Review Article

HERBAL PRODUCTS AGAINST DENTAL CARIES

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ABSTRACT

Background: Even after years and developments in healthcare, dental caries is regarded as the most chronic disease in the human population. Dental caries is associated with oral pathogenic bacteria. For this reason, antibacterial agents are used in their treatment. However, these antibacterial agents contain commonly harsh chemicals such as fluoride. People who are conscious of the side effects of fluoride have started to prefer natural antibacterial products. Studies have focused on the therapeutic properties of plants in terms of dentistry and new oral care products have been developed

Objective: This article aims to collect information about using plants against dental caries and review their effects.

Methods: Studies on the antibacterial activity of herbal products in the literature, especially in the last 5 years, have been reviewed.

Discussion: Essential oils and extracts obtained from plants seem good alternatives to the chemical products. Herbal products contain several active biological components and due to these components, they show the effects of inhibiting dental plaque formation and reducing microbial adhesion.

Key words: caries, herbal product, plants, antibacterial, oral care products.

Introduction

People struggle with many chronic diseases every year. Dental infections, such as dental caries are the one of common bacterial diseases in the human population[1]**.** Dental caries is a disease that occurs by the alteration of demineralization-remineralization cycle[2,3], destroys tooth structure and it can cause negativities in chewing and aesthetic appearance[4]**.**

Factors such as cariogenic microflora, fermentable carbohydrates, plaque, and duration play the most effective roles in the formation of dental caries[5]**.** The bacterial accumulation on dental surfaces known as dental plaque is the reason for dental caries[1]. Dental caries does not occur in the absence of dental plaque or fermentable carbohydrate products[2].

Several studies have proven that the *Streptococcus mutans* (*S.Mutans*) has a higher prevalence in caries containing plaque than healthy tooth surface[6-8]**.** Ritz[9] stated that streptococci follow these precursor type actinomyces, which are dominant for plaque development.

McClure and Hewitt created artificial caries in rats and they observed that dental caries can be inhibited by administration of penicillin in diet and water. This proven application has been extended to other antibiotics and tested on the animals[10]**.** Nowadays, in the fight against dental caries, the use of chemical agents such as alcohols, chlorhexidine, and antibiotics (penicillin, ampicillin, etc.) are quite common[11]. However, the treatment methods of dental caries are symptomatic and do not include a preventable approach to bacterial factors that cause dental caries and periodontal diseases[1]**.** Also, resistance to antibiotics may develop against bacteria in biofilm and this may worsen the prognosis of the disease[12]. To prevent this situation, efforts are underway to develop new anti-infective agents against microorganisms[13]**.**

Tooth brushing can prevent caries, periodontal problems, and gingivitis. However, the use of tooth brushing as a traditional method of oral hygiene for many individuals shows inadequate results in the long term. To provide solutions for plaque-mediated diseases, it has been suggested that prophylactic antimicrobial agents can be added to oral health products[14]. The viability of bacteria in the biofilm is affected by antibacterial agents[15]. The use of antibacterial chemotherapeutic agents has been specifically proposed to reduce levels of oral bacteria, such as *Streptococcus mutans*[16]. It has been reported by Miller that antiseptics can be used as an active agent in the prevention of caries[17].

World Health Organization (WHO), American Dental Association (ADA), and the World Dental Federation (FDI) recommend kinds of toothpaste containing fluoride and triclosan[18]**.** The use of toothpaste containing fluoride and triclosan indeed has benefits. However, excessive use of chemical and synthetic products is harmful. The use of

products containing fluoride can cause changes in the intestinal and oral flora and even oral cancer, vomiting, and dental staining[19]. Other chemicals such as chlorhexidine and amine fluoride cause toxic effects. Ethanol, another chemical added to oral products, has been reported to cause cancer[20, 21]. Recently, herbal products have become popular due to various problems created by chemical products in the human body.

Phytotherapy, which means treatment with plants, is a complementary treatment. All or part of the plants is mixed and used for treatment. During this process, care is taken to preserve the original composition of the plant[22]. When examined in terms of developments in dentistry, phytotherapy is used because of the antimicrobial, anti-inflammatory, analgesic, and sedative properties of plants[23]. One of the methods of using plants in the treatment is to obtain essential oils. Essential oils are aromatic liquids with volatile characters and they are obtained from several parts of plants such as leaves, barks, seeds, and roots. Due to their different components which they have, essential oils can show variations of their mechanisms of action[24]. Their usage areas are quite wide due to their antibacterial, insecticidal, and antifungal effects[25]. The first studies that obtained information on the existence of antibacterial properties of essential oils were carried out by Dela Croix in 1881. The data obtained from this study led other studies that used essential oils in medicine in the following centuries[26].

Some essential oils identified by the American Food and Drug Administration have been generally described as generally recognized as safe/GRAS (Generally Recognized as Safe) food additives or taste-smell additives[27]. Essential oils have irritant, antitussive, rubefian, nervinatic, carminative, emmenagogue, diuretic, anthelmintic, antiseptic, anti-inflammatory, antifungal, antioxidant, and antibacterial properties[28, 29]. Essential oils show antibacterial activity against various bacteria, including *S. Mutans*[30].

As mentioned above, chemical treatments have positive properties besides negative properties. Also, bacteria can develop resistance to these agents. For this reason, oral health products such as mouth rinse and kinds of toothpaste containing various products from plants including essential oils have been developed as an alternative to chemical treatments.

This article aims to discuss the effects of the products containing essential oils on *S.mutans*, one of the pathogens that cause dental caries.

Herbal Toothpaste

S.mutans is an oral pathogen associated with the development of caries[31]. Therefore, if the oral products to be used have antibacterial properties, they may be effective against pathogens. Commercial toothpaste is using as an effective antimicrobial agents against oral microorganisms.

Fluoride is known for its effect on caries prevention and fluoride-containing toothpaste is widely preferred as anti-cariogenic agents[32]. However, due to their harmful effects on organisms, herbal toothpaste can be preferred rather than toothpaste containing harsh chemicals.

Studies have been conducted about plant extracts, essential oils, and phytochemicals for their ability to prevent bacterial adhesion. Some researchers compared fluoride-containing toothpaste and herbal toothpaste[33, 34].

In a study conducted in 2019, the researchers compared fluoride-containing toothpaste and three herbal toothpaste according to the ability to prevent caries development before and after the addition of essential oils obtained from *Origanum dubium (O.dubium)* and *Cinnamommum cassia (C.cassia)*. They observed the close results each other for fluoride-containing toothpaste and two herbal toothpaste before addition. The other herbal toothpaste produced for babies did not show any antibacterial activity. After the addition of essential oil, the group with the highest activity belonged to the paste produced for babies, especially the group containing *C.cassia* essential oil[35]. In a study conducted by Korkmaz et al.[36] in 2019, the antibacterial activities of three different commercial herbal toothpaste (*Aloe vera* L, *Fragaria vesca* L.) investigated against two pathogens that cause infections in the oral cavity. According to the results, these herbal kinds of toothpaste were effective in reducing plaque accumulation.

Herbal Mouthwashes

People generally are not successful in removing dental plaque while tooth brushing. Mouthwashes can be added to the daily care routine to control the bacterial plaque to restrain periodontal diseases[37]. Mouthwashes are chemotherapeutic agents that can deliver the chemicals they contain to all hard and soft surfaces in the mouth and these agents can show activity. Chlorhexidine, one of the chemotherapeutic agents used in mouthwashes, is accepted as the "gold standard" and it is often preferred as a positive control group to compare other materials[38]. However, besides its benefits, chlorhexidine has several side effects, such as erosion of oral mucosa, staining of the teeth, and unpleasant taste. Therefore, there is a need for an agent that

will neutralize the harmful effects of chlorhexidine and act at least as much[38]. As an alternative to chlorhexidine, various studies using natural products and traditional plants have been reported[39, 40].

In their clinical trials in 2020, Kamath et al.[41] compared the effects of 4 types of mouthwash (two herbal containing mouthwashes, one containing chlorhexidine, and one placebo) on children aged between 8 and 14. According to the results of the study, although chlorhexidine is the most effective mouthwash, it has been observed that mouthwashes with herbal ingredients are effective.

Researchers investigated the number of bacteria in saliva, buffering capacity changes in the pH of saliva when using herbal mouthwash and chlorhexidine. Chlorhexidine was found to be more effective than herbal mouthwash but herbal containing mouthwash was increased buffering capacity and the pH and decreased the number of bacteria in saliva[42].

In a study conducted in 2018, herbal mouth rinse was compared with chlorhexidine and measured the levels of *S.mutans* in the saliva of children. Researchers observed that the herbal mouthwashes were better than chlorhexidine[43].

Khoromian et al.[44] completed a randomized cross-over clinical trial study in 2020 and they aimed to determine the effect of herbal containing mouthwash on *S.mutans* in oral flora. According to the results obtained from the study, when the volunteers used herbal containing mouthwash, the number of *S.mutans* in saliva were decreased significantly before use.

Use of Herbal Extracts for Remineralization

White spot lesions can define as white opaque areas caused by the loss of minerals on enamel and these areas can be detected clinically. They are frequently observed after orthodontic treatment and they can create retentive areas for plaque due to their irregular surface structure. As a result of carbohydrate-rich dietary, bacterial infection which modified by saliva and poor oral hygiene, demineralization may occur on enamel[45-49].

Dental remineralization aims to bring minerals from the environment such as saliva and biofilm into the demineralized tooth area. Minerals are replaced in enamel and dentin[50].

Silva et al.[51] (2015) created artificial caries and compared the remineralization potential of proanthocyanidin (the major component of grape seed extract) and fluoride on enamel and dentin of bovine teeth. The grape seed extract was found successful though not as much as fluoride and it can prevent demineralizing in both layers.

In a study conducted by Kim and Jin[52], in 2018 the remineralizing effect of combining *Galla chinensis* extract with calcium was investigated on dental enamel and antibacterial effects on *S.mutans* biofilm. According to the results, *Galla chinensis* can remineralize the enamel and it exhibited synergy with calcium. Also, it inhibited the acid production of *S.mutans*.

Herbal-based toothpaste can protect the enamel from demineralization according to the components they have. Researchers used commercial herbal toothpaste for observation of protective effects on enamel demineralization *in vitro*. All kinds of toothpaste have some antibacterial effects, but only one of them showed an inhibitor effect on enamel remineralization[53]. *Salvadora persica (S.persica)* or miswak is a plant that grows in the middle east and it is important as mechanical cleaning on oral health for the people of this region. Although it seems to provide mechanical cleaning, the components it contains also help it show chemical activity. Sulfur in its composition shows bactericidal effect[54] and its compounds may protect against dental caries[55]. At the same time, the essential oil of *S.persica* stimulates the saliva and may activate the buffering system. If the miswak stick is chewed, a saturation of calcium in the saliva may support enamel remineralization[56]. Wassel and Sherief[57] evaluated the ion releasing and remineralizing effect of propolis, miswak, and chitosan nano-particles based dental varnishes. According to the Knoop hardening tests and scanning electron microscopy images, miswak and chitosan containing varnishes can release ions and gain microhardness to the enamel surfaces.

Tea, especially green tea, is rich in catechins like epigallocatechin gallate, epicatechin gallate, epigallocatechin, epicatechin[58]. Jose et al.[58] stated in their study, tea was increased in microhardness of enamel through these components. Taha researched in their study the remineralizing effect of green tea against acidic drinks. According to the results they obtained, green tea may help stop the erosive effect of acidic drinks and may support the remineralization[59].

In traditional Indian culture, oil pulling which uses edible oil as a mouthwash is observed commonly[60-63]. The reducing effect of *S.mutans* growth of coconut oil has been proved. Its remineralizing effect also wondered. In a study conducted in

2019, researchers created an artificial remineralizing-demineralizing cycle in in-vitro conditions. The coconut products were applied to the demineralized specimens and these specimens were evaluated using scanning electron microscopy. According to the results, the products obtained from coconut oil, water, and milk- may be an alternative to known remineralizing agents[64].

Lemon oil is obtained from peels of lemon and containing Limonine as the main component. Researchers stated that these essential oils have antibacterial effects against the cariogenic bacteria and inhibit their properties of cariogenic [65-67]. This situation has led researchers to research its remineralizing effects also. Ma et al.[68] have concluded that the lemon essential oil can promote remineralization during the development of early caries and also they found that these essential oils can stabilize its structure against collagen degradation.

Conclusion

When various studies were examined, successful results were obtained when the herbal products were compared with the products considered as the gold standard. Although herbal ingredients are thought to be more harmless than those containing heavy chemicals, more studies are needed to learn the biocompatibility and safety of use. If their bio-reliability is proven, they can be used very effectively in the fight against pathogenic bacteria in the field of dentistry.

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