SCIENTIFIC ARCHIVES OF DENTAL SCIENCES (ISSN: 2642-1623)

Volume 3 Issue 2 February 2020

Review Article

Red Wine and its Potential Role as an Antiplaque Agent: A Review

Shanin Farista*, Akhilesh Jakhete and Sana Farista

Private Practice, Mumbai, India

***Corresponding Author:** Shanin Farista, Private Practice, Mumbai, India.

Received: December 10, 2019; **Published:** January 18, 2020

Abstract

Dental caries and periodontitis are the most common diseases in the oral cavity. The etiology of both these diseases can be traced back to dental plaque. Dental plaque is a tenacious oral biofilm which harbours disease causing microorganisms and protects them from body's immune system. The aim of preventing them revolves around elimination of dental plaque. Current research is moving in the direction of inhibiting or removal of oral biofilm using natural products which contain polyphenols. Red wine is one such product which is widely consumed and rich in polyphenols. This paper aims to review the potential of red wine and GSE in inhibition of oral biofilm thereby playing a role in preventing diseases associated with dental plaque.

Keywords: Antiplaque Agent; Red Wine; Grape Seed Extract; Polyphenol; Phytotherapy; Anti Infective Biomaterial

Introduction

In the oral cavity, dental caries and periodontitis are the most prevalent diseases. The etiology for both these conditions can be traced to dental plaque. Dental plaque is one of the important players in etiology of dental caries, as it harbours microorganisms, and protects them from body's immune system [1]. Even though a lot of research has been done to trace the exact etiology and pathogenesis, most of it is still unclear [2]. Currently, the techniques used in preventing dental caries involve the use of fluoride, which makes tooth structure more resistant to acid attack, or use of chlorhexidine mouthwash, an effective chemical anti plaque agent [3] and various antibiotics to modulate host response in periodontitis [2]. But these agents have their limitations as well as adverse effects such as the potential toxic effects of fluoride. Moreover, irrational use of antibiotics leads to alteration of the gut flora, causing conditions like diarrhea [4]. Long term use of antibiotics also leads to development of resistance in bacteria, which is a big problem in itself [5-7]. The gold standard for prevention of periodontitis, that is, chlorhexidine, results in staining of teeth. Thus, it's long term use isn't advocated [3]. Currently, the trend in research is in the direction of identifying active components from natural products for potential use in dentistry [8,9]. Plant derived products have attracted a lot of attention. They contain various secondary metabolites like polyphenols, terpenoids, alkaloids, lectins, polypeptides and polyacetylenes, which are known to be antimicrobial agents [10]. Out of these, the polyphenol group has been widely studied [2]. Polyphenol is a substance that has atleast 1 aromatic ring with 1 or more hydroxyl groups [11,12]. Polyphenol group consist of phenolic acids and flavanoids. Flavanoids include substances like anthocyanins and anthocynadins, catechins, flavones, isoflavones, lignins, proanthocyanidins, stilbenes and tannins all of which has shown some or the other therapeutic effects to an extent [10]. The plant extracts that have been identified for potential use in dentistry are tea, coffee, cranberry, propolis, red wine, grapes and many more [2,10]. The reason for moving towards a herbal source rather than a chemical source, is to overcome the adverse effects of already established materials. This article has reviewed potential of Red Wine as an antiplaque agent. Here Red Wine and Grape Seed Extract are considered collectively to be same. This is done so because Grape seed extract is the product obtained from seeds of Vitis vinifera which may include parts of the skin [2,9] whereas Red wine is obtained from extract of crushed fruit of Vitis vinifera which is subjected to the fermentation process [10,12].

Wine is a very common and widely consumed beverage which is known to have many properties like protective effects against oral infections, bone and cardiovascular diseases [1,2,10,12]. Wine is characterized by high levels of polyphenols whose quality and quantity is dependent on grape variety, environmental location, climate, sun exposure, and the wine making process [13,14]. Particularly the red wine obtained from dark skinned grapes contain 3500 mg/L of polyphenols, in which flavanoids amount to 1000 - 1800 mg/L [15]. Tannins present in red wine cause an increase in anthocyanin stabilization, which provides the colour intensity, antioxidants, and radical scavenging properties [16]. Recent research has indicated that moderate consumption of red wine has positive effects on human health, owing to its high polyphenol composition which are well known anti-oxidants and free radical scavengers [17]. It has been known to exert health benefits with regards to chronic degenerative diseases like CVS pathologies, cancer, diabetes, and its complications [17-24].

Red wine and its effects on oral cavity

In addition to the health benefits, the significant polyphenol fraction may also be a potential therapeutic agent in the oral cavity.

1. Proanthocyanidins are effective in preventing dental caries by inhibiting surface adsorbed glucosyltransferase and F-ATPase activities, as well as inhibition of bacterial acid production [1,25].
2. Studies have also indicated that there is interference in *Streptococcus mutans* adhesion to saliva coated hydroxyapatite, thereby inhibiting biofilm formation [1].
3. Inhibits demineralization and/or promotes remineralisation of root surface caries [26].
4. *In vitro* studies have concluded that red wine exhibits anti bacterial properties against caries causing microorganisms [27].
5. Grape seed extract has been proven to promote remineralisation of dental caries [26,28].
6. Red wine and dealcoholized red wine demonstrated anti microbial activity against *F. nucleatum* and *Streptococcus oralis*, which are components of supragingival plaque, as well as, *Porphyromonas gingivalis* and *Prevotella intermedia* that are known to play a key role in development of periodontitis [29].
7. Development of periodontal disease is known to be associated with a decrease in antioxidant activity of gingival crevicular fluid. Polyphenol fraction of red wine, being a strong oxidising agent, may contribute in increasing the antioxidant activity of the crevicular fluid, thereby, preventing periodontal disease [12,30].
8. Polyphenol fraction may also increase the phagocytic activity of the polymorphonuclear lymphocytes in the crevicular fluid aiding in antibacterial activity [31].
9. Moreover, the polyphenol fraction is also known to counteract production of Prostaglandin E-2 (PGE2) by *P. gingivalis* thus limiting the ill-effects [32].
10. The polyphenol fraction may also have a key role in preventing oral cancer because of their ability to inhibit enzymes involved in carcinogenesis and tumor development. They can also inhibit DNA adduct formation and the cell proliferation in oral cancers caused by human papilloma virus [30].

Discussion

It has been established that the first step of dental plaque formation is the adhesion of bacteria to the teeth surfaces [1]. Dental plaque is one of the etiological factors for development of dental caries as well as periodontitis. Dental plaque harbours the bacteria responsible for them and protects it from the host's immune system. The negative consequences of dental caries and periodontitis not only result in loss of a tooth but decrease the efficiency of the stomatognathic system [3].

To overcome the drawbacks of antibiotics and fluorides, current trend in preventing them is moving in the direction of using products from natural sources as they have little to no reported adverse effects.

Red wine is an age old beverage consumed since centuries. There are 39 compounds which occur commonly in all wine samples, of which, many possess well documented antibacterial activity [33]. Out of these compounds, the polyphenol fraction has attracted the most attention, as the anti plaque properties are associated with it.

Oral mucosa is the place where the polyphenol fraction reaches its highest concentration, as compared to other tissues, and is constantly exposed to the oxidative stress from environment and diet [34,35]. The hypothesis which states that direct antioxidant activity of polyphenols explains its preventive activities against various oral diseases is potentially valid [30]. The polyphenols come in direct contact with tissues before they are absorbed and acted upon

by human and bacterial enzymes thereby [36], converting it into aglycones [37]. The phenolic acids are antibacterial and directly involved in response to microorganisms [38]. Their activity is based on hydrogen peroxide production, bacterial protein or enzyme inactivation and disinfectant activity [39]. Polyphenol activity against various microbial enzymes and/or proteins is concentration dependent. At low concentration specific sites are affected by them, whereas at higher concentration it causes denaturation [40].

Other components of wine such as flavan-3-ols (e.g. epicatechin, catechin, etc) are present in solid part of grape berry possessing antioxidant and antibacterial effects [33,41]. Tannins offer astringency which refers to a puckering and drying sensation in mouth. It occurs as a result of forming complexes with Salivary proteins and has also demonstrated antimicrobial activity including activity against all oral pathogen [42].

In a study conducted by Lorenzo., *et al*. they compared the antimicrobial activity of wine against *S. mutans, S. salivarius* and *S. pyogenes*. Moreover, they also studied the changes occurring in wine during the fermentation process. They concluded that all their samples exhibited antimicrobial activity against the tested microorganisms. Also, the antimicrobial property isn't influenced by the fermentation process. Moreover, they also concluded that there was a positive correlation between the antibacterial property and the antioxidant concentration [10].

Another study done by Furiga., *et al*. concluded that their wine extracts inhibited the glycosyltransferase (GTF) activity thereby preventing the first step in plaque formation that is adhesion [1].

In another study, it was concluded that high consumers of polyphenol rich food such as coffee, tea and red wine showed lower *Lactobacilli* and *S. mutans* count and lower dental plaque scores as compared to low/non consumers [43].

Drawbacks/Limitations

Although there are many positive health benefits in consuming red wine, there are certain challenges which need to be overcome first. Studies are required to understand the influence of oral environment on the active components of red wine as well as the antibacterial activity. Additionally, the contact time between the wine and oral tissues is quite less to exert its positive effects [3]. This needs to be taken into consideration. Moreover, certain cultures prohibit the intake of alcohol. Red wine leads to staining of composite restorations which may be present intraorally [44]. These drawbacks have to be dealt with before advocating the use of red wine as a potential anti plaque agent.

Although polyphenols have been demonstrated to have potent preventive properties especially against oral diseases, there are still questions which need to be answered. First, there are concerns over the maximum concentration of polyphenol which can be consumed safely. Most researchers rely on data which has been published 25 years back. Adult as well as pediatric doses have to be standardized for which human trials will be required [30]. Polyphenols also have a taste and/or colour. Food should not only be healthy but should be acceptable too [45,46]. The mechanism of action of polyphenols may be different *in vivo* as compared to the *in vitro* trials which should be taken into consideration as well [38].

Conclusion

Grape seed extract and red wine have been known to be consumed by humans since time immemorial. The polyphenol content of red wine is known to exert antimicrobial effects. The studies which have been done till date are *in vitro* in nature, and the exact mechanism of how red wine acts in *in vivo* conditions still need to be studied. Recent experimental data has suggested that polyphenols can be used in various biomaterials to counteract bacterial colonization without resorting to the addition of toxic chemicals. This may lead to development of a new generation of biomaterials, which are anti infective, devoid of toxicity, and have interesting biological properties. Moreover, a fraction of red wine, rich in polyphenols, can be incorporated into food items such as chewing gums or lozenges. Red wine exhibits potential, but it requires further studies and clinical trials to completely understand its mechanism of action. There are still issues which require to be attended before it can be used as an anti plaque agent globally.

Bibliography

1. Furiga A, G Dorignac Aline, Lonvaud-Funel, Cecile Badet. In vitro anti bacterial and anti adherence effects of natural polyphenolic compounds on oral bacteria. Journal of Applied Microbiology. 2008;105:1470-1476.

2. Cheng Lei, Jiyao Li, Libang He, Xuedong Zhou. Natural Products and Caries Prevention. Caries Res. 2015;49(1):38-45.

3. Gazzani G, et al. Food Components with Anti-caries Activity. Current Opinion in Biotechnology. 2012;23:153-159.

4. Goldin BR, et al. Alterations of the intestinal microflora by diet, oral antibiotics and lactobacillus: decreased production of free amines from aromatic nitro compounds, azo dyes and glucornides. J National Cancer Institute. 1984;73:689-695.

5. Dickinson B, et al. Infectious Diarrohea:an overview. Curr Gastroenterol Rep. 2004;16:399.

6. Gopinath S, et al. Role of Disease Associated Tolerance in Infectious Superspreaders. Proc Natl Acad Sci USA. 2014;111:15780-15785.

7. Vennila V, et al. Tetracycline induced discolouration of deciduous teeth:case series. J Int Oral Health. 2014;6:115-119.

8. Groppo FC, et al. Use of Phytotherapy in Dentistry. Phytother Res. 2008;22:993-998.

9. Newman DJ. Natural Products as leads to Potential Drugs: an old process or the new hope of drug discovery? J Med Chem. 2008;51:2589-2599.

10. Lorenzo DA, et al. Effect of Wine Making on the Composition of Red Wine as a Source of Polyphenols for Anti-Infective Biomaterials. Materials. 2016;9:316.

11. Yoo S, et al. Antimicrobial Traits of Tea and Cranberry Derived Polyphenols againt Streptococcus mutans. Caries Res. 2011;45:327-335.

12. Petti S, et al. Polyphenols, Oral Health and Disease: A Review. Journal of Dentistry. 2009;37:413-423.

13. Lopez V, et al. The Study of Phenolic Compounds as Natural Antioxidants in Wine. Crit Rev Food Sci Nutr. 2003;43:233-244.

14. Lachman J, et al. Major Factors Influencing Antioxidant Contents and Antioxidant Activity in Grapes and Wines. Int J Wine Res. 2009;101:101-121.

15. Kanner J, et al. Natural Antioxidants in Grapes and Wines. J Agric Food Chem. 1994;42:64-69.

16. Vasquez S, et al. Effects of Wine making Technique on Phenolic Composition and Chromatic Characteristics in Young Red Wine. Eur Food Res Technol. 2010;231:789-802.

17. Giovinazzo G, et al. Functional Properties of Grape and Wine Polyphenols. Plant Foods Hum Nutr. 2015;70:454-462.

18. Nabavi S.F, et al. Anthocyanins as a Potential Therapy for Diabetic Retinopathy. Curr Med Chem. 2015;22:51-58.

19. Mink PJ, et al. Flavanoid Intake and Cardiovascular Disease Mortality: A Perspective Study in Postmenopausal Women. Am J Clin Nutr. 2007;85:895-909.

20. Sobrattee MA, et al. Chemopreventive Actions of Polyphenolic Compounds in Cancer. Biofactors. 2006;27:19-35.

21. Pearson KJ, et al. Resveratrol Delays Age Related Deterioration and Mimics Transcriptional Aspects of Dietary Restriction Without Extending Lifespan. Cell Metab. 2008;8:157-168.

22. Leifert W.R, et al. Cardioprotective actions of Grape Polyphenols. Nutr Res. 2008;28:729-737.

23. Cote C.D, et al. Resveratrol Activates Duodenal Sirt1 to Reverse Insulin Resistance in Rats Through Neuronal Network Nat Med. 2015;21:498-505.

24. Csiszar A, et al. Resveratrol attenuates TNF-alpha-induced activation of coronary arterial endothelial cells: Role of NF- kappaB inhibition. Am J Physiol Heart Circ Physiol. 2006;291:H1694-H1699.

25. Duarte S, et al. The Influence of a Novel Propolis on mutans Streptococci biofilms and Caries Development in Rats. Arch Oral Biol. 2006;51:15-22.

26. Xie Q, et al. In Vitro Remineralization Effects of Grape Seed Extract on Artificial Root Caries. J Dent. 2008;36:900-906.

27. Cueva C, et al. Antibacterial Activity of Wine Phenolic Compounds and Oenological Extracts Against Potential Respiratory Pathogens. Letters in Applied Microbiology. 2012;54:557-563.

28. Kosasi S et al. Inhibitory Activity of Jatropha multifida latex on complement pathway activity in a human serum mediated by a calcium mediating proanthocyanidin. J Ethnapharmacol. 1989;27:81-89.

29. Gonzalez M, et al. Red Wine and Oenological Extracts Display Antimicrobial Effects in an Oral Biofilm Model. J Agric Food Chem. 2014;62:4731-4737.

30. Lolayekar N, et al. Polyphenols And Oral Health. Revista Sul Brasileria de Odontologia. 2012;9(1):74-84.

31. Staudte H, et al. Grapefruit influence the clinical and paraclinical parameters in periodontitis patients. Journal of Dental Research. 2001;80:647.

32. Inaba H, et al. Identification of hop Polyphenolic Components which Inhibit the Prostaglandin E2 Production by Gingival Epithelial Cells Stimulated with Periodontal Pathogen. Biological and Pharmaceutical Bulletin. 2008;31:527-530.

33. Daglia M. Polyphenols as Anti-microbial Agents. Curr Opin Biotechnol. 2013;23:174-181.

34. Halliwell B, et al. Health promotion by Flavanoids, Tocopherol, Tocotrienol and other Phenols: direct or indirect effects? Antioxidant or not? American journal of Clinical Nutrition. 2005;81:268-276.

35. Kempler D, et al. Caries Rate in Hamsters given Nonacidualated and Acidualated Tea. J Dent Res. 1977;56:89.

36. Halliwell B, et al. The Gastrointestinal Tract: A Major Site of Antioxidant Action? Free Radical Research. 2000;33: 819-828.

37. Walle T, et al. Flavanoid Glucosides are Hydrolysed and Thus Activated in the Oral Cavity in Humans. Journal of Nutrition. 2005;135:48-52.

38. Petti S, et al. Polyphenols, Oral Health and Disease: A Review. Journal of Dentistry. 2009;37:413-423.

39. Cushnie TPT, et al. Antimicrobial Activity of Flavanoids. International Journal of Antimicrobial Agents. 2005;26:343-356.

40. Fung DYC, et al. Effects of Butylated Hydroxyanisole (BHA) and Butylated Hydroxytoulene (BHT) on Growth and Aflatoxin Production of Aspergillus Flavus. Journal of Food Safety. 1977;1:39-51.

41. Mattivi F, et al. Wine, Biodiversity, Technology and Antioxidants. Ann NY Acad Sci. 2002;957:37-56.

42. McRae J, et al. Wine and Grape Tanin Interactions with Salivary proteins and Their Impact on Astrigency: A Review of current Research. Molecules. 2011;16:2348-2364.

43. Signoretto C, et al. Differences in Microbiological Composition of Saliva and Dental Plaque in Subjects with Different Drinking Habits. New Microbiol. 2006;29(4):293-302.

44. Omata Y, et al. Staining of Hybrid Composites with Coffee, Oolong Tea or Red Wine. Dental Materials Journal. 2006;25(1):125-131.

45. Lesscchaeve I, et al. Polyphenols: Factors Influencing Their Sensory Properties and Their Effects on Food and Beverage Preferences. Am J Clin Nutr. 2005;81:330S-5S.

46. Scalbert A, et al. Polyphenols: Antioxidants and Beyond. Am J Clin Nutr. 2005;81:215S-217S.

Volume 3 Issue 2 February 2020

© All rights are reserved by Shanin Farista*., et al.*