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Effect of Mushrooms on Dental Caries

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Abstract

Dental caries is one of the most prevalent and common dental lesion seen in the oral cavity. When left untreated it may progress and compromise pulpal and periodontal health. While there are effective preventive measures that can be performed to prevent caries by a dentist, there are also natural methods in the form of a well-constructed diet to manage and prevent dental caries. These are diets that contain functional food that serves and an alternative to synthetic materials to prevent dental caries. This literature reviews the effects of components in mushroom that has anticarious action.

Keywords: Mushrooms, Dental Caries, Shiitake, Lentinula Edodes.

INTRODUCTION

Dental caries is an infectious microbiologic disease of the teeth that results in localized dissolution and destruction of the calcified tissues. It is one of the most common chronic diseases in the world. The prevalence of dental caries has increased in modern times due to a change in dietary consumption. However, evidence suggests the opposite. In developed countries, there is a notable decrease in dental caries in certain populations especially in United States, Western Europe, New Zealand, and Australia[1].

Despite this, caries still remains a problem in developing countries which is made worse by generalized nutritional deficiencies[2]. Hence, in order to prevent caries, numerous methods have been generated. Commonly used is fluoride as an anti-carious agent [3] but it has cytotoxic effects if it exceeds a concentration over 80ppm[4]. Also, mouth rinsing solutions are also commonly used [5] but dental caries still remains prevalent which come to show that the current methods of caries control are not as effective.

Recently, scientist have gone into research of natural methods for caries control [6,7,8,9,10] . Functional foods like mushroom have a wide range of biomolecules with nutritional [11] and medicinal substances[12,13,14] with immunomodulatory, cardiovascular, liver protective, anti-fibrotic ,anti-inflammatory, anti-diabetic, and anti-microbial properties [12-23] . In this literature the anti-carious effects of consuming mushroom are reviewed

DENTAL CARIES

Dental caries in Latin means 'dry rot' and is the name given to the process of slow disintegration that may affect any of the biological hard tissue as a result of bacterial action. The definition by the WHO states that caries is a localized post eruptive, pathological process of external origin involving softening of the hard tooth tissue and proceeding to the formation of a cavity. Patients may vary in their susceptibility to the caries process and in managing dental caries.

There are several theories of caries pathogenesis. The proteolytic theory by Gottlieb states that intitial action is due to proteolytic enzymes secreted by staphylococci in the oral cavity on organic structures of the tooth [24] . Pincus then mentioned that the nysmyth's membrane on the tooth is acted on by sulphatase enzyme released by bacilli yielding sulphuric acid [25]. In the proteolysis chelation theory, Schatz stated that there is simultaneous microbial degradation of the organic portion by proteolysis and the dissolution of inorganic portion by chelation process [26] In Levine's theory, emphasis is given on the continuous demineralization and mineralization of enamel [27,28]. He suggested that in a given time if there is more ions leaving the enamel then ions entering it, there is a net demineralization which initiates the caries process. He also stated that the movement of ions is not a one way process. Instead, it is a continuous process.

Dental caries is a multifactorial diseases cause by a complex interaction between the host,plaque,diet and time. The oral cavity have always been colonized by potentially cariogenic bacteria like Streptococcus mutans ,Streptococcus sobrinus, Lactobacillus and Actinomyces[29] . These bacteria accumulate around the teeth in a sticky mass called plaque which acts as a biofilm. In the presence of sugar commonly sucrose, they produce lactic acid which causes dissolution of the hard structures of the tooth. Remineralization is possible if the acid is neutralized by suitable minerals and preventive aids.

Streptococcus mutans and Streptococcus Sobrinus are considered to be the main etiological agents due to effective colonization on the dental surface, carbohydrate metabolism and lactic acid generation [30,31] .Initially,several adhesion produced by the bacteria interact with glycoproteins on of the acquired pellicle on the teeth surface. Then,bacteria will adhere tightly to the tooth surface as a result of production of exopolysaccharides (glucans) from sucrose metabolism. If dental plaque is allowed to accumulate, Streptococci Mutans will adhere tightly and produce large quantities of lactic acid and cause dissolution of the hard substance of tooth[30,31] .

COMPONENTS IN MUSHROOM

Mushroom contains erythritol which is 1,2 and 3,4-Butanetetrol which has 70 to 80 % sweetness to that of sucrose. It is classified as a non-cariogenic sweetener based on a study done [32]. It showed that Streptococcus Mutans and Streptococcus Sobrinus showed no adherence to glass in the presence of erythritol which suggest that erythritol is a sugar

not used by these bacteria so the synthesis of glucans. Since it is not used by these bacteria, the byproduct lactic acid is not produced.

In a separate study, it was found that anti plaque activities were identified in the low-molecular-mass(LMM) fraction of extracts from an edible mushroom called Shiitake mushroom(Lentinus edodes)[33-35]. These LMM compounds are mainly secondary metabolites like sesquiterpenes and other terpenes, steroids, antraquinone and benzoic acid derivatives, and quinolones and also primary metabolites like oxalic acid [36]. High molecular mass compounds on the other hand are mainly peptides and proteins. The study shows that LMM fractions of shiitake mushrooms with a minimal of 2x concentrations are able to inhibit the growth of Streptococcus Mutans. This shows bacteriostatic action of Shiitake mushrooms by inhibition of DNA synthesis. The bacteriostatic action is also confirmed by morphological effects by the LMM fractions which show elongation of the bacteria with interrupted septa. The morphogenetic effects induced by the mushroom shows similarities to those observed in streptococcal thermo-sensitive temperature or exposed to inhibitory doses of B-lactam antibiotics [37] . This discovery further supports the hypothesis that the anti-biotic mechanism of action is similar to those of quinolones and B-lactams [38-40].

In another study, it showed that both the low and high-molecular-mass fractions causes inhibition of streptococci mutans adherence to hydroxyapatite crystals, promoted detachment of the bacteria from hydroxyapatite crystals, and induced biofilm destruction [41]. It suggested that the component adenosine from mushroom was able to inhibit biofilm formation.

CONCLUSION

The literature shows the potential development of compounds in mushrooms in prevention of dental caries. This feature as well as a safe and natural use of the mushroom extract allows it to be incorporated into our daily diet which is useful especially in developing countries where for economic reasons, prevents the use of commercial products for caries prevention.

REFERENCE

1. Glass RL,editor: The first international conference on the declining prevalence of dental caries, *J Dent Res* 61:1301,1982
2. Marsh PD: Are dental diseases examples of ecological catastrophes? Microbiology 2003, 149:279-294.
3. Guha-Chowdhury N, Iwami Y, Yamada T, Pearce EI (1995). The effect of fluorhydroxyapatite-derived fluoride on acid production by streptococci. J. Dent. Res., 74: 1618-1624
4. Jeng JH, Hsieh CC, Lan WH, Chang MC, Lin SK, Hahn LJ, Kuo MY (1998). Cytotoxicity of sodium fluoride on human oral mucosal fibroblasts and its mechanisms. Cell Biol. Toxicol., 14: 383-389.
5. Otten MPT, Busscher HJ, Vander MHC, Van Hoogmoed CG, Abbas F (2011). Acute and substantive action of antimicrobial toothpastes and mouthrinsed on oral biofilm in vitro. Eur. J. Oral Sci., 119: 151-155.
6. Matsumoto-Nakano M, Nagayama K, Kitagri H (2011). Inhibitory Effects of Oenothera biennis (Evening Primrose) Seed Extract on Streptococcus mutans and S. mutans-Induced Dental Caries in Rats. Caries Res., 45: 56-63.
7. Marsh PD (1992). Microbiological aspects of the chemical control of plaque and gingivitis. J. Dent. Res., 71: 1431-1438.
8. Namba T, Tsunezuka M, Hattori M (1982). Dental caries prevention by traditional Chinese medicines. Part II. Potent antibacterial action of Magnoliae cortex extracts against Streptococcus mutans. Planta Med., 44: 100-106.
9. Shouji N, Takada K, Fukushima K, Hirasawa M (2000). Anticaries effect of a component from shiitake (an edible mushroom). Caries Res., 34: 94-98.
10. Wennstrom J, Lindhe J (1985). Some effects of a Sanguinarine-containing mouthrinse on developing plaque and gingivitis. J. Clin. Periodontol., 12: 867-872.
11. Kalač P. Chemical composition and nutritional value of European species of wild growing mushrooms: A review. Food Chem. 2009; 113: 9–16.
12. Borchers A, Keen CL, Gershwin ME. Mushrooms, tumors, and immunity: an update. Exp Biol Med 2004; 229: 393-406
13. Lindequist U, Niedermeyer THJ, Jülich W-D.The pharmacological potential of mushrooms. eCAM 2005; 2: 285-299.
14. Poucheret P, Fons F, Rapior S. Biological and pharmacological activity of higher fungi: 20-Year retrospective analysis. Mycologie 2006; 27: 311-333.
15. Zaidman B-Z, Yassin M, Mahajana J, Wasser SP. Medicinal mushroom modulators of molecular targets as cancer therapeutics. Appl Microbiol Biotechnol 2005; 67: 453-468.
16. Moradali M-F, Mostafavi H, Ghods S, Hedjaroude G-A. Immunomodulating and anticancer agents in the realm of macromycetes fungi (macrofungi). Int Immunopharmacol 2007; 7: 701-724.22
17. Zhang M, Cui SW, Cheung PCK, Wang Q. Antitumor polysaccharides from mushrooms: a review on their isolation process, structural characteristics and antitumor activity. Trends Food Sci Technol 2007; 18: 4-19.
18. Wasser SP, Weis AL. Medicinal properties of substances occurring in higher Basidiomycetes mushrooms: Current perspectives (Review). Int J Med Mushrooms 1999; 1: 31-62.
19. Beattie KD, Rouf R, Gander L, May TW, Ratkowsky D, Donner CD, Gill M, Grice ID, Tiralongo E. Antibacterial metabolites from Australian macrofungi from the genus Cortinarius. Phytochemistry 2010; 71: 948–955.
20. Ishikawa NK, Kasuya MCM, Vanetti MCD. Antibacterial activity of Lentinula edodes grown in liquid medium. Braz J Microbiol. 2001; 32: 206-210.
21. Shittu OB, Alofe FV, Onawunmi GO, Ogundaini AO, Tiwalade TA. Mycelial growth and antibacterial metabolite production by wild mushrooms. Afr J Biomed Res 2005; 8: 157-162.
22. Suay I, Arenal F, Asensio FJ, Basilio A, Cabello MA, Díez MT, García JB, Del Val AG, Gorrochategui J, Hernández P, Peláez F, Vicente MF. Screening of basidiomycetes for antimicrobial activities. Antonie van Leeuwenhoek 2000; 78: 129–139.
23. Gonçalves O, Pereira R, Gonçalves F, Mendo S, Coimbra MA, Rocha SM. Evaluation of the mutagenicity of sesquiterpenic compounds and their influence on the susceptibility towards antibiotics of two clinically relevant bacterial strains. Mutat Res 2011; 723: 18–25.
24. Gottlieb, B : Dental caries (Lea and Febiger,1947)
25. Pincus, P : A new hypothesis of dental caries. J.Calif. St. Dent. Soc :26,16,1950
26. Schatz, A., Karlson, K.E and Martin,J.J. : Speculation on lactobacilli and acid as possible anticaries factor. N.Y. Dent. J. :21,367,438 ;22, 161, 1954, 1955
27. Levine, R.S : The differential inorganic composition of dentin within active and arrested carious lesions. Caries Res. :7,245,1973
28. Levine, R.S. : The micro radiographic features of dentin caries. B.D.J. :137,301,1974
29. Hardie JM, Whiley RA: Plaque microbiology of crown caries. In Dental Plaque Revisited: Oral Biofilms in Health and Disease. Edited by Newman HN, Wilson M. Bioline; 1999:283-294.
30. Marsh PD, Martin MV: Oral Microbiology. 5th edition. United Kingdom: Churchill Livingstone; 2009.
31. Lamont RJ, Burne RA, Lantz MS, Leblanc DJ: Oral Microbiology and Immunology. USA: American Society for Microbiology Press; 2006

32. Kawanabe J, Hirasawa M, Takeuchi T et al. Non-cariogenicity of erythritol as a substrate. Caries Res 1992 26: 358-362.
33. Daglia M, Papetti A, Mascherpa D, Grisoli P, Giusto G, Lingström P, Pratten J, Signoretto C, Spratt DA, Wilson M, Zaura E, Gazzani G: Plant and fungal food components with potential activity on the development of microbial oral diseases. J Biomed Biotechnol 2011, 2011:Article ID 274578.
34. Spratt DA, Daglia M, Papetti A, Stauder M, O'Donnell D, Ciric L, Tymon A, Repetto B, Signoretto C, Houri-Haddad Y, Feldman M, Steinberg D, Lawton S, Lingström P, Pratten J, Zaura E, Gazzani G, Pruzzo C, Wilson M: Evaluation of plant and fungal extracts for their potential antigingivitis and anticaries activity. J Biomed Biotechnol 2012, 2012:Article ID 510198.
35. Zaura E, BuijsMJ, Hoogenkamp MA, Ciric L, Papetti A, Signoretto C, Stauder M, Lingström P, Pratten J, Spratt DA, Wilson M: The effects of fractions from shiitake mushroom on composition and cariogenicity of dental plaque microcosms in an in vitro caries model. J Biomed Biotechnol 2011, 2011:Article ID 135034.
36. Lindequist U, Niedermeyer THJ, Jülich W-D.The pharmacological potential of mushrooms. eCAM 2005; 2: 285-299.
37. Lleo MM, Canepari P, Satta G: Bacterial cell shape regulation: testing of additional predictions unique to the two-competing-sites model for peptidoglycan assembly and isolation of conditional rod-shaped mutants from some wild-type cocci. J Bacteriol 1990, 172:3758–3771.
38. Higgins P, Fluit AC, Schmitz FJ: Fluoroquinolones: structure and target sites. Curr Drug Targets 2003, 4:181–190.
39. Spratt BG: Distinct penicillin binding proteins involved in the division, elongation, and shape of Escherichia coli. Proc Natl Acad Sci U S A 1975, 72:2999–3003.
40. Buijs J, Dofferhoff ASM, Mouton JW, Wagenvoort JHT, Meer JWM: Concentration-dependency of β-lactam-induced filament formation in Gram-negative bacteria. Clin Microbiol Infect 2008, 14:344–349.
41. Gazzani G, et al. Food components with anticaries activity, Curr Opin Biotechnol (2011), doi:10.1016/j.copbio.2011.09.003