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Role of 4 Plants in Oral Health: A Review

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ABSTRACT
Dental caries is one of the most prevalent diseases in humans. Effective prevention of dental caries can be achieved by regular use of chemical plaque removing agents and mechanical plaque removal. The cost and awareness about the importance of proper oral health care is still a challenge in developing countries for a large section of populace. Across countries people have resorted to using herbs and medicinal plants for oral care. Recently these plants are gaining importance in various fields of dentistry as mouthrinses, for irrigation, additives to toothpastes etc. This review aims to shed light on four plants ,Tea, Tulsi, Licorice and Magnolia.

Key words : caries, tea, ocimum , magnolia extract, liqorice, herbal mouthrinse, root canal irrigant

I. INTRODUCTION

Oral cavity provides an environment that leads to the colonization and growth of an extensive range of microorganisms. These microbes contribute to most common diseases or oral cavity, dental caries and gum disease. Despite many attempts made to control caries at individul as well as at a community level controlling caries remains a challenge. There has been a gradual shift guided by macroeconomic policies of countries towards a more preventive approach towards health. In the field of dentistry this involves exploring the traditional plants for their beneficial effects. This article explores the antibacterial potential and their uses of four plants tea, tulsi, licorice and magnolia.

Tea

Tea plants are known as Camellia sinensis. Two principal varieties of tea, black and green, are produced from the same plant Camellia sinensis. Tea contains almost 4000 bioactive compounds, one-third of which are made up of polyphenols. Green and black tea are rich in polyphenolic compounds, primarily flavonoids such as catechins, epicatechin gallate (ECG), epicatechin (EC), epigallocatechin (EGC) and epigallocatechin gallate (EGCG). [1,2] Other compounds are alkaloids, amino acids, carbohydrates, proteins, chlorophyll, organic volatile compounds, fluoride, aluminium, minerals and trace elements. Herbal teas have been documented as an effective alternative treatment for cancer, heart and liver disease in oriental cultures.

Polyphenols are thought to be responsible for the health benefits of herbal teas, particularly green tea, attributed to the presence of EGCG, one of the most active and abundant catechins in green tea. EGCG was the focal point of the scientists' research as it can mimic some of the biological effects of green tea. Antioxidant, anti-inflammatory and anticarcinogenic properties of green tea are enhanced by the presence of higher amounts of (EGCG) epigallocatechin 3 gallate than black tea.[3]

Antibacterial, anticaries effect of tea

Green tea catechins have a bitter taste. They are water soluble and their biological activities affect cell membrane functions such as signaling, cell cycle, and mitochondrial activity. Catechins have inhibitory effect against S. mutans and S. sobrinus. Antibacterial effects of green tea against mutans streptococcus is reported in previous studies. Rasheed et al. indicated the bactericidal effect of catechins against Escherichia coli, Streptococcus salivarius and Streptococcus mutans. [4,5] The antibacterial property of Camellia Sinensis extract against Streptococcus mutans and Lactobacillus acidophilus is also reported by Anita et al. [6]. Ferrazzano observed a significant reduction in colony counts of Streptococcus mutans and Lactobacillus in saliva after rinsing the patients' mouths by green tea extract for 1 minute 3 times a day during a 7-day period .[7] Tannin and catechins of green tea are able to inhibit enzymatic activity of amylase which is responsible for caries incidence by hydrolysis of starch in foods to lower molecular weight carbohydrates.[8]

Tea catechins increase the minimum pH of the oral cavity from 4.8 to 6.5 . LDH converts pyruvic acid to lactic acid. Although fluoride existing in green tea is a useful component for tooth caries resistance, it is suggested that the main component responsible for anti-caries properties of green tea are polyphenols and tannins .[9] Daneshyar et al. suggested green tea varnish to prevent root surface caries .[10] In a recent human study, the

antimicrobial effects of green tea against Streptococcus mutans, Lactobacilli spp. and Candida albicans was compared with chlorhexidine (CHX). It was concluded that green tea was more effective than CHX for inhibition of Streptococcus mutans and less effective for Lactobacilli spp. Neither CHX nor green tea were sufficiently effective against Candida albicans. The authors suggested green tea as a costeffective material for caries prevention. [11] Wibisono et al conducted a study to evaluate and compare pH of saliva after rinsing with green tea and black tea among thirty two healthy school children between 10-12 years old. They were asked to rinse for one minute after sugary soft drink consumption. Then salivary pH were measured. Results of this study showed that there was no statistically significant difference among subjects rinsing for one minute with green tea and black tea after sugary soft drink consumption. But green tea showed much better effect in rising salivary pH.[12]

Neturi et al compared GT mouthwash with CHX and placebo. In their study, mouthwashes were given to subjects and they were asked to rinse their mouths with them (10 mL) for one minute. Before and 5 minutes after mouthwash, dental plaque was obtained for S. mutans colony count. Based on the results, There was no significant difference between GT and CHX groups. [13]Salama and Alsughier compared GT and placebo mouthwashes used twice daily for 4 weeks by children. Salivary S. mutans colonies were assessed at baseline, 2 and 4 weeks after the start of the study. The results showed a statistically significant reduction in the S. mutans count. [14] Hegde and Kamath compared the efficacy of CHX, CHX + sodium fluoride, and GT mouthwashes. Children used mouthwash daily for two weeks. S. mutans and lactobacilli colonies was counted before and after the study. The three groups showed a significant decrease in bacterial colony counts. By comparison, the combined and GT groups were not significantly different from each other.[15]

Periodontal implication

Various authors have studied the inhibitory effects of catechin contained in green tea on periodontal pathogens, which may provide the basis for beneficial effect of daily intake of green tea on periodontal health.

Green tea catechin inhibit the growth of P. gingivalis, Prevotella intermedia and Prevotella nigrescens and adherence of P. gingivalis on to human buccal epithelial cells.[15]

Combined use of mechanical treatment and the application of green tea catechin using a slow-release local delivery system was effective in improving the periodontal status. The peptidase activities in the gingival fluid were maintained at lower levels during the experimental period in the test sites, while it reached 70% of that at baseline in the placebo sites.[16]

Alveolar bone resorption is a characteristic feature of periodontal disease and involves removal of both the mineral and the organic constituents of the bone matrix, a process mainly carried out by multinucleated osteoclast cells or matrix metalloproteinases (MMPs). EGCG inhibited osteoclast formation in a coculture of primary osteoclastic cells and bone marrow cells, and it induced apoptotic cell death of osteoclast-like multinucleated cells in a dose-dependent manner thus suggesting the role of green tea in the prevention of bone resorption.[17]

The Gram-negative bacterium, Porphyromonas gingivalis, has been reported to stimulate the activity and expression of several groups of MMPs, whereas EGCG has inhibitory effects on the activity and expression of MMPs. EGCG may prevent alveolar bone resorption that occurs in periodontal diseases by inhibiting the expression of MMP-9 in osteoblasts and formation of osteoclast.[18]

Daily intake of green tea was significantly associated with bleeding on probing (BOP), probing depth (PD) and clinical attachment loss (CAL), such that the more frequently subjects drank green tea, better was their periodontal condition.[19] Kaur et al. compared the antiplaque effect of green tea catechin mouthwash on patients and concluded that 7 day application of this mouthwash had comparable anti-plaque efficacy with chlorhexidine, and moreover, it did not have the bitter taste and side effects of CHX, including tooth discoloration and supra-gingival calculus formation related its long-term use .[20] Lagha et al. reported the efficacy of green tea catechins to protect the gingival epithelium against invasion by Porphyromonas gingivalis, so they have a promising effect on prevention from periodontal disease .[21]

Effects of Green Tea on Dental Erosion

MMPs in dentin and saliva are responsible for degradation of the organic matrix of dentin. They activate when the oral cavity pH drops by the acids produced during the cariogenic challenge. MMPs help the progression of dentin caries. Barbosa et al. reported the effectiveness of supplementation of soft drinks with green tea extract on their reduced erosive potential. They suggested green tea as a natural supplement that

does not any side effects or negative effects on taste of the drink .[22]

Kato et al. studied the effect of green tea on dentin erosion and abrasion. They observed the protective effect of green tea. They also reported, in contrary to previous studies, that a delay of 30 minutes for tooth brushing after an erosive challenge did not reduce the amount of tooth wear, and it was the same as brushing immediately after erosion . [23]

Halitosis

Halitosis is caused mainly by volatile sulfur compounds (VSCs) such as H_2S and CH_3SH produced in the oral cavity. Oral microorganisms degrade proteinaceous substrates to cysteine and methionine, which are then converted to VSCs. Because tea polyphenols have been shown to have antimicrobial and deodorant effects, researchers investigated whether green tea powder reduces VSCs in mouth air, and compared its effectiveness with that of other foods that are claimed to control halitosis. In an in vitro study, toothpaste, mints and green tea strongly inhibited VSCs production in a saliva-putrefaction system, but chewing gum and parsley-seed oil product could not inhibit saliva putrefaction. Toothpaste and green tea also demonstrated strong deodorant activities, but no significant deodorant activity of mints, chewing gum or parsley-seed oil product were observed. Therefore, it was concluded that green tea was very effective in reducing oral malodor temporarily because of its disinfectant and deodorant activities, whereas other foods were not effective.[24] Morin et al. reported the ability of green tea extracts to inhibit the growth of Solobacterium moorei, a major bacterium playing role in halitosis. [25]Green tea mouthwash containing 1% tannin can effectively reduce the microbial load in the oral cavity, prevent dental plaque formation and improve the oral malodour caused by bacterial infection. Tea catechins reduce the production of the methyl mercaptan, a major source of halitosis. Hence, green tea products are beneficial in reducing oral malodour because of their excellent deodorant and disinfectant properties.

Root canal medicament

Extracts of Japanese green tea may be useful as a medicament for the treatment of infected root canals.[26] Biocompatible irrigants are needed to promote dental pulp stem cells (DPSCs) attachment to root canal dentin, which is essential to accomplish some regenerative endodontic therapies.[27] In a study, Triphala, GTPs, and mixture of Doxycycline, citric acid and a detergent (MTAD) showed statistically significant antibacterial activity against E. faecalis biofilm formed on tooth substrate.[28] Pujara et al also obtained similar results. [29] Divia et al conduted a. study to evaluate and compare the antimicrobial efficacy of MC, GTPs, and Triphala, with 5% NaOCl against E. faecalis. Group II (NaOCl) was the most effective in elimination of E. faecalis. Its antibacterial effect was comparable to that of Group IV (Triphala). Group V (GTPs) and Group III (MC) also showed a significant antibacterial effect. [30]

Dosage

Most green tea products are sold as dried leaf tea. The best way to get the catechins and other flavonoids in tea is to drink it freshly brewed. The recommended consumption is three to four cups of tea a day. The average cup of green tea contains about 50–150 mg polyphenols.

Use of mouthwash and toothpaste containing green or black tea extract has anti-bacterial, anti-plaque, and, anti-erosive effects comparable to sodium fluoride and CHX mouthwashes and can be a preventative agent against tooth erosion and decay

Ocimum Sanctum

Ocimum sanctum (Tulsi) is a herb, widely used as a traditional medicine in South Asia. Ocimum sanctum has been demonstrated to possess various therapeutic properties including it's anti bacterial, anti fungal, anti arthritic, anti coagulant, anti cancer, cardioprotective, anti ulcer, anti stress anti diabetic activities

Ocimum sanctum is a perennial herb that belongs to the family Lamiaceae.

It is widely distributed throughout South Asia and other tropical areas. The plant is commonly called Tulsi or Holy Basil, is a sacred plant to Hindus .

The chemical constituents of Ocimum sanctum incudes 70% eugenol, methyl eugenol, caryophyllene, phenolic compounds, camphene, stigmasterol, cardine, cubenol, borenol, linoleic acid, linolenic acid, oleic acid , palmitric acid, steric acid, vallinin, gallic acid, circineol, caryophyllene oxide, isorientin, minerals and vitamins.[31,32,33]

The different part of tulsi like leaves, roots, flowers and stems have charismatic therapeutic potential. Tulsi has been used as expectorant, analgesic, anticancer, antiasthmatic, antiemetic, diaphoretic, antidiabetic, antifertility, hepatoprotective, hypotensive, hyolipidimic and

antistress agent . As tulsi is a very effective in treatment of various medical disorders, It is also a very promising herb in management of oral diseases and dentistry. Tulsi leaves are quite effective in treating common oral infections. The tulsi leaves contains strong antibacterials like carracrol and tetpene & sesquiterpene b caryophylline. Chewing of tulsi leaves help in maintenance of oral hygiene

The ethanolic extract of Ocimum sanctum in combination with Choramphenicol and Trimethoprim has a synergistic activity for Salmonella typhi and is potential in combatings. typhi drug resistance and a promising non antibiotic drug for S. typhi infection.[34]

Essential oils extracted from the leaves of tulsi has been found to inhibit the in-vitro growth of E.coli, Bacillus anthracis and P.aeruginosa.[35]

In a study Tusi (Ocimum sanctum) extract and chlorhexidine mouthwashes was evaluated against Streptococcus mutans, Tusli extract demonstrated an anti microbial property against Streptococcus mutans, which is the microorganism that causes dental caries. [36]

Toothache:

A toothache is a pain or soreness within or around a tooth, indicating inflammation and possible infection.

Ocimum sanctum acts as a cox-2 inhibitor, due to the presence of Eugenol. The leaves contain 0.7% volatile oil comprising of 70% eugenol and 20% methyl eugenol, hence it offers a good relief from tooth ache problem.[36]

Antifungal effect:

Most common fungus found in the oral cavity are the Candida species, are common among the normal microbial flora of the oral cavity. Among the Candida species Candida albicans are most commonly found. Ocimum sanctum exhibits good anti fungal activity. The antifungal effect of the essential oil of Tulsi and its components Eugenol and Linalool are investigated against Candida albicans and Candida tropicalis, which are known to cause Oral candidiasis in a study and found that essential oil of tulsi is effective against candida strains. [37]

Recurrent Apthous Ulcer:

Recurrent apthous ulcer is a common condition of the oral cavity that is recurrent, small, round with circumscribed margins. The etiology is not clearly known, it not infectious or contageous

The fixed oil of Ocimum sanctum administered intraperitoneally elicited antiulcer activity against aspirin, indomethacin, alcohol (ethanol 50%), histamine, serotonin or stress induced ulcers in rats. Anti ulcer effect of Ocimum sanctum may be due to its cytoprotective effect rather than antisecretory activity. Thus Ocimum sanctum have anti ulcer effect against peptic ulcers, it may also prove beneficial to oral ulcers.[38,39]

Halitosis:

Halitosis means ‘bad breadth’ or ‘oral malodor’. The word “Halitosis” comes from the Latin halitus ,which means “breadth” and the Greek suffix osis, to specify a condition or a process.

A study analysed the effect of various concentrations of Ocimum sanctum extract ranginging from 0.5%-10%. 4% extract was found to be optimal antibacterial agent.[40]

Another study demonstrated that ocimum sanctum mouthwash prevented plaque formation. Significant reduction was seen in VSCs, organoleptic and plaque and gingival scores after using mouthwash for 15 days.

Sharma et al conducted a study to evaluate the efficacy of chorhexiine, hydrogen peroxide and tulsi extract mouthwashes in reducing halitosis. Tulsi extract was foung to be efeective and more acceptable to the patients.[41]

Dried leaves of Ocimum sanctum are powdered and used to brush the teeth. It is also mixed with mustard oil and made into a paste to be used as a tooth paste, it can be used for Halitosis (bad breath) and to treat various gingival and periodontal diseases

Gingival and periodontal dieases Nadar et al Compared the Efficacy of 4% Tulsi Extract (Ocimum sanctum), Fluoridated and Placebo Dentifrices against Gingivitis and Plaque among 14–15 years School Children.Antiplaque and antigingivitis efficacy of 4% tulsi and commercially available fluoridated dentifrice remained the same after 21 days.[41] Chandrappa et al conducted a study to assess the antimicrobial activity of herbal medicines (neem extract, tulsi extract) and chlorhexidine against Enterococcus faecalis in Endodontics. Herbal extracts (neem, tulsi) have shown significant inhibitory effects against E. faecalis compared to 2% chlorhexidine gluconate. [43] Deepika et al evaluated the antimicrobial activity of Ocimum sanctum gel against oral microbes. O sanctum gels demonstrated effective antimicrobial activityagainst anaerobic microbes at 20 and 25%. A higher

concentration of tulsi in gel is efficient and supplemental in the treatment of periodntosis. CHX gel showed a lower activity. [12]
Tulsi in many frms is a pomising herb to be used in prevntion of caries as well as various gum diseases. Ocimum extract form active ingredient in a novel herbal mouthwash as well as some toothpaste.

Liquorice

Liquorice also known as yashtimadhu, sweetwood or mulhatti is a herbal remedy which has shown to have immense potential in treatment of orofacial diseases. Liquorice is rich in secondary metabolites which are used in cosmetics, foods, traditional and modern medicine. It has well known properties such as antiviral, glucocorticoid, anti-inflammatory, antioxidant, anti-ulcerative, anti-carcinogenic and many more.

Liquorice extracts and liquorice bioactive ingredients such as glabridin, licoricidin, licorisoflavan A, licochalcone A, and glycyrrhizin have shown beneficial effects in preventing and treating oral diseases. . Liquorice root has been an integral part of Chinese medicine and Ayurveda for centuries. The term Glycyrrhiza comes from the ancient Greek words; glycos meaning sweet and rhiza meaning root . Due to its sweet taste, liquorice has been used worldwide as a sweetener and a flavouring agent in food and medicine production. The sweetness of liquorice comes from glycyrrhizin, which constitutes 10–25% of liquorice and is 50 times sweeter than refined sugar. [44]

The biological effects are due to the presence of secondary metabolites like saponins, flavonoids, isoflavonoids, chalcones, coumarins, aurones, benzofurans, phenols, pterocarpans, and stilbenes. [45]

Anticaries effect

Ayurveda recommends chewing on liquorice herbal sticks, twelve angulas (9 inches) long and thickness of one's little finger to reduce dental caries and plaque.[46] Recently, liquorice has been studied extensively for its anticaries properties. He et al. extracted pterocarpenes namely glycyrrhizol A and glycyrrhizol B along with four known isoflavonoids, from the roots Glycyrrhiza uralensis and concluded that all these metabolites show activity against S. mutans and glycyrrhizol A and 6,8-diisopreny l-5,7,4′-trihydroxyisoflavone had highest antimicrobial activity against these bacteria .[47] Based on the above observations, Hu et al. developed a sugar-free orange flavoured liquorice lollipop containing glycyrrhizol A for caries prevention. They found that liquorice lollipops are safe and effective against S. mutans and when consumed for 10 days (twice daily) and lead to a marked reduction in salivary S. mutans. [47]A clinical study evaluated the potential of liquorice lollipops for caries control in pre-school children. Children consumed liquorice lollipops twice a day for a period of 3 weeks and it was noted that there was a steep decline in the number of S. mutans. The numbers were reduced for a period 22 days after the last lollipop and then began to rebound.[48] Study conducted by Mentes on liquorice lollipops et al. observed that there was a reduction of S. mutans with consumption of two liquorice lollipops for a period of 21 days period .[49]

Mouthwash and gargles

Ahn et al. isolated three additional antimicrobial flavonoids namely 1 methoxyficifolinol, licorisoflavan A and 6,8-diprenylgenistein isolated from Glycyrrhiza uralensis which have shown to completely inhibit the formation of biofilm and recommended the use of these flavonoids in oral hygiene products for gargling solutions and in dentrifices.[50] In vitro study conducted by Motsei et al. screened liquorice extracts against C. albicans and reported the antifungal effect of fresh water extract of G. glabra on C. Albicans.[51] Few studies have investigated the effect of liquorice on P. gingivalis. Aqueous extracts of raw polysaccharides from G. glabra have shown to have strong anti adhesive effects against P. gingivalis The ability of liquorice root polysaccharides to reduce bacterial binding to host cells was observed after pre-treatment of P. gingivalis by Wittschier et al. The data suggested that polysaccharides from G. glabra are a potent agent against bacterial adhesion and are able to block the initial step of an infection and thus can be potential prophylactic tools in alternative treatment regimens against bacterial infection.[52] Recently an in vivo study demonstrated that liquorice extract can prevent the production of MMPs by host cell and can be as effective as doxycycline in patients with chronic periodontitis .[53]

A extract of Chinese liquorice (Glycyrrhiza uralensis), and its major isoflavans, Licoricidin and Licorisoflavan A showed to have an inhibitory effect on growth, volatile sulfur compounds (VSCs) production and protease activity of P. gingivalis therefore controlling halitosis. [54]

Aphthous ulcers

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Recent, studies have evaluated the effect of liquorice on pain control and reducing the healing time of aphthous ulcers. Burgess et al. reported that over the counter Canker Melts GX patches which contain liquorice extract alter the course of the aphthous ulcers by reducing lesion duration, size and pain therefore speed healing.[55] A more recent in vivo study evaluated the efficacy of licorice bioadhesive hydrogel patches in controlling pain and reducing the healing time of recurrent aphthous ulcer. According to the results of the study liquorice bioadhesive can be effective in the reduction of pain and the inflammatory halo and necrotic center of aphthous ulcers.[56]

Oral cancer

Liquorice has been investigated as a chemotherapeutic agent for its beneficial role in management of oral squamous cell carcinoma. Isoliquiritigenin (ISL), a flavonoid isolated from liquorice is a novel inhibitor of tumor angiogenesis and possesses great therapeutic potential for Adenoid cystic carcinoma and can be a potential cancer chemotherapeutic agent. [57]Das et al. concluded that Yashtimadhu Ghrita (processed ghee) can be effectively used to reduce chemotherapy induced mucositis in patients with cancers .[58]

Root canal medicament

Few in vitro studies have evaluated the effectiveness of liquorice as root canal irrigant and medicament. Badr et al. evaluated the antibacterial and cytotoxic effects of liquorice as a root canal medicament and compared its action to the commonly used root canal medicament calcium hydroxide $Ca(OH)_2$ The results of the study showed that liquorice extract either by itself or in combination with $Ca(OH)_2$ had a significant inhibitory effect against E. faecalis compared to $Ca(OH)_2$ alone. The use of Liquorice extract followed by Liquorice/$Ca(OH)_2$ mixture retained significantly more viable periodontal ligament cells than $Ca(OH)_2$, which had a strong lethal effect on the cells. [59]

The anti-inflammatory, anti-adhesive, anti-microbial properties of Liquorice have shown beneficial effects in oral diseases like dental caries, ginigivitis, periodontitis, aphthous ulcers and oral cancer. Liquorice has a potential to be used as an effective aid inmaintaing good oral health.

Magnolia

Dental caries is one of the most common chronic diseases around the world. Inhibitory effects of Magnolia grandiflora bark extract has been proved on tooth decay both in vitro and by using free sugar chewing gum). Magnolia plant is used widely in traditional and herbal medicine with many applications listed for it. This plant is scientifically named Magnolia grandiflora, grows as a tree, and is classified in Magnoliaceae family. In addition to antibacterial properties, the magnolia bark extract is also characterized as an antioxidant, anti-cancer, and Antidepressant.

Magnolol and Honokiol are two major polyphenols found in this herb and are well-known for their beneficial characteristics. In various studies, some properties, such as antioxidant, anti-cancer, anti-bacterial, anti-caries, and anti-periodontal diseases have been reported for these components. [60]

Studies have shown that the polyphenols in magnolia not only inhibit the growth of S. mutans but also reduce glucose transferase and amylase activities and acid production in this bacterial species. It also causes loss of adhesion of the bacterium to tooth surfaces [61,62] Magnolia effects have been reported not only on the bacteria, but also on other microorganisms, including fungi .[63]

Magnolia extract as mouthwash

Ghorbani et al conducted a study to determine the minimum inhibitory concentration (MIC) of the large-leaved magnolia against S. mutans and to evaluate the plaque index and the prevalence of S. mutans in dental plaque and saliva after exposure with Magnolia mouthwash. The results of this research showed that the plaque index before starting the project and during the resting phase did not differ significantly between the Magnolia mouthwash group and the placebo one. But after the first and the second rounds of mouthwash administration, the plaque index statistically showed a significant difference between the Magnolia mouthwash group and the placebo one.[64]

This finding is in agreement with MIC found for this plant by Babpour et al. [65]

Other studies also showed that a mouthwash made from Magnolia is able to inhibit the growth of S. mutans in dental plaque. Results obtained were comparable to that of chlorhexidine and fluoride mouthwashes. Therefore, it is suggested that a mouthwash made from magnolia extract may constrain to some extent the formation of microbial plaque. [66, 67]

MBE was in vitro recently tested against multi-species oral biofilms by Fernandez et al . Results showed a significan reduction of biomass, thickness and viability of oral biofilms. [68]

Chewing gums with magnolia extract

Campus et al concluded after their study that Chewing gum containing MBE and xylitol has beneficial effects on oral health, reducing salivary MS, and bleeding and controlling plaque pH. These results prove the potential use of MBE chewing gum as a new functional food to improve hard and soft tissue health.[69]

Caries preventive effect of a sugar-free chewing-gum containing Magnolia Bark Extracts and Xylitol in high-risk adults was investigated by Cagetti et al. Two-hundred seventy-one high-caries-risk subjects were assigned to three groups: Polyols (Pols), Xylitol (Xyl) and Xylitol plus Magnolia (Xyl + Mag). Caries lesions, gingival bleeding, mutans streptococci (MS), and plaque pH were re-evaluated after 2 years. Chewing-gum containing Xylitol and Magnolia has a higher preventive effect compared to Xylitol alone.[70]

Pociani et al conducted a study to assess the efficacy of a sugar-free chewing gum containing zinc acetate and magnolia bark extract (MBE) on oral volatile sulfur-containing compounds (VSC) versus a placebo sugar-free chewing gum. Chewing gum containing zinc acetate and magnolia bark extract can significantly reduce the oral VSC levels for more than one hour. [71]

Komorov et al conducted a study to evaluate the efficacy of Magnolia Bark Extract-based chewing gum with 0.4% concentration The number of Salivary MS (CFU/ml) was counted. In addition, plaque regrowth measurements were undertaken. MBE chewing gum showed better result than control. [72]

Magnolia Bark Extract (MBE), a naturally occurring antibacterial and anti-inflammatory agent, has innumerable medicinal properties, including reducing menopausal symptoms, anxiety, Alzheimer's and Gastrointestinal problems. Its role in decreasing Streptococcus mutans in the oral cavity has been researched and proved by various in-vitro and in-vivo studies. MBE has minimal adverse effects, occurs naturally and is a cost-effective adjunct to prevent the most common conditions that attack the oral cavity - Dental caries, Dental Plaque and Oral Malodor.

II. CONCLUSION

Plant based products derived from tea, tulsi, liquorice and magnolia have the potential to be used in various forms. As a mouthwash they all have proven effective , as a root canal irrigant these can be safe alternative to chemical irrigants. As an adjunct to oral health aids there is a potential of synergistic action which needs to be explored further.

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