

# Periodontal Diseases: A Review on Clinical Trials and Disease Management

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***Abstract:*** Periodontal disease refers to infection in tissues of oral cavity that leads to building of plaque and other bacterial infections such as halitosis, gingivitis related to same. Management of such issues is a need of the hour. Although many measures have been taken but still some of the side effects are faced while having therapy from synthetic materials. The present review discusses about herbal medications that are undertaken to provide herbal therapy, wherein methods adopted in few past years are discussed and then a conclusion is drawn regarding the same. Further, the paper also discusses about some bioactive materials that can be adopted for providing therapy in case of chronic conditions of periodontal disease. The biomaterial discussed here includes bioactive glass, wherein at last the conclusion was drawn that the bioactive glass has enhanced bioactivity and biocompatibility which inhibits demineralization and promotes remineralization thereby preventing the development of plaque on teeth and preventing the issues caused due to gingivitis or gum disorders

***Keywords:*** Bioactive Glass, Gingivitis, Herb, Periodontal Disease

## 1. INTRODUCTION:

Periodontal disease refers to common name that affects the gingiva, supportive connective tissues and alveolar bones, that anchors teeth within jaw, to identify particular type of disease[1]. Periodontal disorders are one of the most prevalent pathological illnesses that humankind have endured for decades. Egyptian and Chinese historians' ancient writings identified the pain of periodontal systems in extreme detail and find a way of dealing with the same. It seems to be major reason of dental decay and is regarded as one of two main dental health risks[2]. There are some 800 bacterial species known in oral cavity and the dynamic relationship between bacterium infection and host reaction, as altered by behavioral constituent like smoking, is believed to be one of most important risk to oral hygiene[2]. Global oral well-being information bank has been developed by World Health Organisation (WHO) by undertaking Collective periodontal index[3]. Such universal epidemiological oral hygiene statistics from major epidemiologic scrutinization from various countries have been compiled to present the prevalence of periodontal diseases in juvenile, adult and older communities (figures 1-3). Score 0 represents no disease, Score 1 represents bleeding when probed, Score 2 presents a calculus and bleeding, Score 3 suggests shallow periodontium pocket of 6-5 mm; Score 4 reveals huge periodontal pockets of 7 mm or more than that.

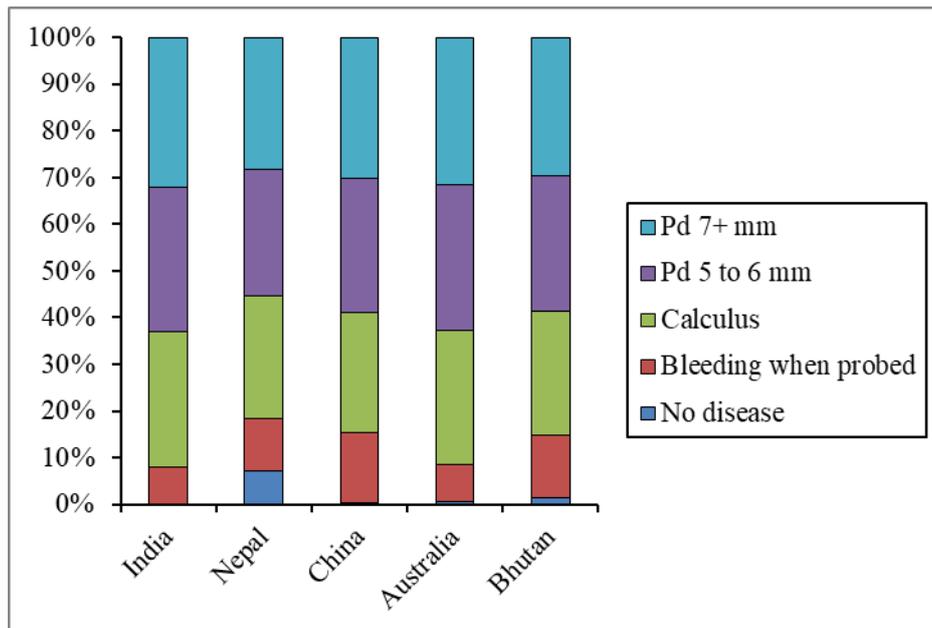


Figure 1: Periodontal index of juvenile. From figure it is observed that percentage of calculus is more in countries that ranged from 10%- 40% and pd that ranged from 40%-72% and Pd 7+ that ranged from 70%-100%.

***Pd refers to pocket depth.***

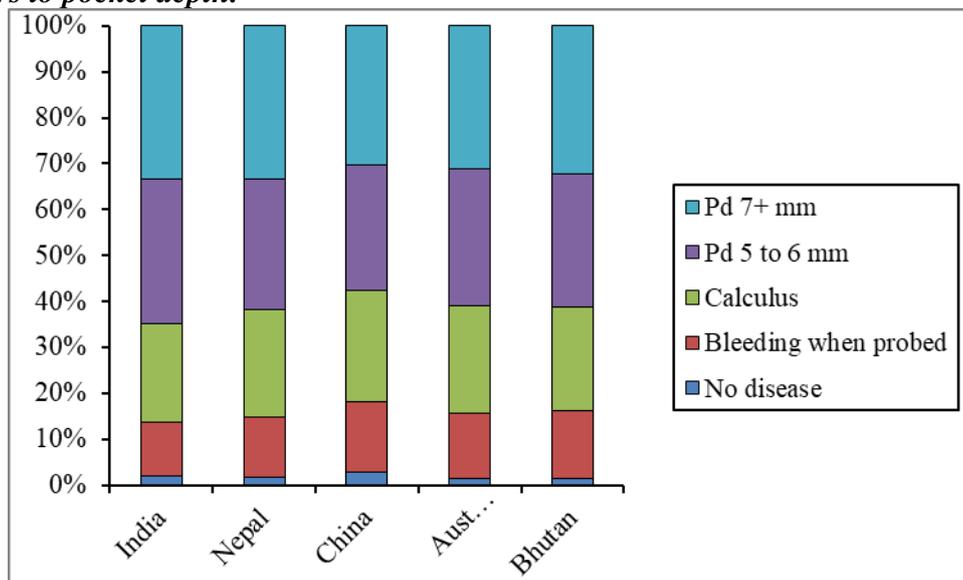


Figure 2: Periodontal index of adults. From figure it is observed that percentage of calculus is more in countries that ranged from 15%-40%, percentage of Pd (5-6mm) ranged from 30%-70%. People with no disease ranged from 0%-6%.

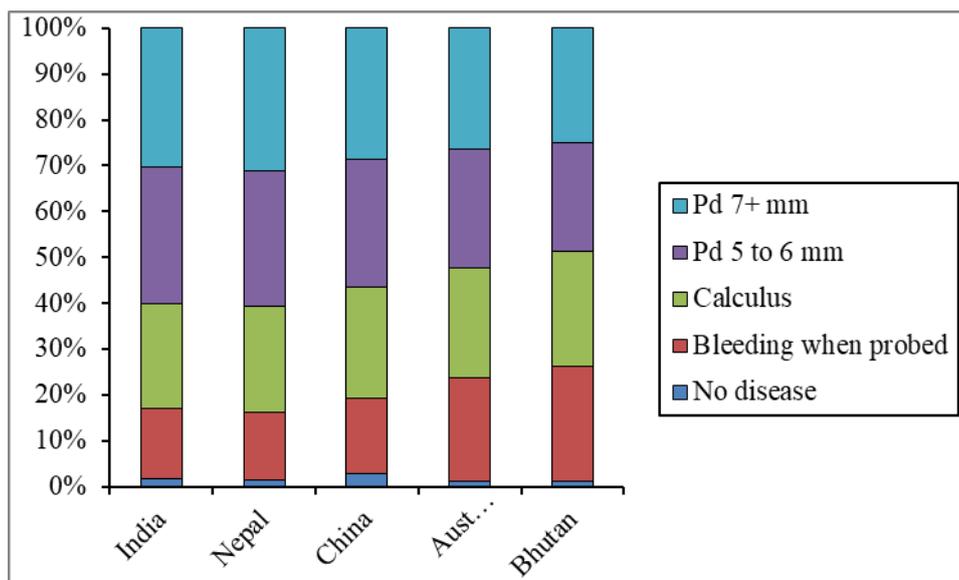


Figure 3: Periodontal index of adults. From figure it is observed that percentage of calculus ranged from 15%-45%. Percentage of Pd 5-6mm ranged from 40%-76%. Percentage of Pd (7+mm) ranged from 70%-100%.

This periodontal conditions are caused by plaque bacteria contaminating the gum tissue and bones preferably involved in protecting teeth. Periodontal diseases are of two type -i) Chronic and ii) aggressive disease[4]. Chronic periodontitis arises commonly, although the population under 30 years are affected by aggressive periodontitis. In mild to severe periodontitis, non-surgical therapy is helpful and in progressive situations, surgical treatment is helpful[4]. For dissemination of antimicrobial agents, confine-mouth delivery systems, drainage solutions and continuous release frameworks are used.

Antimicrobial resistance is mainly developed due to introduction of artificial antimicrobials and antibiotics. It has been noted that previously rare infections are growing maybe due to antimicrobial overuse is erroneous or widespread. The useful replacements for synthetic agents are natural phytochemicals[5]. It is important to remember that most populated countries are china and India that have utilized herbal medicines for treating oral maladies, like periodontal disease[6]. Adults infected with chronic periodontitis have been shown to be scaling and root preparation combined with the usage of an antimicrobial adjunct mediator enhances consumer findings over duration.

Modern chemotherapy agents have been very successful in curing periodontal health however the use of herbal medication has raised recently and could have been particularly of great help to lower socioeconomic community around world because of adverse side effects including discolouration of teeth, altered taste and prices of such substances[6]. Some of the herbs used for treating periodontal diseases is shown in the table 1.

Table 1: Herbs useful in the treatment of periodontal disease[6][7]

Herbs	Properties
Aloevera	Anti-viral. Anti-bacterial, anti-oxidant
Green Tea	Antioxidant
Triphala	Antioxidant
<i>Rubiocordifolia</i>	Anti-inflammatory

Piperine	Anti-oxidant and Anti-inflammatory properties
Sumac	Anti-inflammatory, Antimicrobial, and Antioxidant properties
<i>Ginkbobilob</i>	Anti-oxidant and Anti-inflammatory properties
<i>Psidiumguajava</i>	Antioxidant
<i>Lythrumalicaria</i>	Antioxidant
<i>Ascophyllumnodosum</i>	Antioxidant
<i>Cinnamon zeylanicum</i>	Anti-bacterial, Anti-fungal, Anti-oxidant
<i>Azadirachtaindica</i>	Anti-bacterial, Anti-viral, Anti-parasitic, Anti-inflammatory, Anti-carcinogenic, Antioxidant,
<i>Mikaniaglomerate</i>	Anti-allergic, anti-viral, anti-microbial
<i>Allium sativum</i>	Anti-bacterial, Anti-viral, Anti-fungal and Anti-protozoal

Despite of the herbs mentioned above, research is still going on to explore some more effective herbs in order to treat periodontal diseases effectively. The herbal treatment of the dental caries has served various advantages over conventional treatments conducted by using synthetic drugs thereby setting an example for treating gums disorders without causing any side effects.

Deore GD et al. in 2014 conducted a randomized, controlled, triple-blind study with sample size of 20. The herbal product used was oil pulling with sesame oil. After conducting the study it was a conclusion was drawn that oil pulling may be effectively utilized as a potent preventive adjunctant in maintaining and enhancing oral hygiene as well as health[8]. In a double blinded controlled clinical trial with sample size of 30 it was demonstrated that herbal centered toothpaste (commonly available as colgate herbal toothpaste) shown effectivity towards controlling plaque and periodontal diseases[9]. The aforementioned toothpaste was also very effective when compared to conventional formulation. The composition comprises of calcium carbonate, sage, sodium monofluorophosphate, chamomile, and myrrh eucalyptus[9]. An UDM toothpowder comprising various herbs like haritakichurna, bibhitakichurna, amalakichruna, bakulachurna, babbulachurna, kutajachurna, nimbatwakchurna, sanidhavalavana, karpoora, peppermint and green tea catechin chip was tested on a subjects with sample size of 30 in 2011, wherein a decrease in gingival disease and plaque was observed[10].

The studies so far conducted stated that combination of herbs showed significant effect in inhibiting plaque and treating gingivitis without causing any side effects on soft and hard tissues of oral cavity. After observing such benefits the clinical trials continued to check the effectivity of the herbal formulation in treating periodontal diseases. In 2015 a herbal mouthwash made of lemongrass oil was clinically tested on population with sample size of 60. The clinical trial was randomized, and three arm prospective parallel clinical assessment, wherein 0.25% w/v of herbal oil was tested and statistically significant results were obtained with reduction in gingivitis and plaque after 1 month of regular use[11]. Further in 2016, Sharma V et.al. formulated a gel form an extract of *Syzygiumaromaticum* and tested on different samples with sample size of 20. Results declared that, gel formulation possessing anti-inflammatory properties was effective in eradicating harmful pathogens present within

the mouth thereby preventing the state of halitosis or oral malodor[12]. In 2019 it was hypothesized that ginger extract played crucial role in alleviating the effects of gingivitis thereby treating periodontal disease[13].

All these clinical studies clearly shows the potent nature of herbal formulation in treating the periodontal diseases without causing any side effect on the tissues of the mouth as well as does not create any harm to the body. Although the herbal therapy had served to effective in treating the periodontal diseases but the therapy by using bio-materials or biological agents cannot be denied. But sometimes in adverse conditions therapy also becomes the need of an hour to overcome the problems associated with oral health. Thus at that time, in such chronic stage surgery is required. For that purpose different sorts of biological agents or biomaterials (bioactive glass) have been introduced to conduct periodontal therapy.

Present techniques adopted for caries management includes:1) preventing or managing carie growth, 2) maintaining much harder dental tissues and 3) minimizing re-restoration method. Carious lesions of different severity are listed as: Non-surgical techniques are widely used for original lesions[14]. Fluoride compounds shall be put within teeth in varying ways for remineralization and, through the infiltration of calcium and phosphate, lesion's mineral substances are extracted from higher amount through lesions. Casein phosphate-amorphous calcium phosphate (CPP-ACP) is a balanced Ca-P system, which is able to remineralize carious lesions more efficiently[14]. One improvement is to add fluoride within system, which will increase the effectiveness of remineralization relative to original form.

Any anti-cardiac medications have antibacterial properties that can deter cariogenic bacteria from developing. Chlorhexidine (CHX) refers to an antibacterial agent class that can decrease oral cavity caused due to *Streptococcus mutans* variants[15]. Triclosan is also an anticaries agent that can influence production of acid by biofilm. Earlier study has demonstrated that the impact of arginine on oral biofilms are anticardized. In the case of dental caries, sorbitol is also a safe sugar alternative and has antibacterial ability[16]. They have the potential to regulate bacterial scale and thus facilitate a remineralization phase, like other two previously referred to agents.

Another minimally invasive procedure for procedure of original tooth surface lesions is placement of fissure dentures. Mechanical blockage or binding of lesion for intermediate lesions are efficient way to avoid caries after adding resin-centered cracking density. Topical administration of silver

diamine fluoride (SDF) is also an alternate method of arresting intermediate carious lesions because of their antimicrobial and remineralization effects[14]. Furthermore, all demineralized tissues of tooth are removed by classic routine procedure for severe lesions and toothing material including resin for filling cavities. Stage by stage or selective exclusion of tooth decay is a recent step in protection of dental tissues and also pulpal damage can be minimized.

In comparison, conventional standardized lesion treatment remove some dental restorative substance such as composite resin to fill packed cavidad and remove all demineralized tooth tissues. Naive trend towards protection of dental tissues and reducing the occurrence of pulpal exposure and preferring the production of tertiary dentin following restoration has recently been established, step by step or partially eliminating caries. Different materials are utilized for the following process of reconstruction. These involve acid-base reaction chemically bound ceramic cements such as zinc phosphate, silicates, polycarboxylates and ionomers from water. Composite resin is also another cement form which is determined by a reaction of polycondensation. Resin-altered glass is also available[17], [18]. The synthesis of the two reactions makes ionomer cement.

Bioactive glass is modern agent with potential to repair trauma-related bone defects and contributes to bone recovery. It is seen in many aspects of healthcare. Na, Ca and phosphorus

silicate glasses became first bioactive glass that was developed in 1969[19]. There are actually different forms of biologically active glasses, like glass based on silicate and glass centered on phosphate. In terms of plastic features, bioactive glass is outstanding plastic. Due to bioactivity and biocompatibility, fundamental principle of utilizing bioactive glasses in bone healing is to utilize scaffold to function as the bone regeneration 3-D prototype[19], [20]. The application was made on wide range of areas, especially for bone grafting, scaffolding, dental root canal antiseptic and dental implant covering materials. In bone acquisition and repair, key benefit of bioactive glasses is its bonding power for bone and relaxation of bone development are high interaction in connection with bone surfaces and most excellently-known power for bioactive glasses. First of all particles change into mesoporous form when substance comes in contact with aqueous solution. Close to bone or another hard tissue portion, particles then forms an additive layer to create an appetite-like substance on bone surface. Hydroxyapatite (HA) layer forming requires interaction of ions among the bone surfaces and bioactive substrate[21]. The displacement of precipitates such as knots plays vital role in curing of bone defects.

The effect over tooth is like the effect on bone. Dentine tissues can be mineralized by bioactive glasses to reduce tooth sensitivity. The method is: glass substance is disbanded and then raises the pH of aqueous solution. The pH increase encourages hydroxyapatite precipitation (HA), which is a principal mineral lacquer and dentine portion. A mineralization mechanism can be improved with calcium and phosphate ions through bioactive glasses and saliva mineralizing agents. Dentine repairs with dentine hypersensitiveness can be done with most effective commercial products extracted from noncrystalline amorphous bioactive glasses (Bioglass 45S5) form called NovaMin (GlaxoSmithKline, UK). Biosafety Glass 45S5 consists of silica, comprising of 47 wt% SiO<sub>2</sub>, 25% wt% CaO, Na<sub>2</sub>O is 25 % wt and P<sub>2</sub>O<sub>5</sub> is 6.5% wt. It can occur as particles or granules[22].

While studies have resulted that bioactive glass encourages bone regeneration and harder tissues mineralization, the efficacy of bioactive glasses in preventing and avoiding dental cavities is not understood. Bioactive glass processes on bone replacement, regenerative medicine or dentine hypersensitivity were primarily investigated in existing literature till now. Machinery of bioactive glasses operation on caries control was tested by a few. The aim of this review is to analyze the evidence on bioactive glasses interventions for the treatment of tooth decay in relation to its impact on caries and pathogenic bacteria.

## 2. DISCUSSION

Herbal medications comprises of phytochemicals and are widely recommended efficient antibiotic substitution and alternative solution towards oral and parodontal infection avoidance and rehabilitation treatment[23]. Turmeric is one of most popular herbal medicines in present clinical studies. It is believed to possess a broad range of biological activities. Curcumin has been commonly utilized in ayurveda for a long time since it is non - hazardous and comprise number of medicinal qualities, including antioxidants, analgesics, anti-inflammatory drugs, antiseptic and anticancer function[6].Cyanogenic glycosides and various enzymes such as oxidases, peroxidase and pectinase, which are usually called Babul (*AraciaArabaica*). Its bark includes tanins that are not only considered to be analgesic, antimicrobial, as well as anti-inflammatory qualities[6]. In a new research, scientists attempted to use and show similarly potency of this object's gel and powder. *Cmatechuit Acacia* barks has several components and may be helpful for treating oral mucosal irritation and gum bleedings[24]. It is often assumed that bark constituents improve the good taste.

Studies have demonstrated, *Acacia Arabica's* therapeutic effectiveness in minimizing gingivitis is equal to chlorhexidine. It has also been effective against inhibiting early plaque development, but its function in later phases was doubtful. Neem refers to an effective medicinal plant in India and also in some of South East Asia over thousands of years, sometimes referred to as *Azadirachta indica*. There is significant variety of biological behaviour related to plant itself. The main parts of neem accountable for much of its pharmacological effects include nimbidine and sodium nimbidate.

Green tea is commonly consumed within entire region. There are many substances, including flavonoids, carotenoids, tocopherols, ascorbic acid and minerals. Green tea is also potent against gram negatives anaerobic microbes as they were shown to indicate successful intervention. Catechin present within green tea is expected to minimize harm to the tissue by decreasing operation of collagenase[25]. A latest case in Indian studies found that clinical updatation of catechin chip was enhanced and microbial development was inhibited in addition to root preparation and scaling. Findings of yet another Indian report shows local use of drugs delivery to Parodontal tissues by utilizing green tea extract may be utilized in therapy of chronic paradoxical forms , particularly in people with diabetes[25].

Tulsi is the best-known herbals in India. *Ocimum sanctum* medicines have close ties to numerous traditions and religious traditions. Tulsi is considered to be highly successful in coping with problem of Halitosis. Tulsi's anti-inflammatory pattern is defined to minimize inflammation of the periodontal and gingivitis. Tulsi is healthy source of vit. A and C followed by Ca,Zn, chlorophyll iron and various phytonutrients[26]. Such micronutrients serves an important role towards gingival maintenance. For behavioural conditions affecting various organ systems, ocimum sanctum was utilized with different herbal preparations. A new *Ocimum sanctum* survey of 6% considers it to be Chlorhexidine as active in peridontitis treatment[27]. It showed that anti-gingivitis and anti-inflammatory mouthwashes of *Ocimum Sanctum*, made of extract Shrine Ocimum.

This was also shown by the findings of analysis efficient toward oral microbial population as an antimicrobial agent. During analysis, it was found that 4% *Ocimum sanctum* extract possessed antibacterial activity against bacterial population. *Coriandrum sativum* serves to be important part of ancestral Iranian medicine used to cure flatulence within Umbelliferae tribe[28]. In present Iranian study, *Coriandrum Sativum* was utilized with *Quercus brantii* in state of oral gel state. *Quercus Brantii* is one of several plant species of Fagacea family belonging to western specifically utilized for the treatment of gastric mucosal ulcers. Tannins were found in both *Coriandrum sativum* and *Quercus Brantii* that decreased periodontium bacterial growth, and thus represented a mixture of preference for clinical trial[28]. Crude oil, neem oil, thyme oil, oregano oil and other key oils because of unmeasurable benefits are mostly employed in aromatherapy and thus have good effect on mind-body framework. The anti-fungal and anti-bacterial features of lemongrass oils are also thought to be similar to those of penicillin a thus periodontal bacteria may be regulated effectively. It has also been used as mouth-washing agent and a substantial r drop in outcome of analysis was observed[28]. But it has also been said that lemongrass with great viscosity interrupts with bacterial adhesion thereby decreasing plaque development and periodontal deterioration.

Although herbal therapy for periodontal disease is effective according to various researches cited above which is specifically due to presence of various biological properties in such herbs but still there exist some voids in regards to their efficacy. This may be due to presence of heavy metals within aforementioned herbs[2]. But the treatment of periodontal disease via herbal therapy can be major advantage in coming future as dependency over herbs prevent the exploitation of synthetic agents up to a certain extent, i.e. upto a state where such diseases can be managed. However, if the situation is chronic then it becomes necessary to take quick

measure for treating the adversities caused due to such chronic periodontosis. In that situation, disease management by making use of bioactive glasses can be beneficial.

Oral microbiome, dental biofilm formation are typically located within oral cavity. Dental plaque development (dental biofilm) requires variety of steps. Next, bacterial colonizers have their location in acquired pellicle over tooth wall[14]. Bacteria, molecules and various bacterial products coating the dental surface are then produced and shaped by oral microbiological systems. Principal bacterial species that contribute to caries development are Lactobacilli and Actinomycetes. Staphylococci are high prevalence and proportions that mask initial caries lesions in oral biofilms. *Streptococcus mutans* (*S. mutans*) is main microorganism for production and growth of dental decay. *L. casei* refers to kind of cariogenic bacterial strain that typically exists within deep and advanced caries. More specifically, another organisms known as actinomycetes have been described as caries-associated acid-producing and acid-tolerating[29]. After conducting various researches it was observed that, only few studies explored antimicrobial activity of bioactive glasses. It may be because most immediate advantage of bioactive glasses is its remineralization impact on bone and teeth instead of its bacteriostatic efficacy. Xu et al. assayed biofilm plate of *S.mutans*. This indicates that antimicrobial agent concentrations required for biofilm inhibition may be several times greater than expected for planktonic bacteria inhibitors. The potential event of bioactive glasses on cariogenic bacteria is manumit of alkaline ions, accompanied by increased pH that creates bacterial atmosphere. The mode of action is identical.

This indicates that amount of anti-microbial agent sufficient to suppress biofilm can be several times greater than that required for planktonic microbe. Cariogenic bioactive glasses theoretical activity on bacteria include release of alkaline ions, accompanied by elevation of pH under which bacteria can't thrive in atmosphere. This is analogous to process of activity of arginine wherein methodology of arginine decrease was observed as new technology for preventing dental caries by creating increase in pH along biofilm's tooth surface. Presence of antimicrobial ions may regulate bacterial activity, in addition to mechanism of pH elevation. Biologically active cations doped ceramics like Ag, Mg, Sr, and Zn comprise highly inhibiting effect on *S.mutans* as well as *L.casei*[29], [30]. The silver diamine fluoride (SDF), where silver ion was designated as primary antimicrobial agent, was suggested by two literature reviews.

Bioactivity and biocompatibility are beneficial features of bioactive glass. In earlier experiments, biocompatibility of bioactive glass was tested using direct contact cell viableness approach and cell survival rate was high. A possible new implementation of bioactive glasses for preventing dental caries and remineralization of early caries are very healthy material and centered on above mentioned merits. Further studies could concentrate more towards potentialities on how bioactive glass functions in the direct oral care of dental caries.

### 3. CONCLUSION

A broad variety of biological features, including anti-microbial and anti-inflammatory effects, have proven that herbal remedies are used. Natural phytochemicals in such herbs tend to remove alveolar loss of bone that is striking characteristic of periodontitis. The present review focuses towards clinical trials of herbal medications conducted for periodontal disease and management of the same. The conclusion drawn from the review demonstrated that herbal medicine showed a significant remedy towards periodontal therapy. However, it was also inferred from the review that still some more clinical trials are required to obtain a reliable curing. Further, bioactive glass was also found to be effective in terms of retarding carcinogenic bacteria within oral cavity. Moreover, due to its enhanced bioactivity and bio-

compatibility they also promote remineralization thereby preventing the problems caused due to gingivitis.

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