

Review Article

An Apple a Day Keeps the Dentist Away: Fact or Fiction? (A Brief Review on Effects of Apple on Oral Health)

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Abstract: Apples comprise an important part of everyday diet. This fruit contains micronutrients such as vitamins, calcium, zinc, and fluoride. Moreover, apples contain a high percentage of dietary fiber. Apple is also rich in phytochemicals which act as antioxidants. This fruit is considered to be beneficial for overall health. But are apples effective in preserving oral health? This brief review provides some information regarding effects of apple consumption on oral and dental health.

Keywords: Apple, oral cancer, dental caries, periodontal disease.

INTRODUCTION

Apples comprise an important part of everyday diet. This fruit contains micronutrients such as vitamins, calcium, zinc, and fluoride. Moreover, apples contain a high percentage of dietary fiber. Apple is also rich in phytochemicals which act as antioxidants [1].

APPLE AND ORAL CANCER

A hospital-based case-control study carried out on 6000 participants in 2005 revealed that consumption of one or more medium-sized apples (160 g) per day is associated with 18% decrease in cancer of oral cavity and pharynx, compared to intake of less than one apple per day [2]. Another 14-year follow-up case-control study reported that high intake of dietary flavonoids may reduce the risk of oral cancer by 50% [3]. It must be noted that apples are one of the main sources of flavonoids in human diet.

In-vitro investigations have demonstrated that several important pathways and processes involved in carcinogenesis are affected by apple phytochemicals. One of the main mechanisms of cancer prevention related to apple consumption is antioxidant effect [4]. A diet trial in Turkey revealed that antioxidant enzymes such as SOD and glutathione peroxidase in erythrocytes and overall antioxidant potential in plasma increased as a result of consumption of roughly one apple per day [5]. Other in-vitro and in-vivo studies approve the antioxidant effects of apples [6-8]. Cefarelli et al. [9] demonstrated that 43 components from organic extract of apple have antioxidant activity at different levels. But in some cases, there is inconsistency in the correlation between in-vitro outcomes and in-vivo antioxidant

activity of apple products. This variability may be attributed partly to the types of apples studied and reaction conditions such as pH, concentration, type of reactive oxygen species, and other factors [4]. An in-vitro study by Davis et al. [10] showed that high concentration of apple extracts resulted in reduced NF- κ B. NF- κ B is a protein responsible for regulation of cell proliferation and survival and is constitutively active in many types of tumors such as oral squamous cell carcinoma [11]. This may be another potential mechanism of cancer prevention by apple phytochemicals.

APPLE AND DENTAL CARIES

In-vitro studies have been performed to elucidate effects of apple consumption on the process of cariogenesis. Quercetin which is a polyphenol existing in apple has been shown to inhibit adhesive glucan formation by *Streptococcus mutans* [12], which can impede adherence of bacterial cells to the tooth surface and thus can interfere with formation of carious lesions. Tagashira et al. [13] have shown that apple polyphenols extracted from immature fruits markedly reduced the synthesis of water-soluble glucans by glycosyl transferases of *Streptococcus mutans* and *Streptococcus sobrinus*. Glycosyl transferase is a bacterial enzyme that converts sucrose to sticky glucans and therefore forms a glycocalyx on the tooth surface which is an important factor for initiation of cariogenesis process [14]. An in-vitro study showed that apple condensed tannins are the strongest inhibitors of glycosyl transferase. In addition, this study revealed that tannic acid markedly inhibits activity of salivary α -amylase [15]. α -amylase is a salivary enzyme present in acquired enamel pellicle.

This enzyme binds to oral streptococci and may facilitate starch hydrolysis to provide additional glucose for cariogenic microorganisms [16] nonetheless, there are also reports that apples decrease plaque pH and thus can have cariogenic effects [17].

There are epidemiologic studies supporting the anticariogenic effects shown in some in-vitro studies. apple consumption have been associated with lower DMFT increments in adolescents [18]. However, an epidemiologic study carried out on farm workers in apple-producing, grape-producing, and grain-producing (control) farms revealed that high consumption of apples (eight apples per day) in apple group was significantly associated with higher caries incidence compared to control and grape groups [19].

APPLE AND PERIODONTAL DISEASES

Inflammatory stimulation caused by periodontal pathogens increases the production of gingival crevicular fluid and induces chemotaxis of polymorphonuclear leukocytes. These leukocytes release singlet oxygen and hypochlorous acid into the gingival crevicular fluid in order to inactivate periodontal pathogens [20]. The local oxidative stress generated in this process is commonly negated by the antioxidants present in the crevicular fluid [21]. However, this local oxidative stress may be increased by systemic conditions and external factors such as metabolic syndrome [22], diabetes [23], and smoking [24]. Antioxidants of apple may inhibit development and progression of periodontal disease particularly in patients with sources of oxidative stress [25].

The epidemiologic study on workers of apple-producing, grape-producing, and grain-producing farms concluded that intake of apples is beneficial for periodontal health [19]. Another study revealed that plaque index was significantly lower after chewing apples [26]. However a study on rats revealed that apple intake was associated with higher plaque extent [17].

CONCLUSION

Studying the exact effect of human diet in particular fields of health presents many obstacles. In some instances, in-vitro studies cannot exactly simulate the complex environment in which biological reactions occur. Moreover, restricting human diet to particular food in long-term may be difficult. In addition, it may be impossible to prove that certain biological changes are due to dietary factors, as for many interfering factors and conditions may be influential. Therefore, coming to definitive conclusion regarding effects of dietary items may be irrational.

In conclusion, it seems that although intake of apples may be beneficial for overall and oral health, but appropriate mechanical plaque removal methods including brushing and flossing and fluoride therapy

remains the most important measures to preserve oral and dental health.

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