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Herbal Plants as a Treatment for Halitosis in Children: A Systematic Review

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ABSTRACT

Introduction: Halitosis is an important multifactorial health problem that affects a person's psychological, social life and quality of life. Halitosis is very common in children. It should be noted that the main causes of halitosis in children include dental caries, poor oral and dental hygiene. Common treatments for halitosis include brushing, flossing using dental floss, chewing gum, and using both chemical and herbal mouthwashes. Long-term use of this chemical has side effects in the form of discoloration of the teeth, triggering tartar formation, allergic reactions, as well as desquamation (flaking) of the oral mucosa. Herbal plants are plants that produce active substances and can be used as an alternative to treat several diseases, including halitosis.**Aim:**This systematic review reviews some of the literature on the potential of herbal plants for treating halitosis in children.**Methods**: In this systematic review, article searches were conducted on Google Search and Pubmed. Studies published from 2010 to 2020. As much 84 articles were rated, including 84 articles from electronic databases, 0 from manual searches. 49 records were screened, 35 records excluded, 37 full-text articles were assessed for eligibility and 12 full-text articles were included.**Result**: There are 12 articles about medicinal plants that can be used to treat halitosis in children. **Conclusion**: There are 12 articles on various active substances in herbal plants that can treat halitosis in children.

Keywords:*Herbal plants, Halitosis, Children*

INTRODUCTION

Human breath consists of very complex substances with various odors which can give rise to unpleasant situations such as halitosis. Halitosis is an important multifactorial health problem that affects a person's psychological, social life and quality of life.[1]Halitosis comes from the Latin word halitus which means breath and osis means a pathological change used to describe an unpleasant or unpleasant odor that comes from the breath in a person's mouth. Halitosis, also known as *fetor ex ore*, *fetor oris* or *oral malodor*, is a general term that denotes bad breath to describe and characterize halitosis.[2]

This undesirable condition is a common complaint for both sexes and for all age groups. According to the American Dental Association (ADA), halitosis is the main problem after caries and periodontal disease that is complained of by people in the world. Halitosis is

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very common, with more than 50% of the general population suffering from halitosis.[3]The prevalence of halitosis sufferers in each country varies. In China, patients with halitosis reached 27.5% with a sample of 2500 people. Research conducted in America shows that the prevalence of halitosis sufferers is quite high, reaching 50% of the total population in America. Also in other literature states, the prevalence of halitosis in children is quite high, ranging from 5% to 75%.[4,5]

Halitosis is very common in children. It should be noted that the main causes of halitosis in children include dental caries, poor oral and dental hygiene. The results of Basic Health Research in 2018 stated that, the total proportion of dental and oral problems was 57.6%; the largest proportion were tooth decay/cavity/pain (45.3%). The prevalence of caries or cavities in children and adults is also quite high, including the prevalence of cavities in early childhood and is still very high, namely 93%. Tooth and mouth disease is caused due to the presence of bacteria that colonize the oral cavity to form a biofilm/plaque layer. This will cause various diseases in the oral cavity, one of which is halitosis.[6,7]

Halitosis is basically caused by two things, namely physiological and pathological. The physiological source of this halitosis comes from conditions on the surface of the tongue. The bacteria found on the tongue surface of a healthy patient are different from that of a patient with halitosis.[8]The pathological source involves the severity of pocket gums which is known as periodontal disease. The main cause of halitosis is the release of *Volatile Sulfur Compound* (VSCs) which is caused by the decay activity of gram negative microorganisms. The cause of most halitosis comes from the oral cavity, which is around 80-90%, such as poor oral hygiene, deep caries, periodontal disease, oral infection, xerostomia, ulceration, pericoronitis, leftover food in the mouth and tongue coating, while halitosis originates from from outside the oral cavity occurs only slightly, namely about 10-20% such as systemic diseases, diseases of the respiratory or gastrointestinal system, liver organ failure and metabolic disorders.[9]

A healthy oral cavity allows a person to communicate effectively, enjoy various types of food, improve quality of life, self-confidence, and have a better social life. The existence of halitosis has a negative impact and can even trigger stress. Halitosis can cause harm not only to sufferers but also to others and can affect a person's social life such as shame, avoidance of social interactions and decreased self-confidence in children. [4,5]

Common treatments for halitosis include brushing, flossing using dental floss, chewing gum, and using mouthwash both chemicals and herbs that usually help freshen breath. Long-term use of these chemicals has side effects in the form of discoloration of teeth, triggering formation of tartar, allergic reactions, as well as desquamation (peeling) of the oral mucosa.[5,10]Therefore, one of the alternative ingredients that can be used to reduce halitosis is herbal plants. Herbal plants are plants that produce active substances and are used as alternatives to treat several diseases, including oral diseases. Currently, approximately 40% of drugs available use natural sources, either directly or indirectly, and 25% of them are obtained from plants. Research on herbal plants in dentistry has been used as analgesic, anti-inflammatory, antimicrobial, curative and regenerative, with minimal toxicity, better biocompatibility and lower cost. The World Health Organization (WHO) also recommends and encourages the use of plants as alternative therapies for oral hygiene.[11,12]Therefore, this

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systematic study aims to examine more deeply the potential of herbal plants to treat halitosis in children.

SEARCH METHODS

Data Source

The data was collected by searching the literature on article search sites, namely Google search and Pubmed which were published from 2010 to 2020, the search was carried out in December 2020. The data search was carried out systematically using keywords *herbal plant, halitosis, children*

Research Criteria

A. Inclusion criteria
   1. Articles published from the years 2010-2020
   2. Articles in English
   3. Scientific articles that have been published and available online
   4. Articles that examine herbal plants can be used to treat halitosis

B. Exclusion Criteria
   1. Articles included in systematic reviews, literature review, interview and editorials
   2. Articles that cannot be accessed for free

Data Collection

The data that will be used in this research are secondary data. The data is obtained from articles that are searched for in the article database which will then be reviewed according to the research criteria set by the researcher.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 3, 2021, Pages. 2591 - 2607
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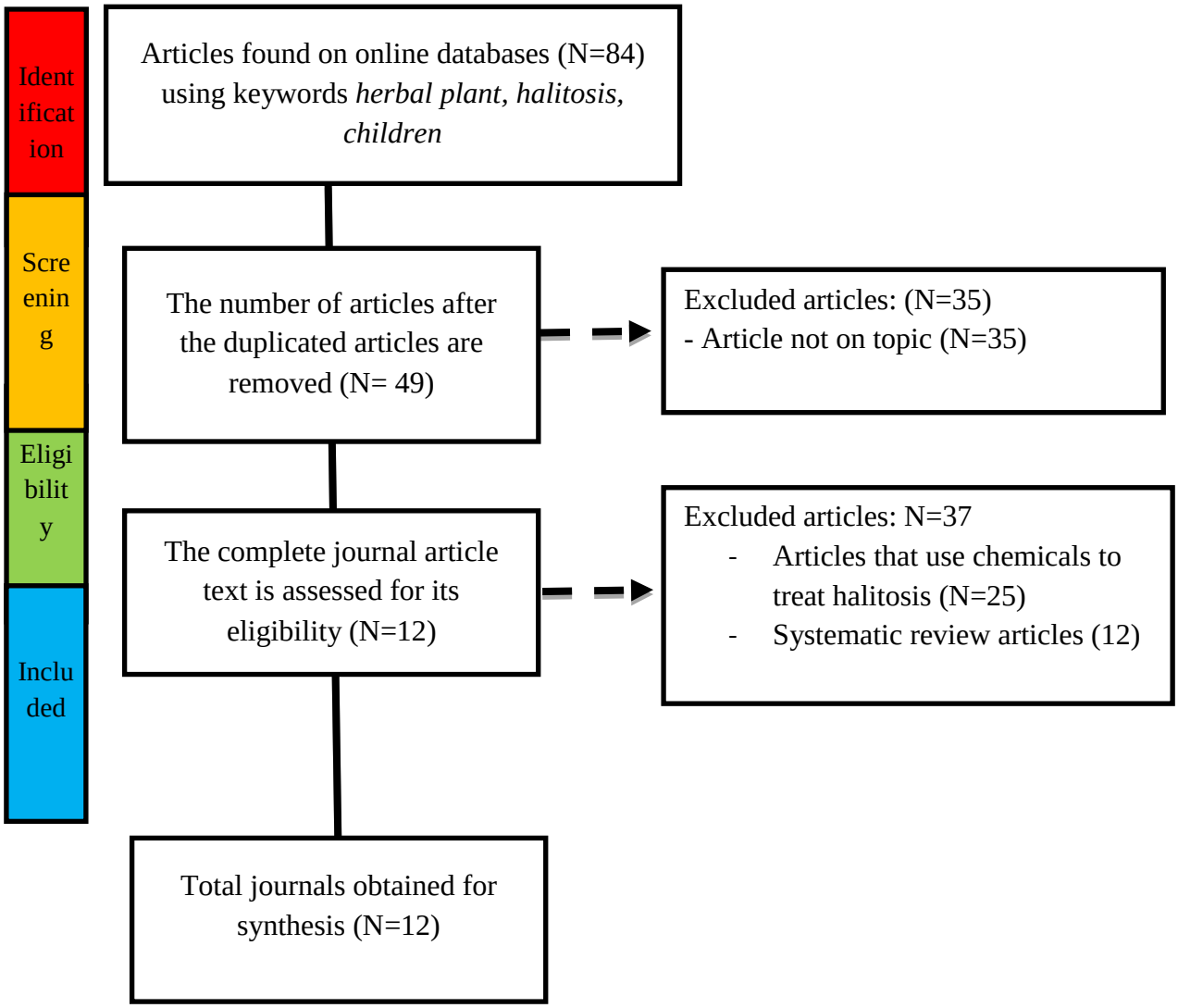

Figure 1. A diagram showing the selection of articles for review

The literature search was carried out on the online database, Pubmed, using keywords, namely *herbal plants*, *halitosis*, *children* found 84 articles. After eliminating duplicate articles, the titles and abstracts of each article were analyzed on 84 articles excluding 69 articles. The full-text articles in the remaining 12 articles were analyzed and excluded as many as 34 articles for the following reasons: articles that use chemicals in treating halitosis (n=25) and systematic review articles (n=12).

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 3, 2021, Pages. 2591 - 2607
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Table 1. Article about herbal plants as a treatment for halitosis in children

No.	Author	Year	Title	Conclusion
1	Minmin Tian, Anthony Bryan Hanley, Michael W.J. Dodds, Bds, & Ken Yaegaki[13]	2013	Chewing gum containing allyl isothiocyanate from mustard seed extract is effective in reducing volatile sulfur compounds responsible for oral malodor	Research shows that allyl isothiocyanate from mustard seed extract can effectively reduce the concentration of volatile sulfur compounds in the mouth.
2	NazliniwatyNazliniwaty, Lia Laila[14]	2019	Formulation and Antibacterial Activity of Plectranthus amboinicus (Lour.) Spreng Leaves Ethanolic Extract as Herbal Mouthwash Against Halitosis Caused Bacteria	The ethanol extract of the leaves of plectranthusamboinicus (lour.) Spreng can be formulated as a mouthwash and has antibacterial activity against Staphylococcus aureus and Streptococcus mutans bacteria that cause halitosis.
3	Muneo Tanaka, Masahiro Toe, Hideki Nagata,MikiOjima,MasaeKuboniwa, Katsumasa Shimizu[15]	2010	Effect of Eucalyptus-Extract ChewingGum on Oral Malodor: A Double-Masked, Randomized Trial	Chewing eucalyptus extract gum had long-term effects on olganoleptic scores, vscs levels, and tongue-coating scores. These findings suggest that eucalyptus extract gum can reduce bad breath by reducing tongue-coating accumulation.
4	Marie-Pierre Morin,Telma Blanca Lombardo Bedran, Jade Fournier-Larente, Bruno Haas,Jabrane Azelmat[16]	2015	Green tea extract and its major constituent epigallocatechin-3-gallate inhibit growth and halitosis-related properties of Solobacteriummoorei	Our research carries supporting evidence that the polyphenol in green tea (*Camellia sinensis*) has a number of properties that may contribute to reducing bacterial halitosis.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 3, 2021, Pages. 2591 - 2607
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5	AbdolhosseinMoghbel, Ahmad Farjzadeh, NasrinAghel,, HomaunAgheli,NafisehRaisi[17]	2015	Evaluation of the Effect of Green Tea Extract on Mouth Bacterial Activity in the Presence of Propylene Glycol	Using green tea extract as a herbal mouthwash is safe and harmless, especially for children. These results suggest that green tea may be able to prevent plaque formation on the teeth so that it can treat halitosis in children.
6	SupaneeRassameemasmaung,PakkaradaPhusudsawang, Vanida Sangalungkarn[18]	2013	Effect of Green Tea Mouthwash on Oral Malodor	Green tea mouthwash can significantly reduce VSC levels after gargling for 4 weeks.
7	Q c zeng, a z wu and j pika[19]	2010	The effect of green tea extract on theremoval of sulfur-containing oral malodor volatiles in vitro and its potentialapplication in chewing gum	Increasing the pH solution from 7.5 to 8.0 was found to significantly increase the effectiveness of green tea extract for methanethiol removal in vitro. Green tea extract was also found to remove hydrogen sulfide and effectively increase pH in the oral cavity to an alkaline condition.
8	Pier Francesco Porciani, Simone Grandini[20]	2012	The Effect of Zinc Acetate and Magnolia Bark Extract Added to ChewingGum on Volatile Sulfur-Containing Compounds in the Oral Cavit	Chewing gum containing zinc acetate and magnolia bark extract can significantly reduce oral VSC levels.
9	Kiyoko watanabe, Hiroko H, Toshizo T, Nobushiro H [21]	2017	Effects of French pine bark extract chewing gum on oral malador and salivary bacteria	The results showed that French pine bark extract gum was effective in reducing bad breath by reducing the accumulation of tongue-coating and the number of hydrogen sulfide-producing bacteria in saliva.

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10	PratibhaMamgain, Abhishek Kandwal, Ravindra K. [22]	2016	Comparative Evaluation of Triphala and ElaDecoction With 0.2% Chlorhexidine as Mouthwash in the Treatment of Plaque-Induced Gingivitis and Halitosis:A Randomized Controlled Clinical Trial	Organic triphala and ela decoctions are easy to prepare economically and are just as effective when compared to chlorhexidine mouthwash.
11	Kriti Sharma, Shashidhar Acharya, EshanVerma, Deepak Singhal, NishuSingla[23]	2019	Efficacy of chlorhexidine, hydrogen peroxide and tulsi extract mouthwash in reducing halitosis using spectrophotometric analysis: A randomized controlled trial	Tulsi extract may not have the same properties as chlorhexidine and hydrogen peroxide mouthwash. However, tulsi is effective in reducing halitosis, plaque and gingivitis. Apart from that, this Tulsi Extract can be used to treat halitosis due to the lack of side effects, economics and cost effectiveness. Spectrophotometric techniques appear to be promising Methods for evaluation of halitosis
12	AbirMajbauddin, Isamu Kodani and Kazuo Ryoke[24]	2015	The Effect of Bamboo Leaf Extract Solution and Sodium Copper ChlorophyllinSolution on Growth and Volatile Sulfur Compounds Production of Oral Malodor Associated Some Anaerobic Periodontal Bacteria	High concentrations of both bamboo leaf extract solutions (0.16%) and sodium copper chlorophyllin (0.25%) showed high inhibitory ability in the four anaerobic periodontal bacteria (*porphyromonasgingivalis* (pg), *prevotellaintermidai* (pi), *fusobacteriumnucleatum*(fn) and *prevotellanigrescence* (pn) and produce *sulfur volatile compounds* that contribute to bad breath.These compounds may have beneficial effects on oral health care.

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DISCUSSION

The use of medicinal plants is one of the solutions in solving health problems that are often faced by the community, apart from using chemical drugs in the preventive and medicinal stages. The use of medicinal plants has a major impact on the sustainability and biodiversity of plants. According to the World Health Organization (WHO), medicinal plants will be the best source for getting various drugs in a disease. Various formulas are found such as mouthwash, toothpaste and gum derived from plant extracts that are able to treat halitosis. Therefore, these plants must be investigated to determine their properties, safety and efficacy as a treatment for halitosis.[11,25]

Based on several studies, there are many plants that can be used as medicine to treat halitosis. Research conducted by Minmin Tian, et al, showed that the use of mustard seed extract in the form of chewing gum can effectively reduce the concentration of volatile sulfur compounds in the mouth that play a role in halitosis. This is because the main constituent of mustard seed extract is allyl isothiocyanate (AITC) which has antibacterial properties which will be formed and released through enzymatic reactions of glucosinolates and mirosinase in aqueous solutions. Apart from that, AITCs also exhibit various health benefits such as anti-inflammatory, anticancer and anti-tumor properties. [13]

Hydrogen sulfide, methyl mercaptan and dimethyl sulfide are the main components of halitosis. Where the presence of AITC content in mustard seeds can effectively reduce the VSC concentration in the mouth for a longer time. The reaction of AITC with VSCs occurs through a nucleophilic addition mechanism where the carbon center lacks electrons in the AITC molecule so that it reacts with nucleophilic substances such as hydrogen sulfide to form a ditiocarbamate complex. However, in this study, it was shown that the use of AITC in chewing gum did not affect the taste of the chewing gum and could reduce VSC effectively. In addition, chewing gum with 0.01% AITC and 0.1% zinc lactate can significantly reduce total VSC levels by up to 180 minutes. The effect will be seen when AITC is combined with zinc lactate without affecting sensory stimulation in reducing halitosis.[13,26]

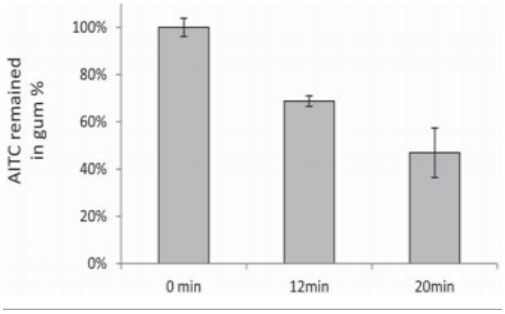

Figure 1. Release of AITC from chewing gum after 12 and 20 minutes of chewing.
Source: Tian M, Hanley AB, Dodds MWJ. Allyl isothiocyanate from mustard seed is effective in reducing the levels of volatile sulfur compounds responsible for intrinsic oral malodor. J Breath Res. 2013;7(2).[13]

Muneo Tanaka et al also mentioned that the use of eucalyptus herbal plant extracts in the gum formula has a long-term effect on the olganoleptic score, VSCs levels, and tongue-coating scores that cause halitosis. Eucalyptus globulus is a plant that has many properties to treat various diseases, namely cold medicine, overcoming pulmonary tuberculosis, diabetes,

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asthma, disinfectant, antiseptic, antibacterial, antiviral, insect repellent or repellant, and antifungal. The chemical compounds that play a role are 1,8-cineol, α-terpineol, quinate, luteolin, and proanthocyanidin. These findings suggest that eucalyptus extract gum can reduce bad breath by reducing tongue-coating accumulation. So that Eucalyptus has the potential to be developed into a drug derived from natural ingredients.[15,27]

Research conducted by Pier Francesco et al using chewing gum containing zinc acetate and Magnolia bark extract (MBE) significantly reduced oral VSC levels. Magnolia bark extract (MBE) is a traditional medicine isolated from the bark of Magnolia officinalis. This extract is extracted by boiling steam and hot water or by extraction of organic solvents. MBE is usually used by Chinese people for the treatment of fever, headache, pain relief, anti-bacterial and stress reduction.[28]

The mechanism for zinc and MBE to reduce oral VSC production is through different routes. Where Zinc acetate when in contact with saliva will release Zn^{2+} ions, which can form stable mercaptides with VSC and its precursors with sulfur, while Magnolia bark extract (MBE) has antibacterial and anti-plaque activity when given in chewing gum or candy. In addition, neolignans from magnolia can also damage bacterial membranes. These considerations suggest a possible synergistic effect of MBE and Zinc acetate to enhance the antihalitotic effect of the active ingredients. Additionally, chewing gum itself may have a mechanical role in reducing plaque by increasing salivary flow. The results of this trial indicated that chewing gum containing zinc acetate and MBE significantly reduced the oral VSC levels at the time of chewing after one hour compared to control chewing gum which did not have this effect.[20]

Generally, saliva plays an important role in eliminating bad odors in the mouth. Chewing stimulates salivary flow, along with cleansing the oral cavity and reducing bad odors. This latest study shows that chewing gum of various flavors stimulates salivary flow and that chewing for a long time is effective at maintaining salivary flow. In addition, regular use of chewing gum could result in a significant reduction in plaque scores. The microorganisms that cause bad breath are gram-negative, anaerobic bacteria similar to the bacteria that cause periodontitis. In this study, chewing PYC (French pine bark extract) gum for 4 weeks resulted in a significant reduction in oral hydrogen sulfide-producing organisms in saliva compared to baseline. PYC has bacteriostatic activity against various microorganisms including cariogenic and periodontopathic bacteria. Therefore, PYC gum contains an effective concentration to reduce the number of microorganisms that cause halitosis.[21,29]

In contrast to the research conducted by Nazliniwaty et al, using the leaf extract of *Plectranthusamboinicus (lour.)*Spreng (EEPL), it can be formulated in the form of a mouthwash that is proven to have antibacterial activity against *Staphylococcus aureus* and *Streptococcus mutans* which causes halitosis. In this study using ethanol as a solvent produced most of the non-volatile compounds. Non-volatile compounds from *Plectranthusamboinicus (Lour.) Spreng* leaves have been reported to have antibacterial activity against gram-positive bacteria such as *Staphylococcus aureus*. In accordance with the results reported by Valgas et al and Gurgelet al, leaf extract of *Plectranthusamboinicus (Lour.) spreng* showed very strong results as an antibacterial because it contains flavonoid compounds in the extract against *Staphylococcus aureus* which causes halitosis.[14,30]

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 3, 2021, Pages. 2591 - 2607
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Several studies have also identified chemical compounds contained in the leaves of *Plectranthusamboinicus (Lour.) Spreng* that play a role in antibacterial activity, namely essential oils such as p-cymene, thymol, β-caryophyllene and γ-terpinene in the leaves of*Plectranthusamboinicus (Lour.) Spreng* which has antibacterial properties against *Staphylococcus aureus*.[14,31]

Apart from *Staphylococcus aureus* and streptococcus mutans which causes halitosis, Solobacteriummoorei is also anaerobic gram-positive bacteria considered as the main causative agent of halitosis. Marie-Pierre Morin et al. Stated that the use of green tea extract containing polyphenols can reduce halitosis associated with Solobacteriummoorei bacteria. In this study, researchers found the active substance associated with green tea polyphenols, namely the presence of EGCG (constituent epigallocatechin-3-gallate) which has bactericidal properties to control halitosis. This suggests that green tea extract contains additional bioactive components. Green tea extract and EGCG can absorb cell membranes resulting in leakage of calcein-AM. Previous studies have also reported that green tea also contains theaflavins and catechins which can play a role in permanently damaging the cytoplasmic membrane of bacteria.[16,20,32]

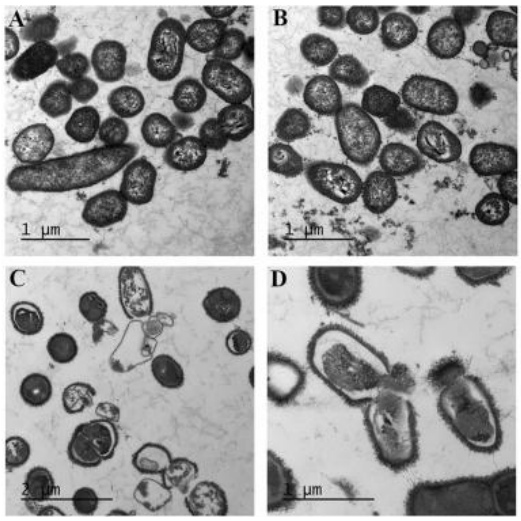

Figure 2. Transmission electron microscopy analysis of *S. moorei*. Panel A: Control untreated bacteria. Panel B: Bacteria treated (4 h) withgreen tea extract (500 µg/ml). Panels C and D: Bacteria treated (4 h) with EGCG (250 µg/ml)

Source : (Morin MP, Bedran TBL, Fournier-Larente J, Haas B, Azelmat J, Grenier D. Green tea extract and its major constituent epigallocatechin-3-gallate inhibit growth and halitosis-related properties of Solobacterium moorei. BMC Complement Altern Med [Internet]. 2015;15(1):1–11)[16]

The formation of biofilms by S. moorei is the main step in the occurrence of halitosis. Although the polyphenols in green tea do not show specific anti-biofilm effects in S. moorei, they can affect biofilms through two mechanisms. First, the biofilm formation by S. moorei on EGCG treated surfaces was particularly affected. Second, green tea extract and EGCG can reduce the previously formed S. moorei biofilm. The mechanism involved in biofilm

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desorption may be related to the ability of green tea polyphenols to alter the integrity of S. moorei cells.[16,33,34]

In previous studies, it has also been shown that S. moorei produces high VSC levels when the presence of cysteine and β-galactosidase are associated with VSC production from mucin. This enzyme can deglycosylate salivary glycoproteins, which can then be degraded into peptides and amino acids by host proteolytic enzymes and bacteria before being converted into VSC. So that β-galactosidase activity in saliva has been associated with halitosis. In this study, showed that green tea extract and EGCG can inhibit β-galactosidase activity in S. moorei which can contribute to reducing halitosis. [32,35,36,37]

This study is also in line with the research by Abdolhosseinmoghbel et al using green tea extract to treat halitosis in children. Green tea contains flavonoids, tannins, vitamins, fluorides and other mineral salts. Some of the antioxidants and antimicrobial agents of green tea can increase strength in teeth. Tannins are biosynthetic materials that have a strong anti-bacterial effect. In this study using propylene glycol (PG) as a solvent rather than ethyl alcohol. In Yamamoto et al's research on green tea in the United States, the use of green tea containing 0.5% tannins with 2% ethyl alcohol solvent reduced various types of staphylococcus by only about 15%. But in Iranian the use of PG 10%, green tea mouthwash 1% and free tannins can decrease the number of bacteria by about 48%. In addition, using PG as a substitute for hazardous ethyl alcohol is not only useful as a co-solvent but also as a chemical stabilizer and causes microbial death and is safe for use for children. This proves that propylene glycol is better used than using ethyl alcohol.[17,38,39,40]

Studies show that toothpaste and mouthwash containing green tea can fight bacteria and prevent plaque formation. Plaque is the cause of bad breath. Green tea can prevent bad breath by consuming mouthwash before and after brushing your teeth, or mixing it with toothpaste products. A herbal mouthwash formulation from Iranian green tea extract containing 1% tannin with 10% propylene glycol can reduce the number of aerobic oral bacteria by 45-64% and can also prevent plaque formation on teeth that results in halitosis.[17,41,42]

Supanee et al. also mentioned the ability of green tea mouthwash to reduce bad breath caused by the antimicrobial activity of green teacatechins, especially in *Porphyromonasgingivalis*, as well as the ability of green tea catechins to convert VSCs into odorless compounds. It has been shown that active catechins and their derivatives can inhibit tissue damage through *P. gingivalis* proteinase activity, thus, catechins and their derivatives can reduce the source of microbial spoilage. According to this study, green tea mouthwash showed a comparable percentage of VSC reduction to mouthwashes containing 0.05% chlorhexidine, 0.05% cetylpyridinium chloride, and 0.14% zinc-lactate.[43,44,45,46]

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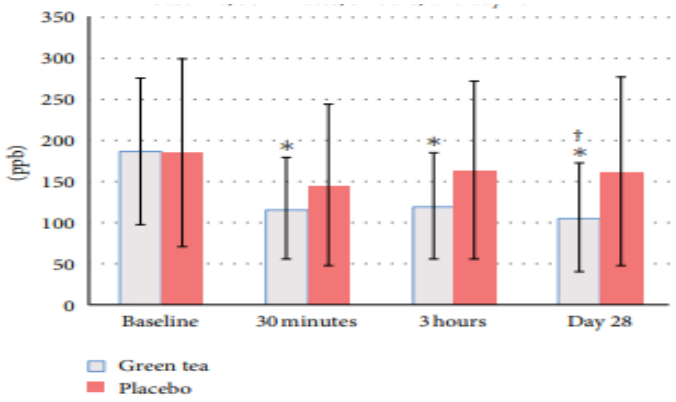

Figure 3: Level of volatile sulfur compounds before and afermouthwash usage: ∗ significantly different compared to baseline (P< 0,05) and † significantly different compared to placebo (P<0.05).
Source :(Porciani PF, Grandini S. Effect of green tea-added tablets on volatile sulfur-containing compounds in the oral cavity. J Clin Dent. 2016;27(4):110–3).[20]

In the study of Pratibhamamgain et al. using triphala and organic ela decoction was effective when compared with chlorhexidine mouthwash in inhibiting halitosis. Triphala has antimicrobial properties and inhibits the growth of activity against bacterial isolates, besides that it is also shown to have antioxidant and free radical reduction properties. Ela churna in combination with Triphala decoction to treat halitosis has an immunomodulatory, and antimicrobial action against the organisms that cause dental caries. Triphala is efficient in inhibiting plaque biofilm and effective in treating biofilm infections present in teeth. Similar results were seen in this study where the plaque index increased for the Triphla and Ela groups at baseline 14 and 21 days. Triphala concentration was 0.6% compared to chlorhexidine concentration of 0.1% and both were efficient in controlling gingivitis and plaque biofilm formation. Also, it appears that Triphala and chlorhexidine show the same inhibitory effect on microbial counts, except for *lactobacillus*, where Triphala has shown better results than chlorhexidine.[22,47,48]

In addition, *Ocimum sanctum* (Tulsi) pharmacological activity has spread in the field of dentistry. In this study, tulsi mouthwash was formulated and had an effect on bad odor assessed after 15 days. A study has analyzed the effect of various concentrations of *Ocimum sanctum* extract ranging from 0.5 to 10%, and it was observed that a 4% extract concentration was optimal as an antibacterial agent against the normal flora of the oral cavity; thus, in this study using a concentration of 4%. *Ocimum sanctum* has been tested against various microorganisms such as *Candida albicans*, *Staphyloccus aureus*, *enteric pathogens*, *Klebsiella*, *Escherichia coli* and *Proteus*.[49,50]

In this study, *Ocimum sanctum* extract mouthwash prevented plaque formation. In addition, the stems and leaves of *Ocimum sanctum* also contain various kinds of active ingredients that have antibacterial properties, including saponins, flavonoids, triterpenoids and tannins which form high molecular complexes, lyse bacteria on the tooth surface and saliva. This study demonstrated a significant reduction in VSCs, organoleptic, plaque and gingival scores in the tulsi extract mouthwash group, which could be attributed to the compounds isolated from the tulsi extract. However, after 15 days of intervention, the mean

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percentage reduction in VSC and organoleptic scores in the chlorhexidine and hydrogen peroxide groups was significantly greater than in the tulsi mouthwash group. Therefore, it can be concluded that tulsi mouthwash, although effective in reducing VSC which is responsible for halitosis, but does not have the same efficacy against chlorhexidine and hydrogen peroxide mouthwash.[23,51,52,53,54,55]

In contrast to the case of bamboo leaf extract which has components such as beta carotene, alpha tocopherol, gamma tocopherol which has strong anti-bacterial activity properties. Apart from that, the phenolic compounds possessed by bamboo leaves themselves are also proven to have a strong bactericidal action. The highest concentration of BLES (Bamboo leaf extract solution) in combination with SCCS (sodium copper chlorophyllin solution) was able to inhibit the growth and proliferation of four bacteria in a concentration-dependent test. BLES and SCCS certainly have an inhibitory effect on the growth and proliferation of anaerobic bacteria against high concentrations of all bacteria showing superior susceptibility. In this context, high concentrations of both bamboo leaf extract solution (0.16%) and sodium copper chlorophyllin (0.25%) showed high inhibitory ability in the four anaerobic periodontal bacteria (*porphyromonasgingivalis* (PG), *prevotellaintermidai* (PI), *fusobacteriumnucleatum* (FN) and *prevotellanigrescence* (PN) and produce sulfur volatile compounds that contribute to bad breath.These compounds may have a beneficial effect on oral health care. New antibacterial agents fight the bacteria that cause halitosis and related oral diseases.[24,56,57]

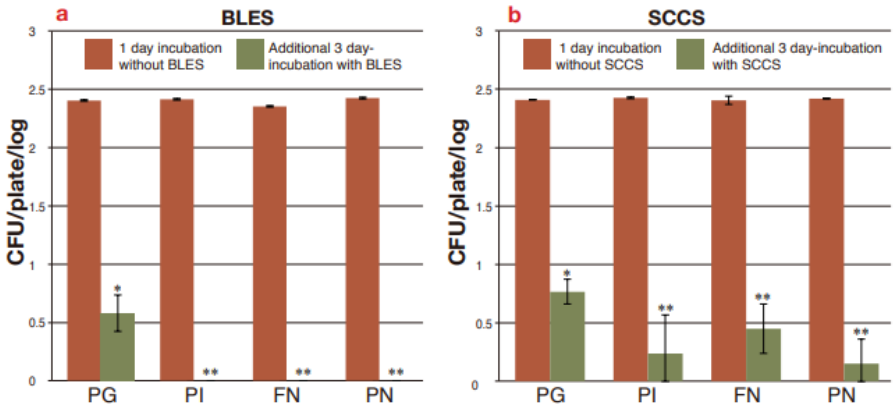

Figure. 4. Growth rate of four strains after 1 day incubation, followed by additional 3 days incubation with 0.16% BLES or 0.25% SCCS. The values **P < 0.001 and *P < 0.01 are shown with 1 day incubation.

Source : (Majbauddin A, Kodani I, Ryoke K. The effect of bamboo leaf extract solution and sodium copper chlorophyllin solution on growth and volatile sulfur compounds production of oral malodor associated some anaerobic periodontal bacteria. Yonago Acta Med. 2015;58(3):129–36)[24]

CONCLUSION

Recent literature shows that herbal plants that have been described have various kinds of active substances that can be the right solution in treating halitosis. This herbal plant can be formulated in preparations as mouthwash, toothpaste, chewing gum or even other products

that can reduce halitosis in children, so this systematic review can be used as a reference in the development of herbal plants in the future, especially dentistry.

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