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Healing Wounds with Honey

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Abstract

Honey has been used to treat wounds throughout the ages, even before bacteria were discovered. This research paper will discuss the healing phases and how honey plays a role in each phase. It also describes the proposed antibacterial, anti-inflammatory, and antioxidant mechanisms of actions and the clinical evidence of the efficacy of **honey** in a variety of acute and chronic wound types ranging from diabetic ulcers to Methicillin-resistant staphylococcus aureus. (MRSA) The use of honey as a wound-healing agent has many attributes that make it an option when treating athletes. Among the benefits discussed are honey's properties, safety, and effectiveness. These benefits make honey not only a viable, but an optimal treatment option in modern wound care. The databases that was used to collect the 18 articles that will be discuss was MEDLINE Complete and SPORTDiscus. This review reveals the possible usage of honey in athletic health care, but further research is recommended.

Introduction

Honey is a kitchen staple that has been around for centuries. Honey has been known to be used as a cough suppressant, and a sleeping aid (Shadkam et al., 2010). But have you ever thought of using honey as a topical healing agent for wounds or infections instead of a way to sweeten up your tea? Honey has been used to treat infected wounds in humans as long as 2000 years before bacteria was discovered (Anyanechi & Saheeb, 2015). In the words of Graham and Bonner (2014), "One of the oldest medicines known to man is gaining new respect as modern science proves its effectiveness at treating wounds" (p.33). Honey has been shown to be effective in many variations of wounds from diabetic foot ulcers, burns, chronic pressure ulcers, surgical wounds, and even Methicillin-Resistant Staphylococcus Aureus (MRSA). It has been found to be particularly effective where standard wound care is limited or unsuccessful. Honey offers broad spectrum antimicrobial properties and promotes rapid wound healing (Majtan, 2014). However there is still hesitation for modern medical practitioners to apply honey for local treatment of wounds. This may be because of the expected messiness of such local application, even though its antibacterial effect has been established during the past few decades (Biglari et al., 2012). In addition to allow adequate improved wound healing, the honey dressing has been reported easier to apply and remove with normal saline without adhesions, damage to the granulation tissue, or bleeding (Surahio et al., 2014). Honey is becoming important now that the antibiotic era is coming to an end as resistance in bacteria is ever-increasing (Graham & Bonner, 2014). Honey treatment also has shown to decrease the time of hospitalization and also the cost since it is most readily available than other agents around the world (Okeniyi et al., 2005).

The purpose of this research paper is to determine the potential uses of honey in health care professions, and establish the usefulness of honey in the athletic training setting. In this research paper, a description of how honey works in the three different healing phases: inflammation, proliferation, and remodeling. Next, the different types of honey as well as the properties of honey that allows it to be a powerful healing agent for wound management will be discussed. Finally, explanations and results of recent studies that use honey for the treatment of variations of wounds.

The Healing Process

Healing is a constantly changing continuum with overlapping events, yet spanning over three different phases (Houglum, 2010). The three phases are inflammation, proliferation, and remodeling. The Inflammation Phase starts as soon as the body recognizes a problem and begins a series of defensive maneuvers to stabilize the threatened area and projects it by immediately rushing chemicals and cells into the area. The process will take two to three days and sometimes up to a week to 10 days to complete. It is an important and necessary step in the healing process, without inflammation, the body would be unable to complete the healing process. However when inflammation is prolonged it can become deleterious. During inflammation vasodilatation occurs to release blood and blood products into the injured site, following release of chemicals. First platelets stimulate the clotting mechanism by creating a plug to stop the bleeding. Within the first few hours of injury, the body attempts to remove debris from the site. The following 24 to 48 hours macrophages remove debris and dead tissue from the area (Houglum, 2010). This step is necessary for the next (proliferation) phase to occur to continue the healing process.

Proliferation Phase

As previously mentioned there is an overlap of phases as the injury site heals. There is no clear-cut delineation between one phase and another (Houglum, 2010). Proliferation phase is the process of development and growth of new blood vessels (angiogenesis) and granulation tissue. Angiogenesis occurs at a rapid rate during this phase, which is important for scar tissue formation. Fibroblasts cells are largely responsible for production of new growth. These cells might not be very strong, but it holds the wound together and helps protect it from infection and stress. In the first five to seven days following injury, the fibroblasts form ground substance and rapidly lay down collagen. The collagen produced in these early days of healing is Type III collagen. The fiber structure is weak and thin, and in addition is placed without an organized arrangement, furthering reduces the strength. It is later replaced by Type I collagen, a much stronger and durable collage (Houglum, 2010). Proliferation phase generally begins five days and ends 21 days after injury, but the timeline can vary.

Remodeling Phase

The last phase of the healing process is called the remodeling phase. The wound tissue converts to scar tissue hence why the phase is called remodeling. Some of the activities that begin during the proliferation phase continue into the remodeling phase (Houglum, 2010). One example of this is wound contraction. Myofibroblasts are responsible for this activity. They have been observed in wounds by the fifth day and have been seen longer than two months after the injury. Myofibroblasts pull the wound edges toward the center to contract the wound's size. Another activity that begins during the proliferation phase and continues into the remodeling phase is collagen transition. As Type I collagen is synthesized, Type III collagen is destroyed. This phase is generally about 12 months long, but may range from 6 months to 18 months. As the area becomes more stable and more permanent in its cellular and structural arrangement, visible changes can also be observe which includes the loss of the scar's red color with progressive change to white and eventually more normal skin tones. The wound sensitivity also lessens (Houglum, 2010).

Honey and the Healing Process

Honey has properties that appear to enhance the healing process. However, most of the data demonstrates the ability of honey to modulate the inflammatory phase (Lee et. al, 2011). For example, honey properties contribute simultaneously to limit inflammation and promote wound healing. In the early inflammatory stage, honey seems to have the most positive effect in helping to remove necrotic tissue (Graham & Bonner, 2014). Removing the necrotic tissue is imperative to the healing process in that all necrotic tissue must be removed prior to the new tissue to rebuild. Therefore, honey would be a positive agent to use during the early stages of

injury. Furthermore, Lee, Sinno, and Khachemoune reports that honey also decreases scarring and contractures on patients, suggesting enhancement of the remodeling phase (Lee et al., 2011).

How Honey Works

Research reported that honey is also used to clear infections, and actively stimulate the repair process, and prevent actively hypertrophic scarring (Graham & Bonner, 2014). Honey has a potent broad spectrum antibacterial activity coupled with anti-inflammatory action, a soothing effect on pain, and is also an antioxidant (Anyanechi & Saheeb, 2015). Even though the chemical properties of honey and how the components behave are still under investigation, research has agreed that the primary benefits of honey are its antibacterial, anti-inflammatory, and antioxidant actions (Graham & Bonner, 2014).

Antibacterial Properties

Several properties of honey help kill bacteria making it antibacterial (Graham & Bonner, 2014). For one, it is acidic. Most of the honey registers between 3.5 and 4 on the pH scale, while most of the bacteria found in wounds thrive best in a neutral to basic environment, around 6 to 8 on the pH scale. The honey is also hygroscopic, which means that its sugar readily absorb moisture and will pull from the surroundings. This gives honey the ability to draw waste products and other fluids out of the wound while keeping the exposed surfaces moist, encouraging fresh lymphatic fluid to flow in the injured area. Bees have the ability to secrete an enzyme called glucose oxidase, and this enzyme remains stable until the honey is exposed to oxygen and water to create a chemical reaction that releases hydrogen peroxide (Graham & Bonner, 2014). Hydrogen peroxide is well known for its bubbling action as it cleans a wound. Glucose oxidase is slowly released to provide an antibacterial activity, but does not give any harm to the body tissue (Surahio et al., 2014). This allows honey to have the ability to provide a protective barrier to prevent cross infection, and create an antibacterial moist healing environment (Surahio et al., 2014). In addition, honey is able to eliminate most bacteria by osmosis due to its high sugar concentration (Pimentel et al., 2013).

Anti-Inflammatory Properties

Honey is also known to have anti-inflammatory properties come from the Methylglyoxal in honey as well as another protein that bees secrete that acts on white blood cells (Graham & Bonner, 2014). Another known property of honey is the antioxidant action. Honey is rich in polyphenols, which is a class of chemical compounds that tend to bind with potentially damaging reactive oxygen species that come as a byproduct of inflammations. This binding is very important since the normal healing process can generate too many byproducts which can inhibit healing (Graham & Bonner, 2014).

Reports of Honey and Specific Injuries

As mentioned before, honey has been studied for the treatments of variety of wounds, to determined the effectiveness that honey can produce. In the next few sections, a variety of wounds, and the studies on each will be furthered discussed.

Diabetic Foot Ulcers

A study using honey to manage diabetic foot ulcers was conducted to evaluate the efficacy and role of honey as local wound dressing agent, and its effect on the rate of amputation. This prospective observational study occurred in the general surgery department (Surahio et al., 2014). The study included 172 patients of either gender, above 18 years of age, belonging to different nationalities. All patients had complicated and non-healing diabetic foot ulcers. After admission and resuscitation, all of the patients had routine investigations, including an x-ray to

see the soft tissue and bony status of the foot. Each patient underwent early surgical debridement, and had a dressing of thick layer of honey applied three times a day after washing the wound with normal saline. The following results were reported. Wounds became healthy within 7-35 days. Three patients (1.75%) underwent big toe amputation and 2 (1.16%) patients underwent below knee amputations. Twenty (11.6%) patients underwent split skin grafting to cover the wound while in other patients the wound healed by secondary intention (Surahio et al., 2014). Secondary intention is when dressings are applied regularly to keep the wound clean, and the wound gradually closes and heals on its own.

The study reported that the risk of amputation is higher in diabetics, and foot ulcers are the single most common cause of hospitalization, and in diabetic patients with lower extremity amputations (Surahio et al., 2014). However, the results suggest that honey can be used successfully for the treatment of diabetic foot ulcers. Therefore, suggesting that honey significantly reduced the rate of amputation, and improved wound healing. This study was highly important since the rate of diabetes has been increasing. It is important for the health care profession to identify effective strategies to reduce amputation rates as well as improved quality of life and cost of care for the patients, because of the increase in number of humans recognized with diabetes (Surahio et al., 2014).

Chronic Pressure Ulcers

Pressures ulcers (PUs) are among the most common complications in patients with spinal cord injury (Biglari et al., 2012). The cost of the medical treatment of patients with PU are 2.5 times higher than the treatment costs of patients without PUs. The main problem in clinical practice is the deep, extended soft tissue damage, necrosis, and the bacterial super infection. These are not only a challenge for the surgeon, but can also lead to life-threatening complications. Pressure ulcers is a lifelong health risk for patients with paraplegic and can recur in one's lifetime. The wound dressing that applied to any wound especially PUs should absorb secretions, facilitate gas exchange to form a barrier, and be readily removable (Biglari et al., 2012). To support this notion a study using a series of professional wound care with medical-grade honey in spinal cord injured patients with PUs was conducted. Twenty adults with different size, depth, grade, and bacterial colonization PUs were included in this study (Biglari et al., 2012). Each patient had undergone unsuccessful PU treatment before they were giving the treatment of Medihoney. There were 7 (35%) female and 13 (65%) male patients. The average age was 48.7 years (30–79). A total of 6 patients (30%) were tetraplegic and 14 (70%) were paraplegic. Overall, 15 patients (75%) were completely paralyzed and 5 patients were (25%) incompletely paralyzed. In all, 5 patients (25%) had grade IV ulcers, and 15 patients (75%) had grade III ulcers according to the National Pressure Ulcer Advisory Panel classification (Biglari et al., 2012).

The application of honey was placed on a non-adherent sterile contact layer that was placed on top of a sterile dressing pad. Approximately 3mm of honey was applied, and conformed to the shape of the ulcers. On average, 21.7 cm2 was the PU size. All PUs were treated once daily with Medihoney after being cleaned with sterile Ringer's solution. After one week of treatment with Medihoney, all swabs were void of bacterial growth. Furthermore, a total of 18 patients (90%) showed complete wound healing after a period of 4 weeks, and the resulting scars were soft and elastic. There was also no negative effects from the honey treatment, and no blood sugar level derailment in the diabetic patients (Biglari et al., 2012).

Surgical Wounds

Honey has been advised as a new agent for split thickness skin graft fixation. Skin grafting is an operative method commonly used in the field of plastic surgery.11 Skin grafts are preformed if a body part has lost skin due to an injury or possibly an illness. It involves removing skin from one part of the body and moving it to a different part. A classic, and the most popular, method

to protect the graft is the placement of a bolster dressing wrapped with a large gauze and tied over onto the grafted bed itself with the attached peripheral sutures (Choi et al., 2015). The described method does not provide any antimicrobial action, which means that it only satisfies two of the three conditions for a successful graft take. However, if infection is not prevented or controlled adequately, the wound will not heal and the graft will eventually be lost (Choi et al., 2015). To study honey and its beneficial effects on split thickness skin graft fixation, 11 patients who underwent different diagnosis were evaluated (Emsen, 2007). The same medical honey was used for the fixation of the skin graft for all patients. No graft loss was seen during either the first dressing or the last view of the grafted areas. Neither infection or graft rejection was detected (Emsen, 2007).

Burns

The use of honey as a burn treatment was first documented by the Egyptians (Nasir et al., 2010). The increasing rate of multi-resistant to parenteral antibiotic and ineffectiveness of antibacterial topical dressings such as silver sulfadiazine (SSD) which is widely used represents a major challenge in burn care (Nasir et al., 2010). This problem required a different treatment option for patients to be created. The following study was completed to optimize honey as a natural product for the treatment of burn wound infections. An ointment containing 20% active antimicrobial honey was formed and applied on the burn wounds (Tasleem et al., 2013). First the wound was treated with normal saline, then a dressing with honey ointment on gauze was applied on to the wound two to three times a day up until complete healing occurred. The size of wound was measured in mm2 by tracing infection boundaries on a transparent paper before and after treatment. In a total of 20 patients with second degree burn wounds participated in the study to use honey as a treatment for burns. Each patient had visited the clinic with burn wound infection on different parts of the body, age range of 1–49 years with Mean (SD) of 23.85 (17.088) years. The application of the newly formulated honey ointment showed 100% healing results, which observed in all burn wound cases within mean healing time for the duration of 8.15 (3–18) days' time period (Tasleem et al., 2013).

The reported signs, symptoms and skin condition of the patient, (e.g., color, appearance (blister), swelling/edema, pain, inflammation, infections) were gently managed in the early 3–5 day application of newly formulated honey ointment dressing (Tasleem et al., 2013). Patients also reported the pain relieving and soothing action of honey had on the wounds. Honey was more active in management of infection and enhanced the rate of healing of burn wounds compared to SSD. The ointment containing 20% active antimicrobial honey controls the local stinging at wound site and ensures the active ingredient to persist at wound site for a longer duration. The ointment in this study was easy to apply, no adherence to wound was observed, the dressing was removed painlessly without any adverse effect to the site of application, and creates a moist wound healing environment which appeared to be favorable to accelerate wound healing (Tasleem et al., 2013). These are optimal properties for health care professionals when selecting a topical application for any kind of wound.

Methicillin-Resistant Staphylococcus Aureus (MRSA)

Methicillin-resistant staphylococcus aureus (MRSA) is a gram positive bacterium commonly found on the skin and in the nose of 25-30% of healthy individuals and in the Athletic Health Care arena (Montgomery et al., 2010). MRSA is becoming more prevalent in health care settings, and has recentlyemerged as a growing issue and challenge for allied health care providers (Garcia et al., 2012). The annual health care costs for MRSA infections total nearly $4.5 billion a year. According to the Centers for Disease Control and Prevention (CDC), the proportion of infections that are antimicrobial resistant has been growing. For example, in 1974, MRSA infections accounted for 2% of the total number of staph infections; in 1995 it was 22%; and by 2004 it rose to 63% (Garcia et al., 2012). Americans visit the doctor approximately 12 million times each year to get checked for suspected *Staphylococcus* species or MRSA skin

infections. This is the cause for some of the spread of MRSA from clinics to athletic settings, and to the greater community as a whole. Athletes are rarely hospitalized due to MRSA, yet many have visited physician for evaluation and treatments (Garcia et al., 2012). For this reason, athletic training operations and facilities are of importance to the entire issue.

According to research, MRSA strains were found on surfaces in both athletic training facilities and locker rooms facilities in 10 rural southeast Ohio high school's athletic training facilities (Garcia et al., 2012). Nine of the 10 schools that were sampled had at least two locations positive for MRSA. One school had seven of nine surfaces (78%) with evidence of MRSA (Garcia et al., 2012). Similarly, the prevalence of *staphylococcus aureus* and MRSA was highest on free weights and mats, respectively on a university campus (Montgomery et al., 2010).

According to the NATA Position Statement: Skin Diseases (Steven et al., 2010), the current treatment for MRSA includes: Athletes with suspicious lesions must be isolated from other team members, and be treated with antibiotic treatment. Also the NATA mentions the criteria for return to competition includes: No new skin lesions for at least 48 hours, completion of a 72-hour course of directed antibiotic therapy, no further drainage or exudates from the wound, and active infections may not be covered for competition. Since MRSA can be controlled by proper cleaning of the facilities, educating athletes about the disease as well as proper hygiene practices, such as taking a shower and not sharing equipment, must take place to stop the spread of the disease. Once an athlete is diagnosed with MRSA, antibiotics are given and the wound is covered (Steven et al., 2010).

To examine the healing of effects using honey 18 strains of MRSA were used, and seven strains of vancomycin-sensitive *Enterococcus Faecalis* isolated from infected wounds. All strains were found to be sensitive to manuka and pasture honey samples (Pimentel et al., 2013). The results concluded that honey can be used as an effective wound antiseptic, with a broad spectrum of antimicrobial activity against MRSA (Pimentel et al., 2013). Knowing the prevalence of MRSA in the athletic training arena and that honey is an effective wound antiseptic for MRSA, then it would be advised that athletic trainers may want to consider using honey to treat athletes with wounds.

Conclusion

The positive results of the studies referenced should encourage other wound-care professionals to implement the use of honey dressings with standardized antibacterial activity (Biglari et al., 2012). The rapid clearance of infection is the most notable feature of honey because it is effectiveness against aerobic, anaerobic, Gram positive, and Gram negative bacteria, and a variety of fungi (Anyanechi & Saheeb, 2015). When honey has been shown to be effective against complicated wounds, then is it possible to use for different types of sports trauma like abrasions and lacerations? Assessment and care of acute sports skin trauma is an essential skill for the healthcare provider on the sideline (Honshik et al., 2007). Athletic trainers and team physicians frequently recognize and treat skin injuries. Rapid and proper management can decrease risk of infection, save an athlete hours in the local emergency room, and at times allow rapid return to the sport. Cleansing and debridement are the most important components in the treatment of abrasions by facilitating healing and preventing infection (Honshik et al., 2007). To prevent the spread of MRSA in athletics, then the use of manuka and pasture honey can be used to treat the wound (Pimentel et al., 2013). The next step is the proper wound dressing for keeping the wound clean and providing the optimal environment for epidermal migration and healing (Honshik et al., 2007). It is essential to keep the honey in contact with the wound bed at all times which means having the honey absorbed in the dressing (Graham & Bonner, 2014). The United States FDA authority gave clearance of Medi honey as a wound dressing product (Tasleem et al., 2013). Nearly 62% of various types of honey have positive outcomes to treat multiple wounds and infections. However, not all patients are willing to return as often as necessary for the multiple dressing changes for the intraoral wound (Anyanechi &

Saheeb, 2015). Choosing the appropriate closure method like honey for open wounds can improve the cosmetic outcome and assist athletes in returning to competition (Honshik et al., 2007). Overall, honey is easily applied, and shows no damage to the wound while undressing the wound. Based on current research, honey can be used in the athletic setting as a topical treatment; however, research is needed to determine its effectiveness within this environment. Additionally, research should be conducted to determine whether there are any side effects of using honey as a treatment.

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