

Why honey is effective as a medicine.

1 Its use in modern medicine

PETER C MOLAN

Honey has been used as a medicine for thousands of years and its curative properties are well documented. However, modern medicine turned its back on honey and it is only now, with the advent of multi-resistant bacteria, that the antibiotic properties of honey are being rediscovered.

Introduction

The usage of honey as a medicine is referred to in the most ancient written records. Honey was prescribed by the physicians of many ancient races of people for a wide variety of ailments. Its ancient use as a wound dressing has been described by Beck & Smedley², Majno³ and by Forrest⁴. The ancient Egyptians, Assyrians, Chinese, Greeks and Romans all used honey, in combination with other herbs and on its own, to treat wounds and diseases of the gut⁵. The Muslim prophet Mohammed recommended the use of honey for the treatment of diarrhoea⁶. Aristotle (350 BC) wrote of honey being a salve for wounds and sore eyes⁷. In ancient times honey from Attica had a special reputation as a curative substance for eye disorders². Dioscorides (c. 50 AD) wrote of honey being 'good for sunburn and spots on the face' and 'for all rotten and hollow ulcers'. He also wrote that 'honey heals inflammation of the throat and tonsils, and cures coughs' and 'mollifies the prepuce so that it can be pulled back over the bared glans penis'.

Honey has continued as a medicine into present day folk-medicine. In India lotus honey is said to be a panacea for eye diseases⁸. The use of honey for coughs and sore throats has also continued into the traditional medicine of modern times². Other examples of current day usage of honey in folk-medicine are: as a traditional therapy for Infected leg ulcers in Ghana⁹; for earache in Nigeria¹⁰; In Mall for the topical treatment of measles, and in the eyes in measles to prevent conical scarring¹¹. Honey also has a traditional folklore usage for the treatment of gastric ulcers¹².

There has been a renaissance in the use of honey as a medicine in more recent times. In outlining the resurgence of its usage in modern professional medicine, Zumla & Lulat in 1989⁵ referred to honey as 'a remedy rediscovered', and expressed the opinion, 'the therapeutic potential of uncontaminated, pure honey is grossly underutilized. It is widely available in most communities and although the mechanism of action of several of its properties remains obscure and needs further investigation, the time has now come for conventional medicine to lift the blinds off this 'traditional remedy' and

give it its due recognition: Possibly the increasing interest in the use of alternative therapies is the result of the development of antibiotic resistance in bacteria becoming a major problem¹³, or because people are experiencing the sometimes severe side-effects of many pharmaceuticals¹⁴ which in the currently prevailing ambience of 'chemophobia' may be sufficient to give rise to an aversion to all synthetic drugs¹⁵.

There is a tendency for some practitioners to dismiss out of hand any suggestion that treatment with honey is worthy of consideration as a remedy in modern medicine. An editorial in *Archives of Internal Medicine* assigned honey to the category of 'worthless but harmless substances'¹⁶. Other medical professionals have clearly shown that they are unaware of the research that has demonstrated the rational explanations for the therapeutic effects of honey^{17,18}. Many are not even aware that honey has an antibacterial activity beyond the osmotic effect of its sugar content¹⁸⁻²⁵, yet there have been numerous microbiological studies that have shown that in many honeys there are other components present with a much more potent antibacterial effect²⁶.

The ancient physicians who prescribed honey for various ailments would have had no knowledge of the principles involved in its medicinal action, just an empirical knowledge gained from its effective usage. But modern physicians generally require there to be a rational explanation for its medicinal action before a traditional, or 'complementary', medicine is given any consideration. Much has been written on the subject outside the professional medical and scientific literature, but many people, especially medical professionals, treat such reports with skepticism, especially since much of the popular literature claims honey to be almost a panacea. The more convincing professional reports are scattered through a very wide range of journals, and some of the

explanations for the medicinal effects of honey are to be found in articles unrelated to honey. Hence this review was undertaken to bring together the evidence that supports the use of honey as a medicine.

The first part of this review will cover the therapeutic effects that have been observed when honey is used as a medicine, and the data from observations, experiments and clinical trials that constitutes the evidence honey is an effective medicine. The second part (the science underlying its effects) will explain the various therapeutic effects of honey.

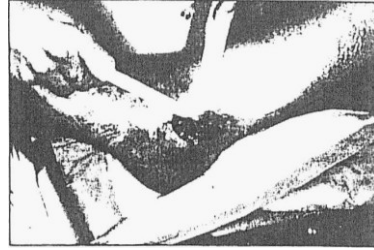
Treatment of wounds

The medical literature on treating wounds with honey has been reviewed recently in specialist wound-care journals, with a focus on the medical evidence²⁷ and with a focus on the clinical aspects²⁸. Here the focus is on the therapeutic effects observed when honey is used as a wound dressing, which will have their mechanism explained later. In the numerous reports in the medical literature on the use of honey as a wound dressing the types of wounds on which honey has been successfully used are very varied (see box).

Of particular note are the successful uses of honey to treat Fournier's gangrene^{36,64,65}, a rapidly spreading infection that is usually managed by aggressive surgical removal of infected tissue, and wounds from surgery for cancer of the vulva^{54,56-58}, which are difficult to treat because they are in a position where it is difficult to prevent infection occurring. But the therapeutic effects of the honey that have been observed are common to all of these different types of wounds.

Rapid healing

In several reports the rapidity of healing seen with honey dressings is noted. One report⁶⁶ refers to wounds becoming closed in a spectacular fashion in 90% of cases, sometimes in a few days. Another⁴⁰ refers to healing being surprisingly rapid, especially for first and second degree burns. Hejase⁶⁵ has also noted the rapid healing changes when honey is applied to Fournier's gangrene. Blomfield¹⁸ is of the opinion that honey promotes healing of ulcers and burns better than any other local application used before. Clinical observations made are that open wounds heal faster^{34,56} and are ready



Liquid honey being spread on a skin ulcer.

faster for closure by stitching³⁴ when dressed with honey (than when dressed conventionally). It has been noted that dressing wounds with honey makes the wound bed suitable early for skin-grafting⁴¹, and gives prompt 'taking' of the skin grafts^{33,35}.

amputations ^{30,32}	foot ulcers in lepers ²⁵
abscesses ¹⁷⁻¹⁹	infected wounds arising from trauma ^{20,24,25,31}
bed sores (pressure sores, decubitus ulcers) ^{21,22,31,34,35-38}	large septic wounds ³⁷
burns ^{15,30,32,36,37-38}	leg ulcers ^{32,51,57}
burst abdominal wounds following caesarean delivery ³⁷	malignant ulcers ²⁶
cancrem ³⁶	sickle cell ulcers ²⁶
cervical ulcers ²¹	skin ulcers ^{15,21,26,51}
chilblains ³⁰	surgical wounds ^{12-14,41,54-61}
cracked nipples ²³	tropical ulcers ³⁹
cuts ²⁹	wounds to the abdominal wall and perineum ⁵⁴
diabetic foot ulcers ^{23,31,34} and other diabetic ulcers ^{37,34,51}	varicose ulcers ^{34,51,57,63}

These clinical observations are in line with the findings from comparative clinical trials and studies on wounds on experimental animals. In one case a patient with multiple ulcers on both legs had one leg dressed with honey and the other treated conventionally (with fibrinolysin and calcium alginate dressing): the ulcers on the leg treated with honey healed much more rapidly⁵³. In another case a patient with a long abdominal wound that had become infected following surgery had one end of the wound dressed with honey and the other end dressed with Debrisan (a modern hydrocolloid wound dressing material); it took 16 days with the Debrisan to reach the stage of regrowth of skin over the healing wound achieved after 8 days with the honey. For treatment of burst abdominal wounds following caesarean delivery, the period of hospitalization required was 2-7 days (mean 4.5) for a group of 15 patients whose wounds were dressed with honey and closed with adhesive tape, compared with 9-18 days (mean 11.5) for the comparative group (19 patients) whose wounds were cleaned with antiseptic and restitched⁴⁹.

Stronger evidence is provided from the statistically significant results from randomized controlled clinical trials. A trial comparing honey-impregnated gauze with a commonly used polyurethane film dressing (OpSite) as a cover for partial thickness burns in two groups of 46 patients found faster healing with the honey (means 10.8 vs. 15.3 days)⁴⁴. Similarly, another trial comparing honey-impregnated gauze with amniotic membrane (a well-established material used as a temporary 'skin') as a cover for partial thickness burns in groups of 40 and 24 patients, respectively, found the burns treated with honey healed faster (means 9.4 vs. 17.5 days)⁴⁵. A trial comparing honey with boiled potato-peel dressings (another established material used as a temporary 'skin') as a cover for partial thickness burns in two groups of 50 patients found faster healing with the honey (means 10.4 vs. 16.2 days)⁴⁶. A trial comparing honey with silver sulfadiazine, the most commonly used burn dressing, as a cover for partial thickness burns in two groups of 52 patients also found faster healing with the honey: 87% of those treated with honey healed within 15 days compared with 10% of those treated with silver sulfadiazine⁴³. A similar trial with two groups of 25 patients found that satisfactory regrowth of skin over the burn had occurred in 84% of those treated with honey by one week, 100% by three weeks, whereas with silver sulfadiazine it had occurred in only 72% of those treated with silver sulfadiazine by one week and 84% by three weeks⁴⁷. A trial comparing honey with saline dressings in the treatment of pressure ulcers (bed sores) in two groups of 20 patients found faster healing with the honey (means 8.2 vs. 9.9 days)³⁸.

Controlled trials have also been carried out on the treatment of wounds on animals, with microscopic examination of the wound tissues confirming the directly observed faster rates of healing with honey. In a trial comparing honey with silver sulfadiazine on

deep burns on the skin of pigs, complete regrowth of skin over the burns was achieved within 21 days with honey, whereas it took 28-35 days with silver sulfadiazine. A sugar solution was also compared in this trial: this gave the same rate of healing as the honey, but microscopic examination of the tissues showed a better quality of healing with the honey, and cellular evidence of a more advanced state of healing. In a study comparing honey with sugar solution on superficial burns on the skin of rats, healing was seen by microscopic examination of the tissues to be more active and advanced with honey than with the sugar solution⁴⁰. The time taken for complete repair of the wound was significantly less with honey than with no treatment. A study on full-thickness skin wounds on buffalo calves found that honey gave a faster rate of healing than did the antibacterial nitrofurazone and the petroleum jelly control⁶⁸. A study on full-thickness skin wounds on rabbits found that honey gave a faster rate of healing than the untreated control wounds⁶⁹.

Other studies on animals have compared honey with saline, a standard moist dressing for wounds. In a study on infected full-thickness skin wounds on buffalo calves, honey gave the fastest rate of healing compared with ampicillin ointment and saline⁷⁰. A study on deep skin wounds on mice found that the regrowth of tissue was significantly greater, and the area of the wound significantly smaller, in those treated with honey compared with those treated with saline⁵⁶. Another study, on rats, found a statistically significant increase in the rate of healing with floral honey compared with saline, but not with honey from sugar-fed bees^{71,72}.

Stimulation of the healing process

Some wounds; termed chronic wounds, may go for long periods, sometimes for

years, without the healing process taking place. Leg ulcers and diabetic ulcers are common examples of this type of wound. Honey has been found to be effective in starting the healing process in non-healing ulcers^{24,31,35,36,41,51,63} some of which had been present for a median time of one year", or had been treated for up to two years", or had shown no healing over more than five years despite usual measures including skin grafts⁵³. Honey has also been used successfully on chronic foot ulcers in lepers and diabetic foot ulcers²⁵.

Honey has a very low failure rate: in reports of at least 143 chronic wounds treated with honey^{24,25,31,33,34,36,38,51,53,57,62} there was only one failure in one report (a Buruli ulcer: treatment with honey was discontinued after 2 weeks because the ulcer was rapidly increasing in size)³⁶ and six in another (where the quantity of honey applied was very small)⁵¹. Over all of the other reports covered in a review of the literature²⁷, with more than 470 cases treated with honey, there were only five cases where successful healing was not achieved: in one report two were attributed to the poor general quality of the patients who were suffering from immunodepression, one was withdrawn from treatment with honey because of a painful reaction to the honey, and one burn remained stationary after a good initial response⁴¹; in another it was an ulcer complicated by the presence of varicose veins".

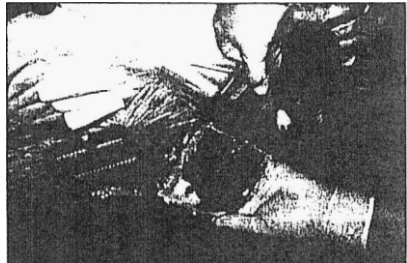
Clearance of infection

Many of the authors reporting the use of honey as a dressing on infected wounds attribute its effectiveness at least part to its antibacterial properties^{5,9,19,33,36,39,41,43-47,49,53,55-58,62,64,67,70,73}.

Honey is reported to be very effective in cleaning up infected wounds^{20,33,35,41,54,57,58,60}. Its action is effective even in treating Fournier's gangrene, a form of necrotizing fasciitis which is a rapidly spreading erupting

infection that is usually treated by aggressive surgical removal of tissue that has died as a result of the infection, which otherwise would support the growth of bacteria. Honey stops the advance of the infection without the need to remove dead tissue^{64,65}.

Honey is effective in clearing infection in wounds where other treatments have failed. One report gave the results of treating with honey dressings 47 patients with wounds and ulcers which had been treated for one month to two years with conventional therapy (including antibiotics) with no signs of healing, or the wounds were increasing in size³⁶. The wounds were of a wide variety of causes. Microbiological examination of swabs from the wounds showed that the wounds with bacteria present became sterile within one week and the others remained sterile. The outcomes were reported as 'showed remarkable improvement following topical application of honey'. A similar report gave the results of treatment with honey dressings of 40 patients, half of which had been treated with 'the usual topical measures' (another antiseptic) which had failed⁴¹. The wounds were large and of a wide variety of causes. The number of species of bacteria isolated from the wounds dropped from 48 to 14 after two weeks of treatment. Of the 33 patients treated only with honey dressings, 29 were healed successfully, with good quality healing, in an average time of 5-6 weeks.



A honey-impregnated dressing pad being prepared for application to a diabetic foot ulcer.

Another report described honey being used on nine Infants with large, open, infected surgical wounds that failed to heal with conventional treatment of at least 14 days of intravenous antibiotic and cleaning the wound with antiseptic⁶⁰. Before treatment with honey the wounds were still open, oozing pus, and bacteria were present. A marked improvement was seen in the appearance of the wounds in all of the infants after five days of treatment with honey. The wounds were closed, clean and sterile in all Infants after 21 days of application of honey.

The speed with which wounds dressed with honey become clear of infection is remarkable. Wounds have been reported to become sterile in 3-6 days^{52,58}, 7 days^{36,49,64} or 7-10 days⁵⁵. But possibly because of differences between honeys in their antibacterial activity, there have been findings of slower clearance of infection: there have been reports of bacteria still present in wounds after 2 weeks^{41,53}, 3 weeks^{47,60,62}, and 5 weeks³⁵.

Dressing infected wounds with honey gives a clean clear base that allows early grafting, and gives prompt graft taking^{33,35}. By cleaning up the wounds it also allows the wound boundaries to be more clearly defined to facilitate surgical procedures^{36,41}. This is of particular advantage in the case of diabetic and malignant ulcers where surgery is often required³⁶.

Perhaps the most important role for honey in wound care will prove to be in the treatment of wounds infected with antibiotic-resistant bacteria. Honey has been shown to be effective in laboratory testing against MRSA (multi-resistant *Staphylococcus aureus*)⁷⁴, and has been found to be effective in clearing up wounds infected with multi-resistant bacteria's.

Cleansing action on wounds

Several authors have reported the cleansing effect of honey on wounds^{29,33,35,41,57,59,62}. The standard procedure for the treatment of wounds is to surgically remove any dead tissue (i.e. debride the wound) which would serve to support the growth of infecting bacteria. Otherwise these would produce toxins which would kill more surrounding tissue. Debridement is a painful procedure that usually requires anaesthesia of some sort. Honey has a debriding effect on wounds so that surgical debridement is unnecessary^{36,43,44,46,64,65} or a minimum of surgical debridement is required⁵⁸. Dead tissue separates easily from the wound bed after honey has been applied to a wound^{31,36,57}. The dry crust formed on the surface of a wound is also removed by the application of honey³¹, and no dry scab forms on burns dressed with honey⁴⁷. It has also been noted that dirt is removed with the bandage when honey is used as a dressing, leaving a clean wound³⁰.

Infected wounds can be malodorous, especially those infected with anaerobic bacteria. This can be distressing for those who have to treat the wounds, and even more so for the patient, who cannot move away from the smell and who may find it embarrassing. Honey has been reported to give rapid deodorization of offensively smelling

Stimulation of tissue regeneration

When a wound heals, the dead or damaged tissue is replaced by the growth of new connective tissue and a new outer layer of skin (epithelium) spreads over the surface of the wound. The new connective tissue grows in a granular fashion (around newly formed blood vessels), hence is termed granulation. Many have reported that honey promotes the formation of clean healthy granulation

tissue^{31,33,35,36,47,50,52,55,58,59,62,64} and growth of epithelium over the wound^{36,45,47,50,64,65}. Thus it helps the skin regenerate, making plastic surgery unnecessary^{47,54,58,64,65}. It has also been reported that dressing wounds with honey gives little or no scarring⁶⁴.

These clinical observations of stimulation of tissue growth have been corroborated by microscopic examination of wound tissues in studies of the effect of honey on wound healing in animals, where there has been clear evidence seen of stimulation of tissue growth^{40,56,67-70}. These studies have also shown a stimulation of the synthesis of collagen, the protein responsible for giving the strength to skin and to scar tissue^{68,75}. The formation of other connective tissue components is also stimulated⁷⁶, and there is improvement of the strength of collagen's and of the healed wounds⁶⁹. The stimulation of the development of new blood vessels in the bed of wounds has also been observed^{68,70}.

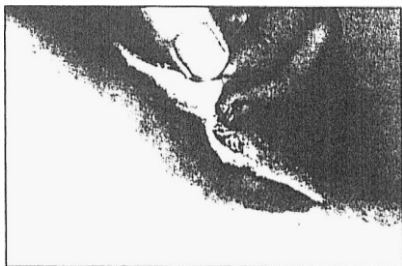
Reduction of inflammation

The inflammation of surrounding tissues that results from infection of a wound, or directly from the damage to tissues caused by burns, is the major cause of the pain and discomfort associated with wounds. The process of inflammation involves blood capillaries opening up and allowing plasma from the blood to flow out into the surrounding tissues. This causes swelling of the tissues (oedema), the pressure giving rise to damage and discomfort in the healing area. It also causes plasma to exude from open wounds, sometimes in large quantities. Honey has been reported to reduce inflammation^{40,47,50}, oedema^{36,46,62,64,65} and exudation^{36,40,64,65}. This would account for the soothing effect observed when honey is applied to wounds^{21,30,40,44} and the reduction of pain from burns^{40,44}. In some cases there is a rapid diminution of local pain⁵⁰.

The anti-inflammatory effect of honey has also been observed by microscopic examination of wound tissues in studies of the effect of honey on wound healing in animals, where reduction in the number of white blood cells involved in inflammation could be seen^{40,67-72}. The reduction in inflammation seen when honey is applied to wounds must be a direct anti-inflammatory effect, not just a result of removing inflammation-causing bacteria: the anti-inflammatory effects of honey were seen in animal studies where there was no infection involved^{40,67-70}.

Comfort of honey dressings

Honey generally causes no pain on dressing^{54,57} or causes only momentary stinging^{30,41,57}, is non-irritating and does not cause allergic reaction^{33,36,41,45,49}. In several of the reports of honey being used on wounds the authors have observed that honey has no harmful effects on tissues^{33,36,46,49,57}. Over all the reports of honey being used on wounds, with a total of more than 600 cases, there have been no reports of any harmful effects of honey on tissues. Nor have any adverse effects been noted in any of the studies in which honey has been applied to wounds on animals^{56,67,70,72}. These studies have included microscopic examination of the wound tissues^{56,67,70,71,75,76}. However, there have been two cases where the pain persisted for 15 minute?' and in two cases where the pain was such that the application of honey could not be tolerated^{41,51}. The pain or discomfort usually associated with changing dressings is minimized when honey dressings are used, which are easy to apply and remove^{29,33,35}. There is no difficulty removing dressings' because there is no adhesion to cause damage to the exposed regrowing tissues on the surface of wounds^{38,47,54,57}. Also there is no bleeding when removing dressings⁴⁴. Any honey left on the surface of the wound is easily



Honey dressings do not adhere to wounds, so can be removed without pain or damage to the tissues.

removed by simple bathing²⁰, unlike with many other dressing materials which have to be wiped off or forcefully washed off.

Gastroenteritis

The Holy Hadith records the Muslim prophet Mohammed instructing a man afflicted with diarrhoea to take honey⁶. The Roman physician Celsus, (c. 25 AD) used honey as a cure for diarrhoea⁷⁷. Dosage with water and honey is also used by many veterinarians for treatment of diarrhoea in small animals⁷⁸, and dosage with an 8% (vol./vol.) solution of honey has been reported to be effective for the treatment of chronic diarrhoea in a horse⁷⁸. Honey has been used at a concentration of 5% (vol./vol.) in place of glucose in a rehydradon fluid (solution of electrolytes) in a clinical trial conducted on 169 infants and children admitted into hospital with gastroenteritis⁷⁹. The patients were randomly assigned into two groups, the control group being treated with the standard rehydration therapy (2% wt/vol. glucose in a solution of electrolytes). Testing showed that in each group there were 18 patients with bacterial diarrhoea. The treatment with honey gave a statistically significant reduction in the duration of the diarrhoea (58 h cf. 93 h), and gave no increase in the duration of non-bacterial diarrhoea.

Peptic ulcers and gastritis

Honey has a traditional folklore usage for the treatment of peptic ulcers¹². Also there are numerous reports of oral dosage of honey being successfully used in modern times to treat upper gastrointestinal dyspepsia, including gastritis, duodenitis and ulceration, particularly in Russia and Arabic countries⁸⁰⁻⁸⁶.

A clinical trial has been reported⁸⁴ in which 45 patients with dyspepsia were given no medication other than 30 ml of honey before meals three times daily. After treatment with honey the number of patients passing blood (from peptic ulcers) in their faeces had decreased from 37 to four; the number of patients with dyspepsia had decreased from 41 to eight; the number of patients with gastritis or duodenitis seen on endoscopy had decreased from 24 to 15; the number of patients with a duodenal ulcer seen on endoscopy had decreased from seven to two. The healing effect of honey on gastric ulcers has also been shown in a trial carried out on rats with ulcers caused by aspirin¹². After 3 days of treatment the control group of 10 rats (given saline) had 15 ulcers whereas the group of 10 rats given honey from sugar-fed bees had eight ulcers, and the group of 10 rats given floral honey had three ulcers: the differences between these numbers were statistically significant. In a similar study⁸⁷ the gastric ulcers in the rats were caused by indomethacin, another non-steroidal anti-inflammatory drug (NSAID), which is like aspirin in its action. The healing rate achieved with the honey in this study was 70%, measured as the number of ulcers in the honey-treated group compared with an untreated control group.

Other studies with rats have shown that honey also has a preventative action, protecting the stomach from ulceration by



Honey being used as eye drops for conjunctivitis.

substances which commonly cause peptic ulcers in people: an NSAID (indomethacin)⁸⁸, and alcohol⁸⁸⁻⁹¹.

Ophthalmology

In ancient times honey from Attica had a special reputation as a curative substance for eye disorders². Aristotle wrote in 350 BC in section 627a 3 of *Historic Animalium*⁷ that 'White honey.... is good as a salve for sore eyes'. In India lotus honey in more recent times (1945) was said to be a panacea for eye diseases⁸. Honey is also a traditional therapy in Mali for measles, it being put in the eyes to prevent scarring of the cornea which occurs in this infection¹¹.

Meier has referred to honey being used to treat eyes discharging pus⁹². Sama, an ophthalmic surgeon at Rangaraya Medical College, India, has been treating bacterial corneal ulcers with honey⁹². The use of honey to treat blepharitis (inflammation of the eye-lids), catarrhal conjunctivitis, and keratitis (inflammation of the cornea) has also been reported⁹⁴: good results in general were obtained, with remission in more than 60% of the cases. Another report has described the use of honey in place of petroleum jelly in a 3% sulfidine eye ointment for the treatment of three cases of keratitis⁹⁵: significant improvement in one

case and complete restoration of vision in the other two cases resulted from the treatment with honey, yet there had been no effect when treated with the 3% sulfidine in petroleum jelly. This same paper reported the successful treatment with the honey ointment of 28 patients with various ailments of the cornea, successful in all cases; also the effective treatment with honey of syphilitic keratitis, corneal ulcers, injuries to the cornea, and lime burns of the cornea. It also described a case where a lime burn of the cornea was treated with pure honey, with half-vision being restored in 12 days; and reported that several cases of scrofulous keratitis had responded to treatment with pure honey. Mozherenkov & Prokofeva have reviewed the use of honey in ophthalmology in Russia⁹⁶. Anti-inflammatory, antibacterial and fungal actions are seen, the honey being applied to the eye under the lower eyelid. It has been used for chemical and thermal burns to the eye, conjunctivitis, and infections of the cornea, being applied undiluted or as a 20-50% solution in water. The results have been reported of treating 102 patients with a variety of ophthalmological disorders not responding to conventional treatment, such as keratitis, conjunctivitis and blepharitis⁹⁷. The honey was applied under the lower eyelid as an eye ointment would be applied. Improvement was seen in 85% of the cases, with no deterioration seen in any of the other 15%. There was reported a transient stinging sensation and redness of the eye soon after putting honey in the eye, but never enough to stop the treatment in the 102 cases in the trial. A similar reaction was reported by one of the other authors describing the use of honey in ophthalmology⁹⁵.

Acknowledgements

The assistance of Mat Al Somai, Anna &atter. David Foreman, Paola Gallmberti and Jacek Krzyzosiak in translating papers is gratefully acknowledged.

References

- RANSOME. H M (1937) *The sacred bee in ancient times and folklore*. George Allen and Unwin: London, UK; 308 pp.
- BECK, B SMEDLEY, D (1944) *Honey and your health*. McBride; New York, USA (2nd edition).
- MAJNO, G (1975) *The healing hand. Man and wound in the ancient world*. Harvard University Press; Cambridge, Massachusetts, USA; 571 pp.
- FORREST, R D (1982) Early history of wound treatment *Journal of the Royal Society of Medicine* 75: 198-205.
- ZUMLA, A; LULAT, A (1989) Honey a remedy rediscovered. *Journal of the Royal Society of Medicine* 82: 384-385.
- AL-BUKHARI, M ((c. 740 AD) 1976) *Sahih Bulthari*. Nazi Publications; Chicago, LISA (3rd rev. edition).
- ARISTOTLE (350 BC) *Volume IV. Historic; animalium*. In Smith, J A; Ross, W D (eds) *The works of Aristotle*. Oxford University; Oxford, UK (translated by D'A W Thompson, 1910).
- FOTIDAR, M FOTIDAR, S N (1945) 'Lotus' honey. *Indian Bee Journal* 7: 102.
- ANKRA-BADU, G A (1992) Sickle cell leg ulcers In Ghana. *East African Medical Journal* 69(7): 366-369.
- OBI, C14 UGOJI, E O; EDUN, S A; LAWAL, S F; ANYIWO, C E (1994) The antibacterial effect of honey on diarrhoea causing bacterial agents isolated in Lagos, Nigeria. *African Journal of Medico) Sciences* 23: 257-260.
- IMPERATO, P J; TRAORE (1969) Traditional beliefs about measles and its treatment among the Bambara of Mali. *Tropical and Geographical Medicine* 21: 62-67.
- KANDL ^{fr4} EL-BANBY, M; ABDEL-WAHED, K; ABDEL-GAWWAD, M; FAYEZ II (1987) Curative properties of true floral and false nonfloral honeys on Induced gastric ulcer. *Journal of Drug Research (Cairo)* 17(1-2): 103-106.
- GREENWOOD, D (1995) Sixty years on: antimicrobial drug resistance comes of age. *Lancet* 346 (Supplement 1): \$1.
- THOMPSON, W A f (1976) Herbs that heal. *Journal of the Royal College of General Practitioners* 26: 365-370.
- KAUFFMAN, G B (1991) Chemophobia. *Chemistry in Britain* June: 512-516.
- SOFFER, A (1976) Chihuahuas and laetrite, chelation therapy, and honey from Boulder, Colo. *Archives of Internal Medicine* 136: 865-866.
- SOUTH AFRICAN MEDICALJOURNAL (1974) Honey: sweet and dangerous or panacea? *South African Medical Journal* 56: 2300.
- CONDON, R E (1993) Curious interaction of bugs and bees. *Surgery* 113(2): 234-235.
- BOSE, 13 (1982) Honey or sugar In treatment of infected wounds? *Lance* I (April 24): 963.
- GREEN, A E (1988) Wound healing properties of honey. *British Journal of Surgery* 75(12): 1278.
- KEAST-BUTLER, J (1980) Honey for necrotic malignant breast ulcers. *Lancet* ii (October II): 809.
- MOSSEL, D A A (1980) Honey for necrotic breast ulcers. *Lancet* ii (November 15): 1091.
- SEYMOUR, F I; WEST, K S (1951) Honey - Its role In medicine. *Medical Times* 79: 104-107.
- SOMERFIELD, S D (1991) Honey and healing. *Journal of the Royal Society of Medicine* 84(3): 179.
- TOVEY, F I (1991) Honey and healing. *Journal of the Royal Society of Medicine* 84(7): 447.
- NOLAN, P C (1992) The antibacterial activity of honey. 1. The nature of the antibacterial activity. *Bee World* 73(1): 5-28.
- MOLAN, P C (1998) A brief review of the clinical literature on the use of honey as a wound dressing. *Primary Intention* (in press).
- MOLAN, P C (1998) The role of honey In wound care. *Joumol of Wound Care* (in press).
- BLOMFIELD, R (1973) Honey for decubitus ulcers. *Journal of the American Medical Association* 224(6): 905.
- ZAL13 (1934) Der Honig in aufletticher Anwendung. *Manchener Medizinische Wochenschrift* Nr. 49:1891-1893,
- HUTTON, D J (1966) Treatment of pressure sores. *Nursing limes* 62(46): 1533-1534.
- LUCKE, H (1935) Wundbehandlung mit Honig and Lebertran. *Deutsche Medizinische Wochenschrift* 61(41): 1638-1640.
- FAROUK, A; HASSAN, T; KASHIF, H; KHALID, 5 k MUTAWAU, I; WADI, M (1988) Studies on Sudanese bee honey: laboratory and clinical evaluation. *International Journal ofCrude Drug Research* 26(3): 161-168.
- HANDY, M H; EL-BANBY, M KHAKIFA, K I; GAD, E M; HASSANEIN, E M (1989) The antimicrobial effect of honey in the management of septic wounds. In *International Bee Research Association Fourth International Conference on Apkulture in Repko?*

- Climates*; 1988; Cairo. International Bee Research Association; London, UK; pp 61-67.
35. WADI, 11; AL-AMIN, H; FAROUQ, A; KASHE, F H; KHALED, S A (1987) Sudanese bee honey in the treatment of suppurating wounds. *Arab Medico* 3: 16-18.
 36. EFEM, S E E (1988) Clinical observations on the wound healing properties of honey. *British Journal of Surgery* 75: 679-681.
 37. DANY-MAZEALI, M P G (1992) Honig auf die Wunde. *Krankenpflege* 46(1): 6-10.
 38. WEHEIDA, S M; NAGUBIR H H; EL-ESANNA H MARZOUK, 5 (1991) Comparing die effects of two dressing techniques on healing of low grade pressure ulcers. *Journal of the Medical Research Institute, Alexandria University* 12(2): 259-278.
 39. ADESUNKANMI, OYELAMI, O A (1994) The pattern and outcome of burn injuries at Wesley Guild Hospital, Ilesha, Nigeria: a review of 156 cases. *Journal of Tropical Medicine and Hygiene* 97(2): 108-112.
 40. BURLANDO, F (1978) Sull'azione terapeutica del miele nelle usdoni. *Minerva Dermatologica* 113: 699-706.
 41. NDAYISABA, G; BAZIRA, 14 HABONIMANA, E; MUTEGANYA, D (1993) Clinical and bacteriological results in wounds treated with honey. *Journal of Orthopaedic Surgery* 7(2): 202-204.
 42. PHILLIPS. C E (1933) Honey for burns. *Gleanings in Bee Culture* 61: 284.
 43. SUBRAHMANYAM, M (1991) Topical application of honey in treatment of burns. *British Journal of Surgery* 78(4): 497-498.
 44. SUBRAHMANYAM, M (1993) Honey Impregnated gauze versus polyurethane film (OpSite(r)) In the treatment of burns - a prospective randomised study. *British Journal of Plastic Surgery* 46(4): 322-3.
 45. SUBRAHMANYAM, M (1994) Honey-impregnated gauze versus amniotic membrane in the treatment of burns. *Burns* 20(4):331-333,
 46. SUBRAHMANYAM, M (1996) Honey dressing versus boiled potato peel in the treatment of burns: a prospective randomized study. *Burns* 22(6): 491-493.
 47. SUBRAHMANYAM, M (1998) A prospective randomised clinical and histological study of superficial burn wound healing with honey and silver sulfadiazine. *Burns* 24(2): 157-161.
 48. VOIGTLANDER, H (1936) Umschau and Ausschau aus anderen Bienenzeifungen. *Rheinische Bienenzeitung* 88: 305-308.
 49. PHUAPRADIT, W; SAROPALA N (1992) Topical application of honey in treatment of abdominal wound disruption. *Australian and New Zealand Journal of Obstetrics and Gynaecology* 32(4): 381-4.
 50. YANG, K L (1944) The use of honey in the treatment of chilblains, nonspecific ulcers, and small wounds. *Chinese Medical Journal* 62: 55-60.
 51. WOOD, 8; RADEMAKER, M; MOLAR P C (1997) Manual honey. a low cost leg ulcer dressing, *New Zealand Medical Journal* 110: 107.
 52. BRANIKI, FJ (1981) Surgery in Western Kenya. *Annals of the Royal College of Surgeons of England* 63; 348-352.
 53. HARRIS, S (1994) Honey for the treatment of superficial wounds: a case report and review. *Primary Intention* 2(4): 18-23.
 54. MCINERNEY, R J F (1990) Honey - a remedy rediscovered. *Journal of the Royal Society of Medicine* 83: 127.
 55. ARMON, P J (1980) The use of honey in the treatment of Infected wounds. *Tropical Doctor* 10: 91.
 56. BERGMAN, A; YANAI, J; WEISS, J; BELL ID; DAVID M P (1983) Acceleration of wound healing by topical application of honey. An animal model. *American Journal of Surgery* 145: 374-376.
 57. BULMAN, M W (1955) Honey as a surgical dressing, *Middlesex Hospital Journal* 55: 188-189.
 58. CAVANAGH, D; BFAZLEY, J; OSTAPOWICZ, F (1970) Radical operation for carcinoma of the vulva. A new approach to wound healing. *Journal of Obstetrics and Gynaecology of the British Commonwealth* 77(11): 1037-1040.
 59. WEBER, H (1937) Honig zur Behandlung vereiterter Wunden. *Therapie der Gegenwart* 78: 547.
 60. VARDI, A; BARZILAY, Z; LINDER, N; COHEN. H A; PARET. G; BARZILAI, A (1998) Local application of honey for treatment of neonatal postoperative wound Infection, *Acts Feedlot:Ica* 87(4): 429-432.
 61. DANY-MAZEAU, 11; PAUTARD, G (1991) L'utilisation du miel dans le processus de cicatrisation. De la ruche a rh6pItal. *Kronkenpflege Solns Infirmiers* 84(3): 63-69.
 62. DL/MRONGLERT, E (1983) A follow-up study of chronic wound healing dressing with pure natural honey. *Journal of the National Research Council of Thailand* 15(2): 39-66.
 63. BLOOMFIELD, E (1976) Old remedies. *Journal of the Royal College of General Practitioners* 26: 576.
 64. EFEM, S E E (1993) Recent advances In the management of Fournier's gangrene: preliminary observations. *Surgery* 113(2): 200-204.

65. HEJASE, M J; E. S J; BIHRLE, R; COOGAN, C L (1996) Genital Fournier's gangrene: experience with 38 patients. *Urology* 47(5): 734-739.
66. DESCOTTES, B (1990) De la niche a ('hospital ou 'utilisation du miel dans l'unité de soins. *L'Abeille de fiance et l'Apiculture* (754): 459-460.
67. POSTMES, T J; BOSCH, M M C; DUTRIEUX, R; VAN BAARE, J; HOEKSTRA M J (1997) Speeding up the healing of bums with honey. An experimental study with histological assessment of wound biopsies. In Mirrahi, A; Lensky, Y (eds) *Bee products: properties, applications and apitherapy*. Plenum Press; New York, USA; pp 27-37.
68. KUMAR, k SHARMA, V K; SINGH, H P; PRAKASH, P; SINGH, S P (1993) Efficacy of some Indigenous drugs in tissue repair in buffaloes. *Indian Veterinary Journal* 70W: 42-44.
69. ORYAN, A; ZAKER, S R (1998) Effects of topical application of honey on cutaneous wound healing in rabbits. *Journal of Veterinary Medicine Series A* 45(3): 181-8.
70. GUPTA, S K; SINGH, H; VARSHNEY, A C; PRAKASH. P (1992) Therapeutic efficacy of honey In infected wounds in buffaloes. *Indian Journal of Animal Sciences* 62(6): 521-523.
71. KANDE, EL-BANBY, ABDEL-WAHED, K; ABOU-SEHLY, G; EZZAT, N (1987) Healing effect of true floral and false nonfloral honey on medical wounds. *Journal of Drug Research (Cairo)* 17(1-2): 71-75.
72. EL-BANBY. KANDIL, A; ABOU-SEHLY, G; EL-SHERIF. M E; ABDELWAHED, K (1989) Healing effect of floral honey and honey from sugar-fed bees on surgical wounds (animal model). In International Bee Research Association *Fourth international conference on apiculture in tropical climates; 1988*; Cairo. International Bee Research Association; London, UK; pp 46-49.
73. POSTMES, T; BOGAARD, A E VAN DEN; HAZER M (1993) Honey for wounds, ulcers, and skin graft preservation. *Lancet* 341(8847): 756-757.
74. MOLAN, P; BRETT, M (1989) Honey has potential as a dressing for wounds infected with MRSA. *The second Australian Wound Management Association conference; 1998* March 18-21, Brisbane, Australia.
75. SUGUNA, 14 CHANDRAKASAN, G; THOMAS JOSEPH, K (1992) Influence of honey on collagen metabolism during wound healing in rats. *Journal of Clinical Biochemistry and Nutrition* 13: 7-12.
76. SUGUNA, L; CHANDRAKASAN, G; RAMAMOORTHY. U; THOMAS JOSEPH. K (1993) Influence of honey on biochemical and biophysical parameters of wounds in rats. *Journal of Clinical Biochemistry and Nutrition* 14: 91-9.
77. CELSUS ((c. 25 AD) 1935) *De medicina*. Heinemann: London, UK.
78. UNMET", P (1996) Honey for equine diarrhoea. *Contra and Therapy* 1996: 906.
79. HAFFEJEE. I E; MOOSA, A (1985) Honey in the treatment of Infantile gastroenteritis. *British Medical Journal* 290: 1866-1867.
80. AMERICAN BEE JOURNAL (1982) Hospitals using honey as a fan new antibiotic. *American Bee Journal* 122(4): 247.
81. KHOTKINA, M L (1955) Honey as part of therapy for patients with stomach ulcers. *Collection of papers from the Irkutsk State Medical Institute*; pp 252-262.
82. MEN'SHIKOV, F K; FEIDMAR S I (1949) Curing stomach ulcers with honey. *Sovetskaya Meditsina* 10: 13-14.
83. MLADENOV, S (1974) Present problems of apitherapy. *International symposium on apitherapy; 1974; Madrid, Spain*. Apimondia Publishing House; Bucharest, Romania.
84. SALEM, S N (1981) Honey regimen in gastrointestinal disorders. *Bulletin of Islamic Medicine* 1: 358-62.
85. SLOBODIANIUK, A A; SLOBODIANIUK, M (1969) *Complex treatment of gastritis patients with high stomach secretion in combination with (and without) a 15-20% solution of honey*. Ufa: Bashkir. Khniz. had-vo.
86. YOIRISH, N (1977) *Curative properties of honey & bee venom*. New Glide Publications; San Francisco, USA; 198 pp.
87. ALL A T M (1995) Natural honey accelerates healing of indomethacin-induced antral ulcers in rats. *Saudi Medical Journal* 16(2): 161-166.
88. ALI, ATM M; AL-HUMAYYD, 11 S; MADAN. e R (1990) Natural honey prevent: Indomethacin- and ethanol-induced gawk lesions in rats. *Saudi Medical Journal* 11(4) 275-279.
89. ALI, ATM M (1995) Natural honey exerts it protective effects against ethanol- induce(gastric lesions in rats by preventing depletion of glandular nonprotein suffisydryls. *Tropkc Gastroenterology* 16(1); 18-26.
90. ALI. AT M M (1991) Prevention of ethanol Induced gastric lesions in rats by natura honey, and its possible mechanism of actor *Scandinavian Journal of Gastroenterology* 2E 281-288.
91. AL-SWAYEH, O A; ALI, ATM (1998) Effect c ablation of capsicainsensitive neurons a gastric protection by honey and sucralfatt *HepatoGastmenterology* 45(19): 297-302.

92. MEIER, K E; FREITAG, G (1955) Ober die andbidschen Eigenschaften von Sacchariden und Bienenhonig, *Zeitschrift fur Hygiene und Infektionskrankheiten* 141:326-332,
93. SAKMA, t1 C (1988) Honey in the treatment of bacterial corneal ulcers. Personal communication cited in Efem, S E E; Udoh, K T; Iwara, C I (1992) The antimicrobial spectrum of honey and its clinical significance. *Infection* 20(4): 227-229.
94. POPESCU, F1 P; PALOS, E; POPESCU, F (1965) Studlul eficacitatil terapiel biologice complexe cu produse apicole in unele afectiuni oculare localizate palpebral si conjunctival in radon cu modificarile clinico-functionale. *Revista de Chinezie Oncologie Radialogie ORL Oftalmologie Stomatologie Sena Oftalmidagie* 29(1): 53-61.
95. OSAULKO, G K (1953) [Use of honey in treatment of the eye.] *Vestnik Oftoemologii (Moskow)* 32: 35-36 (in Russian).
96. MOZHERENKOV, V P (1984) [Honey treatment of poscherpetic opacities of the cornea.] *Oftarmologicheskij Zhurnal* (3): 188 (in Russian).
- 97, EMARAH, M H (1982) A clinical study of the topical use of bee honey in the treatment of some ocular diseases. *Bulletin of Islamic Medicine* 2(5): 422-425.