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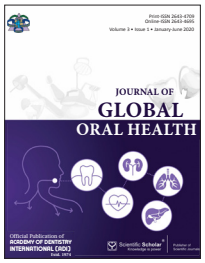

Review Article

Leptospermum honey – A medicinal wonder for periodontal health

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ABSTRACT

Antibacterial therapy has always been included effectively in the regimen of periodontitis. The inability to access periodontal disease-causing organisms within periodontal pockets has limited the effectiveness of mechanical plaque removal and the use of antibacterial agents. The drug's systemic administration results in therapeutic concentrations at the site of infection, but only in the short term, necessitating repeated dosing over longer periods. Topical antibiotics have been studied for their ability to overcome the limitations of conventional therapy. It is of interest to use sustained release formulations to deliver antimicrobial agents to the site of infection (periodontal pocket). At much lower doses, these products provide long-term treatment at the site of infection. From time immemorial, honey is not only considered as a natural sweetener but is also used for its healing power. It is used in traditional folk and tribal medicines and 93% of the consumers of honey use it for its medicinal value. Active *Leptospermum* Honey (ALH) is the most researched medical grade honey for wound and burn treatment. This article documents the efficacy of ALH as a topical drug delivery system in patients with chronic periodontal disease.

Keywords: Chronic periodontitis, local drug delivery, Active *leptospermum* honey

INTRODUCTION

Honey is a natural bliss from flower nectar or the excretions or secretions from plant parts. Honey bees collect it, process it, and combine it with their unique substances to mature and ripen.[1] Honey is a centuries-old remedy for infected wounds that have only recently been "rediscovered" by the medical fraternity.[2] Laboratory studies have shown honey's antibacterial effects against a variety of bacteria and fungi. Notable among the bacteria is Pseudomonas aeruginosa, an organism known for its resistance to antibacterial compounds.[2,3]

Honey was prescribed in 147 prescriptions in Ebers Papyrus (1550 BC) for external and post-operative application, as a suppository, and to reduce inflammation. It was used in wound healing on the Smith Papyrus (circa 1700 BC).[4] Honey was used for a variety of purposes in Ayurvedic medicine in ancient India. According to the Ayurvedic scripture Ashtanga Hridaya, written around AD 500, honey can be used to treat a variety of diseases, including wound healing and infection control.[5] Honey has a high concentration of enzymes and free amino acids. It is also high in B vitamins, minerals, and antioxidants such as flavonoids and Vitamin C. Honey is available in four varieties: comb, extract, chunk, and cream.[6,7]

In Australia and New Zealand, *Leptospermum* spp. is known by several common names, including tea tree, manuka, goo bush, and jelly bush. More than 100 substances are candidates for the antibacterial properties of this honey, but the mechanism of action is unknown. Despite the fact that the action of hydrogen peroxide is inhibited and the osmotic effect of honey is hampered by dilution, the honey selected by *Leptospermum* spp. demonstrated a significant antibacterial effect. The effectiveness of antibacterial activity in natural honey from other sources can vary up to 100-fold (due to hydrogen peroxide).[8]

Honey's antibacterial activity is referred to as "inhibine." Depending on the concentration, honey can be both bacteriostatic and bactericidal. Bacteriostatic activity is achieved at concentrations of 5–10% and 8–15% (v/v) in pasture honey (4–8%) and manuka honey (5–11%), respectively. Honey has been shown to inhibit approximately 60 different types of bacteria, including aerobic and anaerobic bacteria, as well as Gram-positive and Gram-negative bacteria. Nine honey has a MIC (minimum inhibitory concentration) ranging from 1.8% to 10.8% (v/v), indicating that it has enough antibacterial capacity to prevent bacterial growth if diluted at least 9 times.[9] In comparison to dextrose and sucrose, natural honey lowers plasma glucose, C-reactive protein, homocysteine, and blood lipids in healthy, diabetic, and hyperlipidemic subjects.[3,10]

Raw honey inhibits fungal growth, while diluted honey inhibits toxin production.[1] Some yeasts, *Aspergillus* and *Penicillium* species, as well as all common skin fungi, have been shown to have antifungal properties. Candidiasis, caused by *Candida albicans*, can be triggered by honey. Honey is extremely irritating to the skin and superficial fungi such as ringworm and tinea pedis. This response is caused in part by fungal growth inhibition and in part by bacterial colonization inhibition. Natural honey has antiviral properties as well.[11]

Honey has been shown to reduce the activity of cyclooxygenase-1 and to have anti-inflammatory effects on cyclooxygenase-2. Honey also has immunomodulatory properties. Furthermore, oral administration of diluted natural honey has been shown to reduce prostaglandin plasma concentrations such as PGE2, PGF2, and thromboxane B2 in normal human plasma.[12] Lesions treated with honey had less edema, less granulation and mononuclear cell infiltration, less necrosis, better wound shrinkage, improved epithelium, and lower glycosaminoglycan and proteoglycan levels. Furthermore, it decreases inflammation and secretions, promotes wound healing, reduces scar size, and stimulates tissue regeneration.[13] Many flavonoids, phenolic acids, ascorbic acid, tocopherols, catalase, superoxide dismutase, reduced glutathione, Maillard reaction products, and peptides work together to provide a synergistic antioxidant effect.[4,14] Honey cleanses wounds, promotes tissue regeneration, and reduces inflammation.[13]

Antibiotics attack bacteria's cell walls or block intracellular metabolic pathways, whereas honey is hygroscopic, drawing moisture from the environment, and eventually dehydrating the bacteria. Honey's sugar content is also high enough to inhibit bacterial growth, but this is not the only reason for its antibacterial properties.[15] Standard antibacterial activity has been demonstrated by appropriate *in vitro* test methods. Unlike glucose oxidase, the antibacterial properties of *Leptospermum* spp. honey is light and heat resistant. The final sterilization process, gamma irradiation, has no effect on any of the operations. More than 100 substances are candidates for these honey's unique antibacterial properties. Despite the fact that, the action of hydrogen peroxide is inhibited and the osmotic effect of honey is hampered by dilution, the honey selected by *Leptospermum* spp. demonstrated a significant antibacterial effect. Natural honey from other sources can vary in antibacterial activity by up to 100 times (due to hydrogen peroxide). In addition to antibacterial properties, medicinal honey has anti-inflammatory properties that speed up wound healing.[16]

Chronic periodontitis is the most common form of periodontitis and is often characterized by a slowly progressive inflammatory disease. However, systemic and environmental factors (e.g., diabetes and smoking) can alter the host's immune response to dental biofilms for periodontal destruction. Although chronic periodontitis is most commonly seen in adults, it can occur in children and adolescents as a response to chronic plaque and tartar buildup. Honey has been reported a potential therapeutic role in the treatment of gingivitis and periodontal disease.[17]

Periodontal pockets are chronic inflammatory lesions in the process of ongoing repair. Complete healing does not occur due to persistent bacterial attack, which, further, stimulates an inflammatory response, thereby causing degradation of newly formed tissue elements in the ongoing attempt of repair. The condition of the soft-tissue wall of the periodontal pocket is the result of the interaction of destructive and constructive tissue changes. Their balance determines clinical features such as color, consistency, and surface texture of the pouch wall. Honey is thought to have a therapeutic role in the treatment of such wounds.[17] Honey's acidity increases the release of oxygen from hemoglobin, making the wound environment less favorable for destructive protease activity, and its high permeability draws fluid out of the wound bed to induce lymphatic flow, as occurs with negative pressure wound therapy.

This type of therapy has the effect of reaching the bottom of the periodontal pocket and remaining there for an appropriate amount of time for the antibacterial effect to occur. The periodontal pocket acts as a natural reservoir irrigated with gingival fluid, making it easy to insert the delivery device.[18]

A study conducted by English *et al.,* in New Zealand found that manuka honey reduced plaque scores statistically significantly.[17] Honey showed minimal inhibitory concentrations for seven species other than streptococci in a study by Basson *et al*. The antibacterial activity of honey was measured at 12% for *Streptococcus oralis*, 17% for *Streptococcus anginosus*, and 25% for *Streptococcus gordonii*, *Streptococcus mutans*, *Streptococcus salivarius*, and *Streptococcus sanguinis*. This suggests that honey has anti-streptococcal activity and is useful in the treatment of gingivitis.[19]

Antibacterial agents are effective in the treatment of periodontal infections. The inability to access periodontal disease-causing organisms within the periodontal pocket limits the effectiveness of mechanical plaque removal and repeated use of topical and systemic antibacterial agents. The drug systemic administration results in therapeutic concentrations at the site of infection, but only for the short term. Topical antibiotics have been studied for their ability to overcome the limitations of conventional therapy. It is of interest to use sustained release formulations to deliver antimicrobial agents to the site of infection (periodontal pocket). At much lower doses, these products provide long-term and effective treatment at the site of infection.

The literature has shown that honey can be used in the treatment of periodontitis, dry socket, and canker sores. The anti-inflammatory action of honey provides a soothing effect when applied topically. The antioxidants present in honey along with its anti-inflammatory effect prevent the deterioration of periodontal tissues.[2] Honey can activate white blood cells, which helps prevent the rapid growth of periodontal bacteria. The next important property of honey in the treatment of periodontal disease is that honey can stimulate the growth of granulation tissue and epithelial cells, helping to repair periodontal tissue.[3] However, studies have shown that it is less sugary than sucrose. According to Molan, candied honey can prevent halitosis, or bad breath, because honey quickly removes odors from infected wounds. Using a soft gel, honey can be applied periodically to the gum line and prevents gingivitis or the colonization of caries causing bacteria on the gingival tissue.[20]

DISCUSSION

The most common type of periodontitis is chronic periodontitis, which is characterized by a slowly progressive inflammatory disease. Chronic periodontitis is a multifactorial infectious disease caused by a challenge between the host response and specific periodontal pathogens, characterized by the gradual and irreversible loss of periodontal support tissue over time.[21] Systemic and environmental factors such as diabetes and smoking can alter the host's immune response to dental biofilms so that periodontal destruction becomes more progressive. Chronic periodontitis lesions are characterized by bone attachment and resorption and are considered irreversible. In the existing literature, ALH has been widely used as a dressing for faster and better wound healing as well as an antibacterial agent that has been shown to give positive results.[8,22]

Studies have reported a lower plaque index and gingival inflammation, which can be explained by the fact that honey contains a significant level of antioxidants and has an anti-inflammatory action that has been demonstrated to be direct and not secondary to infection clearance.[23] According to a recent study, honey inhibits the activities of cyclooxygenase-1 and cyclooxygenase-2, demonstrating anti-inflammatory and immunomodulatory properties.[24,25] The study was carried out to investigate the effects of manuka honey on plaque and gingivitis; the findings suggested that manuka honey confectionery may have a potential therapeutic role in the treatment of gingivitis.[17] Another study was conducted to assess the efficacy of manuka honey on clinical levels of dental plaque, and the author concluded that manuka honey may have a therapeutic impact in the treatment of gingival and periodontal disease.[26] These findings are consistent with ours, implying that due to the reduction in inflammation, there will be less plaque accumulation at the site.

Honey is antibacterial and has been shown to inhibit the growth of approximately 60 bacteria species, including aerobes and anaerobes, Gram-positives, and Gram-negatives.[2] One possible explanation for its antimicrobial activity is its acidic pH, which ranges from 3.2 to 4.5 and creates an environment, in which periodontal microorganisms cannot survive. Even minor changes in pH can alter the growth rate and pattern of gene expression in subgingival bacteria, increasing the competitiveness of some putative Gram-negative anaerobic pathogens at the expense of periodontal health species.[27] Another possible explanation for honey's antimicrobial effect is the production of hydrogen peroxide, which is toxic to microorganisms.[2] Furthermore, volatiles, organic acids, lysozyme, beeswax, nectar, and pollen are present which provides antibacterial properties to honey.[28] Thus, the present study found that ALH has anti-plaque and anti-inflammatory properties, making it a promising local drug delivery agent in periodontitis patients.

CONCLUSION

It can be concluded that honey has a positive antimicrobial effect against a select number of periodontal pathogens but more research could explore the entire antimicrobial spectrum of honey against periopathogens. Isolation of active honey components is required to make future medical formulations. Honey requires as much attention in periodontal research as conventional antimicrobials.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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