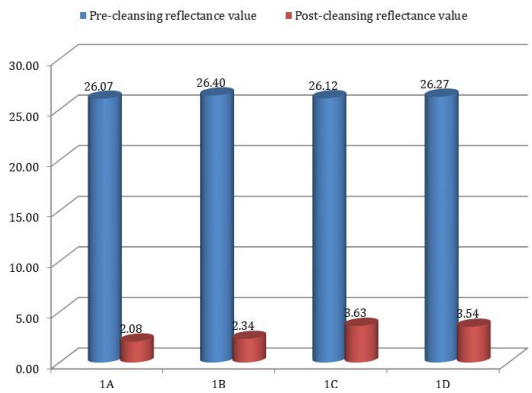

Figure 1: Pre and post cleansing reflectance value (Tea)

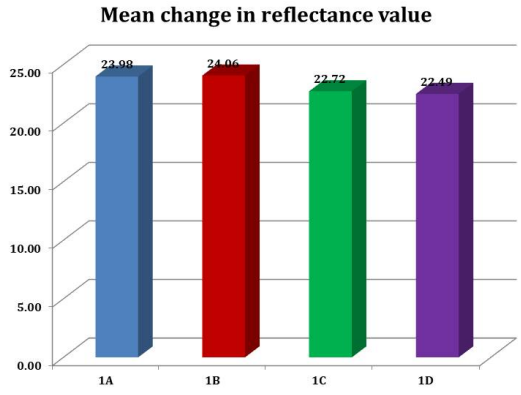

Figure 2: Mean Change in Reflectance Value (Tea)

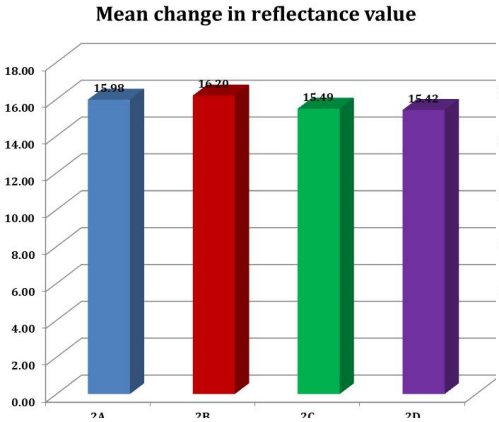

Figure 3: Mean Change in Reflectance Value (Turmeric)

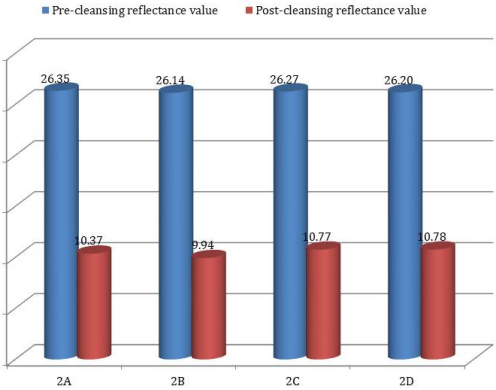

Figure 4: Pre and post cleansing reflectance value (Turmeric)

CLINICAL SIGNIFICANCE

A major cosmetic concern of denture wearers is the staining of dentures. Ingestion of colored foodstuffs, smoking, and drinking beverages such as coffee and tea often result in denture stains. Moreover, the tissue surface of acrylic resin dentures shows micro pits and micro porosities which harbor micro-organisms that are difficult to remove. Denture cleansers which are easily accessible, effective, and cheaper are desirable.

CONCLUSION

Commercial denture cleansers are difficult to procure everywhere in the Indian market, especially in the remote areas.On the other hand, certain products like vinegar and baking soda are readily available in each house hold. Moreover, the household products are found to be equally effective when used as denture cleansing agents, with added advantage of being cost effective.

CONFLICTS OF INTEREST: Nil

REFERENCES

1. Suresan V, Mantri S, Deogade S, Sumathi K, Panday P, Galav A.(2016). Denture hygiene knowledge, attitudes, and practices toward patient education in denture care among dental practitioners of Jabalpur city, Madhya Pradesh, India. J Indian Prosthodont Soc. 16:30–5.
2. Yannikakis SA, Zissis AJ, Polyzois GL, Caroni C. (1998). Color stability of provisional resin restorative materials. J Prosthet Dent 1998;80: 533-9.
3. Kumar B, Sandhu PK, Kumar N, Patil C. (2017). A comparative study for plaque removing efficacy between commonly used denture cleansers in India.J Indian Prosthodont Soc. 17(3): 295–300.
4. Joseph RM. (2009). Comparison of efficacy of Sodium Hypochlorite with Sodium Perborate in the removal of stains from heat cured clear acrylic resin. J Indian Prosthodont Soc. ;9:6-12
5. American Dental Association.(1974). Guide to dental materials and devices. 6th ed. Chicago:152-3.
6. Makhija PP, Shigli K, Awinashe V.(2016). Evaluating the efficacy of denture cleansing materials in removal of tea and turmeric stains: An ***in vitro*** study. Indian J Dent Res.27:528–34.
7. Jagger D, Al-Akhazami L, Harrison A, Rees J. (2002). The effectiveness of seven denture cleansers on tea stains removal from PMMA acrylic resin. Int J Prosthodont 15: 549– 552.
8. Da Silva FC, Kimpara T, Mancini MN, Balducci I, Jorge AO, Koga-Ito CV. (2008). Effectiveness of six different disinfectants on removing five microbial species and effects on the topographic characteristics of acrylic resin. J Prosthodont;17:627-32.
9. Nakamoto K, Tamamoto M, Hamada T. (1991). Evaluation of denture cleansers with and without enzyme against *Candida albicans*. J Prosthet Dent;66:792-5.
10. Anthony DH, Gibbons P. The nature and behaviour of denture cleansers. J Prosthet Dent 1958;8:796-810.
11. Mathai JR, Sholapurkar AA, Raghu A, Shenoy RP, Mallya HM, Pai KM, D'Souza M. Comparison of efficacy of sodium hypochlorite with sodium perborate in removal of stains from heat-cured clear acrylic resin.N Y State Dent J. 2011;77(4):48-53.
12. Joseph RM. Comparison of efficacy of sodium hypochlorite with sodium perborate in the removal of stains from heat cured clear acrylic resin. J Indian Prosthodont Soc. 2009;9:6–12.
13. Pinto TM, Neves AC, Leao MV, Jorge AO. Vinegar as an antimicrobial agent for control of *Candida* spp. In complete denture wearers. J Appl Oral Sci 2008;16:385-90

14. Basson NJ, Quick AN, Thomas CJ. (1992). Household products as sanitizing agents in denture cleansing. J Dent Assoc S Afr. ;47(10):437-9.
15. Madeswaran S, Jayachandran S. (2018). Sodium bicarbonate : A review and its uses in dentistry. Indian J Dent Res ;29:672-7
16. Kleber CJ, Moore MH, Nelson BJ. (1998). Laboratory assessment of tooth whitening by sodium bicarbonate dentifrices. J Clin Dent;9:72-5.

CITATION OF THIS ARTICLE

A Rewari, R Sanan, A Nagpal, B Raina, S Phukela, O Shetty. Comparing Various Commercial and Household Denture Cleansing Agents for Their Efficacy – an *In Vitro* Study. Bull. Env.Pharmacol. Life Sci., Spl Issue [2]: 2022: 167-173