Re-introducing Honey in the Management of Wounds and Ulcers - Theory and Practice

Clinical Observations

Topical application of honey has been reported to rapidly clear infection, heal deeply infected surgical wounds, and halt advancing necrotizing fasciitis. Honey has healed wounds not responding to conventional therapy with antibiotics and antiseptics, including wounds infected with antibiotic-resistant bacteria, such as methicillin-resistant Staphylococcus aureus. It rapidly deodorizes wounds and debrides them to facilitate the rapid development of a clean granulating wound bed. Wounds dressed with honey have a rapid rate of healing, and honey can start the healing process in dormant wounds. Also, honey has been reported to stimulate the growth of epithelium over wounds, making plastic
surgery unnecessary,6,7,11,16,24 Honey reduces inflammation,24,25 edema,7,8,16,30,31 and exudate amounts,7,8,16,25 and has a soothing effect when applied to wounds23,25,32 and burns.23,25 It also minimizes scarring.7,19,22,29 In the more than 500 reported cases of using honey on wounds and the more than 140 cases of using honey in ophthalmology, the only adverse effect reported in some patients is a stinging sensation, which appears to be due to the acidity of honey.33

In addition, honey has been used successfully on skin grafts,34 infected skin graft donor sites,19,33 infected traumatic wounds,8,11,17,35 necrotizing fasciitis (Fournier's gangrene),7,8,16 abscesses,33,36 pilonidal sinuses,33 pressure ulcers,8,26,27,33,37 leg ulcers,17,18,28,33 diabetic ulcers,8,17,33,38 tropical ulcers or Naga sores (large, open, sloughing ulcers usually at the site of a wound or abrasion on the feet and legs, often infected with spirochetes and bacteria), sickle cell ulcers, and malignant ulcers.8 Honey is also a reliable alternative to conventional dressing for managing skin excoriation around stomas (ileostomy and colostomy), facilitating epithelialization of the raw surface.39

Comparative Effectiveness

In three prospective, randomized, controlled clinical trials, honey was found to help heal superficial burns quicker than polyurethane film (OpSite®, Smith + Nephew, Largo, Fla.), a dressing commonly used for creating a moist healing environment, or than silver sulfadiazine ointment, the "gold standard" dressing for preventing infection in burn wounds. In the study comparing honey-impregnated gauze with the polyurethane film, the mean times to healing in each group (n = 46) were 10.8 days and 15.3 days, respectively \((P < 0.001)\). In addition, significantly fewer honey-dressed wounds became infected \((P < 0.001)\).23

In the first of the two studies that compared honey-impregnated with silver sulfadiazine-impregnated gauze (n = 52 patients in each group), 87% of the wounds treated with honey healed within 15 days, compared with 10% of those treated with silver sulfadiazine \((P < 0.001)\).22 A statistically significant difference \((P < 0.001)\) also was found in the clearance of bacteria from the burns. In 43 out of 52 cases that presented positive swab cultures on admission in the group treated with honey, 91% became sterile in 7 days. In the comparison group, only 7% of 41 wounds with positive swab cultures became sterile. In the second trial, (n = 25 patients in each group), 100% of the wounds treated with honey healed within 21 days, compared to 84% of those treated with silver sulfadiazine \((P < 0.001)\).24 Also, greater histopathological evidence of reparative activity (80% of wounds treated with honey dressing compared to 52% of the wounds treated with silver sulfadiazine, \(P < 0.005)\) was noted in biopsy samples from the wound margins after 7 days of treatment. Regarding the clearance of bacteria from burns, in 23 of the 25 cases treated with honey that had positive swab cultures on admission in the group, 65% of the wounds became sterile in 7 days and 96% in 21 days. By comparison, of the 22 wounds with positive cultures treated with silver sulfadiazine, 73% became sterile in 7 days and 86% in 21 days \((P < 0.001)\).

Although these trials showed that honey offered better control of infection than standard treatments, a trial40 on moderate burns where half of the total burn area was full-thickness showed that control of infection was better with early tangential excision followed with autologous skin grafting than with honey treatment. In two groups (n = 25) of young adults, 34% of swab cultures were positive for the group treated with honey, compared with 10% of the group treated with early tangential excision \((P < 0.05)\). Antibiotics were needed for 32 ±
18 days in the honey-treated group compared with 16 ± 3 days in the excision group ($P < 0.001$). However, the mean blood volume replaced was less with the honey treatment (21% ± 15%, compared with 35% ± 12%, $P < 0.01$) and skin grafting was required on only 11 patients of the group treated with honey. The poor results obtained with honey in controlling infection could have been because the honey selected for use in this trial did not have a good antibacterial activity (see "Variation among honeys" in the next section).

In recent reports where selected honey was used on an infected wound following surgical treatment of hidradenitis suppurativa\(^\text{15}\) and infected skin lesions from meningococcal septicemia\(^\text{19}\), honey chosen for its good level of antibacterial activity gave rapid clearance of infection and healing of the wounds. In both studies, it had not been possible to achieve healing with the many systemic antibiotics and modern dressing materials previously tried over a long period of time.

Good infection control was reported in a crossover study\(^\text{13}\) of nine infants with large infected surgical wounds. Honey was used on the wounds after they failed to heal following at least 14 days of treatments with intravenous antibiotics (a combination of vancomycin and cefotaxime, subsequently changed according to bacterial sensitivity), fusidic acid ointment, and wound cleaning with aqueous 0.05% chlorhexidine solution. Marked clinical improvement was seen in all cases after 5 days of treatment with honey; all wounds were closed, clean, and sterile after 21 days of honey application.

A prospective, randomized controlled trial\(^\text{14}\) on severe postoperative wound infections following Caesarean section or abdominal hysterectomy was conducted to compare dressing with honey ($n = 26$) to washing wounds with 70% ethanol and applying povidone-iodine ($n = 24$). In the group treated with honey, infection was eradicated in less than half the time, the wounds completely healed in less than half the time, postoperative scars were less than half the size, and the period of hospitalization was less than half that for the patients in the control group ($P < 0.05$). Another trial\(^\text{9}\) found that dehisced abdominal wounds following Caesarean section healed in less than half the time (mean length of stay in hospital 4.5 days, range 2 to 7 days) when the wound margins were held together by micropore tape and the wounds dressed with honey, compared retrospectively with the usual treatment of wound care (cleansing with hydrogen peroxide, Dakin's solution, and packing with saline-soaked gauze) and subsequent re-suturing (mean length of stay in hospital 11.5 days, range 9 to 18 days).

### Antibacterial Action

Infection or a heavy bacterial burden in a wound is a major impediment to healing.\(^\text{41}\) Honey’s therapeutic importance as an antibacterial has been recognized since 1892, and a large amount of laboratory research has been conducted since that time.\(^\text{42}\) Its high osmolarity, due to its sugar content, is sufficient in the undiluted product to stop the growth of all microbial species. In addition, honey contains the enzyme glucose oxidase that, when honey becomes diluted, produces low levels of hydrogen peroxide.\(^\text{42}\) Because the production is continuous, the low level is sufficient to act as an antibacterial agent, even though the concentration typically achieved in diluted honey (approximately 1 mmol/L\(^\text{43}\)) is about 1,000 times less than in a commonly used 3% solution of hydrogen peroxide. In some honeys, augmentation of the antibacterial activity by phytochemicals in the nectar collected by the bees occurs.\(^\text{42}\) Usually, this is a minor factor, but in honey from Leptospermum species from Australia and New Zealand, this factor can make a major contribution to healing.\(^\text{42}\)
Although the osmotic inhibition of bacterial growth is lost when honey becomes diluted by wound exudate, the antibacterial activity remains important. Also, the osmotic action on bacteria is only effective on the wound surface; whereas, the other antibacterial factors diffuse into wound tissues.

**Variation among honeys.** The potency of the additional antibacterial factors varies as much as 100-fold between different types of honey.\(^{43}\) The Ancient Greeks recognized that some honeys were better than others for wound care. Dioscorides (circa 50 AD) stated that a pale yellow honey from Attica was the best.\(^{44}\) Aristotle (384 to 322 BC) referred to pale honey as "good as a salve for sore eyes and wounds."\(^{45}\) In present-day folk medicine, in practice in various parts of the world, certain local honeys are recognized for particular use.\(^{43}\)

Discovery of the antibacterial activity over and above the osmotic effect of honey on bacteria came from research on honey as far back as 1937. A system of rating the antibacterial activity of honeys, the "inhibine number," was devised in 1955.\(^{42,43}\) Yet, today, almost all clinical reports of honey use show no recognition of the variance in their antibacterial activity potency. Failure to take this variance into account has complicated conclusions on the sensitivity of different species of bacteria to the antibacterial activity of honey. However, the large number of microbiological studies that have been performed demonstrate that honey has a very broad spectrum of action.\(^{42}\) This offers an important advantage in managing infected wounds because sensitivity testing before starting treatment is not required.

**Action against specific bacteria.** More recently, honeys with standardized antibacterial activity (near the median level in the normal range of potency) were tested against some common wound-infecting species of bacteria. These studies have shown that the antibacterial activity of honey is quite significant. One study\(^{46}\) of type culture collection specimens of seven common wound-infecting bacterial species found that the minimum inhibitory concentration (MIC) of honey ranged from 1.8% to 10.8% (v/v) - ie, the honey was still able to stop bacterial growth if diluted nine to 56 times. A study of 58 clinical isolates of *S. aureus* found the MIC of honey to range from 2% to 4%,\(^{47}\) and a study of 20 isolates of Pseudomonas from infected wounds found the MIC of honey to range from 5.5% to 9.0%.\(^{48}\) A study of 82 epidemic strains of methicillin-resistant *S. aureus* (MRSA) found the MIC of honey to range from 3% to 8%, and for 56 strains of vancomycin-resistant Enterococci (VRE) to range from 5% to 10%.\(^{49}\) In a similar study, the MIC of honey was below 10% for eight strains of MRSA isolated from swabs collected from acute and chronic wounds; for 16 strains of VRE isolated from the hospital environment; for 15 strains of beta-hemolytic Streptococci; and for seven strains of vancomycin-sensitive Enterococci isolated from acute and chronic wound swabs.\(^{50}\)

**Deodorizing.** It is probably more than just the antibacterial action that is responsible for the rapid deodorizing of wounds observed when honey dressings are used. The malodorous substances produced by bacteria are ammonia, amines, and sulfur compounds. These are formed from the metabolism of amino acids from decomposed serum and tissue proteins. Honey provides a copious quantity of glucose, a substrate metabolized by bacteria in preference to amino acids.\(^{51}\)

**Immune System Activity**
The clearance of infection may not only be the result of the antibacterial action of honey. Recent research indicates that honey may work by stimulating the activity of the immune system. Honey at concentrations as low as 0.1% has been found to stimulate proliferation of peripheral blood B-lymphocytes and T-lymphocytes in cell culture and activate phagocytes from blood.\(^5^2\) Also, honey at a concentration of 1% has been reported to stimulate monocytes in cell culture to release the cytokines TNF-1, IL-1, and IL-6, which are intermediates in the immune response.\(^5^3,5^4\)

In addition to the reported stimulation of leukocytes, honey has the potential to further augment the immune response by supplying glucose. This is essential for the "respiratory burst" in macrophages that generates hydrogen peroxide, the dominant component of the bacteria-destroying activity of these cells.\(^5^5\) The sugars in honey also provide substrates for glycolysis, the major mechanism for energy production in the macrophages. This would allow them to function in damaged tissues and exudates where the oxygen supply is often poor.\(^5^5\)

**Debriding**

Like any other moist wound dressing, honey is expected to induce debridement of wounds by allowing the autolytic action of tissue proteases. But unlike other wound dressings, honey creates a moist environment by drawing out lymph fluid from the wound tissues through its strong osmotic action. This provides a constantly replenished supply of proteases at the interface of the wound bed and the overlying necrotic tissue, which may, in part, explain the rapid debridement brought about by honey. This osmotic action also washes the surface of the wound bed from beneath. This accounts for the long-known feature of honey dressings of removing dirt with the dressing.\(^5^6\) It also helps explain the painless lifting off of slough and necrotic tissue that is observed.\(^7,8,1^6,2^2,2^3,3^0\)

Another possible explanation for the observed rapid debridement is activation of the proteases by the hydrogen peroxide that is liberated by honey. The proteases in wound tissues are normally in an inactive state but can be activated by oxidation. The matrix metalloproteases of connective tissue, normally present in a catalytically inactive conformation, may be activated by the hydrogen peroxide.\(^5^7,5^8\) The neutrophil serine proteases are normally inactive because of the presence in wound tissues of an inhibitor, but hydrogen peroxide inactivates the inhibitor, so the protease becomes active.\(^5^9\)

High protease activity is strongly associated with impaired wound healing, which may suggest that activation of proteases by honey would be harmful rather than beneficial. However, a causal effect has never been proved; possibly, the association is the result of both the impaired healing and the high protease activity together caused by the same factor. Excessive inflammation prevents healing and the attraction of inflammatory leukocytes gives rise to high levels of proteolytic enzyme activity at the site of the inflammation.\(^6^0\) The potent anti-inflammatory action of honey (see below) would resolve such a situation and prevent excessive proteolytic activity. It also has been suggested that high levels of proteolytic activity and high levels of inflammation are both caused by a lack of secretory leukocyte protease inhibitor, which is an inhibitor both of serine proteases and the production of TGF-b, a potent chemoattractant of inflammatory cells. Yet proteolysis in wound tissues is a normal part of the healing process and responsible for autolytic debridement. Standard practice requires adding proteolytic activity to a wound to debride it, either through streptokinase preparations or larval therapy (maggots). Honey provides a much less expensive (and more comfortable) alternative.
Anti-inflammatory Action

Clinical observations of reduced inflammation following application of honey to a wound are substantiated by the results of in vivo studies that have shown that honey, when compared to various controls, reduces inflammation. Histological evidence of reduced numbers of inflammatory cells present in wounds dressed with honey exists from studies of deep\textsuperscript{61} and superficial\textsuperscript{25} burns as well as full-thickness wounds\textsuperscript{62-64}. These effects were due to components other than the sugar in honey.\textsuperscript{25,61} Evidence also has come from similar findings in biopsy samples from burn wound tissue of hospital patients.\textsuperscript{24} The conclusion that a reduction in inflammation was due to an anti-inflammatory component of honey, and not just a secondary effect of the honey clearing infection and debriding the wound, was based on results of experimental wound studies in which few or no bacteria were present.\textsuperscript{25,61-64} Evidence of the anti-inflammatory properties of honey is also based on reports about decreased stiffness of inflamed wrist joints of guinea pigs\textsuperscript{65} following the use of honey.

Although it is a vital part of the normal response to infection or injury, excessive or prolonged inflammation can prevent healing or even cause further damage to tissues. Suppressing inflammation, as well as reducing pain for the patient, reduces the opening of blood vessels, thus reducing edema and exudate. Pressure in tissues secondary to edema restricts the flow of blood through the capillaries,\textsuperscript{66} starving the tissues of the oxygen and the nutrients vital for leukocytes to fight infection and for fibroblasts to multiply for wound healing. Finally, healing may be impaired because swelling increases the distance for diffusion of oxygen and nutrients from the capillaries to the cells.\textsuperscript{67}

Free radicals. A more serious consequence of excessive inflammation is the production of reactive oxygen species (free radicals) in the tissues,\textsuperscript{68} side products of the activity of phagocytes in the inflammatory process. These reactive free radicals can break down proteins, nucleic acids, and cell membrane lipids, damaging or destroying tissue. Reactive oxygen species also recruit more leukocytes into areas of inflammation as a self-amplification of the inflammatory response.\textsuperscript{68} The mechanism of self-amplification of the inflammatory response is a result of activating the transcription factor NF-kB that promotes the production of the pro-inflammatory cytokines IL-1, IL-8, and TNF.\textsuperscript{69} Further amplification comes from the activation of proteases by reactive oxygen species\textsuperscript{57-59}; their increased activity results from activation of macrophages by oxidative activation of the transcription factor NF-kB,\textsuperscript{70} as the powerful chemoattractant TGF-b present in wounds requires proteolysis to become active.

Although the hydrogen peroxide produced in honey may have the potential to cause inflammation, it is produced at very low levels. In a discussion of the sense of cells using reactive oxygen species as messengers, it was noted that they can function only within a narrow concentration range.\textsuperscript{70} The antioxidant content of honey (see below) also would help prevent inflammation - oxidative species formed from hydrogen peroxide, rather than hydrogen peroxide itself, are responsible for the activation of the transcription factor NF-kB.\textsuperscript{70} This activation can be prevented by antioxidants.\textsuperscript{69} In experiments on monocytes\textsuperscript{53} and lymphocytes\textsuperscript{52} in cell cultures, honey mildly stimulated mitogenesis compared to classical mitogens (lipopolysaccharide or concanavalin A), but provided no additional stimulation if cells are stimulated by the classical mitogens. Honey also reduces production of reactive oxygen species in cells stimulated by lipopolysaccharide.\textsuperscript{53}
Burn wounds. Burn wounds characteristically have a large amount of inflammation that can lead to worsening of the original tissue damage. A study of burn wounds showed that the application of antioxidants to mop up free radicals reduces inflammation.\(^7^1\) Honey's significant antioxidant content mops up free radicals,\(^7^2\) which may explain why, in one study, honey dressings prevented partial-thickness burns from converting to full-thickness burns.\(^2^4\)

Leg ulcers. Whether it is the antioxidants in honey breaking the feedback loop of self-amplification of inflammation or another anti-inflammatory component is involved, the anti-inflammatory action of honey likely has a part in the notable effectiveness of honey in healing venous leg ulcers. Leg ulcers are in a state of continual reperfusion injury, a condition in which a large amount of reactive oxygen species is produced. This is because when ischemia is present (which occurs in a leg ulcer with venous stasis), xanthine oxidase is formed in tissues, which produces reactive oxygen species from the oxygen supplied when tissues are re-perfused (which occurs when the leg with a venous leg ulcer is elevated).

Scarring. The anti-inflammatory action of honey provides the most likely explanation for the reduction in hypertrophic scarring observed in wounds that were dressed with honey. The reactive oxygen species formed during inflammation stimulate the activity of the fibroblasts that produce the collagen fibers of scar tissue. In situations of prolonged inflammation, their over-stimulation can lead to hypergranulation and fibrosis.\(^7^3\) Fibroblasts are also responsible for wound contraction, so the anti-inflammatory action of honey may explain the reduction in contractures seen when honey is used to dress burn wounds.

Bioactivity: Stimulation of Tissue Growth

Honey is a bioactive wound dressing that provides rapid wound healing,\(^1^2,2^5,2^6\) promotes the formation of clean healthy granulation tissue,\(^5-8,1^0,2^4,3^1,3^6\) and hastens epithelialization,\(^7,8,1^6,2^4,2^9\) often obviating the need for skin grafting.\(^6,7,1^1,1^6,2^4\) Honey's stimulation of cell growth is probably also responsible for "kick-starting" the healing process in chronic wounds that have remained non-healing for long periods.\(^8,1^7,1^8,2^7,2^8\)

The ability of topically applied honey to stimulate tissue growth in wounds has been confirmed by measurements and histological observations in many experimental animal wound studies.\(^1^2,2^5,6^1-6^3,7^4\) In a study comparing rats treated with topically applied honey to untreated controls,\(^7^4\) wound size decreased by 43% over the first 4 days \((P < 0.001, n = 6)\) and the period required for complete epithelialization decreased by 15\% \((P < 0.05, n = 6)\). In another study on mice\(^1^2\) comparing topically applied honey to a saline control, epithelialization in the honey group increased by 114\% after 6 days \((P < 0.001, n = 12)\) and thickness of granulation tissue increased by 69\% \((P < 0.01, n = 12)\).

Collagen. Studies on experimental wounds in animals have demonstrated that, compared with untreated controls, topically applied honey stimulates collagen synthesis \((by 24\% after 6 days; \(P < 0.001, n = 6)\)\(^7^5\) and other connective tissue components \((hexosamine by 13\% after 8 days, \(P < 0.01, n = 6); \) and uronic acid by 23\% after 8 days, \(P < 0.001, n = 6)\),\(^7^4\) and improves collagen strength \((cross-linking) \((by 23\% after 6 days; \(P < 0.05; n = 6)\)\(^7^5\) and wound tensile strength \((by 21\% after 10 days; \(P < 0.05; n = 6)\).\(^7^4\)

Angiogenesis. Stimulation of angiogenesis by honey also has been observed in
histological studies of experimental in vivo wounds. This is an important feature for the promotion of healing, as oxygen supply is the rate-limiting factor granulation tissue comprises granules of fibroblasts growing where new capillary beds form. The acidity of honey also aids oxygenation by increasing the release of oxygen from hemoglobin.

Nutrients. The new capillaries formed also supply essential nutrients to growing fibroblasts, another factor limiting the rate of healing. Wounds heal faster if a nutrient mixture is applied topically. Honey supplies sugars and a wide range of amino acids, vitamins, and essential minerals. Through its osmotic action, drawing out lymph, honey also provides a constant flow of nutrients from the functioning capillaries deeper down. Honey also promotes healing by supplying glucose to the epithelial cells; they must build up an internal store of carbohydrate to provide the energy they need to migrate across the surface of a wound.

Hydrogen peroxide. Hydrogen peroxide is a stimulus for cell multiplication in many cell types within the body, acting at various points in the mechanisms of the cells that control the cycle of cell growth and division. It is produced to repair damage as part of the normal inflammatory response to injury or infection and the growth of fibroblasts and epithelial cells. Applying creams containing hydrogen peroxide stimulates the development of new capillaries in wound tissue. Low concentrations of hydrogen peroxide might be used to stimulate wound healing instead of expensive cell growth factors used for this purpose, but this is feasible only if the concentration is carefully controlled to avoid tissue damage (as occurs in honey). Honey also might be used in place of recombinant growth factors to provide hydrogen peroxide to stimulate the healing of burns.

The action of exogenously supplied hydrogen peroxide augments what occurs in an intracellular mechanism of response to growth factors binding to receptors on cells. The pathway of response to growth factors is via the Ras protein - this protein activates a second pathway, as well as the tyrosine phosphorylation of MAP kinase pathway, that then activates transcription factors. This second pathway activates the Rac protein, to form a complex that produces superoxide. The superoxide, possibly via other reactive oxygen species, activates the transcription factor NF-kB, stimulating mitosis. In vascular smooth muscle cells, the hydrogen peroxide endogenously produced as part of the signal transduction process in response to stimulation by platelet-derived growth factor activates MAP kinase; exogenous hydrogen peroxide in the concentration range of 0.1 to 1.0 mmol/L also will do this.

Hydrogen peroxide also activates insulin receptor complexes in cells. Activation triggers a chain of molecular events that stimulates the uptake of glucose and amino acids and promotes anabolic metabolism, giving cell growth. Intravenous infusion of insulin or its topical application to wounds stimulates the rate of wound healing; thus, indicating another possible mechanism by which honey promotes the healing process, stimulating uptake and anabolic metabolism of the nutrients it supplies to wound tissues.

Physical Properties as a Wound Dressing

Osmotic action. Honey differs from other wound dressings that provide a moist healing environment in that it has an osmotic action that draws fluid out from the wound bed. This creates a layer of fluid beneath the dressing layer - a contact with the wound surface that is a dilute solution of honey in plasma or lymph, allowing no adherence. Hence, no pain or
tearing away of newly grown repair tissues occurs when dressings are changed. Although the osmotic effect could dehydrate wound tissues, the circulation of blood underneath replaces fluid lost from cells and the osmotic effect of sugar on the surface creates an outflow.\textsuperscript{94}

The osmotic action of honey also removes any risk of skin surrounding a wound becoming macerated by the moisture accumulating under a dressing. Even when diluted, honey will induce a withdrawal of moisture rather than a hydration of skin.

**Infection barrier.** The high viscosity of honey provides a physical barrier against external contamination. This is particularly useful as an alternative to when gauze dressings would be required to avoid occluding the wound and, thus, encouraging growth of Pseudomonas in the moist conditions created, as in the treatment of burn wounds. As long as the honey used has sufficient antibacterial activity (see Recommendation 2), Pseudomonas growing in the moist conditions created by occluding the wound with honey would not be a threat. The antibacterial activity of honey also prevents growth of any bacteria already present on the surface of the wound, so odor associated with dressing changes is not a problem.

**Challenges.** The stickiness and fluidity of honey can be a practical challenge in dressing wounds, especially in retaining the honey when it is further liquefied by absorption of wound exudate.\textsuperscript{95} This issue was addressed by the Ancient Egyptians, who used honey mixed with fat covered with fibers for dressing wounds.\textsuperscript{96} In more recent times, the usual practice is to spread the honey on a wound and cover it with gauze or to spread the honey on gauze before placing it on the wound,\textsuperscript{4} although occasionally honey-impregnated gauze has been used. The disadvantage of these practices is that gauze does not absorb much honey.

**Recommendations.** In some situations, a "blister" of honey can be held on a wound using an adhesive membrane dressing. However, this is not a suitable form of dressing if the wound is exuding heavily. On most wounds, the best practice is to use an absorbent dressing impregnated with honey that allows an effective amount of honey to be easily applied and held in place. As long as the amount of honey impregnated does not exceed the amount the dressing will absorb, the honey does not run out, even under pressure bandaging. Impregnating dressings with honey is facilitated by warming the honey to body temperature and, if necessary, adding one part water to 20 parts honey to make the honey more fluid. Typically, 20 mL of honey would be used in a 4-inch by 4-inch dressing pad (cellulose or soft alginate fiber) (see Table 1).

**Conclusion**

The various forms of manufactured honey dressings currently being developed for marketing to the medical professions completely overcome any problems of messiness and difficulty of handling, making honey as convenient to use as the more familiar modern wound dressings. This brings the most ancient form of wound dressing known into the realms of the most modern - an easy-to-use, bioactive dressing that provides a moist healing environment, with the advantage of having within the one product a range of functionalities (debriding, deodorizing, antibacterial, growth-promoting, anti-inflammatory, and scar-minimizing) normally available only individually in a range of products. - OWM

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