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Mini Review

Oral and physiological benefits of cranberries

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Abstract

Cranberries are known to prevent urinary tract infection and it is also helpful in maintaining oral health. Cranberry juice is a widely consumed and recommended beverage for preventing urinary tract infections. Clinical studies in women have shown that cranberries help to stop the recurrence of infection, as the evidence showed the presence of various extracts of cranberries in the patients' urinary tracts, proving the effectiveness and the mechanism. The primary compound involved in the fight against the infection is Proanthocyanidin A which is now the focus of studies to treat common diseases such as *Helicobacter pylori*-associated gastritis, as well as dental caries and periodontal disease, from which it is speculated the mechanism involves disrupting the bacterial adhesion.

Introduction

Cranberries are now known to help in oral health, especially when the juice is already a popular beverage and an advised dietary remedy for the prophylaxis of Urinary Tract Infection (UTI). Clinical trials showed that cranberries did improve the condition of recurrent urinary tract infections in females. There were traces of cranberry extracts in the urine samples and could be linked to proanthocyanidins, which is now a hot compound for studies on its use in other common diseases, such as *Helicobacter pyloric*-associated gastritis, dental caries, and periodontal disease, given that it is suspected to play a role in inhibiting the adhesion of bacteria on tissues or cells. Proanthocyanidins (PACs) [1-5], the most abundant flavonoid extracted from cranberries, have been reported to show antimicrobial, antioxidant, and anti-inflammatory activities and prevent the adhesion of microorganisms. Recent in vitro studies have shown that PACs may be a potential therapeutic agent for the prevention and management of periodontitis, an inflammatory disease of bacterial origin affecting the tooth-supporting tissues. Since the phytochemicals in cranberries

have been proven to benefit human health, this review would focus on the specific preventive effect of PACs on the breakdown of connective tissues and alveolar bone destruction, as well as their potential for controlling periodontal disease. Possible mechanisms may include inhibiting bacterial and host-derived proteolytic enzymes, inflammatory response in the host, and osteoclast differentiation and activities. With the interesting properties exhibited by PACs in these in vitro studies, the evidence does warrant further investigation by clinical trials to better evaluate the potential of the compound to control the periodontal disease [6-8].

Cranberry extract

In the past few years, cranberry extract has increasingly attracted more attention from dental researchers [9-12]. This paper would explore the potential benefits of the extract in oral diseases, such as dental caries and periodontal disease. Cranberries are rich in high-molecular-weight polyphenols and they exist in thousands of different forms, all of which are very promising in fixing caries (dental plaques) and periodontal disease, as well as controlling the inflammatory

response and enzymes that break down the extracellular matrix. The cranberry extract is now characterized as an anti-caries agent, for its ability to inhibit acid production, bacterial adhesion, and biofilm formation, targeting specifically the *Streptococcus* strains, in which the production of glucan-binding protein, the activities of extracellular enzymes, the metabolism of carbohydrates and bacterial hydrophobicity are affected [13-16]. For periodontal disease, the cranberry extract acts to suppress the host's inflammatory response, inhibit the production and destructive activities of bacterial enzymes in the plaques, and prevent the formation of biofilm for adhesion, proteolytic activities, and aggregation of pathogens in the periodontium. These show that cranberries, especially its high-molecular-weight ingredient, can be used as a bioactive substance for the prevention and treatment of oral diseases [15,17-20]. Cranberry components are potential anti-caries agents since they inhibit acid production, attachment, and biofilm formation by *Streptococcus mutans*. Glucan-binding proteins, extracellular enzymes, carbohydrate production, and bacterial hydrophobicity, are all affected by cranberry components.

Composition of cranberries

Cranberries contain quite a variety of substances, such as Proanthocyanidins A (PACs), tannic acid, organic acids, catechins, iron, zinc, and other trace elements. Studies have pointed out that the major antibacterial component is Proanthocyanidins A, which can prevent dental caries, periodontal disease, or urinary tract infection [18,19]. Scientists have found that nutrients in cranberries and blueberries can be highly effective in protecting the teeth against a strand of bacteria responsible for accelerating tooth decay. These natural compounds, known as polyphenols, help fend off harmful bacteria in the mouth. Over the last decade, in vitro, clinical studies have found that some raspberry extracts are involved in microbial infection and spreading, especially proanthocyanidins, which have an inhibitory effect on the adhesion of *E. coli* to urothelial cells. According to research, high-molecular-weight extracts in cranberries also showed a similar effect to prevent the adhesion of P-fimbriated *E. coli*, as well as *Helicobacter pylori* to the mucosa of the gastric wall in humans; thus, preventing the development of gastric ulcers. These in vitro observations are consistent with the evidence of cranberry extracts inhibiting urinary tract infection and *Helicobacter pylori* infection. There is also some evidence supporting its inhibitory effect on some skin pathogens, but unfortunately, it has no effect on the oral pathogen, *Candida albicans* [21-23].

Pathophysiological mechanism of preventing periodontal disease

Proanthocyanidins are extracted from cranberries the fruit and are the most abundant flavonoid among the ingredients. They are anti-bacterial, anti-adhesion, antioxidant, and anti-inflammatory. Recent experiments have all pointed to its therapeutic potential as an agent in the prevention and treatment of periodontitis, which is an inflammatory disease of bacterial origin affecting the tooth-supporting

periodontium [24-29], besides its potential to prevent urinary tract infection and oral health, as well. Studies have shown that PACs in cranberries will help the connective tissues such as the gums and alveolar bones to resist breakdown and destruction by bacteria. It is speculated that it can: 1) inhibit bacterial and host-derived proteolytic enzyme activities; 2) inhibit the inflammatory response in the host; and 3) prevent the differentiation and activities of osteoclasts. These were proven in animal experiments, but it will require more clinical trials (randomized and controlled) to better assess its potential in the prevention and treatment of periodontal disease [30-35]. Drinking 100% cranberry juice can help fight cavities. It works by inhibiting the bacteria from clinging to your teeth and causing tooth decay. Cranberry juice has a specific enzyme that acts as a bacteria-repellent on teeth. This enzyme inhibits bacteria from sticking. Studies have found that the flavonoids in cranberry extract can inhibit the Glucosyltransferase enzymes (GTF) required for the formation of dental plaque, and an average of 250 mg of flavonoids can effectively inhibit 50% of GTF activities, while the teeth are naturally built to resist the bacteria by as much as 40%. Furthermore, experimental data showed that the active substances of cranberries, specifically the flavonoids (including Quercetin and Myricetin) can resist some degree of acidification and control the bacterial strain, *S.mutans*, that causes tooth decay. Reducing the chance of forming dental plaque, will help to prevent tooth decay. In addition, cranberries stop *Haemophilus* bacteria from adhering to the mucosal epithelial cells; hence, reducing the chance of urinary tract infection. Recently, it was confirmed that PACs can prevent periodontal disease and dental caries by inhibiting the proteolytic enzymes from bacteria and the host, or inhibiting the host's inflammatory response, as well as inhibiting the differentiation and activities of osteoclasts. For periodontal disease and the necrosis of the tissues that are induced by gram-negative bacteria, cranberry extract is highly effective in inhibiting MMPs and elastase secreted by inflamed oral cells. Plus, it plays to stop the acid-producing enzyme B and C (GTF-B, GTF-C), as well as F-Type ATPase in bacterial mitochondria. Overall, the evidence showed that cranberry extracts function to prevent periodontal disease and tooth decay, in addition to the inhibition of plaque formation and bacterial adhesion [36-42].

Conclusion

Cranberries are rich in healthy ingredients with nutritional value. Over the last decade, there was an increase in the public's attention to the use of cranberries (*Vaccinium macrocarpon*) in North America, specifically the phytochemicals, namely anthocyanins, flavonols, flavan-3-ols, phenolic acid derivatives, proanthocyanidines, etc. These chemicals are the highlight of the cranberries' inhibitory effect on bacteria, helping to fight against urinary tract infections and childhood diseases [43-46]. PACs are flavonoid-rich substances extracted from cranberries, which are known to be anti-bacterial, anti-adhesion, antioxidant, and anti-inflammatory. In recent years, more experiments have extracted PACs from cranberries as the potential agent to treat periodontitis [5-8,47,48]. Thus, it is expected that cranberries to show unlimited potential in oral health care in the future.



References

- Philip N, Walsh LJ. Cranberry Polyphenols: Natural Weapons against Dental Caries. *Dent J (Basel)*. 2019 Mar 1;7(1):20. doi: 10.3390/dj7010020. PMID: 30823634; PMCID: PMC6473364.
- Pellerin G, Bazinet L, Grenier D. Effect of cranberry juice deacidification on its antibacterial activity against periodontal pathogens and its anti-inflammatory properties in an oral epithelial cell model. *Food Funct*. 2021 Nov 1;12(21):10470-10483. doi: 10.1039/d1fo01552d. PMID: 34554173.
- Prasain JK, Barnes S. Cranberry polyphenols-gut microbiota interactions and potential health benefits: An updated review. *Food Frontiers*. 2020; 1(4): 459-464.
- Pellerin G, Bazinet L, Grenier D. Deacidification of Cranberry Juice Reduces Its Antibacterial Properties against Oral Streptococci but Preserves Barrier Function and Attenuates the Inflammatory Response of Oral Epithelial Cells. *Foods*. 2021 Jul 15;10(7):1634. doi: 10.3390/foods10071634. PMID: 34359504; PMCID: PMC8305880.
- Al-Juhaishi AMR, Mousa TH, Mustafa R, Al-Shehristani RMM. Effect of cranberry in enhancing oral hypoglycemic agents in uncontrolled type-II diabetic patients. *J Global Pharma Technol*. 2019; 10(8):319-24.
- Szczęśna W, Tsigotis-Maniecka M, Szyk-Warszyńska L, Balicki S, Warszyński P. Insight into multilayered alginate/chitosan microparticles for oral administration of large cranberry fruit extract. *European Polymer Journal*. 2021; 160: 110776.
- Nowaczyk PM, Bajerska J, Lasik-Kurdyś M, Radziejewska-Kubzdela E, Szwengiel A, Woźniewicz M. The effect of cranberry juice and a cranberry functional beverage on the growth and metabolic activity of selected oral bacteria. *BMC Oral Health*. 2021 Dec 20;21(1):660. doi: 10.1186/s12903-021-02025-w. PMID: 34930215; PMCID: PMC8686276.
- Gu I, Howard L, Lee SO. Volatiles in Berries: Biosynthesis, Composition, Bioavailability, and Health Benefits. *Applied Sciences* 2022, 12(20), 10238.
- Khalil RR, Mohammed ET, Mustafa YF. Various Promising Biological Effects of Cranberry Extract: A Review. *Clinical Schizophrenia & Related Psychoses*. 2021.
- Gill S, Kaur A, Kapoor D, Goyal J, Duhan H. Cranberry polyphenols: Beneficial effects for prevention of periodontal disease and dental caries. *The Saint's International Dental Journal*. 2016; 2(2): 38.
- Bonifait L, Grenier D. Cranberry polyphenols: potential benefits for dental caries and periodontal disease. *J Can Dent Assoc*. 2010;76:a130. PMID: 20943032.
- Pellerin G, Bazinet L, Grenier D. Effect of cranberry juice deacidification on its antibacterial activity against periodontal pathogens and its anti-inflammatory properties in an oral epithelial cell model. *Food Funct*. 2021 Nov 1;12(21):10470-10483. doi: 10.1039/d1fo01552d. PMID: 34554173.
- Figueiredo LC, Freitas Figueiredo N, da Cruz DF, Baccelli GT, Sarachini GE, Bueno MR, Feres M, Bueno-Silva B. Propolis, Aloe Vera, Green Tea, Cranberry, Calendula, Myrrha and Salvia Properties against Periodontal Microorganisms. *Microorganisms*. 2022 Oct 31;10(11):2172. doi: 10.3390/microorganisms10112172. PMID: 36363764; PMCID: PMC9693270.
- Nemzer BV, Al-Taher F, Yashin A, Revelsky I, Yashin Y. Cranberry: Chemical Composition, Antioxidant Activity and Impact on Human Health: Overview. *Molecules*. 2022 Feb 23;27(5):1503. doi: 10.3390/molecules27051503. PMID: 35268605; PMCID: PMC8911768.
- Nowaczyk PM, Bajerska J, Lasik-Kurdyś M, Radziejewska-Kubzdela E, Szwengiel A, Woźniewicz M. The effect of cranberry juice and a cranberry functional beverage on the growth and metabolic activity of selected oral bacteria. *BMC Oral Health*. 2021 Dec 20;21(1):660. doi: 10.1186/s12903-021-02025-w. PMID: 34930215; PMCID: PMC8686276.
- Sayal D, Sood R, Yadav N, Jha B, Dodwad V. Comparing the effect of three different mouthwashes cranberry, HIORA and chlorhexidine on the management of periodontal diseases. *IP International Journal of Periodontology and Implantology*. 2021; 1(2): 55-62.
- Feghali K, Feldman M, La VD, Santos J, Grenier D. Cranberry proanthocyanidins: natural weapons against periodontal diseases. *J Agric Food Chem*. 2012 Jun 13;60(23):5728-35. doi: 10.1021/jf203304v. Epub 2011 Nov 29. PMID: 22082264.
- Gościniak A, Paczkowska-Walendowska M, Skotnicka A, Ruchała MA, Cielecka-Piontek J. Can Plant Materials Be Valuable in the Treatment of Periodontal Diseases? Practical Review. *Pharmaceutics*. 2021 Dec 17;13(12):2185. doi: 10.3390/pharmaceutics13122185. PMID: 34959467; PMCID: PMC8705740.
- Darvishi M, Shahi S, Goli M, Maghsoudi Z, Ranjbaran SM. Evaluation of optical parameters of Vaccinium macrocarpon fruit (Iranian cranberry) as a substitute for Cornus mas with emphasis on chemical properties in the prevention and treatment of oral diseases. *Yafteh*. 2021; 23(2): 196-208.
- Nawrot-Hadzik I, Matkowski A, Kubasiewicz-Ross P, Hadzik J. Proanthocyanidins and Flavan-3-ols in the Prevention and Treatment of Periodontitis-Immunomodulatory Effects, Animal and Clinical Studies. *Nutrients*. 2021 Jan 15;13(1):239. doi: 10.3390/nu13010239. PMID: 33467650; PMCID: PMC7830097.
- Hlazunov O, Hruzdeva A, Fesenko V, Kornichuk O, Penskyi K. The particulars of Applying Odontoprotectors at different stages of therapeutic Process of Periodontal Diseases (A Scoping Review). *International Journal of Statistics in Medical Research*. 2022; 11: 41-50.
- Greene AC. Engineering Formulations for the Treatment of Periodontal Disease (Doctoral dissertation, University of Pittsburgh) 2022.
- Barzegar PEF, Ranjbar R, Yazdani M, Tahmasebi E, Alam M, Abbasi K. The current natural/chemical materials and innovative technologies in periodontal diseases therapy and regeneration: A narrative review. *Materials Today Communications*. 2022; 104099.
- Al Gaoal ZIY, Al-Azzawi KGS, Al-Sabaawi MBD. Urinary Tract Infections in Pregnant Women. *New Opportunities Anti-Relapse Therapy*. 2022; 22(3):53.
- Abbas KS, Amber AA, Waleed H, Samer S. Periodontal Disease And Type 2 Diabetics Versus Non diabetics In Adhamiyah Sector, Baghdad-Iraq, 2018. *Medico-Legal Update*. 2022. 2022; 22(3).
- Basilicata M, Di Lauro M, Campolattano V, Marrone G, Celotto R, Mitterhofer AP, Bollero P, Di Daniele N, Noce A. Natural Bioactive Compounds in the Management of Oral Diseases in Nephropathic Patients. *Int J Environ Res Public Health*. 2022 Jan 31;19(3):1665. doi: 10.3390/ijerph19031665. PMID: 35162688; PMCID: PMC8835582.
- Kuang X, Chen V, Xu X. Novel Approaches to the Control of Oral Microbial Biofilms. *Biomed Res Int*. 2018 Dec 31;2018:6498932. doi: 10.1155/2018/6498932. PMID: 30687755; PMCID: PMC6330817.
- Howell AB, Reed JD, Krueger CG, Winterbottom R, Cunningham DG, Leahy M. A-type cranberry proanthocyanidins and uropathogenic bacterial anti-adhesion activity. *Phytochemistry*. 2005 Sep;66(18):2281-91. doi: 10.1016/j.phytochem.2005.05.022. PMID: 16055161.
- Sánchez MC, Ribeiro-Vidal H, Bartolomé B, Figuero E, Moreno-Arribas MV, Sanz M, Herrera D. New Evidences of Antibacterial Effects of Cranberry Against Periodontal Pathogens. *Foods*. 2020 Feb 24;9(2):246. doi: 10.3390/foods9020246. PMID: 32102416; PMCID: PMC7074180.
- Gill S, Kaur A, Kapoor D, Goyal J, Duhan H. Cranberry polyphenols: Beneficial effects for prevention of periodontal disease and dental caries. *The Saint's International Dental Journal*. 2016; 2(2): 38.
- Bonifait L, Grenier D. Cranberry polyphenols: potential benefits for dental caries and periodontal disease. *J Can Dent Assoc*. 2010;76:a130. PMID: 20943032.



32. Bodet C, Grenier D, Chandad F, Ofek I, Steinberg D, Weiss EI. Potential oral health benefits of cranberry. *Crit Rev Food Sci Nutr*. 2008 Aug;48(7):672-80. doi: 10.1080/10408390701636211. PMID: 18663617.
33. Figueiredo LC, Freitas Figueiredo N, da Cruz DF, Baccelli GT, Sarachini GE, Bueno MR, Feres M, Bueno-Silva B. Propolis, Aloe Vera, Green Tea, Cranberry, Calendula, Myrrha and Salvia Properties against Periodontal Microorganisms. *Microorganisms*. 2022 Oct 31;10(11):2172. doi: 10.3390/microorganisms10112172. PMID: 36363764; PMCID: PMC9693270.
34. Nemzer BV, Al-Taher F, Yashin A, Revelsky I, Yashin Y. Cranberry: Chemical Composition, Antioxidant Activity and Impact on Human Health: Overview. *Molecules*. 2022 Feb 23;27(5):1503. doi: 10.3390/molecules27051503. PMID: 35268605; PMCID: PMC8911768.
35. Noreen S, Niazi MK, Hassan F, Amjed M, Ismail RI, Iftikhar R. Phytochemical and bioactive potential of Cranberry (*Vaccinium macrocarpon*) juice and its applications against Kidney and urinary tract infection (UTI). *Int Med Health Sci*. 2021; 1(1): 16-23.
36. Feghali K, Feldman M, La VD, Santos J, Grenier D. Cranberry proanthocyanidins: natural weapons against periodontal diseases. *J Agric Food Chem*. 2012 Jun 13;60(23):5728-35. doi: 10.1021/jf203304v. Epub 2011 Nov 29. PMID: 22082264.
37. Nawrot-Hadzik I, Matkowski A, Kubasiewicz-Ross P, Hadzik J. Proanthocyanidins and Flavan-3-ols in the Prevention and Treatment of Periodontitis-Immunomodulatory Effects, Animal and Clinical Studies. *Nutrients*. 2021 Jan 15;13(1):239. doi: 10.3390/nu13010239. PMID: 33467650; PMCID: PMC7830097.
38. Khalil RR, Mohammed ET, Mustafa YF. Various Promising Biological Effects of Cranberry Extract: A Review. *Clinical Schizophrenia & Related Psychoses*. 2021.
39. La VD, Howell AB, Grenier D. Anti-*Porphyromonas gingivalis* and anti-inflammatory activities of A-type cranberry proanthocyanidins. *Antimicrob Agents Chemother*. 2010 May;54(5):1778-84. doi: 10.1128/AAC.01432-09. Epub 2010 Feb 22. PMID: 20176905; PMCID: PMC2863644.
40. Li M, Li R, Jin Q, Pang J, Xu Z. The efficacy of proanthocyanidins and secnidazole in the treatment of chronic periodontitis after scaling and root planing therapy. *J Biol Regul Homeost Agents*. 2017 Jan-Mar;31(1):93-97. PMID: 28337876.
41. Díaz Sánchez RM, Castillo-Dalí G, Fernández-Olavarría A, Mosquera-Pérez R, Delgado-Muñoz JM, Gutiérrez-Pérez JL, Torres-Lagares D. A Prospective, Double-Blind, Randomized, Controlled Clinical Trial in the Gingivitis Prevention with an Oligomeric Proanthocyanidin Nutritional Supplement. *Mediators Inflamm*. 2017;2017:7460780. doi: 10.1155/2017/7460780. Epub 2017 Dec 10. PMID: 29375198; PMCID: PMC5742508.
42. H R R, Dhamecha D, Jagwani S, Patil D, Hegde S, Potdar R, Metgud R, Jalalpure S, Roy S, Jadhav K, Tiwari NK, Koduru S, Hugar S, Dodamani S. Formulation of thermoreversible gel of cranberry juice concentrate: Evaluation, biocompatibility studies and its antimicrobial activity against periodontal pathogens. *Mater Sci Eng C Mater Biol Appl*. 2017 Jun 1;75:1506-1514. doi: 10.1016/j.msec.2017.03.054. Epub 2017 Mar 7. PMID: 28415444.
43. Sravani K, Suchetha A, Mundinamane DB, Bhat D, Chandran DN, Rajeshwari HR. Plant products in dental and periodontal disease: an overview. *International Journal of Medical and Dental Sciences*. 2015: 913-21.
44. Hlazunov O, Hruzdeva A, Fesenko V, Korniiuchuk O, Penskyi K. The Particulars of Applying Odontoprotectors at Different Stages of Therapeutic Process of Periodontal Diseases (A Scoping Review). *International Journal of Statistics in Medical Research*. 2022; 11: 41-50.
45. Pellerin G, Bazinet L, Grenier D. Effect of cranberry juice deacidification on its antibacterial activity against periodontal pathogens and its anti-inflammatory properties in an oral epithelial cell model. *Food Funct*. 2021 Nov 1;12(21):10470-10483. doi: 10.1039/d1fo01552d. PMID: 34554173.
46. Nowaczyk PM, Bajerska J, Lasik-Kurdyś M, Radziejewska-Kubzdela E, Szwengiel A, Woźniewicz M. The effect of cranberry juice and a cranberry functional beverage on the growth and metabolic activity of selected oral bacteria. *BMC Oral Health*. 2021 Dec 20;21(1):660. doi: 10.1186/s12903-021-02025-w. PMID: 34930215; PMCID: PMC8686276.
47. Darvishi M, Shahi S, Goli M, Maghsoudi Z, Ranjbaran SM. Evaluation of optical parameters of *Vaccinium macrocarpon* fruit (Iranian cranberry) as a substitute for *Cornus mas* with emphasis on chemical properties in the prevention and treatment of oral diseases. *Yafteh*. 2021; 23(2): 196-208.
48. Abbas KS, Amber AA, Waleed H, Samer S. Periodontal Disease and type 2 diabetics versus non diabetics In Adhamiyah Sector, Baghdad-Iraq, 2018. *Medico-Legal Update*. 2022; 22(3).

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