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Aloe vera: A Multipurpose Healer and Bacterial Eradicator

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Abstract

Objective: The purpose of this study was to examine and discover how *Aloe vera* can be used as an alternative therapy in the dental field.

Methods: The PubMed, Google Scholar and Dentistry & Oral Sciences (DOSS) databases were utilized to find current scientific evidence on the effects of *Aloe vera*. Relevant articles were summarized to write a review of findings. In this study, 21 articles published from 2015 to present were reviewed.

Results: From the studies, there is strong evidence to support that *Aloe vera* exhibits beneficial effects in prevention of carious lesions, non-surgical scaling and root planing in patients with chronic periodontitis, and oral wounds. Furthermore, it is cost effective and easily accessible.

Conclusion: This review's findings indicate that dental health care providers could recommend *Aloe vera* as a preventive and an alternative treatment option to improve patients' oral health status.

Introduction

Throughout the eastern hemisphere, herbal and natural remedies are a common use in treating injuries and illnesses. In the traditional healing process, these sources are used especially by rural populations in developing regions, such as Eastern Asia, India and Africa for primary healthcare.^{1, 2} Recently, the western hemisphere has also been adapting this type of practice by switching from modern to more natural remedies in regards to alleviating pain and disease. When it comes to westernized medicine, antibiotics are typically prescribed to prevent infections. However, it has been found that antibiotics can actually cause more harm to our bodies, resulting in negative side effects and an increase in bacterial resistance.^{3, 4} Because of this, alternative medicine has been a popular topic of interest, in which researchers are finding ways to incorporate natural products into therapeutic treatments.⁴ *Aloe vera* is one of the most popular medicinal plant species with a historical reputation in holistic healing. Due to the naturally occurring chemical compounds, *Aloe vera* possesses beneficial inhibitory effects on gram-positive and gram-negative bacteria such as *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Porphyromonas gingivalis*.^{3, 5}

Properties of Aloe vera

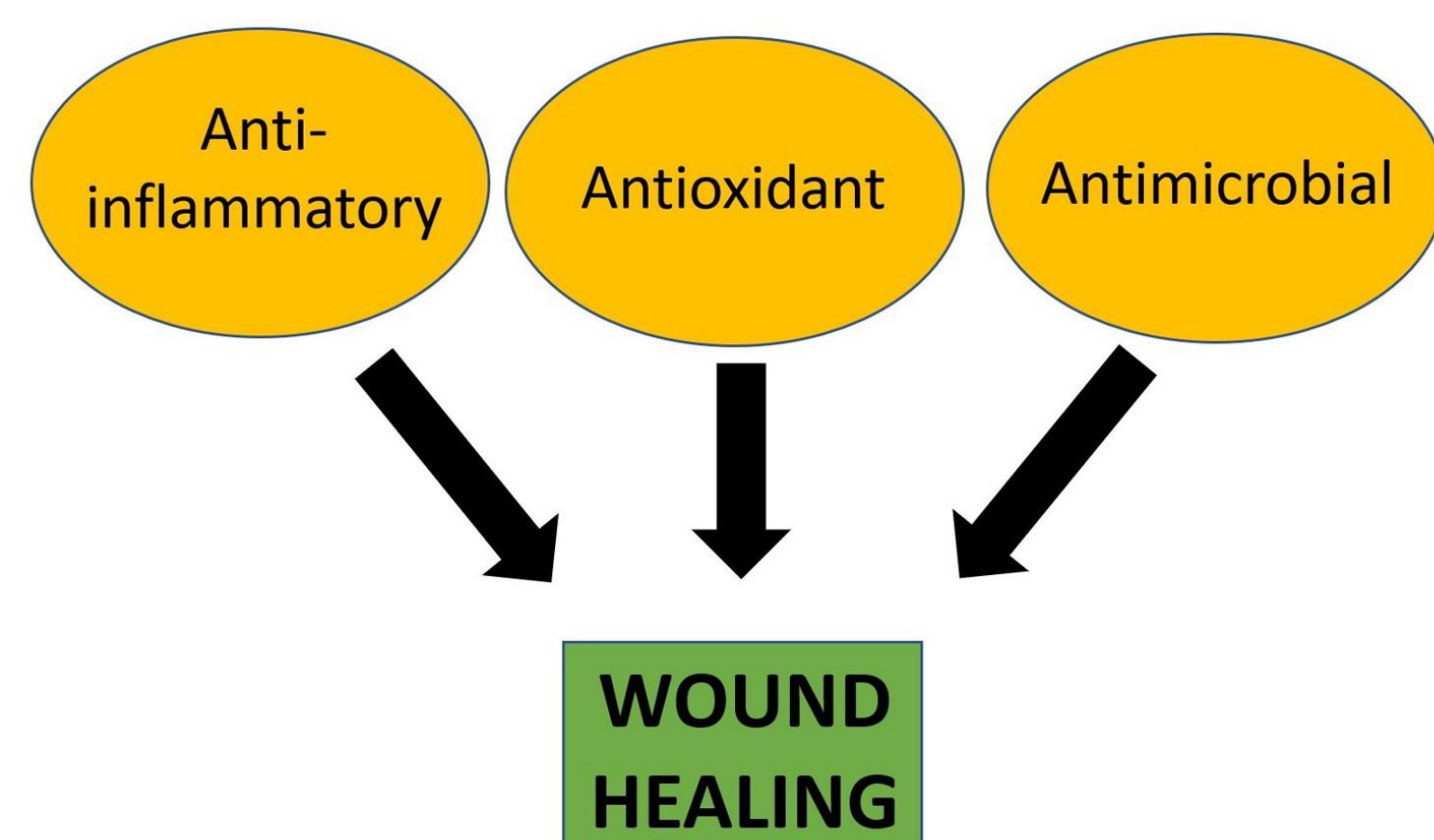


Figure 1: Beneficial properties of *Aloe vera* that contribute to wound healing.

Aloe vera in Dentistry

Cariou Lesions

- Randomized *in vivo* study⁶
 - Minimally invasive hand excavation of caries
 - Use of chlorhexidine as an antimicrobial agent underneath restorations can cause microleakage
- Three dentinal samples collected
 - Baseline dentin sample: removed from center of lesion with a spoon excavator after isolation with rubber dam prior to caries excavation
 - Second dentin sample: collected from the hard dentin with a spoon excavator after removal of caries
 - Third dentin sample: collected from the same area of hard dentin with a spoon excavator after being disinfected for 60 seconds and air dried
- Conclusion: *Aloe vera* could act as an alternative aid in preventing secondary caries and long-term success of restorations.

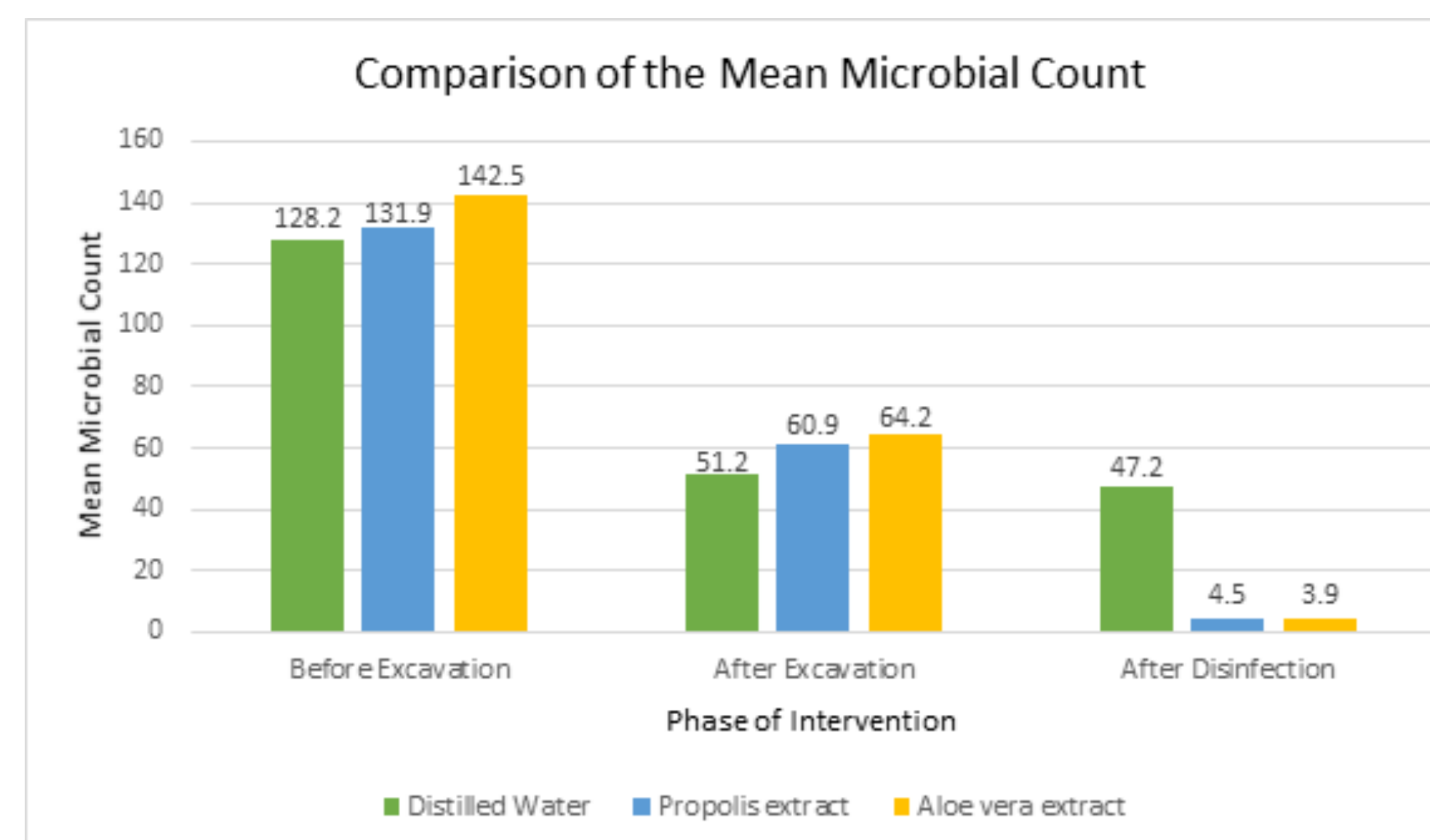


Figure 2: Comparison of the mean bacterial count between three study groups.

Adjunct to SC/RP in Chronic Periodontitis Patients

- Locally deliver *Aloe vera* gel into periodontal pockets after SC/RP
- Alternative treatment that utilizes its antimicrobial effects to eradicate pathogens such as *Actinobacillus actinomycetemcomitans* and *Porphyromonas gingivalis*⁷
- Blinded study on the effectiveness of *Aloe vera* gel versus Metronidazole⁸
 - Analyzed and compared results on 30-, 60-, and 90-day intervals based on plaque index, gingival index, and pocket depths utilizing independent t-tests
 - Conclusion: *Aloe vera* could serve as a substitute for Metronidazole delivery after SC/RP.
 - Associated with decreased plaque index, reduced pocket depths, and improved rate of regaining attachment loss

Oral Wounds

- Various formulations of *Aloe vera*, such as mouthwash, are efficient in the treatment and management of oral wounds⁹
- Meta-analysis study of treating oral lichen planus (OLP) with *Aloe vera* versus synthetic corticosteroids¹⁰
 - *Aloe vera* clinically improved OLP: reduced pain, reduced burning sensations, oral striations disappeared, and no adverse side effects
 - Synthetic corticosteroids were found to be superior in managing OLP, however they have adverse side effects such as: candidiasis, bad taste, nausea, xerostomia, sore throat, swollen mouth.
 - Conclusion: *Aloe vera* is a promising aid for OLP due to its lack of adverse effects and lack of contraindications found with corticosteroids.

Aloe vera in Dentistry

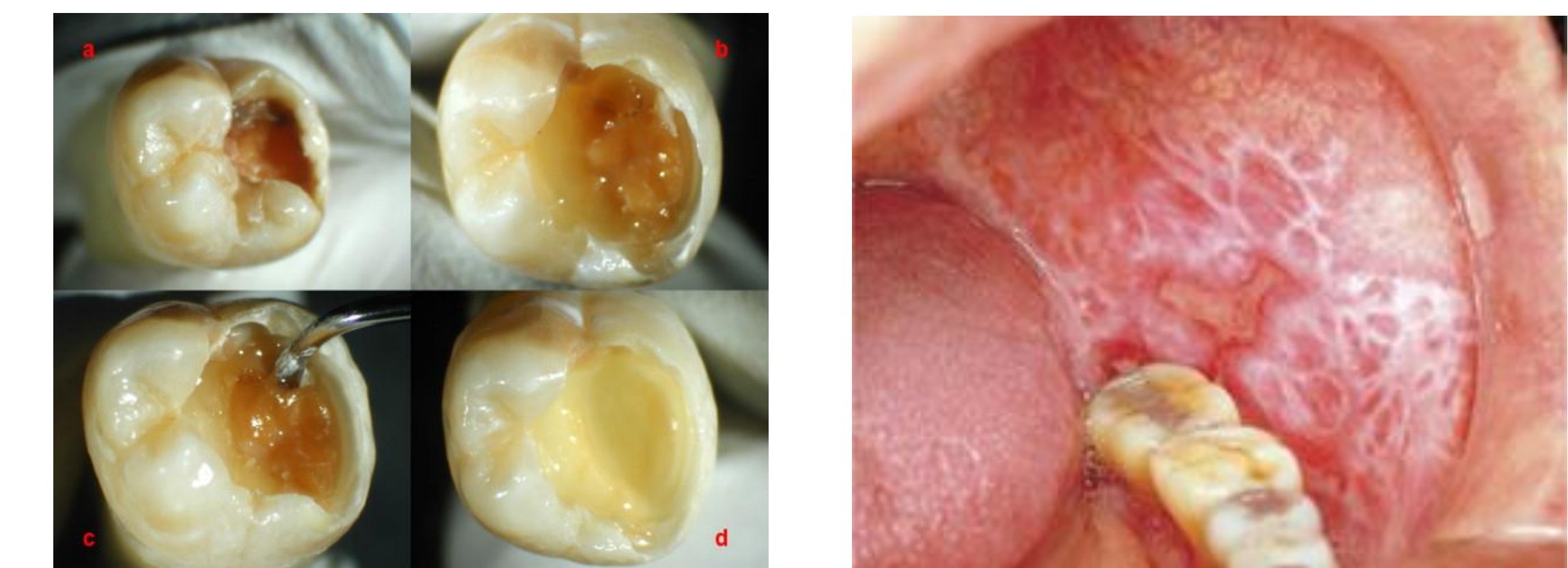


Figure 3: Hand excavation process of dental caries.



Figure 4: Oral lichen planus in the oral cavity.

Conclusion

- *Aloe vera* can serve as an alternative therapy in the dental field.
- *Aloe vera* can aid in preventing carious lesions, non-surgical scaling and root planing in patients with chronic periodontitis, and oral wounds.
- *Aloe vera* is cost-effective, easily accessible, clinically applicable, utilizes minimal equipment, and has no known adverse side effects.

Future Research

- Conduct additional research to promote alternative therapeutic treatments using *Aloe vera*
- Include larger sample sizes and longer time intervals to follow-up and track progress
- Use *Aloe vera* for treatment in conjunction with other herbal and natural products

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***Aloe vera* in Dentistry: A Multipurpose Healer and Bacterial Eradicator**

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Abstract

The *Aloe vera* plant is a succulent known for its rich content in vitamins and minerals, thus gaining popularity over the years in healthcare products. With advancements in alternative medicine, it has been recently found useful in dentistry due to properties such as anti-inflammatory, antioxidant and antimicrobial actions that contribute to wound healing. The purpose of this study was to examine and discover how *Aloe vera* can be used as an alternative therapy in the dental field. The PubMed, Google Scholar and Dentistry & Oral Sciences (DOSS) databases were utilized to find current scientific evidence on the effects of *Aloe vera*. Relevant articles were summarized to write a review of findings. In this study, 21 articles published from 2015 to present were reviewed. From the studies, there is strong evidence to support that *Aloe vera* exhibits beneficial effects in prevention of carious lesions, non-surgical scaling and root planing in patients with chronic periodontitis, and oral wounds. Furthermore, it is cost effective and easily accessible. This review's findings indicate that dental health care providers could recommend *Aloe vera* as a preventive and an alternative treatment option to improve patients' oral health status.

Introduction

Throughout the eastern hemisphere, herbal and natural remedies are a common use in treating injuries and illnesses. In the traditional healing process, these sources are used especially by rural populations in developing regions, such as Eastern Asia, India and Africa for primary healthcare.^{1,2} Recently, the western hemisphere has also been adapting this type of practice by switching from modern to more natural remedies in regards to alleviating pain and disease. When it comes to westernized medicine, antibiotics are typically prescribed to prevent infections. However, it has been found that antibiotics can actually cause more harm to our bodies, resulting in negative side effects and an increase in bacterial resistance.^{3,4} Because of this, alternative medicine has been a popular topic of interest, in which researchers are finding ways to incorporate natural products into therapeutic treatments.⁴ *Aloe vera* is one of the most popular medicinal plant species with a historical reputation in holistic healing. Due to the naturally occurring chemical compounds, *Aloe vera* possesses beneficial inhibitory effects on gram-positive and gram-negative bacteria such as *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Porphyromonas gingivalis*.^{3,5}

Beneficial Components of *Aloe vera*

Anti-inflammatory properties

The *Aloe vera* plant has been found to contain anti-inflammatory properties.⁶ Research shows that it inhibits histamine and leukotrienes released by mast cells or can cause macrophages to release nitric oxide and cytokines.⁷ *Aloe vera* also inhibits the cyclooxygenase pathway, which reduces prostaglandin E2 (PGE2) and breaks down bradykinin to reduce pain.⁷ There is a reduction of leukocyte adherence and tumor necrosis factor- α (TNF- α), which then blocks the inflammatory process from continuing.⁸ Each of the pathways deals with the immune system and ultimately causes the anti-inflammatory property in *Aloe vera*.⁷ Additionally, the plant contains anti-inflammatory fatty acids such as cholesterol and campesterol, which helps with a variety of immune system diseases.⁵

Antioxidant properties

The viscous secretion in *Aloe vera* known as mucilage contains various vitamins and amino acids. Specifically, vitamins A, C and E are antioxidant compounds that contribute to ridding potentially damaging oxidative agents and carcinogens.^{9,10} Additionally, *Aloe vera* mucilage contains antioxidant enzymes such as glutathione peroxidase and superoxide dismutase, which work to counteract free radicals produced from the site of infection. The plant's antioxidant properties work synergistically with the anti-inflammatory components to expedite wound healing.⁹ Confirmation of *Aloe vera*'s antioxidant effects has been reported in both *in vivo* and *in vitro* in past studies.¹¹

Antimicrobial properties

Aloe vera's antimicrobial effect is mainly due to the plant's natural anthraquinones found in the sap, which are associated with inhibiting bacterial protein synthesis. Studies have shown that *Aloe vera* exhibits antimicrobial effects against highly resistant bacteria such as *Staphylococcus aureus* and *Pseudomonas aeruginosa*.³ The plant also contains an antibacterial agent called acemannan, which plays an indirect part in its therapeutic activities through phagocytosis.¹² Studies completed *in vitro* and *in vivo* contribute to *Aloe vera*'s ability in fighting against bacteria by reducing secondary infections, increasing the activity of T-lymphocytes, and also increasing the activity of macrophages, eventually resulting in wound healing.¹

Wound Healing

Aloe vera possesses several beneficial properties as mentioned above. Together the anti-inflammatory, antioxidant and antimicrobial properties work simultaneously to heal wounds. Traditionally, *Aloe vera* is known for its ability to heal unprotected skin that is exposed to

ultraviolet and gamma rays.¹³ Even though *Aloe vera* has been used for thousands of years throughout various cultures, it has recently been proven as a therapeutic aid in healing.¹³ Most importantly, *Aloe vera* contains compounds such as vitamins, sugars, enzymes, minerals, lignin, saponins, salicylic acids, amino acids, and anthraquinones that promote cell regeneration.¹³ This cell regeneration stimulates healing effects in which *Aloe vera* can be delivered topically to heal eczema, burns, acne, dermatitis and psoriasis.¹³ The healing property makes *Aloe vera* beneficial and unique in the medical field.

***Aloe vera* in Dentistry**

Cariious lesions

Prevention is the foundation to sustaining optimal oral health. When not maintained, carious lesions can unfortunately develop. Prabhakar et al. conducted a randomized *in vivo* study to determine *Aloe vera*'s efficacy as a potential cavity disinfecting agent following minimally invasive hand excavation of dental caries. Three comparison groups (distilled water, *A. vera* extract, propolis extract) were utilized and results showed significant amounts of cariogenic bacteria leftover from hand excavation alone. No significant difference was found between all three groups for pre-excitation and post-excitation of dental caries. However, bacterial counts were statistically significant post-cavity disinfection ($p < 0.01$). Disinfecting caries with propolis and *Aloe vera* extract resulted in a significant reduction in bacterial count compared to distilled water ($p < 0.001$). The two extracts had similar disinfecting potential, but *Aloe vera* was marginally more efficacious ($p = 0.99$). This essentially indicates that *Aloe vera* is tremendously potent in its properties. Antimicrobial agents such as chlorhexidine have been used to eradicate bacteria under restorations but have been found to display adverse effects such as microleakage. Thus, it can be concluded that using *Aloe vera* as a potential cavity disinfecting agent is a great method in alternative therapy, possibly aiding in the prevention of secondary caries and long-term success of restorations.¹²

Non-surgical scaling and root planing in patients with chronic periodontitis

Chronic periodontitis is a common disease within the oral cavity, characterized by deep gingival pocket formation, destruction of the alveolar bone, and attachment loss.¹⁴ The first step in treatment of chronic periodontitis is removing the bacteria and risk factors that allow the disease to progress, and then reconstructing and regaining attachment.¹⁴ The non-surgical method to treating periodontal disease is completed by scaling and root planing to debride bacterial plaque and calculus that is embedded to the tooth surface, which is known as the "gold standard" of treatment.¹⁵ Additionally, scaling and root planing is completed with the usage of chemotherapeutic agents released subgingivally into the pocket to access areas that are difficult

to reach with instrumentation alone.¹⁶ Examples of chemotherapeutic agents released subgingivally during treatment of chronic periodontitis are chlorhexidine gluconate (Periochip®) and minocycline hydrochloride (Arestin®). Recent studies have proven topical use of *Aloe vera* within periodontal pockets during treatment of chronic periodontal disease in adjunct to scaling and root planing is effective in the treatment of periodontal disease.

In Iran, a study was completed with chronic periodontitis patients who received scaling and root planing on all their teeth.¹⁴ After the procedure, patients were instructed to use “Signal Family Protection toothpaste” and not to change their oral hygiene home care.¹⁴ The patient's mouth was divided into two quadrants; one quadrant had *Aloe vera* gel injected into their periodontal pockets using a syringe, and the other quadrant was injected with distilled water.¹⁴ During this study, dental professionals completed measurements of plaque index, gingival index and pocket depth at various intervals and then compared the results based on differences using an independent t-test (significance level is $p < 0.05$). In the end, the quadrants injected with the *Aloe vera* gel had significantly improved results in relation to gingival index and pocket depth, but there was no significant effect on plaque index when compared to the control quadrant.¹⁴ The p-value was $p = 0.244$ for the plaque index, which does not show a significant difference between the control and test group. The significant difference of the gingival index was $p = 0.001$ and pocket depth was $p = 0.026$, which proves that *Aloe vera* is effective in aiding the gingiva during periodontal treatment.¹⁴

Another study compared the effectiveness of *Aloe vera* versus metronidazole in adjunction to scaling and root planing.¹⁵ Patients who received scaling and root planing treatment received either *Aloe vera* gel or metronidazole gel (Elyzol®) locally applied to their pockets.¹⁵ Metronidazole is a common antibiotic that is an active agent against periodontitis, which targets the anaerobic microorganisms.¹⁵ The patients were then analyzed and compared based on their plaque index, gingival index, and probing depths at 30-, 60- and 90-day intervals. The p-value was $p < 0.0001$ for all clinical parameters, which indicates it to be statistically significant and that *Aloe vera* was effective in the treatment. The end results of this study proved that *Aloe vera* could serve as a substitute for metronidazole delivery after scaling and root planing procedures in patients with chronic periodontitis due to its effectiveness, cost and natural remedies.¹⁵

Based on the usage of *Aloe vera* gel in the treatment of chronic periodontitis in adjunction to non-surgical scaling and root planing, both studies support the idea that *Aloe vera* gel is an ideal alternative in the treatment of chronic periodontitis.¹⁶ Part of this is due to *Aloe vera* being a suitable option for extended use of plaque control.¹⁷ Locally delivering *Aloe vera* gel into periodontal pockets has been associated with a decrease in plaque index, reduction in pocket depths, and improved rate of regaining attachment loss. This is mainly due to its antimicrobial effects in eradicating pathogens such as *Actinobacillus actinomycetemcomitans* and *Porphyromonas gingivalis*, along with the plant's anti-inflammatory and antioxidant properties.^{16,8}

Oral wounds

Wounds in the oral cavity can lead to discomfort or pain that can manifest day-to-day life such as speaking, swallowing and mastication.¹⁸ Subsequently, xerostomia and oral dysesthesia can occur.¹⁸ Some causes of oral lesions include: infection, physical, chemical, thermal, immunological, systemic diseases, trauma, neoplasia and chronic habits.¹⁸ Proper treatment or management of oral wounds is necessary to alleviate the detrimental symptoms.

The wound healing properties of *Aloe vera* are important to medical and surgical procedures as it has been demonstrated in laboratory and clinical studies.¹⁹ Ultimately the research suggests various formulations of *Aloe vera*, such as mouthwash, are efficient in the treatment and management of oral wounds.¹⁹

Ali and Wahbi found that *Aloe vera* is a successful aid in managing oral lichen planus (OLP) wounds with no adverse effects.⁷ *Aloe vera* is inferior to the gold standard, synthetic corticosteroid triamcinolone acetonide, in managing OLP.⁷ However, the meta-analysis suggests *Aloe vera* is a promising aid for OLP due to its lack of adverse effects and lack of contraindications found with corticosteroids.⁷ Other studies found that *Aloe vera* has a 74% success rate in reducing lesions caused by OLP, similar to triamcinolone acetonide (0.1%) having a 78% success rate.⁷ These results demonstrate the statistically significant result of *Aloe vera*'s effectiveness in treatment of OLP as an oral wound.

Conclusion

With thorough research, it is concluded that *Aloe vera* is a beneficial aid in dentistry. The synergistic relationship between *Aloe vera*'s anti-inflammatory, antioxidant and antimicrobial properties contributing to wound healing, essentially benefits systemic and oral health. In summary, our findings suggest that *Aloe vera* is successful in prevention of carious lesions, non-surgical scaling and root planing in patients with chronic periodontitis, and oral wounds. *Aloe vera* is easily accessible, cost-effective, clinically applicable, utilizes minimal equipment and causes no adverse effects. This makes *Aloe vera* an ideal preventive substitute in the growing healthcare field. Thus, implementation of *Aloe vera* in dental practices as an alternative treatment option will yield positive and effective results in the patient's oral cavity and overall health.

Future Research

Further research should be put into practice for the usage of *Aloe vera* in dentistry to promote alternative therapeutic treatments. Future studies should include larger sample sizes and longer time intervals to follow-up, along with tracking treatment and progress. Another area of interest for the success of *Aloe vera* in future studies includes *Aloe vera* being used for treatment in conjunction with other herbal and natural products.

Studies such as Sahgal et al. show pomegranate (*Punica granatum*) as a useful eradicator of periodontal pathogens and has similar effects to chlorhexidine.²⁰ Future studies might include

Aloe vera in combination with pomegranate in reducing periodontal pathogens to discover if the two in combination enhance antimicrobial effects. Another study found that 10 mg *Salvadora persica* dried ethanol extract combined with 940 mg *Aloe vera* gel had superior healing effects on gingival index (1.5 ± 0.6) compared to chlorhexidine (2.31 ± 0.73), when used as a mouthwash on intubated patients in an Intensive Care Unit (ICU).²¹ For future studies, it would be useful to examine the formulated mouthwash containing 10 mg of *S. persica* dried ethanol extract with 940 mg *Aloe vera* gel used in Rezaei et al.'s study on patients going through periodontal therapy.²¹

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