ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 11, pp.75716-75723, November, 2018

DOI: https://doi.org/10.24941/ijcr.33128.11.2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

ABRASIVITY OF HERBAL AND NON HERBAL TOOTH PASTE: A PROFILOMETRIC STUDY

[1]Dr. Karthika Krishna Kumar, [2]Dr. Yashwanth Gowda, [3]Dr. Veena S Pai, [4]Dr. Ashwath H. and [5]Dr. Roopa R Nadig

[1]MDS, Dayananda Sagar College of Dental Sciences, Bangalore
[2]Senior lecturer, Dayananda Sagar College of Dental Sciences, Bangalore
[3]Reader, Dayananda Sagar College of dental Sciences, Bangalore
[4]Project Manager, Himalaya Private Limited
[5]Professor and Head, Dayananda Sagar College of Dental Sciences, Bangalore

ARTICLE INFO

Article History:
Received 10th August, 2018
Received in revised form
19th September, 2018
Accepted 22nd October, 2018
Published online 30th November, 2018

Key Words:

Toothpaste, Enamel,
Abrasion, Profilometry.

ABSTRACT

Background and Objectives: Removal of plaque, stains and preservation of periodontal health as well as dental caries are some of the benefits of tooth brushing with cleansing action depends on the abrasive agent which might cause abrasion and sensitivity. Herbal products have been in market as they are easily available and biocompatible. They are used for regular maintenances as well as desensitizing agent. This study was done to evaluate and compare the abrasiveness of herbal abrasive based and herbal enzyme based and non herbal regular tooth paste.

Methods: Enamel samples were prepared and embedded in acrylic blocks. Initial surface profile of samples was measured by a optical profilometer. Samples were then subjected to a brushing twice daily till 28 days using powered toothbrush with toothpaste. Their secondary surface profile was measured by a profilometer at the end of 7th, 14th, 21st, 28th day. The difference between the obtained values before and after the abrasion was indicative of the abrasiveness of toothpastes in micron. Obtained data were entered SPSS software and analysed using one-way ANOVA and Repeated Measures ANOVA.

Results: The present study evaluated the mean surface roughness of the tooth enamel when two herbal paste and one non herbal regular tooth paste are used for 7, 14, 21 and 28 days. At the end of seventh day, there was an increase in surface roughness in samples in group A and group C but inter group comparison no significant difference among group A and group C. At the end of 14th day, there is a sudden increase in the surface roughness in all the three groups group B being the least. Statistically significant difference between group A and group B and group B and group C but no significant difference among group A and group C. At the end of 21th and 28th day, according to Bonferroni's post hoc test there is no significant increase in the surface roughness within all the groups. In all the groups, there was a significant increase in surface roughness from day 7 to day 28. Maximum surface roughness was seen with herbal regular toothpaste followed by non herbal regular tooth paste and then herbal enzymes based tooth paste, the least.

Conclusion: Based on the present study findings, statistically significant difference exists between the abrasiveness of herbal regular and herbal enzyme based tooth paste and non herbal regular paste.

***Citation: Dr. Karthika Krishna Kumar, Dr. Yashwanth Gowda, Dr. Veena S Pai, Dr. Ashwath H. and Dr. Roopa R Nadig*. 2018.** "Abrasivity of herbal and non herbal tooth paste: a profilometric study", *International Journal of Current Research*, 10, (11), 75716-75723.

INTRODUCTION

"Health is wealth". A good health begins with clean oral cavity.

Oral hygiene measures comprise of mechanical methods and chemical methods. Mechanical oral hygiene procedures seem to be the most effective form of all oral hygiene measures available.

Corresponding author: **Dr. Karthika Krishna Kumar**
MDS, Dayananda Sagar College of Dental Sciences, Bangalore

Mechanical oral hygiene aids include use of toothbrushes along with dentifrices and other interdental aids (Porciani, 2010; Moore, 2008 and Gift, 1989). Removal of dental plaque, elimination of exogenous stains and prevention of gingival and periodontal diseases as well prevention of dental caries as plaque can lead to dental caries formation are among the benefits of tooth-brushing (Murray, 2006). The cleansing action of tooth brush is enhanced with the use of toothpaste. Many commercially available tooth paste are used for the same. The most important component of toothpaste is its

abrasive agent along with astringent, flavouring agent, desensitizing agent, fluoride, antimicrobial, polishing agents and whitening agent. The cleansing effect of toothpastes depends on their abrasive and polishing agent content (Craig, 2002). The abrasiveness of toothpastes depends on the hardness, size and shape of abrasive particles. Abrasives are mainly carbonates, phosphates, silica, aluminium and organic abrasives (Ebadifar, 2008). Silica possesses both the abrasion and polishing properties. Other types of polishing agents are calcium carbonate, lime powder. Extensive research and development have been conducted in an effort to optimize the cleaning efficiency of dentifrice abrasives, while minimizing any deleterious wear effects to the teeth. Although this might appear to be easily accomplished, the practice of designing effective dentifrice abrasive systems is actually quite complex and is dependent on a variety of properties of the agent, including chemical composition, crystal structure, cleavage, friability, and hardness, as well as concentration, shape, size distribution, and surface features of the particles. In addition to balancing these characteristics to optimize stain removal without causing harmful abrasion to the teeth, abrasives must be compatible with other dentifrice ingredients, particularly therapeutic agents (*e.g*., fluoride), and must demonstrate acceptable formulation properties (*e.g.*, viscosity and flow) without compromising important consumer attributes (*e.g*., taste and appearance) (White, 2001). For effective and satisfactory cleansing action by toothpaste some degree of abrasivity must be tolerated (Forward, 1991). Usually high abrasive content toothpaste can cause onset of hypersensitivity by dislodging the occluded tubule and also decrease enamel hardness due to its abrasive particles

The International Standard Organisation (ISO) has set dentine abrasivity maximum, that is, Relative Dentine Abrasivity (RDA) not to exceed 250 (ISO, 2017). Usually whitening toothpastes have medium (RDA – 60–100) or high (RDA > 100) abrasivity (PaPatil, 2014). In a study by Addy *et al* demonstrated that the toothpaste with higher RDA value caused greater abrasion compared to the one with lower RDA value (Addy, 2012). In order to overcome the deleterious effect, many herbal alternatives with abrasives as well enzyme based formulations are introduced. Herbal dentifrices normally do not contain artificial substances such as sweeteners, colours, preservatives, etc. Instead they are formulated from naturally derived components which is considered to be safe and efficient. Natural enzyme extract from the plants has been incorporated in whitening toothpaste recently. One such enzymatic action whitening toothpaste that has natural proteolytic enzymes such as papain and bromelain is considered in this study (Kalyana, 2011). An in-vitro study reported that a papain and bromelain (proteolytic enzymes) containing dentifrice was more effective in removing stains than the regular dentifrice (Chakravarthy, 2012). Till date, there is lack of sufficient peer review in literature on the abrasivity of herbal based toothpastes. Many methods are used for assessing the rate of abrasion like RDA, SEM, Profilometry Stereomicroscopy, reflex microscopy, Digital 3D computer graphics systems (Barbakow, 1987). Different *in vitro* studies have used profilometer to measure surface abrasivity. We used Profilometry which is more accurate than measuring the mass loss of samples. Also, profilometry is the most popular methods used worldwide for abrasion studies (Attin, 2006). Its accuracy, and not damaging the surface during the measurement are among the most important advantages of this method (Attin, 2006). It is the responsibility of dental professionals to provide patients with accurate and current scientific information pertaining to these products. However, this can be difficult owing to the lack of professional agreement on the subject. Therefore, this study was undertaken with the objective to compare the abrasivity of non-herbal and herbal (abrasives and enzyme based formulations) paste.

MATERIALS AND METHODOLOGY

Selection of Sample

Inclusion criteria: Intact incisors with proper coronal structure.

Exclusion Criteria

- Teeth with fracture
- Teeth with caries
- Teeth with internal resorption
- Previous restoration or endodontic treatment

Infection control protocols for extracted teeth collected for educational purposes: Collection, storage, sterilization and handling of extracted teeth used in the study followed OSHA and the CDC recommendations and guidelines.

Materials and Armamentarium

- Straight hand piece (NSK)
- Diamond disc
- Herbal Complete Care toothpaste (The Himalaya Drug Company)
- Herbal Sensi-White tooth paste (The Himalaya Drug Company)
- non herbal commercially available paste
- Power tooth brush
- Distilled water
- Dapen dish
- Luer lock syringe
- 3D Optical Profilometry

METHODOLOGY

Thirty extracted anteriors were collected, cleaned of gross debris and sectioned mesio-distally to obtain flat labial surfaces. The specimens were placed in deionized water till enamel blocks were prepared. Any stains, food debris, and calculus adhering to the mounted specimens were cleared off.

Experimental design

Enamel specimens of size 5 x 5 x 5 mm were prepared. A total of 30 specimens were prepared.

All 30 samples were subjected to profilometer to record the baseline values (Fig.1) The samples were further divided into two groups (Group1, 2, 3). Each group comprised of 10 mounted specimens.

Group 1: Herbal complete care tooth paste.
Group 2: Herbal sensi-white tooth paste.
Group 3: non herbal commercially available paste.

Brushing was carried out for twice daily duration of 2 minutes for 28 days using standardized powered tooth brush (Fig. 2.)

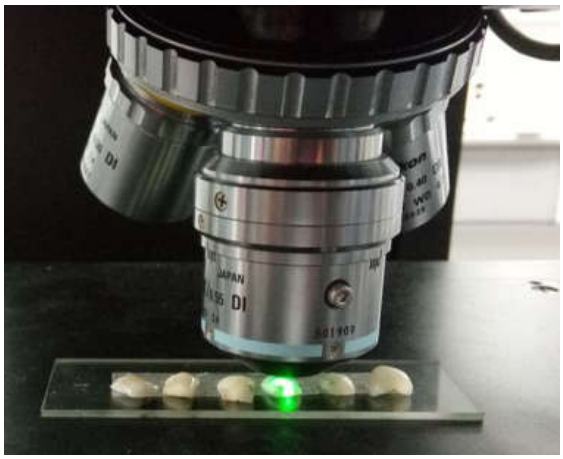

Fig. 1. Profilometer analysis

Fig. 2. Sample brushing with powered tooth brush and paste

Table 1. Complete care tooth paste

Name of the plant	Activity
Punicagranatum	Anti-inflammatory
Zanthoxylumalatum	Antioxidant, Anti-Inflammatory
Acacia arabica	Astringent
Triphala	Antioxidant, Antiplaque
Embelia ribes	Antioxidant, Anti-Inflammatory Analgesic
Vitexnegundo	Anti-Inflammatory
Salvadorapersica	Anti-Plaque, Analgesic, Anti-Inflammatory, Astringent
Acacia farnesiana	Astringent, Anti-inflammatory
Acacia catechu	Anti-inflammatory, Antioxidant, Astringent
Mimusopselengi	Analgesic, Anti-Inflammatory, Antioxidant,
Azadirachtaindica	Antimicrobial
Trachyspermumammi	Antimicrobial

Table 2. Sensi-white tooth paste

Name of the Ingredient	Activity
Spinach	Dentinal tubular occlusive
Suryakshara (Potassium nitrate)	Nerve desensitization
Carica papaya [Papain]	Tooth whitening
Ananas comosus [Bromelain]	Tooth whitening
Salvadorapersica [Miswak]	Astringent
Menthol	Cooling, Flavoring agent
Cinnamon oil	Fragrance
Clove oil	Fragrance

Table 3. Non herbal commercially available paste

Name of the Ingredient	Activity
Potassium nitrate	Nerve desensitization
Sodium Monofluorophosphate	Tooth whitening
Titanium dioxide	Tooth whitening
Hydrated silica	Abrasives
Peppermint oil *Mint*	Cooling, Flavoring agent

Toothpaste group

The toothpaste used in the present study were complete care tooth paste (The Himalaya Drug Company), Sensi-White tooth paste (The Himalaya Drug Company) and non herbal commercially available paste with the active components of each paste are summarized in Table 1, 2 and 3 respectively. Tooth paste group slurries were prepared in a dilution of 1: 3 tooth paste: water mixture. The blocks were brushed using a power brush for 2 minutes twice daily. Relative dentin abrasivity (RDA) value Complete Care tooth paste is 140 ; Sensi-White tooth paste 70 and non herbal commercially available paste is 125.

Profilometry investigation

The samples were subjected to profilometry analysis before the start of the study to record the baseline values of the enamel surface roughness. Again was subjected to Profilometry analysis at the end of 7^{th} day, 14^{th} day, 21^{st} day and 28^{th} day. The changes in the surface roughness values at each analysis was recorded and calculated.

Statistical Analysis

The study data was analyzed using SPSS [Statistical Package for Social Sciences] software.

Descriptive Statistics

The frequency distribution for the study variables were expressed in terms of number & percentage.

Inferential Statistics

The level of significance [p-value] was set at P<0.05.

RESULTS

A statistically significant difference was observed in mean surface roughness when three different tooth paste were used at different time intervals (Table 4). There is statistically significant difference between group A and group B and group B and group C but no significant difference among group A and group C at different time intervals (Table 4).

The present study evaluated the mean surface roughness of the tooth enamel when two herbal paste and one non herbal regular tooth paste are used for 7, 14, 21 and 28 days. At the end of seventh day, there was an increase in surface roughness in samples in group A and group C but inter group comparison no significant difference among group A and group C(Table 5). At the end of 14th day, there is a sudden increase in the surface roughness in all the three groups group B being the least. Statistically significant difference between group A and group B and group B and group C but no significant difference among group A and group C. At the end of 21th and 28th day, according to Bonferroni's post hoc test there is no significant increase in the surface roughness within all the groups. In all the groups, there was a significant increase in surface roughness from day 7 to day 28 (Table 6). Maximum surface roughness was seen with herbal regular toothpaste followed by non herbal regular tooth paste and then herbal enzymes based tooth paste, the least.

Table 4. Comparison of mean Surface Roughness [Ra] between 03 study groups using One-way ANOVA test followed by Tukey's HSD post hoc Analysis

Comparison of mean Surface Roughness [Ra] between 03 study groups using One-way ANOVA test followed by Tukey's HSD post hoc Analysis										
Time	Group A [n=10]		Group B [n=10]		Group C [n=10]		P-Value	Tukey's Post hoc Analysis		
	Mean	SD	Mean	SD	Mean	SD		A Vs B	A Vs C	B Vs C
BL	0.188	0.129	0.135	0.058	0.159	0.076	0.45	0.42	0.76	0.84
7th Day	0.275	0.155	0.137	0.036	0.261	0.044	0.005*	0.009*	0.94	0.02*
14th Day	0.366	0.187	0.152	0.047	0.290	0.062	0.001*	0.001*	0.34	0.04*
21st Day	0.497	0.217	0.202	0.065	0.355	0.045	<0.001*	<0.001*	0.06	0.04*
28th Day	0.525	0.211	0.247	0.037	0.395	0.068	<0.001*	<0.001*	0.08	0.04*

*Statistically Significant

Table 5. Comparison of mean surface roughness [Ra] between different time intervals in each study group using Repeated measures of ANOVA

Comparison of mean surface roughness [Ra] between different time intervals in each study group using Repeated measures of ANOVA						
Group	Group	Group	SD	Min	Max	P-Value
Group A	BL	0.188	0.129	0.06	0.50	<0.001*
	7th Day	0.275	0.155	0.07	0.53	
	14th Day	0.366	0.187	0.08	0.64	
	21st Day	0.497	0.217	0.19	0.85	
	28th Day	0.525	0.211	0.26	0.84	
Group B	BL	0.135	0.058	0.08	0.23	<0.001*
	7th Day	0.137	0.036	0.09	0.19	
	14th Day	0.152	0.047	0.09	0.24	
	21st Day	0.202	0.065	0.11	0.32	
	28th Day	0.247	0.037	0.20	0.32	
Group C	BL	0.159	0.076	0.06	0.29	<0.001*
	7th Day	0.261	0.044	0.18	0.32	
	14th Day	0.290	0.062	0.19	0.37	
	21st Day	0.355	0.045	0.29	0.43	
	28th Day	0.395	0.068	0.32	0.53	

Table 6. Pairwise comparison of mean differences between different time intervals in each study group using Bonferroni's Post hoc Analysis

Pairwise comparison of mean differences between different time intervals in each study group using Bonferroni's Post hoc Analysis						
Group A	Time	T0 Vs T1	T0 Vs T2	T0 Vs T3	T0 Vs T4	T1 Vs T2
	P-Value	0.31	0.04*	0.001*	0.007*	0.04*
	Time	T1 Vs T3	T1 Vs T4	T2 Vs T3	T2 Vs T4	T3 Vs T4
	P-Value	<0.001*	0.005*	0.003*	0.14	1.00
Group B	Time	T0 Vs T1	T0 Vs T2	T0 Vs T3	T0 Vs T4	T1 Vs T2
	P-Value	1.00	1.00	0.35	0.004*	0.16
	Time	T1 Vs T3	T1 Vs T4	T2 Vs T3	T2 Vs T4	T3 Vs T4
	P-Value	0.78	0.005*	0.78	0.67	0.67
Group C	Time	T0 Vs T1	T0 Vs T2	T0 Vs T3	T0 Vs T4	T1 Vs T2
	P-Value	0.08	<0.001*	0.001*	<0.001*	1.00
	Time	T1 Vs T3	T1 Vs T4	T2 Vs T3	T2 Vs T4	T3 Vs T4
	P-Value	0.007*	0.01*	0.16	0.003*	0.75

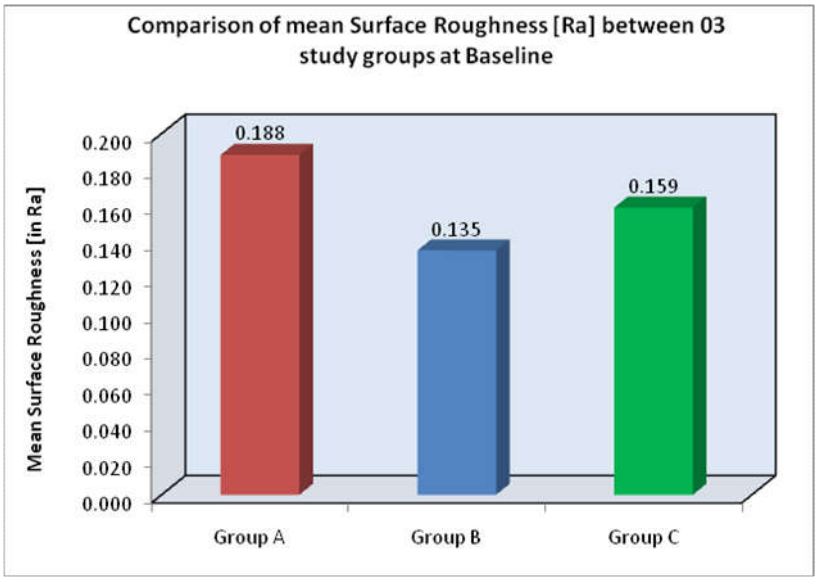

Fig. 3. Comparison of mean Surface Roughness [Ra] between 03 study groups at Baseline

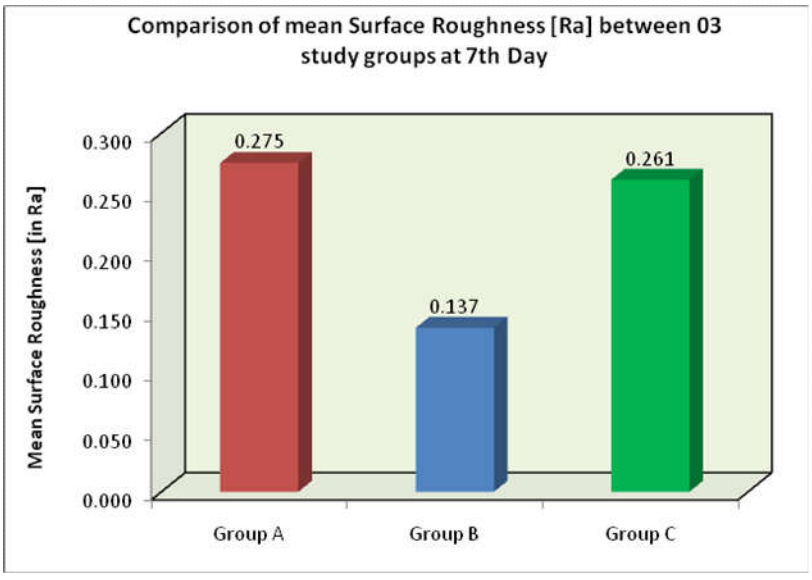

Fig. 4. Comparison of mean Surface Roughness [Ra] between 03 study groups at 7th Day

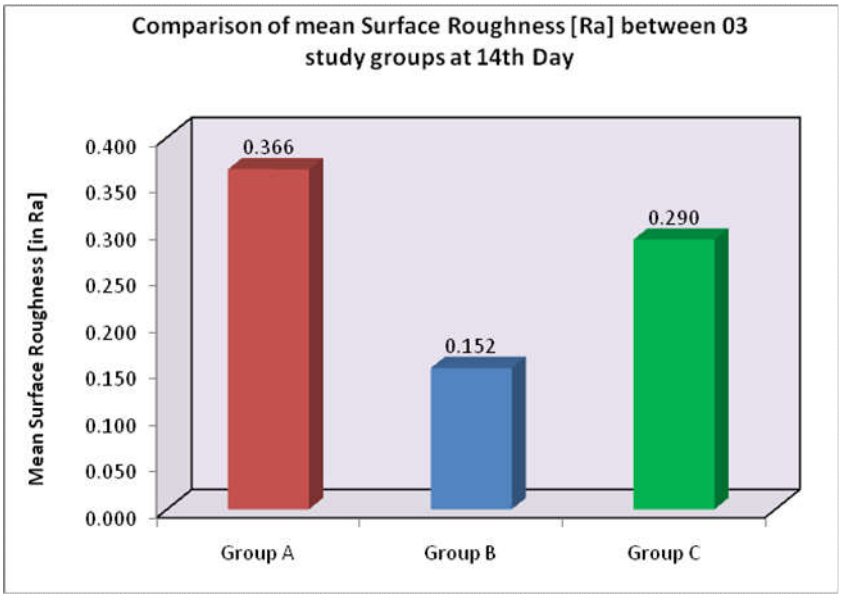

Fig. 5. Comparison of mean Surface Roughness [Ra] between 03 study groups at 14th Day

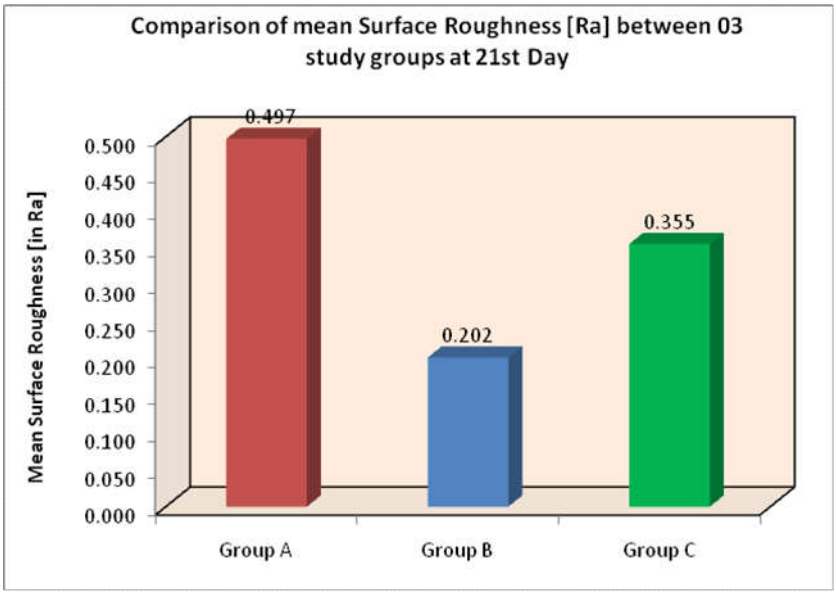

Fig. 6. Comparison of mean Surface Roughness [Ra] between 03 study groups at 21st Day

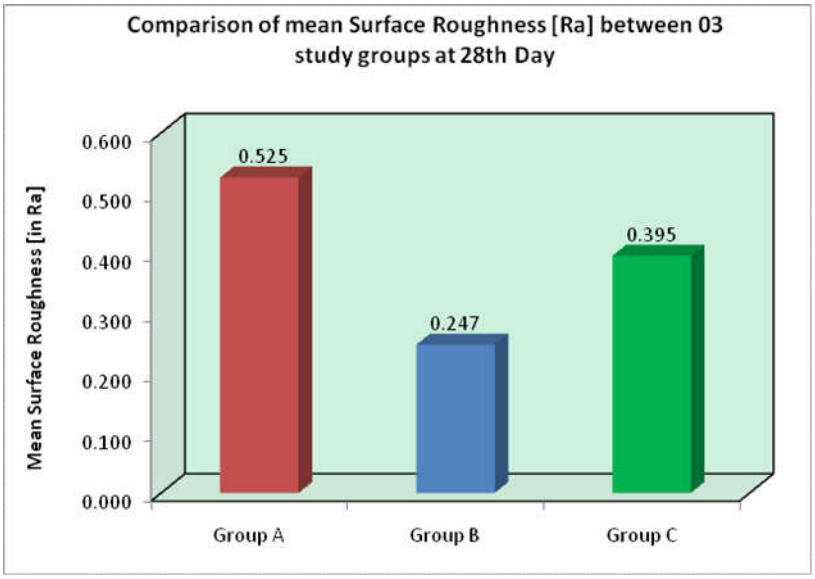

Fig. 7. Comparison of mean Surface Roughness [Ra] between 03 study groups at 28th Day

DISCUSSION

Removal of dental plaque, elimination of exogenous stains and prevention of gingival and periodontal diseases as well prevention of dental caries as plaque can lead to dental caries formation are among the benefits of tooth-brushing (Murray, 2006). It is established that tooth-brushing is the most commonly used methods of oral hygiene maintenance. It not only decrease plaque and calculus deposits on teeth but also help in eradicating stains and discolorations. It must be realized that stains are deposition of a variety of pigments originating from the diet or tobacco use on the tooth surface. This deposition can be reduced by effective oral hygiene practices, which focuses on toothbrushes and dentifrices (Porciani, 2010; Moore, 2008 and Gift, 1986). The wearing of the tooth surface caused by friction of tooth with a foreign object is called “abrasion”. Buccal surfaces of teeth are more prone to abrasion due to overzealous brushing. Abrasion is most commonly associated with tooth brushing on the cervical margins of teeth. Regular tooth brushing with dentifrices has been considered an etiological factor (Sandeep Kumar, 2014).

The International Standard Organisation (ISO) has set dentine abrasivity maximum, that is, Relative Dentine Abrasivity (RDA) not to exceed 250 (ISO, 2017). Usually whitening toothpastes have medium (RDA – 60–100) or high (RDA > 100) abrasivity (PaPatil, 2014). In this study two herbal paste and 1 non herbal paste was taken, group A- complete care with RDA 140 having silica as the abrasive agent, group B- sensiwhite with RDA 70 having papain and bromaline as the enzymatic cleansing agent and group C- non herbal commercially available tooth paste with RDA 125 having hydrated silica as the abrasive agent. With the return of the time honoured herbal era, several natural products have been tried against caries, gum infections, for treating dentinal hypersensitivity and tooth whitening. There is a perpetual demand for the use of natural products and various herbal extracts have been incorporated in the dentifrices and tried so far. In-vivo studies conducted earlier have reported that papain and bromelain containing dentrifices are more effective in removing stains. Papain and Bromelain are proteolytic enzymes derived from Papaya (Carica papaya) and Pineapple (Ananas comosus) (Chakravarthy, 2012). With this in mind,

Himalaya drug company have come out with a novel polyherbal stain removal tooth paste formulation containing Papain, Bromelain, having astringent /antibacterial activity, triphala that reduces plaque and gingivitis, embelia, neem, and thymol. This enzyme based herbal formulation has all natural ingredients and is claimed to be safe and effective, unlike other already available dentifrices containing harmful bleaching agents. In the present study profilometer is used to check the surface roughness which is more accurate than measuring the mass loss of samples. Also, to add Profilometry is among the most popular methods used worldwide for abrasion studies. Profilometry can be in contact or non-contact form. In the present study, we used non contacting profilometer. In this technique, the samples are covered on one side with a protective tape, creating a so-called reference area, and the other part of the sample remains uncovered to determine the dental wear. Thus, the profilometry measures the difference in height (Δh) between the exposed area and the reference. The main advantage of profilometry is the speediness of measurements which take approximately on minute per sample. Its accuracy compared to other methods, and not damaging the surface during the measurement are among the most important advantages of this method (JaberYaghini, 2012). Profilometry is a fast and non-destructive method, which may be adopted to determine wear with high precision (Passos, 2014). In our study, we observed that the enzymatic paste caused less surface roughness than the abrasive paste group. The test dentifrice in the group B, extracts of papain and Bromelain, which are proteolytic enzymes. Papain and Bromelain hydrolyse the pellicle, and thereby preventing the bacteria and stain accumulation on the tooth surfaces.

Papain is considered a chemical debridement agent, which helps in the healing process, acts as an anti-inflammatory agent, non cytotoxic and is biocompatible with oral tissues. The toothpaste that contains papain conveniently has a pH near to neutral approximately 7, with a view to guaranteeing the activity of the enzyme without demineralizing the enamel (28). Bromelain is derived from stem and leaves of pineapple. Surface stains stick to the pellicle first, so Bromelain helps break down the protein pellicle on the tooth surface (Desser, 2001). In the present study, the abrasive agent present in group A and group C toothpastes was silica. Thus, the difference between these toothpastes can be attributed to the shape, size, percentage of abrasive agents and also the lubricating agents (Kaidonis, 1998). These dentifrices has shown significant difference in the surface roughness more with complete care at the end of 14^{th} day and 28^{th} day followed by non herbal paste and least with enzyme based herbal tooth paste. There is no significant difference at the end of 7^{th} day. This is because the abrasive agent shows significant effectiveness only after 2 and 4 weeks of brushing. There was significant differences between the time intervals in each group showing the surface roughness increases with the brushing. Another factor responsible for abrasivity of toothpastes may be the presence of various ingredients in the composition of toothpastes with different pH and subsequent increased or decreased abrasiveness of the paste.

Ranjitkar et al, in 2009 demonstrated that use of some agents and lubricants in the composition of toothpastes and their percentage can affect abrasivity of toothpastes due to their lubricating property and reducing friction (Ranjikar, 2009). Whitening toothpaste with abrading action should be advised for upto 4 weeks to prevent adverse effects on enamel and dentine. Studies by various authors have led to the result that abrasive whitening toothpastes are effective between 2 and 4 weeks (Joiner, 2002). Collins et al. and Koertge et al. showed that the calcium carbonate/perlite abrasive system significantly reduced stain over the relatively short time of 2 weeks (Collins, 2005 and Koertge, 1998). However, Putt *et al* showed that a low abrasive, dual-phase, sodium bicarbonate toothpaste did not significantly remove tooth stain after 2 weeks of brushing compared with a commercially available regular toothpaste, and significance was only obtained after 4 and 6 weeks of brushing (Putt, 2004). Studies have shown Bromelain- and papain-based gels were both effective in bleaching stained dental enamel. Study by Chakravarthy PK has shown significant stain removal using toothpaste containing papain, alumina and citrate (Chakravarthy, 2012). Also a Preliminary study showed enzymatic paste reduced naturally occurring stains more efficiently than abrasive paste (unpublished). Hence, to prevent the action of abrasive agents on the wear of dental tissue, enzymatic toothpaste was considered in this study. However, this *in vitro* study had certain limitations.

One of the factors that could be of much importance in methodological resemblance of the dental abrasion *in vitro* researches to its really occurring situation inside the mouth is the simulation of continuous washing action of the saliva and its Remineralizing protective effects over the worn surfaces of teeth as well as the occlusion conditions. Few *in vitro* studies have been conducted assessing the role of saliva in abrasion and it was concluded that the abrasion was significantly lowered if saliva was used as a medium (Voronets, 2010 and Voronets, 2008). In the present study, the effect of saliva and its role in prevention of abrasion was not taken into consideration. Saliva is essential for a lifelong conservation of the dentition. Previous studies carried out by Kumar *et al.*, Hila Hajizadeh *et al.*, Zuryati *et al.*, Kaur and Nandlal have evaluated abrasion produced on dental materials but these studies also had the limitation that the plausible role of saliva in abrasion process was not evaluated. Hence, the authors recommend conducting further *in vitro* studies taking saliva into consideration (Van Nieuw Amerongen, 2004; Kumar, 2014; Hajizadeh, 2013 and Zuryati, 2013). This in vitro study was performed for a short duration; hence, the role of toothpastes for long-term use cannot be documented. The study did not take into consideration the abrasive nature of toothbrush.

Conclusion

From the limitations of the study it can be concluded that natural enzymes based formulation Papain and Bromelain used in toothpaste are more effective in removing naturally occurring stains without causing surface roughness on enamel as compared to much established abrasive whitening systems. As it is proved to be friendly to enamel the resultant toothpaste can be used for regular toothpaste use and for patients with compromised enamel. However, studies related to the effect of these enzymes on oral health are sparse and research with an in-depth understanding of these enzymes is entailed.

REFERENCES

Abrasion, Polishing, and Stain Removal Characteristics of Various Commercial Dentifrices In Vitro study. *The Journal of Clinical Dentistry.*

Addy M, Hughes J, Pickles MJ, Joiner A, Huntington E. 2002. abrasion of dentine. Comparison of 2 products. *J ClinPeriodontol*., 29:896- 900.

Attin T. 2006. Methods for assesment of dental erosion. *Monogr oral Sci*., 41:221-227.

Barbakow F, Lutz F, Imfeld T. A review of methods to determine the relative abrasion of dentifrices and prophylaxis pastes. Quintessence Int 1987;18:23–28.

Chakravarthy P, Acharya S. 2012. Efficacy of extrinsic stain removalby novel dentifrice containing papain and bromelain extracts. *J Young Pharm*., 4:245–249. doi:10.4103/0975-1483.104368

Collins LZ, Naeeni M, Sch€afer F et al. 2005. The effect of a calcium carbonate/perlite toothpaste on the removal of extrinsic tooth stain in two weeks. *Int Dent J*., 55: 179–182.

Craig RG. Restorative dental material. 10th Ed. St Louis: The C.V Mosby co: 2002; chap 3: 66-63.

Desser L, Holomanova D, Zavadova E, Pavelka K, Mohr T, Herbacek I. 2001. Oral therapy with proteolytic enzymes decreases excessive TGF-beta levels in human blood. *Cancer Chemother Pharmacol*., 47: S10–S15.

Ebadifar A, Naghibi A. 2008. Comparation of 3 colourspooneh toothpaste in prevention of formation of microbial plaque. *J Dent Med Tehran Uni Med Sci.,* 55: 140 – 144.

Eliseu A. Münchow1,2 & Henry J. Hamann3 & M. Teresa Carvajal4 & Rodolfo Pinal3 & Marco C. Bottino1 Stain removal effect of novel papain- and bromelain-containing gels applied to enamel

Forward GC. 1991. Role of toothpastes in the cleaning of teeth. *Int Dent J.,* 41: 164–170.

Gift HC. 1986. Current utilization patterns of oral hygiene practices. In: Loe H, Kleinman DV, editors. Dental plaque control measures and oral hygiene practices. *Oxford.,* pp. 39–71.

Gunnar Johannsen, Georg Tellefsen, AnnsofiJohannsen, and Anders Liljeborg. The importance of measuring toothpaste abrasivity in both a quantitative and qualitative way. *ActaOdontol Scand.*, 2013 May; 71(3-4): 508–517.

Hajizadeh H, Ameri H, Eslami S, Mirzaeepoor B. 2013. The effect of bleaching on toothbrush abrasion of resin composites. *J Conserv Dent.*, 16: 17–20.

ISO 11609. Dentistry – Toothpastes – Requirement, Test Methods and Marking. Online Material:11609:ed-2:v1:en

JaberYaghini, Ahmad Mogharehabed, MaedehKaveh, 2012. Hassan Mousazadeh, Moloud Madani. A comparative Study of the Abrasive Effects of Different Toothpastes on Enamel. *Journal Dental School*., 29(4):274-282.

Joiner A, Pickles MJ, Matheson JR, Weader E, Noblet L, Huntington E. 2002. Whitening toothpastes: effects on tooth stain and enamel. *Int Dent J*., 52: 424–430.

Kaidonis J, Richards L, Townsend G. 1998. Wear ofhuman enamel. *J Dent Res*., 77:1983-1990.

Kalyana, P., Shashidhar, A., Meghashyam, B., Sreevidya, K.R., Sweta, S. 2011. Stain removal efficacy of a novel dentifrice containing papain and Bromelain extracts—an in vitro study. *Int J Dent Hyg.,* 9: 229–233. doi:10.1111/j.1601-5037.2010.00473.x

Koertge, T.E., Brooks, C.N., Sarbin, A.G., Powers, D,. Gunsolley, J.C. 1998. A longitudinal comparison of tooth whitening resulting from dentifrice use. *J Clin Dent.,* 9: 67–71..

Kumar S, Kumar Singh S, Gupta A, Roy S, Sareen M, Khajuria S. 2015. A Profilometric Study to Assess the Role of Toothbrush and Toothpaste in Abrasion Process. *J Dent (Shiraz).* 16(3 Suppl):267-73.

Kumar, S., Kumari, M., Acharya, S., Prasad, R. 2014. Comparison of surface abrasion produced on the enamel surface by a standard dentifrice using three different toothbrush bristle designs: A profilometric in vitro study. *J Conserv Dent.*, 17: 369–373.

Moore M, Hasler-Nguyen N, Saroea G. 2008. In vitro tooth whitening effect of two medicated chewing gums compared to a whitening gum and saliva. BMC Oral Health., 8:23.

Murray J, Sakaguchi R. 2006. The Prevention of dental disease. 2nd Ed. St Louis The C.V Mosby co : Mosby Co. chap 2:162.

PaPatil, AV Ankola, MI Hebbala, AC Patil. 2014. Comparison of effectiveness of abrasive and enzymatic action of whitening toothpastes in removal of extrinsic stains – a clinical trial. Int J of Dental Hygiene 2014

Passos VF and Santiago SL. Methodologies to Analyze the Micromorphological Alterations of Enamel Subjected to Abrasion/Erosion. Dentistry. Volume 4 • Issue 9 • 1000255

Porciani PF, Perra C, Grandini S. 2010. Effect on dental stain occurrence by chewing gum containing sodium tripolyphosphate--a double-blind six-week trial. *J Clin Dent.,* 21(1):4–7

Putt MS, Milleman JL, Milleman KR *et al.*, 2004. Removal of tooth stain by bicarbonate, calcium, and phosphate-containing dentifrice. *J Dent Res*., 84: 4028.

Ranjikar S, Narayana T, Kaidonis J. 2009. The effect of cpp-Acp on erosive dentin wear. *Aust Dent J.,* 54:101-107.

Sandeep Kumar, MinalKumari, Shashidhar Acharya, Ram Prasad. 2014. Comparison of surface abrasion produced on the enamel surface by a standard dentifrice using three different toothbrush bristle designs: A profilometric in vitro study. *Journal of Conservative Dentistry* | Vol 17 | Issue 4

Van NieuwAmerongen A, Bolscher JG, Veerman EC. 2004. Salivary proteins: protective and diagnostic value in cariology? *Caries Res.,* 38: 247–253.

Voronets J, Jaeggi T, Buergin W, Lussi A. Controlled toothbrush abrasion of softened human enamel. *Caries Res.* 2008; 42:286–290.

Voronets J, Lussi A. 2010. Thickness of softened human enamel removed by toothbrush abrasion: an in vitro study. *Clin Oral Investig.,* 14: 251–256.

White DJ. 2001. Development of an improved whitening dentifrice based upon "stain-specific soft silica" technology. *J Clin Dent.,* 12:25-29.

Zuryati AG, Qian OQ, Dasmawati M. 2013. Effects of home bleaching on surface hardness and surface roughness of an experimental nanocomposite. *J Conserv Dent.*, 2013; 16: 356–]

****