

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 as an alternative to synthetic materials to prevent dental caries. This literature reviews the effects of components in mushroom that has anticariogenic 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 Australia¹.

Despite this, caries still remains a problem in developing countries which is made worse by generalized nutritional deficiencies². Hence, in order to prevent caries, numerous methods have been generated. Commonly used is fluoride as an anti-cariogenic agent³ but it has cytotoxic effects if it exceeds a concentration over 80ppm⁴. Also, mouth rinsing solutions are also commonly used⁵ but dental caries still remains prevalent which come to show that the current methods of caries control are not as effective.

Recently, scientists 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 nutritional¹¹ and medicinal substances^{12,13,14} with immunomodulatory, cardiovascular, liver protective, anti-fibrotic, anti-inflammatory, anti-diabetic, and anti-microbial properties¹²⁻²³. In this literature the anti-cariogenic 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 initial action is due to proteolytic enzymes secreted by staphylococci in the oral

cavity on organic structures of the tooth²⁴. Pincus then mentioned that the nysmyth's membrane on the tooth is acted on by sulphatase enzyme released by bacilli yielding sulphuric acid²⁵. 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 process²⁶. 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 than 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 disease caused by a complex interaction between the host, plaque, diet and time. The oral cavity has 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 adhesions produced by the bacteria interact with glycoproteins on 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, *Streptococcus 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 done³². 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, anthraquinone and benzoic acid derivatives, and quinolones and also primary metabolites like oxalic acid³⁶. 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 antibiotics³⁷. This discovery further supports the hypothesis that the anti-biotic mechanism of action is similar to those of quinolones and B-lactams³⁸⁻⁴⁰.

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 destruction⁴¹. 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.

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