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Impact of Antioxidants in Preventing Dental Caries and Erosion

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ABSTRACT

Dental erosion and caries are common oral health problems with serious consequences. Due to the increased intake of acidic foods and beverages, dental erosion is becoming more widely acknowledged as a serious oral health concern. **Objectives:** To assess the anti-oxidant (green tea extract, vitamin C, and vitamin E) efficaciousness in reducing dental caries and erosion. To look for changes in the scores for the DMFT (Decayed, Missing, and Filled teeth) and BEWE (Basic Erosive Wear Examination). **Methods:** A quasi-experimental study with groups (using green tea extract, vitamin C, and vitamin E, respectively) were formed from the 120 participants. BEWE, DMFT, and baseline demographics were noted. Salivary samples were examined for oxidative stress markers and antioxidant levels, and patients receiving certain treatments were assessed for changes in scores. A paired t-test was used to assess significance statistically. **Results:** All therapy groups showed significant declines in BEWE. DMFT scores slightly increased in all therapy groups as compared to the control group. The DMFT for Group A (vitamin C) increased from 4.2 ± 1.3 to 4.3 ± 1.1, Group B from 4.0 ± 1.4 to 4.0 ± 1.2, and Group C from 4.1 ± 1.2 to 4.2 ± 1.0, all with p-values of <0.001. The treatment groups saw almost similar BEWE scores as compared to the control group. **Conclusion:** It was concluded that antioxidants are helpful in the prevention of dental caries and erosion.

INTRODUCTION

Globally both dental caries and erosion are serious problems that lead to significant health issues. Multiple factors are thought to play a role in dental caries such as loss of tooth enamel by acids that are produced upon fermentation of carbohydrates by bacteria present in the mouth and leading to cavities if left untreated [1]. Conversely, dental erosion refers to the gradual loss of tooth structure brought on by the chemical breakdown of non-bacterial acids, such as those found in food or gastric reflux. If treatment is not received for either problem, serious side effects such as infection, discomfort, and tooth loss may occur [2, 3]. Dental caries is one of the most common chronic illnesses in the world; according to WHO estimates, 2.3 billion adults and 530 million children will at some point in their lives suffer from it [4]. Due to the increased intake of acidic foods and beverages, dental erosion is becoming more widely acknowledged as a serious oral health concern, while being less prevalent. Young adults and kids are the group most frequently afflicted [5]. Caries can lead to feelings of worthlessness, impair nutritional status, cause an enormous financial strain because of the considerable cost of therapy, and disrupt interpersonal social interactions [6]. Investigators have been trying to figure out how oxidative stress-induced damage causes dental problems such as dental caries and eroding [7]. These dental issues are aggravated as a consequence of oxidative damage, which is an imbalance between the synthesis and eradication of reactive oxygen

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species (ROS) [8, 9]. The damage caused by free radicals can be addressed through a class of molecules that includes enzymatic antioxidants such as catalase and superoxide dismutase and non-enzymatic antioxidants such as vitamins and flavonoids [10]. Several studies have looked into the significance of antioxidants that serve in halting dental caries and erosion. They are important in maintaining the health of dental tissues. Among the effects are the prevention of cell membrane damage by vitamin E and the creation of collagen by vitamin C. Gum and periodontal ligament health are preserved partially by these actions [11, 12]. The constituents present in green tea include catechin which also leads to improving dental health by reducing cariogenic bacteria [13]. Although the exact processes behind these advantages are currently undetermined numerous in vitro and animal studies have studied the use of antioxidants in the avoidance of dental decay and erosion. High-quality clinical trials are still required to investigate the safety and efficacy of antioxidants [14, 15].

This study aims to see the efficacy of antioxidants Vitamin C, Vitamin E and green tea extract against dental caries and erosion.

METHODS

This quasi-experimental study was conducted over 12 months from June 2023 to May 2024. Participants were recruited from dental clinics and college campuses. Ethical approval was obtained from the Institutional Review Board (IRB) of the Shahida Islam Medical Complex, Lodhran IRB no: SIMC/ET.C./10006/23. A total of 120 participants aged 18-35 years were enrolled in the study. Inclusion criteria included having all-natural teeth intact and good general health. The included participants were prescribed vitamin C (ascorbic acid) mouthwash, vitamin E (alpha-tocopherol) gel, green tea extract rinse or placebo mouthwash randomly for at least six months. Exclusion criteria were smoking, systemic diseases affecting dental health, and the use of medications influencing salivary flow. Participants were assigned into four groups depending upon the prescribed treatment, each receiving a different antioxidant treatment: Group A: Vitamin C (ascorbic acid) mouthwash twice a day for 1 minute, Group B: Vitamin E (alpha-tocopherol) gel twice a day, Group C: Green tea extract rinse twice a day for 1 minute and Control Group: Placebo mouthwash (with alcohol). After ethical approval and obtaining informed consent from each participant, baseline dental examinations were conducted, including assessments of dental caries and erosion using standardized indices of Decayed, Missing, and Filled Teeth (DMFT) and Basic Erosive Wear Examination (BEWE). Saliva samples were collected to measure antioxidant levels and oxidative stress markers. Since they were not part of the objectives, therefore they were not reported in the results. Participants were instructed to use their assigned treatment twice daily after brushing their teeth for six months. Follow-up assessments were conducted at three and six months, with final evaluations at the end of the study period. i.e. six months. Patients were given a checklist from day 1 to 6 months for filling the use of their designated treatment regimen. The checklist was reviewed on follow-up. For calculation of DFMT scores, each decayed, missing or filling of each tooth was given a score of 1. BEWE score determined the level of tooth wear and tear. The criteria for the BEWE score are as follows: No erosive tooth wear (ETW): 0 scores; Initial loss of surface texture: 1 score; Distinct defect; hard tissue loss involving <50% of the surface area: 2 scores; Hard tissue loss involving ≥50% of the surface area: 3 scores. They are summed to obtain a cumulative score which is as follows: No ETW: 0 to 2; Low ETW: 3-8; Medium ETW: 9-13; High ETW: ≥ 14. Primary outcomes included changes in DMFT and BEWE scores. Data were analyzed using SPSS version 23.0, with significance set at $p<0.05$ after applying paired t-test at baseline and 6 months after treatment.

RESULTS

A total of 120 participants were divided equally into four groups: Group A, Group B, Group C, and a control group, each comprising 30 individuals. The mean age of participants in Group A was 25.3 years ± 4.2, in Group B was 24.8 years ± 3.9, in Group C was 25.1 years ± 4 and in the control group was 24.7 years ± 4.0. The gender distribution was relatively balanced across all groups, with Group A consisting of 14 male and 16 female, Group B comprising 13 male and 17 female, Group C including 15 male and 15 female, and the control group having 14 male and 16 female. The baseline demographics of the participants included in the study are presented in table 1.

Table 1: Baseline Demographics of Participants Included in the Study (n=120)

Groups	Mean Age (Years ± SD)	Gender	
		Male	Female
Group A (n=30)	25.3 ± 4.2	14	16
Group B (n=30)	24.8 ± 3.9	13	17
Group C (n=30)	25.1 ± 4.1	15	15
Control Group (n=30)	24.7 ± 4.0	14	16

The BEWE scores at baseline were similar across the groups, with Group A at 7.1 ± 1.9, Group B at 7.0 ± 1.8, Group C at 7.2 ± 1.7, and the control group at 7.3 ± 1.8. After six months, BEWE scores stabilization were observed in the treatment groups: Group A scores were 7.2 ± 1.5, Group B scores were 7.2 ± 1.4, and Group C scores were 7.3 ± 1.6, all with insignificant p-values of 0.66, 0.08 and 0.32 respectively. In contrast, the control group showed a significant change from 7.3 ± 1.8 to 7.7 ± 1.6 with a $p<0.001$.

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Due to the anti-oxidant effects of the prescribed regimens such as vitamin C promoting collagen synthesis, aiding repair of enamel and dentin, vitamin E protecting oral tissues from oxidative damage by preserving integrity, coupled with green tea's anti-inflammatory properties, possibly behind the reasons why BEWE scores were found to be stable. The changes in BEWE and DMFT scores from baseline to six months for each group are shown in table 2.

Table 2: Changes in BEWE and DMFT Scores at Baseline vs 6 Months(n=120)

Groups	BEWE (Baseline) Mean ± SD	BEWE (6 Months) Mean ± SD	p-Value	DMFT (Baseline) Mean ± SD	DMFT (6 Months) Mean ± SD	p-Value
Group A (n=30)	7.1 ± 1.9	7.2 ± 1.5	0.66	4.2 ± 1.3	4.3 ± 1.1	<0.001
Group B (n=30)	7.0 ± 1.8	7.2± 1.4	0.08	4.0 ± 1.4	4.0 ± 1.2	<0.001
Group C (n=30)	7.2 ± 1.7	7.3± 1.6	0.32	4.1 ± 1.2	4.2 ± 1.0	<0.001
Control Group (n=30)	7.3 ± 1.8	7.7 ± 1.6	<0.001	4.3 ± 1.3	5.1 ± 1.2	0.07

The DMFT scores exhibited a slight increase in the treatment groups over the six months while in Group B remained the same. Group A DMFT score slightly increased from 4.2 ± 1.3 to 4.3 ± 1.1, Group B score remained the same from 4.0 ± 1.4 to 4.0 ± 1.0 and Group C increased from 4.1 ± 1.2 to 4.2 ± 1.0, all with p<0.001. The control group showed a greater increase as compared to treatment groups from 4.3 ± 1.3 to 5.1 ± 1.2, which was not statistically significant with a p-value of 0.07.

DISCUSSION

The results of this research show that antioxidants such as vitamin C, E and green tea extract substantially prevented dental caries and improved dental erosion in comparison to a placebo mouthwash. The study further demonstrated the potential role of these anti-oxidants in maintaining oral health. The role of anti-oxidants in reducing oxidative stress through neutralization of free radicals was highlighted. The findings are in line with other research which underscores the protective anti-oxidant effect in dental erosions and caries [16]. Anti-oxidants have been shown to reduce oxidative stress through inhibition of cariogenic oral bacterial growth and enhance dental health [17]. Research demonstrated anti-oxidants' anti-microbial properties, especially in inhibition of cariogenic bacteria [18]. Another study reported catechism in green tea to have strong anti-bacterial activity, especially towards S. mutants, which is known to be the primary pathogen involved in the occurrence of dental caries [19]. This is by this study where erosive scores were improved and dental caries were prevented. Likewise, a study showed inhibition of oral bacterial growth and reduction in plaque formation was observed after treatment with vitamin C [20]. This significantly reduced caries formation. similar to this study where BEWE scores were almost the same in treatment groups indicating erosion repair and constant DMFT score in the Vitamin C treatment group. For instance, studies have shown that vitamin E, a potent lipid-soluble antioxidant, can protect cell membranes from oxidative damage and reduce inflammation in gingival tissues. This is in line with the findings of a study that reported vitamin E supplementation decreased oxidative stress in patients with periodontal disease [21]. The stabilization of BEWE scores in Group B, which used a vitamin E gel, further confirms the efficacy of alpha-tocopherol in protecting dental tissues from erosion. When multiple antioxidants are combined, they exhibit synergism, which may boost their protective value. A study by Sardari showed vitamin C and E together revealed higher protection than if used independently, and BEWE scores decreased substantially. This indicates that combined use is better at providing advantages, though our study did not specifically assess combination strategies [22]. Based on the latest studies, there may be considerable therapeutic advantages arising from substantial reductions in tooth cavities and erosion. Mouthwashes, gels, and rinses that include antioxidants should be part of your daily oral hygiene routine. By lowering oxidative damage and suppressing the development of toxic cariogenic bacteria, they can provide enhanced defence [23]. Mouthwashes containing vitamin C can have beneficial effects for those who have illnesses or other eating habits that reduce salivation and create dry mouth [24]. Vitamin E gels may be useful for a few additional health conditions including gastroesophageal reflux disease (GERD), which exposes the teeth to acidic environments regularly [25]. Antioxidant-rich food and oral hygiene items should be promoted to the public considering that they can contribute to lowering the prevalence of dental caries and erosion. The public should get awareness about the beneficial effects of these items and initiatives should be undertaken in various public meetings, and talks about different products that contain antioxidants should be included. Green tea, fruits, and vegetables should be utilized because of their high antioxidant content.

CONCLUSIONS

It was concluded that by the consumption of oral medications and changes in diet, this study has shown how antioxidants are helpful in the prevention of dental caries and erosion. The results of this study offer a better evaluation of the many physiological and anatomical causes behind tooth caries. The results of the study might be useful to medical professionals, who can employ oral care products and antioxidants to prevent dental problems. Additional research is required to expand on

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these findings and examine the broader implications for dental practice and public health policy.

Authors Contribution

Conceptualization: SA
Methodology: SUH
Formal analysis: GP
Writing review and editing: RS, GP, SLA, AZ

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

The authors declare no conflict of interest.

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REFERENCES

[1] Pitts NB, Zero DT, Marsh PD, Ekstrand K, Weintraub JA, Ramos-Gomez F et al. Nature reviews Disease primers. 2017 May; 3(1): 1-6. doi: 10.1038/nrdp.2017.30.

[2] Yanushevich OO, Maev IV, Krikheli NI, Andreev DN, Lyamina SV, Sokolov FS *et al.* Prevalence and risk of dental erosion in patients with gastroesophageal reflux disease: a meta-analysis. Dentistry journal. 2022 Jul; 10(7): 126. doi: 10.3390/dj10070126.

[3] Tulek A, Mulic A, Runningen M, Lillemo J, Utheim TP, Khan Q *et al.* Genetic aspects of dental erosive wear and dental caries. International journal of dentistry. 2021; 2021(1): 5566733. doi: 10.1155/2021/5566733.

[4] Achmad H, Armedina RN, Timokhina T, Goncharov VV, Sitanaya R, Riyanti E. Literature review: Problems of dental and oral health primary school children. Indian Journal of Forensic Medicine & Toxicology. 2021; 15(2). doi: 10.37506/ijfmt.v15i2.15019 .

[5] Kanzow P, Wegehaupt FJ, Attin T, Wiegand A. Etiology and pathogenesis of dental erosion. Quintessence international. 2016 Apr; 47(4).

[6] Konradsson K, Lingström PE, Emilson CG, Johannsen G, Ramberg P, Johannsen A. Stabilized stannous fluoride dentifrice in relation to dental caries, dental erosion and dentin hypersensitivity: A systematic review. American Journal of Dentistry. 2020 Apr; 33(2): 95-105.

[7] de Sousa Né YG, Lima WF, Mendes PF, Baia-da-Silva DC, Bittencourt LO, Nascimento PC *et al.* Dental caries and salivary oxidative stress: global scientific research landscape. Antioxidants. 2023 Jan; 12(2): 330. doi: 10.3390/antiox12020330.

[8] Subramanian AK, Narayan V, Navaneethan R. Oxidative Stress and Oral Diseases. Role of Oxidative Stress in Pathophysiology of Diseases. 2020: 1-2.

[9] Loveren CV. Oral and dental health: prevention of dental caries, erosion, gingivitis and periodontitis. 2020 Jun. doi: 10.1007/978-981-15-1568-2_1.

[10] de Souza-Rodrigues RD, Pereira WW, Lima RR. Antioxidants in Oral Cavity Disorders. In Drug Discovery and Design Using Natural Products. Cham: Springer Nature Switzerland. 2023 Aug: 453-463. doi: 10.1007/978-3-031-35205-8_16.

[11] Gossweiler AG and Martinez-Mier EA. Vitamins and oral health. The Impact of Nutrition and Diet on Oral Health. 2020; 28: 59-67. doi: 10.1159/000455372.

[12] de Oliveira AA, Xavier AL, da Silva TT, Debortolli AL, Ferdin AC, Boteon AP *et al.* Acquired pellicle engineering with the association of cystatin and vitamin E against enamel erosion. Journal of Dentistry. 2023 Nov; 138: 104680. doi: 10.1016/j.jdent.2023.104680.

[13] Li Y, Jiang X, Hao J, Zhang Y, Huang R. Tea polyphenols: application in the control of oral microorganism infectious diseases. Archives of Oral Biology. 2019 Jun; 102: 74-82. doi: 10.1016/j.archoralbio.2019.03.027.

[14] Hendi SS, Goodarzi MT, Moghimbeigi A, Ahmadi-Motamayel F. Evaluation of the status of salivary antioxidants in dental caries. Infectious Disorders-Drug Targets (Formerly Current Drug Targets-Infectious Disorders). 2020 Dec; 20(6): 816-21. doi: 10.2174/1871526519666191031100432.

[15] de Sousa Né YG, Frazão DR, Bittencourt LO, Fagundes NC, Marañón-Vásquez G, Crespo-Lopez ME, Maia LC *et al.* Are dental caries associated with oxidative stress in saliva in children and adolescents? a systematic review. Metabolites. 2022 Sep; 12(9): 858. doi; 10.3390/metabo12090858.

[16] Pytko-Polończyk J, Stawarz-Janeczek M, Kryczyk-Poprawa A, Muszyńska B. Antioxidant-rich natural raw materials in the prevention and treatment of selected oral cavity and periodontal diseases. Antioxidants. 2021 Nov; 10(11): 1848. doi: 10.3390/antiox10111848.

[17] Lugo-Flores MA, Quintero-Cabello KP, Palafox-Rivera P, Silva-Espinoza BA, Cruz-Valenzuela MR, Ortega-Ramirez LA et al. Plant-derived substances with the antibacterial, antioxidant, and flavoring potential to formulate oral health care products. Biomedicines. 2021 Nov; 9(11): 1669. doi: 10.3390/biomedicines9111669.

[18] Chen X, Daliri EB, Kim N, Kim JR, Yoo D, Oh DH. Microbial etiology and prevention of dental caries: exploiting natural products to inhibit cariogenic biofilms. Pathogens. 2020 Jul; 9(7): 569. doi:

DOI: https://doi.org/10.54393/pjhs.v6i2.2199

10.3390/pathogens9070569.

[19] Chatterjee S, Damle SG, Iyer N. A study on genetic and mutans streptococcal transmissibility of dental caries. Journal of Oral and Maxillofacial Pathology. 2022 Oct; 26(4): 604. doi: 10.4103/jomfp.jomfp_201_22.

[20] Hegde MN, Kumari S, Hegde ND, Shetty SS. Relation between salivary and serum vitamin C levels and dental caries experience in adults-a biochemical study. Journal of Health and Allied Sciences Nitte University. 2013 Dec; 3(04): 030-3. doi: 10.1055/s-0040-1703698.

[21] Blaner WS, Shmarakov IO, Traber MG. Vitamin A and vitamin E: will the real antioxidant please stand up? Annual review of nutrition. 2021 Oct; 41(1): 105-31. doi: 10.1146/annurev-nutr-082018-124228.

[22] Sardari F, Khalili P, Rezvaninejad R, Rezvaninejad R, Eslami A. Dietary Vitamins and DMFT index in Rafsanjan adults, a Cross-sectional Study on Rafsanjan Adults Cohort Data. 2023 May. doi: 10.21203/rs.3.rs-2833239/v1.

[23] Wortzman M and Nelson DB. A comprehensive topical antioxidant inhibits oxidative stress induced by blue light exposure and cigarette smoke in human skin tissue. Journal of Cosmetic Dermatology. 2021 Apr; 20(4): 1160-5. doi: 10.1111/jocd.13991.

[24] Cagetti MG, Wolf TG, Tennert C, Camoni N, Lingström P, Campus G. The role of vitamins in oral health. A systematic review and meta-analysis. International journal of environmental research and public health. 2020 Feb; 17(3): 938. doi: 10.3390/ijerph17030938.

[25] Jiang Q, Im S, Wagner JG, Hernandez ML, Peden DB. Gamma-tocopherol, a major form of vitamin E in diets: Insights into antioxidant and anti-inflammatory effects, mechanisms, and roles in disease management. Free Radical Biology and Medicine. 2022 Jan; 178: 347-59.