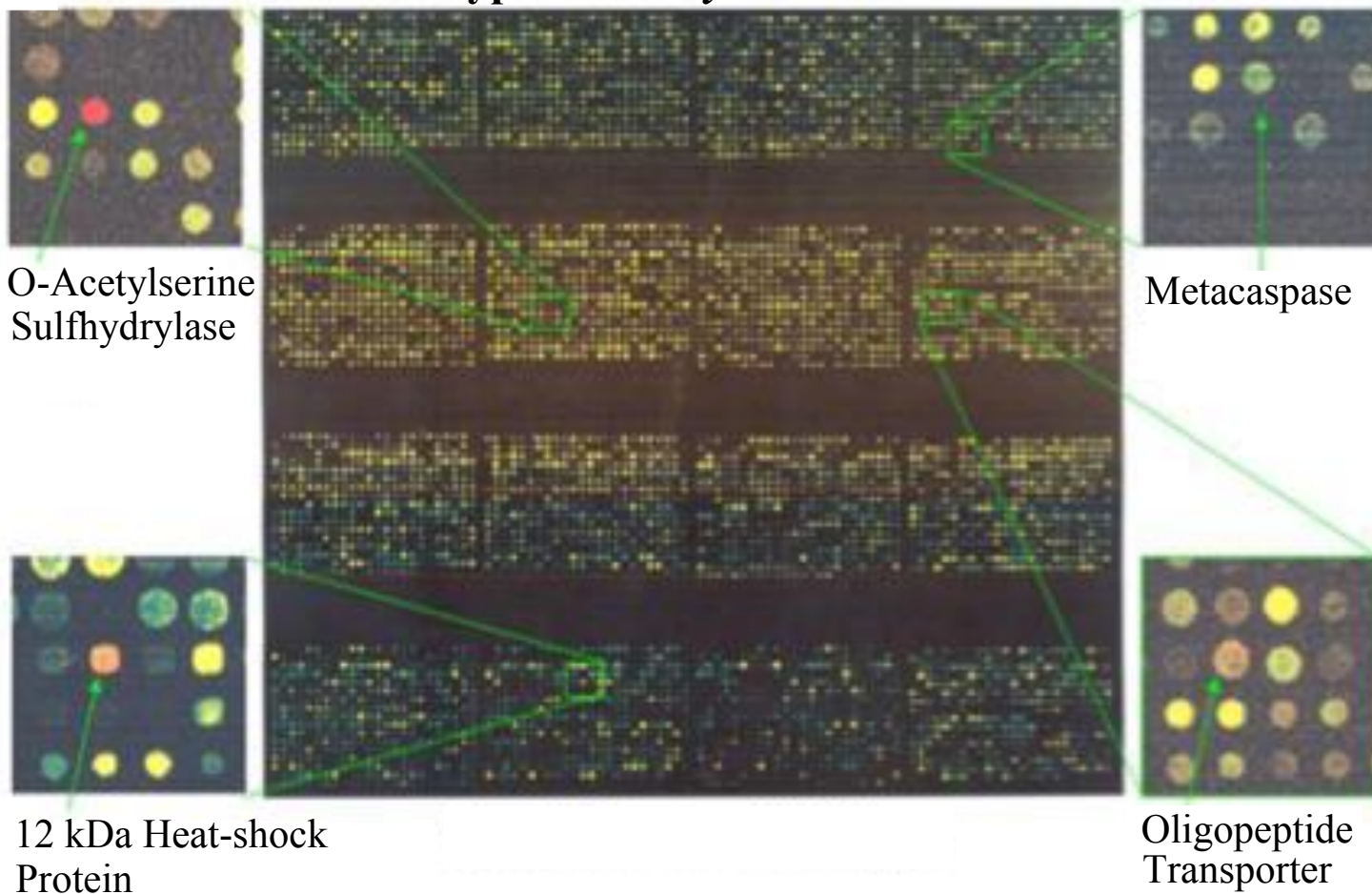


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Honey: A Natural Remedy in Dental and Oral Diseases

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Abstract

Honey is a natural medicine that has anti-bacterial, anti-inflammatory, anti-ulcer and antioxidant properties. The medicinal value of honey is attributed to several components including hygroscopic sugars, and enzymes like diastase, invertase, catalase and glucose oxidase. Glucose oxidase catalyzes the oxidation of glucose to hydrogen peroxide and gluconolactone. The hydrogen peroxide is further converted to water and oxygen by enzyme catalase. The low moisture content and high viscosity of honey provide protective barrier against bacterial infection. Honey not only has an excellent nutritional value but it is also used as an ointment or a drug as a complementary and alternative medicine called "Apitherapy". This mini review presents the medicinal value of honey in the treatment of dental and oral diseases/conditions such as oral ulcer, oral candidiasis, stomatitis, dental caries, plaque, gingivitis, periodontal disease and orthodontic treatment, and tooth extraction.

Keywords; Anti-bacterial, anti-inflammatory, apitherapy, dentistry, honey.

Introduction

Honey is a low-cost natural product made when the nectar and sweet deposits from plants are gathered, modified and stored in the honeycomb naturally by honey bees. In ancient times, honey was considered to be the food of gods and the symbol of wealth and happiness. Its prescription for a standard wound salve was discovered in the Smith papyrus, an Egyptian text dating between 2600 and 2200 B.C.¹ Honey in Islamic Medicine is considered a healthy drink. The Holy Qur'an has vividly illustrated the potential therapeutic value of honey as "And thy Lord taught the bee to build its cells in hills, on trees, and in (men's) habitations: Then to eat of all the produce (of the earth), and find with skill the spacious paths of its Lord: there issues from within their bodies a drink of varying colors, wherein is healing for men: verily in this is a sign for those who give thought" (The Holy Quran, 14:68-69). Moreover, the Muslim Prophet Mohammad^{pbuh} recommended the use of honey for the treatment of diarrhea. Honey was used to treat infected wounds as long ago as 2000 years before the bacteria were discovered to be the cause of infection. It is continuously being used by human beings as food as well as medicine for the treatment of various systemic, respiratory and skin diseases including asthma, urinary, gastro-intestinal, ulcers, wounds, seborrheic dermatitis and dandruff, eczema, psoriasis.^{2,3}

One feature of honey is that it is beneficial in promotion of oral wellness by virtue of its antibacterial and anti-inflammatory activities.³ The antibacterial effects of honey, bacteriostatic and bactericidal activities mostly

against gram-positive bacteria, are reported against many pathogenic strains.^{4,5} Honey glucose oxidase produces the antibacterial agent hydrogen peroxide. While another enzyme, catalase further breaks it down to water and oxygen.⁶ The antibacterial property of honey is attributed to high catalase and hydrogen peroxide activity. The roles of catalase and hydrogen peroxide in honey are demonstrated utilizing catalase deficient mutants (katA) against the *Pseudomonas aeruginosa*.⁷ Many researchers have reported that natural unheated honey possesses potent antibacterial, anti-inflammatory, anti-ulcer and antioxidant activities which show beneficial effects against several diseases.⁸⁻¹¹

Usage of Honey in Dental and Oral Diseases

Honey is implicated in the treatment of dental and oral diseases.¹²⁻²⁷ Honey contains about 181 known substances and nutrients such as amino acids, natural carbohydrates and enzymes, trace minerals (calcium, phosphorus and fluoride).²⁸ Diastase enzyme is responsible for converting starch to dextrins and sugars,²⁹ whereas invertase enzyme is responsible for converting sucrose in a nectar source to glucose and fructose.³⁰ Glucose oxidase catalyzes the oxidation of glucose to hydrogen peroxide and gluconolactone.⁶ The hydrogen peroxide is further converted to water and oxygen by another enzyme catalase.⁷ The trace minerals are the building blocks of tooth enamel.²³ Honey as a complementary and alternative medicine (termed as "Apitherapy")³¹ has been used for centuries to treat following dental and oral diseases:

Periodontal Disease

Periodontal disease (Periodontitis) is a serious form of gingivitis and chronic inflammation caused by bacteria, which destroys gums and other supporting structures around the teeth.^{19,22,32} Periodontitis is treated by natural honey. The distinctive characteristic of natural honey to treat periodontal disease lies in the stimulation of the growth of granulation tissue and epithelial cells by its anti-inflammatory activity.⁵ This process aids in repair of the damaged tissues, which are infected by bacteria or by the free radicals due to pro-inflammatory response.¹⁹

Periodontal inflammation is initiated by acute inflammatory responses, which is mainly caused by bacterial infection. This inflammatory response then progresses to chronic stage by the accumulation of white blood cells (leukocytes).³² It is possible that toxins released from bacteria can induce cytokines from the dental tissues that could invite macrophages, neutrophil and lymphocytes. The anti-inflammatory activity of honey protects the dental connective tissues and bone against the pro-inflammatory response, leading to the decrease in periodontal inflammation.³³ Hyperactivation of immune cells can also cause collateral damage to tissues through the release of reactive oxygen species (free radicals), as products of inflammation. The initial inflammatory response is elicited by bacterial cell wall components, but reactive oxygen species released from the activated phagocytes feedback as signals to elicit further inflammatory response. It has also been proposed that antioxidants can be used to protect the periodontal tissues from damaging free radicals, which are produced by pro-inflammatory process.³⁴

Oral Ulcer

Oral ulcers are caused by stress, thermal or chemical injury or acidic food or tissue injury induced by dentures, braces and sharp/broken teeth. They are characterized by a loss of mucosal layer within mouth that can be acute, chronic, localized or diffused. The use of honey, as an apitherapeutic agent, against oral ulcers has been centuries old practice. A large volume of literature is available on the effectiveness of honey in treatment of infected wounds and skin ulcers.^{12,25} This indicates that honey has also a great potential for the therapy of mouth ulcers and oral health problems. Honey can adsorb toxins from the mucous membrane and precipitate proteins, so the pus and inflammatory exudates may be easily adsorbed by the natural honey, thereby protecting the underlying tissues and enhanced normal healing and the re-epithelialization as well. Viscous properties of the natural honey facilitates in coating the ulcer. This process of coating the ulcer prevents it from secondary infection and also protects

ulcer surface from direct contact to different chemicals and microbes. Application of honey while treating ulcers has no allergic mucosal reaction or toxic effects.³⁵

Oral Candidiasis

Oral candidiasis or oral thrush is commonly caused by yeast/fungi. There are several fungi such as *Candida albicans*, *Candida glabrata* or *Candida tropicalis* which causes infection on the mucous membranes of the mouth. The *Candida albicans* is largely associated with oral candidiasis; in patients with impaired immunity.³⁶ Honey shows differential activity against candidiasis. For example, undiluted (100%) honey exhibits complete inhibition of *C. albicans*, whereas *C. stellatoidea*, *C. reukaufii* and *C. tropicalis* are inhibited by 50% diluted honey and only 10% diluted honey is required to prevent *C. pseudotropicalis* growth.³⁷ In another study, a mere 1.6% dilution of honey has shown the complete inhibition of *C. albicans*.³⁸ Among three South African Blue gum, Fynbos and Wasbessie honeys, Wasbessie honey demonstrates 29.4% inhibition of *C. albicans* by 25% concentrated honey.³⁹ These reports show various kind of honeys have inhibitory effects against candidiasis.

Orthodontic Treatment

Orthodontics is an important dentistry specialty. Orthodontia is an area of dentistry that diagnoses and treats improperly positioned teeth and jaws. Orthodontic misalignments or malocclusion can cause difficulty in eating, chewing and speaking. After orthodontic treatment, good oral hygiene is key to avoid the accumulation of bacteria around the braces that can later cause decay or gum disease. Orthodontic wax (made from bee wax naturally found in honey) is used during orthodontic treatment. A study conducted on bacterial isolates obtained from patients undergoing orthodontic treatment show that the honey is a more effective antibacterial than some of the common antibiotics tested, further suggesting that honey could inhibit dental plaque formation and aid in controlling gingivitis associated with orthodontic procedures.^{17,18}

Stomatitis

Stomatitis is inflammation of mucosal membrane of the mouth and lips that also called "Mucositis". Stomatitis is normally caused by chemotherapy and radiotherapy and can affect lips, cheeks, gums, tongue or throat. Several chemical mouthwashes (for e.g., chlorhexidine) have been used to maintain oral hygiene.²⁰ Honey, as a non-chemical mouthwash, is also used to preserve cellular

epithelium tissue in stomatitis conditions, to prevent intercellular rupture and wound infection. It is also used to reduce the growth of bacteria through its antibacterial activity. The anti-inflammatory and antioxidant activity, anti-ulcer of honey reduce inflammation, infected surgical infection, burn wounds and stimulate tissue repair.³ These activities of honey could possibly be of benefit for the relief of oral conditions resulting from radiotherapy and chemotherapy of cancer.

Dental Caries

Dental caries (tooth decay) is a very common infectious and communicable disease resulting in destruction of tooth structure by acid-forming bacteria found in dental plaque, an intraoral biofilm. The disease results in tooth loss if left untreated. On the other hand, fluoride in the mouth can inhibit demineralization in early carious lesions and promote remineralization, leading to rebuild stronger outer layers of the tooth (*i.e.*, enamel on the crown of the tooth and cementum on the root).²⁷ Water fluoridation, fluoride therapies, placement of dental sealants and fluoride-releasing filling materials are implicated in preventing dental caries.⁴⁰ Other appropriate oral health care approaches are utilized in the prevention and control of dental caries. An attempt is made to study the effect of honey in preventing dental caries in patients undergoing orthodontic treatment. This study concludes that honey can be used as an alternative remedy for the prevention of dental caries and gingivitis following orthodontic treatment.¹⁷

Tooth Extraction

Tooth extraction is a process of elimination of a tooth from its socket. The alternative methods have been applied for the healing of sockets post extraction with least possible side effects. The therapeutic features of honey seen in its usage in wound care elsewhere on the body indicate that it has the potential to be useful for prevention or treatment of infected wounds following tooth extraction or surgery.⁴¹ Honey, in its natural form, has the efficacy to heal the sockets after tooth extraction. The local application of honey promotes the rapid healing process particularly by increasing fibroblast proliferation and bony trabeculae.

A clinical trial conducted by Elbagoury and Fayed (1985) describes placing honey in sockets before closure of wound after surgical removal of impacted third molar tooth. They conclude that the patients have less pain and swelling, and less incidence of postoperative complications in honey treated group than in the untreated control group.²¹ The effectiveness of honey in such applications is likely to be limited as it has a tendency to dissolve quickly in saliva and thus, does not

have a longer therapeutic effect. In 2000, a novel wound dressing material consisting of gelled honey is developed by the University of Waikato, New Zealand. This gelled honey may be useful for the healing of sockets or oral ulcers, as it adheres to the oral mucosa and slowly dissolves in saliva. A similar rapid alleviation of pain is observed when the gelled honey is applied to the damaged bone after surgery, which is caused by the infection-induced erosion of the gum and jaw. The gelled honey is used because the conventional treatment is non-responsive for the period of six months.⁴²

Plaque and Gingivitis

Gingivitis is usually caused by bacterial infection, and inflammation of the gums. Honey is eco-friendly medicine, which has been used to treat wounds for many years. Manuka honey has superior antimicrobial properties, which can successfully be used in the treatment of wound healing, peptic ulcers and bacterial gastro-enteritis.²² A pilot study is undertaken to determine whether or not Manuka honey with its superior antibacterial activity with UMF (Unique Manuka Factor) above 15 could be used to reduce dental plaque and clinical levels of gingivitis. A chewable "honey leather" is produced for this trial.^{5,42} Thirty volunteers are randomly allocated to chew or suck either the Manuka honey or sugarless chewing gum, for 10 minutes, three times a day, after each meal. Plaque and gingival bleeding scores are recorded before and after the 21-day trial period. Analysis of the results indicates that there are statistically highly significant reductions in the mean plaque scores (0.99 reduced to 0.65; $p=0.001$), and the percentage of bleeding sites (48% reduced to 17%; $p=0.001$), in the Manuka honey group with no significant changes in the control group. These results suggest that there may be a potential therapeutic role for Manuka honey in the treatment of gingivitis and periodontal disease.^{5,22,42}

Biofilms in Dentistry

Dental biofilms are formed by disease causing bacteria present in the intercellular matrix comprising of organic and inorganic materials derived from saliva, gingival crevicular fluid and bacterial products.¹⁶ The biofilms can be reduced by physical and/or mechanical process or by the use of antimicrobials, sanitizers or disinfectants, to reduce the load or kill biofilm organisms. However, these biofilms cannot be eliminated completely because they are highly resistant to these approaches. Honey at high concentrations has been reported to inhibit biofilm formation and adhesion of bacteria due to its

antibacterial properties.¹⁶ Manuka honey has also shown to effectively inhibit the formation of biofilm formed by *Streptococcus pyogenes*.²⁴

Conclusion

Dental diseases are currently a costly burden to health care services around the world. The treatment of dental diseases is not affordable in developed as well as in developing countries. Dental treatment approximately costs between 5 and 10% of total health care expenditure, which exceeds the cost of treating even, cancer, osteoporosis and cardiovascular disease. Clinicians are attempting to reduce the prevalence of enamel demineralization, stomatitis, oral ulcer, oral candidiasis, plaque formation, gingivitis and periodontitis. Natural, pure and superior quality of honey has a potential to treat such dental diseases. The beneficial effects of honey on dental and oral diseases can be attributed to its anti-bacterial, anti-inflammatory, anti-ulcer and antioxidant properties. The use of honey can promote oral hygiene by preventing enamel demineralization, ulcers, gingivitis and periodontitis as well as inhibit plaque formation after orthodontic treatment.

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