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Role of Aloe Vera and its Clinical Efficiency on Dental Caries: A Systematic Review

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***Abstract*: *Background:* As most microorganisms are drug-resistant, the periodontal health of individuals is affected by dental caries. So as an alternative treatment option, Aloe Vera, which has high medicinal properties, can be used in the treatment of periodontal diseases. *Aim:* To evaluate the efficacy of aloe Vera mouthwash in dental caries and improve periodontal health. *Methodology:* A literature review was done using Pub Med, science direct, Medline, Cochrane, Scopus using keywords aloe Vera mouthwash and dental caries. There were 210articlesfrom various sources; four studies were selected for systematic review. *Results:* Aloe Vera has a significant reduction in the plaque and gingival score and dental caries, which is comparable to chlorhexidine mouthwash. All four studies selected have significant p-value with statistical Analysis. P-values were <0.001 in every study. *Conclusion:* Aloe Vera mouthwash is equally effective and can be an alternative to prevent dental caries and maintain dental health.**

***Keywords*: Aloe Vera mouthwash, Dental caries, Bacterial infection, Aloe Vera gel, Systematic review.**

1. Introduction

Dental caries is one among the most common infections in humans. Caries incidence increased dramatically during the post-industrial revolution with increasing affluence, particularly with the availability of processed sugar. The disease results from a complex interaction between acid producing tooth-adherent fermentable carbohydrates and bacteria. Over a period of time, the acids in the dental plaque may cause demineralization of enamel and dentin in the smooth surfaces and the fissures of the tooth. The earliest visual sign of dental caries is the white spots. On continuation of demineralization, the surfaces of the white spot will cavitate, resulting in a cavity. However, if the demineralization environment is reduced or eliminated, white spot lesions may re-mineralize and not progress [1]. Risk for caries includes high numbers of cariogenic bacteria, high-frequency sugar consumption, inadequate salivary flow, insufficient fluoride exposure, poor oral hygiene and poverty. In more recent times, improved oral hygiene practices coupled with fluoridation of the public water supply and fluoride in dentifrices, mouth rinses and processed foods have greatly reduced the prevalence of dental caries in the population [2].

Aloe vera (Aloe barbadensis) is a plant that belongs to the Liliaceae family. The name Aloe is derived from the Arabic word "Alloeh", meaning shining bitter substance, while "vera" in Latin means true. It contains various minerals and vitamins. It has various properties such as immunomodulatory, antiviral, and anti-inflammatory [3]. Aloe vera consists of different ingredients, including minerals, e.g. (Sodium, potassium, calcium, magnesium, manganese, copper, zinc, chromium and iron), enzymes (e.g., amylase, lipase, carboxypeptidase), sugars, anthraquinones their derivatives (Barbaloin, aloe-emodin9-anthrone, lsobarbaloin, Anthrone-C-glycosides and chromones), lignin, saponins, sterols, amino acids and salicylic acid [4], [5]. It is also an effective wound healer for bruises, X-ray burns, insect bites, anti-arthritics, antihelminthics and somatics. Aloe vera has been used in the treatment of various skin diseases such as frostbite, radiodermatitis, genital herpes infection and psoriasis. Its pharmacological actions include anti-inflammatory, antibacterial, antiviral, antioxidant and antifungal [6]. The dental uses of aloe vera are numerous. There is increased interest among researchers in analyzing the use of aloe vera in dentistry, and various studies have proved the effectiveness of this plant. Having good antiseptic and anti-inflammatory properties, they are used to treat gingivitis and periodontitis. They readily reduce the gingival inflammation and pain associated with it. Clinically proven studies have shown that mouth rinses and dentifrices containing aloe vera have shown a remarkable reduction in gingivitis and plaque accumulation after its use [7].

Aloe vera tooth gel is more effective in controlling bacteria that cause cavities than other commercially available toothpaste. Aloe veragel's capability to kill and remove harmful microorganisms is due to compounds called anthraquinones, which are anti-inflammatory. Aloe vera gel does not contain the abrasives found in most toothpaste, hence less harsh on teeth, and it is an effective alternative for people with sensitivity in the teeth [6]. It contains carboxypeptidase, which inactivates

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bradykinin, prevents vasodilation, and produces an anti-inflammatory effect [5]. It is also effective in controlling bacteria that cause plaque and cavities in the oral cavity. Hence the aim of the study is to evaluate the efficacy of aloe Vera mouthwash in improving periodontal health and its effectiveness in dental caries.

2. Materials and Methods

Objective: To evaluate the efficacy of aloe vera mouth wash in improving dental caries.

Study design: A systematic review of randomized control trial studies done on the efficiency of aloe vera mouthwash on dental caries.

Search strategy: The following electronic databases were used to search articles on aloe vera mouthwash and plaque efficacy - PubMed, Medline, ScienceDirect, Scopus and Cochrane. Each database was searched using Mesh representation. Prisma shows a flow diagram of the search method.

Inclusion criteria:

1. Original articles related to research.
2. Articles emphasizing the efficacy of aloe vera mouthwash on Dental caries.
3. Randomized control trial.

Exclusion criteria:

1. Studies that are not emphasizing periodontal health.
2. Studies that are not emphasizing other products of Aloe Vera other than mouthwash
3. Review articles.
4. Articles which don't have full text
5. In vitro studies.

Search engine: 1. Medline 2. PubMed 3. Cochrane Library 4. ScienceDirect 5. Scopus.

Search Method:

The search yielded 210 records, and 15 full-text articles were independently assessed. Among these, four were included.

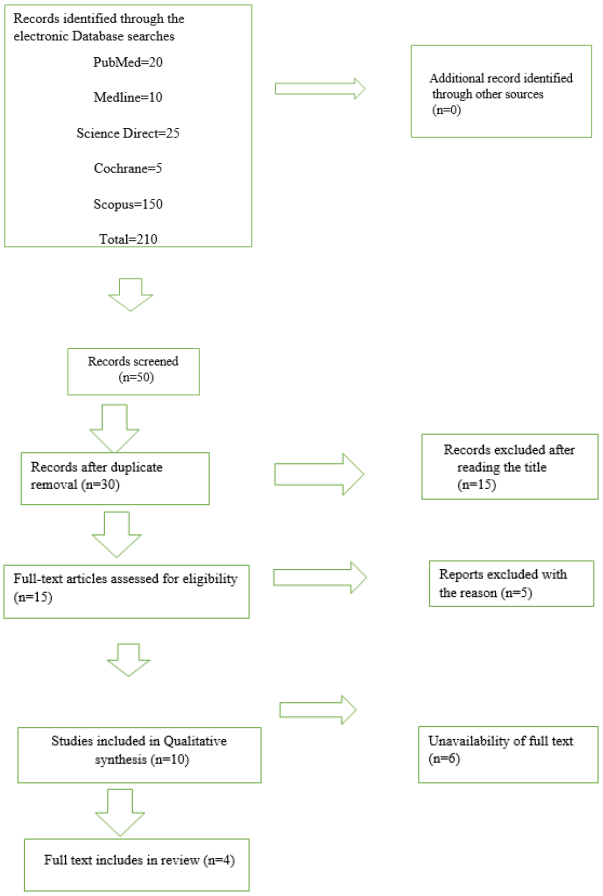

Fig. 1. PRISMA flow diagram shows the number of studies identified, screened and assessed for systematic review

Figure 1 represents the flow diagram of the report that was identified, screened, assessed for eligibility, excluded and included in the review. It shows that a total of 210 articles were yielded by searching different databases. After removing duplicates and others, four full-text articles fulfilling the inclusion criteria were included in the study.

Table 1
Characteristics in intervention of the studies

Author Name	Year	Total Number of Sample	Preparation	Intervention
Suraj Bhaiyana et al [9]	2019	25 samples for each group	In a sterile container, the solid mucilaginous gel was collected from fresh mature leaves of aloe vera after removing its thick outer layer. Then10ml of gel was mixed in a 100ml of 2% Dimethyl Sulfoxide (DMSO) and kept at 4°C.	Group1(AloeVera)=25 Group2 (Cefixime)=25 Group 3 (Ofloxacin)=25 Control group (Distilled water)=25
N.P. Kamath et al. [10]	2019	152 Males=89Females=63	The ingredients used for the preparation of the Aloe vera mouthwash were aloe vera (7 g), peppermint oil (0.025 g), tween-80 (0.5g), benzylalcohol (0.2 g), and Milli-Q water q.s. to100 ml/g. The pre-weighedTween-80, which serves as a surfactant, was added to one-fourth water and mixed well.	Group1(aloevera)=38, Group 2 (chlorhexidine) =38, Group 3 (tea tree oil) =38 andGroup4(placebo)=38.
Gaurav Patri et al. [11]	2017	40	The Aloe vera plant leaves were washed with distilled water, cut open, and fresh pulp was collected in a sterile container. The slurry was formed with the help of a mortar and pestle and stored in sterile Syringes for easy application.	Group I (2% chlorhexidine) =10, GroupII(teatreeoil)=10, Group III (Aloe vera gel) =10 with a control group (distilled water)=10.
A.R. Prabhakar et al. [12]	2015	30	The plant leaves were washed with distilled water, cut open, and fresh pulp was collected. The gel was dried in an oven at 800°C for 48 h and then powdered. An ethanolic extract was obtained by dissolving 20g of the powder in 200 ml of ethanol. The contents were then filtered using Whatman filter paper no. 1, and the filtrate was evaporated for dryness.	Group I (Control) = 10, Group II (A. vera) =10 and GroupIII(propolis)=10.

Table 2
Characteristics of outcome and results

Author Name	Year	Primary Outcome	Result
Suraj Bhaiyana et al. [9]	2019	Among the various concentrations of AloeVera, the group with AloeVera extract at 100% concentration showed the best results, but the antibacterial efficacy was lower as considered with cefixime and ofloxacin.	The group with Aloe Vera extract at 100% concentration showed the best results. (p-value=<0.001) (Mean ±SD=10.48±2.735).
N.P. Kamath et al [10]	2019	Aloe vera and tea tree oil mouthwashes decreases gingivitis, plaque and S. mutans in the oral cavity in children. The activity of these two agents is comparable to that of chlorhexidine.	The difference in variables between groups using aloe vera, Tea tree oil, and chlorhexidine was not statistically significant. (p-value=<0.001), (Mean score= 0.33±0.09)
Gaurav Patri et al [11]	2017	The present study results showed a statistically significant reduction in TVC, when compared between pre and post-excavation in all the groups and post-excavation and post-disinfection inall the test groups (except the controlgroup). Post-disinfection, 2% chlorhexidine showed the highest reduction in TVC, followed by1% teatreeoil and aloe vera gel.	Natural anti bacterial agents like aloe vera and tea tree oil could be effectively used as cavity disinfectants which will help in the reduction of secondary caries and renders a long-term therapeutic success.(p-value = <0.001). (Mean Value=71.73)
A.R. Prabhakar et al [12]	2015	In all three groups, a significant number of bacteria were left behindafter hand excavation. However, group II and Group III, in which cavities weretreated with Aloe vera and propolis extracts, respectively, showed a significant reduction in bacterial counts compared to the control group.	Hand excavation alone does not eliminate bacteria, predisposing treated teeth to secondary caries. However, both propolis and Aloe vera extracts can be used as natural disinfecting agents (p-value=<0.001) (Mean Value=3.9)

Table 3
Assessment of risk of bias in the included studies

	Random Sequence Generation (Selection Bias)	Allocation Concealment (Selection Bias)	Blinding of Participants and Personnel (Performance Bias)	Blinding of Outcome Assessment (Detection bias)	Incomplete outcome Data Addressed (Attrition Bias)	Selective reporting (Reporting Bias)	Diagnosis Reliability (Misclassification Bias)	Baseline Balance (Selection Bias)
Suraj Bhajyana et al [9]	-	+	+	-	-	+	-	-
N.P.Kamath et al [10]	-	+	+	+	+	?	-	-
Gaurav Patri et al. [11]	-	-	+	+	+	+	-	-
A. R. Prabhakar et al. [12]	+	?	+	+	+	+	-	-

+ = low risk bias, - = high risk bias,? = unclear bias

3. Discussion

Periodontal health can be well maintained by proper brushing, flossing, regular scaling and using mouthwash. Mouthwashes are medicated solution which is used in the oral cavity and wished to eliminate microorganisms. [13]

The standard gold mouthwash used in everyday life is chlorhexidine. As it has a wide microbial spectrum, it causes the effective reduction of plaque in the oral cavity. Other commercially available mouthwashes along with chlorhexidine had side effects such as hypersensitivity reaction, tooth staining and toxicity. So medicinal plants like Aloe vera containing phytochemicals can be used as an alternative to synthetic mouthwash to avoid such adverse effects has two types of action on the oral cavity. It has antimicrobial properties as it contains sulfur, salicylic acid, urea nitrogen, cinnamomic acid, phenols and lupeol, which cause the elimination and prevention of bacteria, viruses and fungal organisms. Another important one is its anti-inflammatory property. It causes a reduction in prostaglandin inhibition of the cyclooxygenase pathway and also causes the E2 production from arachidonic acids, which causes a decrease in inflammation. [14]

The synergistic relationship between its anti-inflammatory, antimicrobial and antioxidant properties contributes to the wound-healing process. Additionally, studies suggest aloe veracan help prevent caries and is an effective adjunct to nonsurgical SRP in patients with periodontitis. [15]

Suraj Bhaiyana et al. [9] conducted a study and concluded that plaque samples were collected early morning from inter-proximal sites of lower central incisors with sterile curettes, including supragingival and sub-gingival plaque. The clinical isolate was then grown in Brain-Heart Infusion broth and incubated for 24 hours at 37°C. The antimicrobial activity of the Aloe Vera Gel was tested by the disc diffusion method. Among the various concentrations of Aloe Vera, the group with Aloe Vera extract at 100% concentration showed the best results. Still, the antibacterial efficacy was lower as considered with cefixime and ofloxacin. Hence it can be concluded that Aloe Vera gel can be used as an antibacterial agent to prevent and treat some oral infectious diseases such as dental caries at higher concentrations.

N. P. Kamath et al. [10] conducted a study to evaluate the effect of two herbal types of mouth wash containing aloe vera

and tea tree oil on the oral health of school children. A double-blinded, placebo-controlled interventional study was conducted on school children of age 8–14 years. The participants of the study were divided into four groups depending on the mouthwash used: Group 1 (aloe vera), Group 2 (chlorhexidine), Group 3 (tea tree oil) and Group 4 (placebo). The data recorded were plaque index, gingival index and salivary Streptococcus mutans counts, which were recorded at baseline, four weeks after supervised mouth rinse and after two weeks of stopping the mouth rinse. A total of 89 boys and 63 girls were included. A statistically significant decrease were noted in all variables after using both the herbal preparations at the end of 4 weeks which was maintained after the 2-week washout period. The difference in variables between groups using aloe vera, Tea tree oil, and chlorhexidine was not statistically significant. The use of aloe vera and tea tree oil mouthwashes can decrease plaque, gingivitis and S. mutans in the oral cavity in children. The activity of these two agents is comparable to that of chlorhexidine.

Gaurav Patri et al. [11] conducted a study on the role of tea tree oil and aloe vera as cavity disinfectant adjuncts. The study included three test groups, Group I (2% chlorhexidine), Group II (tea tree oil) and Group III (Aloe vera gel), with a control group (distilled water). Ten patients with atleast one tooth with an occlusal or occluso - proximal lesion suitable for Atraumatic Restorative Treatment (ART) were selected for each group; dentinal samples were collected using sterile spoon excavators at three stages from each tooth viz., pre-excavation, post-excavation and post-disinfection of the cavities. These dentinal samples were subjected to microbiological Analysis for Total Viable Count (TVC). The data collected were statistically analyzed using ANOVA and Bonferroni post-hoc test. The results of that study showed a statistically significant reduction in TVC when compared between pre and post-excavation in all the groups and post-excavation and post-disinfection in all the test groups (except the control group). Post-disinfection, 2% chlorhexidine showed the highest reduction in TVC, followed by 1% tea tree oil and aloe vera gel. It was concluded that natural antibacterial agents like aloe vera and tea tree oil are effective cavity disinfectants which will help in the reduction of secondary caries and rendering a long-term restorative success.

A.R. Prabhakar et al. [12] conducted an experimental, in vivo intergroup split-mouth, randomized clinical trial. The study included GroupI (Control), GroupII (Aloe vera) and Group III (propolis). Ten patients with three teeth, each having occlusal/occluso proximal lesions suitable for ART were selected. Dentinal samples were collected three times from each tooth, viz., pre-excavation, post-excavation, and post disinfection of the cavities. These dentinal samples were subjected to microbiological analyses for the total viable count. Statistical Analysis Used: Repeated analysis measures of variance (ANOVA) with Bonferroni post-hoc test and one-way ANOVA with Tukey post-hoc test. In all three groups, a significant number of bacteria were left behind after hand excavation. Group II and Group III, in which cavities were treated with A. vera and propolis extracts, respectively, showed a significant reduction in the bacterial counts compared to the control group. It was concluded that hand excavation alone does not eliminate bacteria, which may predispose treated teeth to secondary caries. Both propolis and Aloe vera extracts can be used as potential natural disinfecting agents, thereby embracing the concept of phytotherapy in minimum intervention dentistry.

Assessment of bias was compared among the selected studies. Most of them have performance bias, detection bias and attrition bias. However, none of them has selection bias in their studies.

Almost all of the above studies show that Aloe Vera has a nearly equal efficacy of plaque control in periodontal health and prevents dental caries compared to the gold standard chlorhexidine mouthwash. In contrast with traditional medicine modalities, Aloe vera is easily available and economical; it will markedly reduce both high medical costs and invalidity. Dentistry is varying with the induction of modern science to practice dentistry. [8] Aloe vera tooth gel used as toothpaste has an antibacterial effect in the oral cavity. The capability of Aloe vera tooth gel to do that successfully has been a point of contention for some dental professionals. [16]

4. Conclusion

Thus, it is concluded that there exists a solid bactericidal movement of Aloe vera gel against cariogenic microscopic organisms. This action is credited to various pharmacologically dynamic mixes, including anthraquinones, aloin, aloe-emodin, aloetic corrosive, anthracene, aloe mannan, Aloe rid, antranol, chrysophanic corrosive, resistance and saponin. Aloin and aloe-emodin have solid antibacterial and antiviral exercises. Aloin and aloe-emodin have polyphenolic structures, which can repress protein union by bacterial cells, in this way clarifying their antimicrobial action. The studies done to compare the efficacy of Aloe Vera and chlorhexidine mouthwash reveals that Aloe vera shows a significant reduction in dental plaque, dental caries and gingival score, which is comparable to chlorhexidine mouthwash.

Though chlorhexidine has a slightly higher reduction than aloe Vera mouthwash, the difference is insignificant. Chlorhexidine is a synthetic chemical that produces hypersensitivity and toxic effects in individuals. But Aloe Vera is an organic product and is less harmful. In addition, it is easily available at a low cost. So, Aloe vera mouthwash can be a suitable alternative to the gold standard for the treatment of dental caries.

References

[1] Selwitz RH, Ismail AI, Pitts NB. Dental caries. Lancet. 2007 Jan 6;369(9555):51-9.

[2] John E. Bennett MD, in Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, 2020.

[3] Mangaiyarkarasi SP, Manigandan T, Elumalai M, Cholan PK, Kaur RP. Benefits of Aloe vera in dentistry. J Pharm Bioallied Sci. 2015 Apr;7(Suppl 1):S255-9.

[4] Vangipuram S, Jha A, Bhashyam M. Comparative efficacy of aloe vera mouthwash and chlorhexidine on periodontal health: A randomized controlled trial. J Clin Exp Dent. 2016 Oct 1;8(4):e442-e447.

[5] Joseph B, Raj SJ. Pharmacognostic and phytochemical properties of Aloe vera linn an overview. Int J Pharm Sci Rev Res. 2010 Jan 1;4(2):106-10.

[6] Kumar GR, Devanand G, John BD, Ankit Y, Khursheed O, Sumit M. Preliminary antiplaque efficacy of aloe vera mouthwash on 4-day plaque

re-growth model: randomized control trial. Ethiopian journal of health sciences. 2014 Apr 14;24(2):139-44.

[7] Sujatha G, Kumar GS, Muruganandan J, Prasad TS. Aloe vera in dentistry. J Clin Diagn Res. 2014;8(10):ZI01-ZI2.

[8] Mangaiyarkarasi SP, Manigandan T, Elumalai M, Cholan PK, Kaur RP. Benefits of Aloe vera in dentistry. J Pharm Bioallied Sci. 2015 Apr;7(Suppl 1):S255.

[9] Bhaiyana S, Puri A, Nangia R, Bhat N. Antibacterial effect of aloe vera gelagainst plaque and caries bacteria: an in-vitro study. International Journal of Health and Clinical Research. 2019;2(3):21-5.

[10] Kamath NP, Tandon S, Nayak R, Naidu S, Anand PS, Kamath YS. The effect of aloe vera and tea tree oil mouthwashes on the oral health of school children. European Archives of Paediatric Dentistry. 2020 Feb;21(1):61-6.

[11] Patri G, Sahu A. Role of herbal agents-tea tree oil and aloe vera as cavity disinfectant adjuncts in minimally invasive dentistry-an in vivo comparative study. Journal of Clinical and Diagnostic Research: JCDR. 2017 Jul;11(7):DC05.

[12] Prabhakar AR, Karuna YM, Yavagal C, Deepak BM. Cavity disinfection in minimally invasive dentistry-comparative evaluation of Aloe vera and propolis: A randomized clinical trial. Contemporary clinical dentistry. 2015 Mar;6(Suppl 1):S24.

[13] Manipal S, Hussain S, Wadgave U, Duraiswamy P, Ravi K. The mouthwash war-chlorhexidine vs. herbal mouth rinses: A meta-analysis. Journal of clinical and diagnostic research: JCDR. 2016 May;10(5):ZC81.

[14] Surjushe A, Vasani R, Saple DG. Aloe vera: a short review. Indian journal of dermatology. 2008;53(4):163.

[15] Linda Blackburn, BS, Leira Jimenez, Mary Tran, BS and Joan Pellegrini. Role of Aloe Vera in Oral Health Management Recognized for its antioxidant and antimicrobial action, aloe vera's anti-inflammatory properties can also be beneficial as an alternative dental therapy.

[16] Academy of General Dentistry. "Tooth Gel: Healing Power of Aloe Vera Proves Beneficial for Teeth and Gums, Too." ScienceDaily. ScienceDaily, 28 July 2009. Available at: www.sciencedaily.com/releases/2009/07/090717150300.html