



Honey in Medicine: A Review

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SHORT HISTORY OF HONEY IN MEDICINE



Pabasa tombs, 26th Dynasty, 760-656 BC



Preparation of honey medicine from Materia Medica, Dioscorides, Arab translation 1224

Wound healing was probably the first use of honey for human health. In the oldest human scriptures from Sumer, dating back about 2000 BC a prescription for treating wounds states: *Grind to a powder river dust and (words missing) then knead it in water and honey and let plain oil and hot cedar oil be spread over it*⁷⁵

According to the Ebers papyrus (1550 BC) honey is included in 147 prescriptions in external applications: *“Mix honey, red ochre, powdered alabaster to cure spotted baldness”* or includes honey after surgery, as suppository and to reduce inflammation.⁷⁵

According to the Smith papyrus (1700 BC) it was used in wound healing: *“Thou shouldst bind [the wound] with fresh meat the first day [and] treat afterwards with grease, honey [and] lint every day until he recovers.”*⁷⁵

In the first compendium of ancient Chinese Medicine Shen Nang, compiled many years BC, and mentioned in a written form for the first time around 200 AD there are many prescriptions and medical indications which contain honey¹⁴⁰.

In ancient India ayurvedic medicine uses honey for many purposes. According to the Ayurveda classic Ashtanga Hridaya, written about 500 AD honey can be used against many diseases, e.g. healing and cleaning wounds, against different internal and external infections⁸²

The ancient Greeks considered honey as medicine and believed that if bee honey is taken regularly human life could be prolonged. Early thinkers such as Homer, Pythagoras, Ovid, Democritus, Hippocrates and Aristotle mentioned that people should eat honey to preserve their health and vigour. Dioscorides, in the first century AD (see picture to the left) used honey for treating wounds⁸⁵

Honey was the most useful substance used in old Roman pharmacopoeia. Pliny writes that it is good for afflictions of the mouth, pneumonia, pleurisy and snake bites⁷⁵

The wise Solomon praises the virtues of honey in the old testament. The Koran says” thy Lord taught the bee to build its cells in hills, on trees and in (men's) habitations..... there issues from within their bodies a drink of varying colours, wherein is healing for mankind (Quran 16:68-69).

The ancient Maya civilisations used Melipona (stingless bee) honey in the treatment of cataracts⁷⁵

Today the knowledge on the healing virtues of honey and the other bee product is called apitherapy is compiled in many books or on the Internet www.apitherapy.com, www.apitherapy.org

HONEY IN TRADITIONAL MEDICINE

Honey in traditional Chinese medicine

Honey was mentioned as medicine by Shen Nang, some 2000 BC. In the “52 prescription book, 3rd century BC includes a prescription including honey. According to Chinese medicine honey has a balanced character (neither Yin nor Yang) and acts according to the principles of the Earth element, entering the lung, spleen and large intestine channels. There are many original prescriptions and medical indications which contain honey¹⁴⁰

Christopher Gussa a TCM practitioner writes on www.naturalnews.com :

“Honey is known as Feng Mi and has the ability to nourish yin energy and strengthen the spleen. Apart from its widely recognized nutritional value, honey is also the Chinese people's favorite as a "neutral" food with medicinal properties. In the "Compendium of Materia Medica," the TCM classic by pharmacist Li Shizhen in the Ming Dynasty (1368-1644), "Honey can help dispel pathogenic heat, clear away toxins, relieve pain and combat dehydration." Li Shizhen showed that eating honey regularly resulted in clear sight and rosy cheeks. He also wrote that eating honey every morning can help prevent constipation and it is a good choice for those who suffer chronic coughing.

TCM also shows that due to honey's affinity for the stomach and spleen it can greatly enhance the effect of many of the super-tonics such as He Shou Wu”

According to the Fundamentals of Chinese Medicine honey has following properties

- “balanced, sweet, non-toxic. Enters the lung, spleen and the large intestine meridian channels. Supplements the center and moistens the lung. Relieves pain and resolves toxin.....Treats cough due to lung dryness; constipation due to dryness of the intestines; stomach pain; deep source nasal congestion, mouth sores, scalds and burns”²²

Sui Wan summarises: “Honey has been used in traditional Chinese Medicine to treat many diseases for more than two thousands years. In Traditional Chinese Medication, honey is a combination used with bee venom, propolis, royal jelly, pollen and other herbal medications in medical treatment. In addition, the following diseases are good indications for using honey. I) Infectious Diseases: Bacterial Infections: A. Infections caused by gram-positive bacteria, e.g. Streptococcal infections- Pharyngitis, Enterococcal infections, Pneumococcal infections; Staphylococcus Aureus infections, B. Infections caused by gram-negative bacteria, e.g. Meningococcal infections- Meningococcal meningitis., Salmonellae infections-Typhoid fever, Salmonella Gastro-enteritis., Shigella infections-Shigella dysentery. II) Gastrointestinal Diseases: A. Gastritis, B. Peptic ulcer Disease, C. Celiac Disease, D. Antibiotic-Associated Colitis. E. Inflammatory Bowel Diseases. III) Allergic and Immunologic Disorders: A. Allergic Rhinitis B. Rheumatoid arthritis, C. Systemic Lupus Erythematosus(SLE), D. Ankylosing spondylitis, E. Multiple Sclerosis. IV) Traumatic wounds: traumatic and surgical wounds managements”¹⁴⁴

Honey in Ayurveda Medicine

Honey has a long tradition in traditional ayurveda medicine. This topic has been reviewed by¹²⁷

According to D Ramanathan, director of the Sitaram Ayurveda Pharmacy Limited & Specialty Hospital, Thrissur on the role honey plays in ayurvedic treatment: “Honey known as madhu in ayurvedic scriptures is one of the most important medicines used in ayurveda. In ayurveda, honey is used for both internal and external applications. It is mainly used for the treatment of eye diseases, cough, thirst, phlegm, hiccups, blood in vomit, leprosy, diabetes, obesity, worm infestation, vomiting, asthma, diarrhoea and healing wounds. It is also used as a natural preservative and sweetener in many ayurvedic preparations. It is also used as a vehicle along with some medicines to improve its efficacy or to mitigate the side effects of the other medicines it is mixed with. It is also known to mitigate the increased kapha dosha. (Kapha dosha is the ayurvedic category for body constitutions- those with kapha dosha are of larger proportions with robust frame.) It should also be kept in mind that fresh honey helps to increase body mass while old honey produces constipation and decreases body mass. Honey should not be heated or consumed warm as it causes toxic effect. Cold honey should always be preferred.

According to ayurveda, there are eight different types of honey:

- 1.Makshikam: Used in the treatment of eye diseases, hepatitis, piles, asthma, cough and tuberculosis
- 2.Bhraamaram: Used in the treatment when blood is vomited

- 3.Kshoudram: Used in the treatment of diabetes
- 4.Pauthikam: Used in the treatment of diabetes and urinary infection
- 5.Chathram: Used in the treatment of worm infestation, when blood is vomited and diabetes
- 6.Aardhyam: Effective for eye diseases, cough and anaemia
- 7.Ouddalakam: Increases taste and swarasudhi.Used in the treatment of leprosy and poisoning cases
- 8.Daalam: It increases digestion and helps in the treatment of cough, vomiting and diabetes.

(The gathering of these honeys is described in ¹²⁷)

We prescribe a particular brand called Samskritha Madhu (which means cultured or purified honey) which is made by most of the authentic ayurvedic Manufacturing units as per the ayurvedic scriptures. In ayurveda, what is the bee species that is most preferred- are they are Italian species (that are kept in boxes) or Indian species (that are found in the wild). As far as Ayurveda is concerned our acharyas who made this system of medicine utilized Indian honey and tested the wild honey, hence any ayurvedic physician will prefer the Indian honey wild honey”

Honey in traditional medicine

A traditional medicine branch, called apitherapy, has developed in recent years, offering treatments based on honey and the other bee products against many diseases. The knowledge on this subject is compiled in various books e.g. ^{34, 80, 125} or on relevant web pages such as www.apitherapy.com, www.apitherapy.org

Unifloral honey in practical apitherapy after³³

Honey type	Applications
<i>Acacia</i> , liquid and mild;	Sweetener for people with Diabetis Type II. Improved digestions. Applied at diseases of stomach, intestines, liver and kidney
<i>Buckwheat</i> , dark and strong	High antioxidant activity, improves digestions, to be taken by pregnant women and when nursing
<i>Eucalyptus</i> , dark and strong	Against infections and diseases of respiratory organs and urinary passages. Increases immunity
<i>Calluna</i> , dark and strong	High antioxidant activity. Invigorating at fagigue and convalescence; against problems with kidney urinary bladder
<i>Chestnut</i> , dark and strong	Improves blood circulation; against anemia and infactions of kidney urinary bladder
<i>Clover</i> , light und mild	sedative
<i>Lavendel</i> , aromatic	Treatment of wounds, burns, insect stings, infections or respiratory organs and depressions
<i>Linden</i> , strong, aromatic	Diaphoretic, diuretic, palliative, apetising; against cold, flu, cough, sinusitis, headache, sleeplessness and anxiety.
<i>Manuka</i> , Dark and strong	High antibacterial activity, against infections and for wound healing
<i>Dandelion</i> , aromatic	Hemo-protective, against gastric, intestine, liver, kidney and gall bladder diseases
<i>Citrus</i> , light and mild	Against indigestion and sleeplessness
<i>Rape</i> , mild	Sedative, relaxing
<i>Rosmarine</i> , mild	Hemo-protective; against gastric, intestine, liver diseases
<i>Sunflower</i> , mild	spasmolytic in asthma cases, gastric, intestine colic
<i>Fir, honeydew</i> , dark and strong	High antioxidant activity. Against infections of respiratory organs
<i>Thyme</i> . dark and strong	Against infections of respiratory organs; wound treatment

Unifloral honeys are used in folk medicine for different purposes. The applications given in the table below remain to be confirmed by experimental science. Indeed, in most scientifically conducted clinical studies the botanical origin of the honey was not determined. On the other hand, the antibacterial and the antioxidant activity of honey depends strongly on the botanical origin. Health enhancing effects of different unifloral honey have been claimed in different practical apitherapy books, e.g. ^{32, 89, 100}. The table below has been compiled from them. At present there is no scientific explanation of many of the claimed effects.

HONEY AND WOUND CARE: AN OVERVIEW

By Keith Cutting, with some additions by S. Bogdanov, *Ostomy Wound Management*⁴⁹, 2007

History

Until the first part of the 20th century, honey dressings were part of everyday wound care practice. With the advent of antibiotics in the 1930s and 1940s, views changed and honey was consigned to items of historical interest. Misuse of antibiotics, the emergence of resistant bacteria, and increasing interest in therapeutic honey have provided an opportunity for honey to be re-established as a broad-spectrum, antibacterial agent that is non-toxic to human tissue.

Despite lack of promotional support from large corporations, interest in the use of honey in wound management has increased in recent years. However, a clinical profile in wound care commensurate with other modalities has not been achieved despite offering similar indications of use and an increase in research activity and clinical reports. It is observed that “The therapeutic potential of uncontaminated, pure honey is grossly underutilized”¹⁶⁴

Clinicians need reassurance that any health-related agent is safe and meets its stated therapeutic purpose. Therefore, it is important to emphasize that although natural in origin, the honey used in wound care should be of medical-grade standard and not sourced from honey destined for the supermarket shelf. Medical grade honey is filtered, gamma-irradiated, and produced under carefully controlled standards of hygiene to ensure that a standardized honey is produced¹⁵⁹

Therapeutic benefit of honey in wound care

The therapeutic properties of honey are variable and depend on the type of honey used⁹⁹. Manuka (the Maori name for the New Zealand tea tree/bush *Leptospermum scoparium*) or *Leptospermum* is honey derived from the tea tree; the former is the more widely used term. In a review of the literature, Moore showed that Manuka honey has “very special healing properties” and described it as “the best natural antibiotic in the world.”¹⁰⁶

Medical grade Manuka honey is prepared purely for medical use and controlled by a rigorous set of systems and standards.

A systematic review¹⁰⁶ of honey as a wound dressing noting the dearth of good evidence on topical wound agents contradicts Molan’s literature review¹⁰¹ of the evidence (17 randomized, controlled trials involving 1,965 participants and five clinical trials involving 97 participants, plus numerous case studies) — supports the use of honey as a wound dressing and underscores clinician failure to recognize that evidence. Molan’s research reviews also addressed the range of honey’s therapeutic activities¹⁰³ :

Bioactivity of honey	Suggested Rationale
Prevention of cross-contamination	Viscosity of honey provides a protective barrier
Provides a moist wound healing environment	Osmolarity draws fluid from underlying tissues
Dressings do not adhere to wound surface.	The viscous nature of honey provides an interface between wound bed and dressing
Tissue does not grow into dressings	
Promotes drainage from wound	Osmotic outflow sluices the wound bed
Removes malodor	Bacterial preference for sugar instead of protein (amino acids) means lactic acid is produced in place of malodorous compounds
Promotes autolytic debridement	Facilitates the autolytic action of proteases
Stimulates healing	Stimulation of cytokine production ¹³¹
Anti-inflammatory	Number of inflammatory cells reduced in honey-treated wounds Prevents cutaneous inflammation by honey flavonoids ⁹¹
Managing infection	Antiseptic properties found to be effective against a range of microbes including multi-resistant strains
Increases immune reaction	Effect of lipopolysaccharides and apalbumine 1 and 2 ⁶⁴
Promotes pain relief and epitelisation	Analgetic effect of honey ⁸⁸
Regulates oxidative stress in the wound	Inhibition of reactive oxygen species production by activating polymorphonuclear neutrophils ¹⁵⁴
Inhibits adhesion of bacteria in wound	Antiadhesive properties against wound pathogens ⁹⁰
Eliminates bacterial infection of wound	Due to antibacterial and bactericidal effects it kills quickly all bacterial with little danger of development of resistant strains

Wound bed preparation

Wound bed preparation may be viewed as management of the wound in order to accelerate endogenous healing¹⁰³. The bio-activity of honey aligns closely with the concept of wound bed preparation. The physiology of healing in acute wounds is a carefully controlled series of events that ensures healing progresses in a timely fashion. However, in chronic wounds this orderly sequence is disrupted and the repair process is delayed. If wound bed preparation is to be successful, the impediments to healing must be recognized and addressed, implying appropriate management of exudate, devitalized tissue, and associated bioburden. The appropriate application of honey dressings offers a way forward in managing potential wound-related barriers to healing.

Exudate

A clinical study by Al-Waili and Saloom¹⁰ compared honey with topical antiseptics in 50 patients with postoperative abdominal wound infections; Ahmed et al's⁶ non-randomized study of 60 patients with chronic surgical or trauma wounds; and Betts and Molan's³⁰ in vivo pilot study reported that honey helps reduce the amount of wound exudate. This is most likely a consequence of honey's anti-inflammatory properties. Inflammation — increased vessel permeability increases fluid movement into soft tissue, subsequently increasing surface exudate. A decrease in inflammatory cells has been found (histologically) in animal models following application of honey in full-thickness burns. Similar findings¹²⁴ have been reported in animal studies comparing ampicillin and nitrofurazone in treating infection of full-thickness wounds^{83, 116}. The anti-inflammatory activity of honey also has been documented in clinical studies of human burn wounds and in "in vitro studies"¹⁴⁹⁻¹⁵¹. The potential consequences of effectively managing inflammation include rapid reduction of pain, edema, and exudate; additionally, hypertrophic scarring is minimized by avoiding protracted inflammation that may result in fibrosis¹⁰⁴. It follows that reducing inflammation lessens exudate production and dressing change frequency, which may conserve resources in terms of dressings used, staff time, and unnecessary disturbance of the patient and the wound bed.

Devitalized tissue

It has been established that dressings that create the type of moist wound environment that honey provides facilitate the process of autolytic debridement. The osmotic pull of honey draws lymph from the deeper tissues and constantly bathes the wound bed. Lymph fluid contains proteases that contribute to the debriding activity of honey. In addition, the constant sluicing of the wound bed is believed to help remove foreign body (e.g., dirt and grit) contamination¹⁰⁴. Molan¹⁰⁰ has suggested the most likely explanation for honey's debriding activity involves the conversion of inactive plasminogen to plasmin, an enzyme that breaks down the fibrin that tethers slough and eschar to the wound bed. Stephen-Haynes¹⁴⁸ who presented the results of three patient case studies and an additional five patients who benefited from management of wound malodor, attests to the clinical impact of honey in debridement. Malodor is known to occur in a variety of wounds in conjunction with slough and necrotic tissue; it is a particular concern when managing fungating lesions. Malodorous substances such as ammonia and sulphur compounds are produced when bacteria metabolize protein. Because honey provides bacteria an alternative source of energy (glucose), these noxious compounds are no longer produced and wound malodor is avoided.

Maceration

Macerated periwound skin can be a problem in some wounds and is often related to the dressing used⁴⁸. The osmotic action of honey, previously mentioned, has been shown in previous reviews of the literature to reduce the risk of maceration — honey draws moisture rather than donates it¹⁰⁴. Thus, periwound skin is protected from overhydration.

Bioburden

Honey has been shown in clinical observations to have the ability to manage wound infection in situations where conventional antimicrobial (antibiotics/antiseptics) have failed^{55, 57, 160}. Honey also has been found to be effective in vitro against a range of multiresistant organisms including methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant Enterococci (VRE), and other multiresistant Gram-negative organisms including *Pseudomonas aeruginosa*⁶⁵. Other in vitro studies involving different microorganisms also have demonstrated honey's effectiveness against antibiotic-resistant bacteria^{46, 79}. George and Cutting specifically identified honey's antibacterial activity⁶⁵. The binding of water can be added to these antibacterial properties:

- The high sugar content/low water activity provides osmotic action
- Acidic pH (3.2 to 4.5) inhibits bacterial growth
- Glucose oxidase enzyme helps produce hydrogen peroxide
- Plant- and bee-derived factors

The antibacterial action most likely reaches below the wound surface. Although topical honey manages superficial bacteria (bactericidal in action rather than bacteriostatic)^{46, 155} it also has been shown in vitro to provide prompt clearance of deep-seated infection and boils with unbroken skin, suggesting that honey's antibacterial activity may diffuse through the skin to deeper tissues. Cooper et al⁴⁶ performed sensitivity testing of 17 strains of *P. aeruginosa* isolated from infected burns using two honeys with different types of antibacterial activity; Wahdan¹⁵⁵ compared the antibacterial activity of a sugar solution and honey on 21 types of bacteria and two types of fungi.

Wound management by medical grade honey, after Watts and Frehner, 2016¹⁵⁸

Remark by SB: Although natural honey can also be used for wound management, only the use of medical grade honey (honey treated by radiation to destroy all bacteria) is permitted for hospital use. The medical grade honey is mainly manuka honey. See original references in the original publication¹⁵⁸

Effectiveness in reducing infection

There is a sizable number of laboratory studies indicating the broad spectrum of honey's antibacterial activity but the number of randomised control trials (RCT) on the effectiveness of medical grade honey is still limited. Of the numerous case series or case study reports using honey to treat long-standing chronic wounds that had failed to respond to other wound management strategies, only two found the honey did not eliminate bacteria from the wound. Of the case studies and case series that reported success in eliminating bacteria from the wounds, the majority employed honey only, while two used honey in conjunction with negative pressure wound therapy. The potential for bacteria to develop resistance to honey derived from the *Leptospermum* bush was tested under experimental conditions. A temporary resistance was observed under long-term stepwise resistance testing but no lasting mutations were detected. It is concluded that the risk of bacteria acquiring resistance to medical grade honey will be low if honey with a high level of antibacterial activity is used consistently in clinical care.

Effectiveness in promoting healing

Many different RCTs showed that honey promoted a fast healing of wounds. In RCTs with comparison of honey with a usual dressings (povidone iodine or "usual care") the honey treated wounds were equally or slightly more efficient than the usual treatment groups. Of the numerous reported trials only in one study reported two cases in which there was no progress in healing; in both these wounds honey was not effective in eradicating infection.

In a prospective RCT (n=42) comparing honey with povidone iodine dressings in the treatment of chronic

Effectiveness in reducing wound malodour

The RCT comparing honey and silver coated dressings for the treatment of malignant wounds over a period of four weeks found both treatments demonstrated a statistically significant reduction in malodour over the intervention period (p=0.007) with no significant difference between groups. In a RCT comparing honey with conventional dressings in reconstruction surgery for patients with head and neck cancer, the percentages of patients in both groups who were satisfied/very satisfied with control of odour were almost the same in the honey 17 and conventional dressings group. Four case studies also reported on the rapid reduction and elimination of odour when using honey dressings.

Effectiveness in relation to pain and patient comfort

A number of studies reported on pain, including general wound pain (in particular those studies focusing on patients with chronic wounds) and/or pain associated with the dressing procedure. Generally honey wound treatment had an equal effect on subjective pain as the usual care treatment. There is a tendency of less pain in the honey treated patients.

Adverse effects

Honey dressings should be avoided in patients with a known history of allergy to honey (individuals who have a bee or bee sting allergies are usually not allergic to properly irradiated honey products)

Due to honey's osmotic effect drawing fluid from surrounding tissues, increased levels of exudate may increase the risk of maceration of the surrounding skin

Best practice recommendations

- There is evidence to support the use of medical-grade honey for chronic wounds that are not responding to conventional treatments.
- Honey is effective in eliminating wound malodour.
- Before applying a honey dressing, ensure the patient is not allergic to honey.

- Assess for both general wound pain and pain associated with dressing changes, and administer analgesics as appropriate
- Given honey's osmotic effect, excessive exudate may occur. This could require superabsorbent dressings and more frequent dressing changes.
- To avoid the potential of microbial resistance developing, only use honey products that have a high level of antimicrobial activity e.g. UMF15+, >500+MGO, and change the dressing regularly particularly in heavily exuding wounds.

Some commercial honey preparations used in wound healing



Medihoney for wound care



Antibacterial wound gel



Moistering cream against eczemas



Medihoney wound gauze



Wound-healing creams



Wound dressing with Medihoney gauze

Biofilms

In recent years, attention has turned to the potential role of biofilms in wound infection. A biofilm may be described as a bacterial community living within a self-produced extracellular polysaccharide (EPS) matrix. The EPS protects the bacterial community from antimicrobial and phagocytic onslaught. Lately, in vitro evidence has indicated that honey is an effective agent for preventing biofilm formation. In an in vitro study it was found that laboratory-grown *Pseudomonas* biofilms were disrupted following application of Manuka honey⁷². These findings are particularly encouraging when considering the emergence of antimicrobial-resistant bacteria. No evidence has yet been presented that bacterial resistance to honey has occurred — it is highly unlikely that bacteria will select for resistance to honey because bacteria rely on sugar as a source of food.

Cross-contamination

Use of honey dressings may help prevent cross contamination. This is and will remain an important issue in healthcare. The viscous nature of honey is believed to provide a physical barrier that helps safeguard patients by preventing cross contamination.

Dressing wounds with honey

All dressings must be used in accordance with the manufacturer's instructions. This helps endorse the maxim do no harm and ensure that the full benefit of the product is realized.

Because of its fluid and viscous nature, honey can be difficult to apply. This is particularly true when profuse exudate is present, diluting the honey. Experience has shown that use of the appropriate honey vehicle, including a secondary dressing, can sometimes circumvent this problem:

- **Honey liquid or gel dispensed from a tube:** Applied directly onto wound or onto appropriate dressing before application
- **Absorbent alginate dressing with honey:** Can be applied to most acute/chronic wounds including infected or sloughy wounds
- **Honey in a hydrocolloid-like sheet:** Should be selected according to the exudate level of the wound

Allergy

Before honey is applied to a wound, the patient should be asked routinely if he/she is allergic to honey or bee products, including bee stings. It is advisable not to proceed with a honey-containing dressing if the answer is affirmative.

Discomfort

Occasionally, some patients report transient stinging on application of honey. The discomfort often disappears in a short period of time or after the first few applications. Analgesia is required only in those rare circumstances when pain may persist. In a review paper, Molan noted that patient response to honey applied to open wounds was reported as soothing, pain-relieving, and non-irritating, and demonstrated no adverse effects¹⁰¹

Conclusion

The resurgence of interest in honey as a modern wound dressing offers opportunities for both patients and clinicians. Recent additions to the honey product range of dressings indicate commercial confidence in the future of therapeutic honey. The wheel has turned full circle and honey is being re-established as a valuable agent in modern wound care management. Its advantages — providing a moist environment, debriding, deodorizing, antibacterial, anti-inflammatory capabilities — are factors that have been shown to facilitate healing. These advantages have been experienced by patients and clinicians in Europe and Australia and are now available to patients in North America. Use of any medical device must be based on clinical justification and available evidence about product safety and effectiveness. Continued research is needed to increase our understanding about the role of honey in a variety of wounds and its effect on healing compared to other treatment modalities.

A 2014 study by a Swedish research group has thrown some more light on the origin of the wound healing properties of honey. In a 2014 study this research was continued. A unique lactic acid bacterial (LAB) microbiota was discovered which is in symbiosis with honeybees and present in large amounts in fresh honey across the world. The LAB symbionts are the source to the unknown factors contributing to many of honey's properties. The LAB was very active against severe wound pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa* and vancomycin-resistant *Enterococcus* (VRE) among others. The mechanisms of action are partly shown by elucidating the production of active compounds such as proteins, fatty acids, anaesthetics, organic acids, volatiles and hydrogen peroxide. This and other symbionts produce a myriad of active compounds that remain in variable amounts in mature honey, and which are largely responsible to the wound healing properties of honey²⁷⁴

HONEY FOR WOUND HEALING UNDER HOME CONDITIONS

Besides scientifically based use of honey in wound care in hospitals (see next section), honey can also be used under home conditions, as it was used for many centuries. Although sterilised honey is only used in hospitals, raw honey can also be used under home conditions without any risk, as no adverse effects have been reported. Indeed, Prof. Descotte lectured in several Apitherapy conferences that his team has used raw honey routinely for wound care in hundreds of cases in the hospital of Limoge, France⁵³

Honey applied in wound healing in a Swiss hospital



Wound at the treatment beginning

A painful and infected wound on the left leg. The fracture was stabilised with plates and screws. After several operations the blood circulation of the leg was diminished and sores were built because of the prolonged bed lying.

The wound treatment with conventional means was not successful. The patient agreed to make a honey treatment.



After only 5 days of treatment the wound condition was significantly improved. New tissues were built and the bacterial inflammation has diminished significantly

After two months the wound was completely closed. The cicatrise is almost invisible and the skin is healthy, tender and elastic at the same time.

photos and comment by Kathrin Rieder, Switzerland, application see below.

Application of honey for wound healing under home conditions, after³³

It is not necessary to disinfect wound because honey will disinfect it

1. Apply honey as much honey on a gauze or clean cotton cloth as it is necessary to cover wound fully. Gauze and cloth need not be sterile.
2. Abscesses, cavity or deep wounds need more honey to adequately penetrate deep into the wound tissues. The wound bed should be filled with honey before applying the honey dressing pad.
3. Change bandage once a day. When doing it, wound need not be cleaned from honey. Honey is „dissolved“ in the wound or sticks to the gauze.
4. When changing the bandage remove hornification at the border of the wound with a pincette. This can be done under running water or with a soft tooth brush. Cell debris, which were not removed will not disturb healing process.
5. After cleaning, wound should be padded with as much gauze as is needed for drawing the wound liquid.
6. If wound is infected by yeast or it heals badly, a mixture of honey-betadine 1:1 can be used.

The applications of honey in wound and burn healing have been treated in different reviews, the recent ones being:^{15, 35, 36, 51, 76, 77, 87, 133}

Honey against infections of the skin

Honey inhibits a number of microbes relevant in skin infections such as *Staph. aureus*, *Pseudomonas aur*, *E. coli*, *Candida alb.* and a number of dermatophytes and has thus a potential for application against microbial skin diseases⁹⁵

ORAL HEALTH



There is much debate whether honey is harmful to teeth. Some reports show a cariogenic effect of honey^{37, 138}, while others claim that the effect of honey is less cariogenic effect than sucrose^{52, 38}. Due to its antibacterial activity honey ingestion inhibits the growth of bacteria, that cause caries^{102, 147} and might have a carioprotective effect^{56, 137}. It was shown to have an anti-plaque effect in vitro and in-vivo (tests with volunteers)²³. It was also shown that Manuca honey, a very potent antimicrobial honey, has a positive effect against dental plaque development and gingivitis and thus can be used in the place of refined sugar in the manufacture of candy¹⁰².

According to electron microscopic studies ingestion of honey does not cause erosion of tooth enamel as observed after drinking of fruit juice (pH 3.5). Ten minutes after consumption of fruit juice tooth erosion was seen, while 30 minutes after honey ingestion the erosion was only very weak. This effect can be explained only partially by the calcium, phosphorous and fluoride levels of honey, other colloidal honey components have to be also responsible⁶⁷.

Stomatitis and other oral lesions

Stomatitis is inflammation of the mouth mucose. Aphthous stomatitis, as well as as other oral lesions like recurrent herpes labialis, recurrent intraoral herpes, atrophic/erosive oral lichen planus, oral candidiasis and

oral psoriasis can be successfully treated with honey. Honey significantly speeded resolution of the inflammatory and ulcerative oral lesions. It significantly lowered the pain sensation and reduced the duration of some lesions and increased the number of pain free days⁵⁸.

To treat the conditions listed above, smear the individual ulcers, boils or aphthae with honey - or simply trickle a good spoonful of honey in your mouth and then swirl it around the mouth, in order to reach as many sores as possible. (It will become runny, but honey does penetrate the tissues very quickly; and it seems it is precisely when diluted that its curative power is activated.)¹

Against halitosis (malodour)

Manuka and acacia honey have been successfully used against halitosis (malodour)¹³⁹

Plaque and Gingivitis

A study investigated whether or not manuka honey with an antibacterial activity rated UMF 15 could be used to reduce dental plaque and clinical levels of gingivitis. A chewable "honey leather" was produced for this trial. Thirty volunteers were randomly allocated to chew or suck either the manuka honey product, or sugarless chewing gum, for 10 minutes, three times a day, after each meal. Plaque and gingival bleeding scores were recorded before and after the 21-day trial period. Analysis of the results indicated that there were statistically highly significant reductions in the mean plaque scores (0.99 reduced to 0.65; $p=0.001$), and the percentage of bleeding sites (48% reduced to 17%; $p=0.001$), in the manuka honey group, with no significant changes in the control group⁶⁰

Summarising the different findings, it can be concluded that honey is probably not as cariogenic as other sugars and in some cases can be also carioprotective, especially when strong antibacterial honey is ingested. However, for safety reasons, after consumption of honey it is advised to clean the teeth.

OTHER EXTERNAL APPLICATIONS BASED ON THE ANTIMICROBIAL ACTION OF HONEY

Besides the application in wounds and burns honey has also other external applications:

Honey against eye diseases

Since ancient times honey has been used for the treatment of eye disorders. This topic is reviewed by Molan, 2001, see there the original references¹⁰³: Aristotle has written in his *Historia Animalium* that "*honey is good as a salve for sore eyes*". It has also been used by traditional Indian medicine and in Mali. In the Rangarya Medical College of India it has been used to treat corneal eye ulcers, treatments of plepharitis (inflammation of the eye-lids) catarrhal conjunctivitis and keratitis. Honey is also successful in various ailments of the cornea. The use of honey in Russia has been reviewed: undiluted or 20-50 % water solutions being applied to the eye under the lower eye lid against chemical and thermal burns of the eye, conjunctivitis and infections of the cornea. The healing effect of honey is explained by its anti-inflammatory, antibacterial and antifungal actions of honey.

There are reports on the successful treatment by honey of keratitis, conjunctivitis and blepharitis in Egypt⁵⁹.

A successful double blind trial on the efficacy of treatment of vernal keratoconjunctivitis has been reported¹³⁵

The positive effect in keratitis to reducing the levels of angiogenic factors (VEGF and TGF-beta), inflammatory cytokines (IL-12) and chemokines (CC chemokine receptor 5(CCR-5))¹⁵³

Another explanation of the healing effect of honey in eye diseases is a irritation effect, triggering healing processes of the eye¹⁹. Stingless bee honey has been traditionally used by the Mayas against cataract¹⁰⁸.

Against catheter infection of CKD

Honey can be used to fight Chronic Kidney Infections Disease (CKD), by application to the dialysis catheter

This topic has been reviewed by Frances et al in 2015, in which it was reported that in three clinical studies

application of honey to the could prevent successfully bacterial infections⁶² Topical medihoney can be successfully use against catheter infections⁷⁴

Against virus action on lips and genitals¹⁴:

Apply honey on gauze auf critical point and change once a day

Against boils and furuncles

Mix liquid honey and flour 1:1, add a little water and brush with it affected area. Cover with gauze and leave it overnight.

Against muscle cramps

Cover affected area with honey, cover with gauze or cloth and fix it with adhesive plaster. Ev. cover with a warm wool cloth. Leave at least 2 hours.

Against bruises and contusions

Mix honey and olive oil 1:1 and cover with mixture affected area. Cover with gauze and leave for 4-6 hours.

Enhances post tonsilitis inflammation healing

Tualang honey from Malaysia enhances post tonsilitis inflammation healing process⁸⁶

Honey and cosmetics

A recent review summarises the used in honey in cosmetics. In cosmetic formulations, it exerts emollient, humectant, soothing, and hair conditioning effects, keeps the skin juvenile and retards wrinkle formation, regulates pH and prevents pathogen infections. Honey-based cosmetic products include lip ointments, cleansing milks, hydrating creams, after sun, tonic lotions, shampoos, and conditioners. The used amounts range between 1 and 10%, but concentrations up to 70% can be reached by mixing with oils, gel, and emulsifiers, or polymer entrapment. Intermediate-moisture, dried, and chemically modified honeys are also used. Mechanisms of action on skin cells are deeply conditioned by the botanical sources and include antioxidant activity, the induction of cytokines and matrix metalloproteinase expression, as well as epithelial-mesenchymal transition in wounded epidermis⁴⁰

SIDE EFFECTS OF CANCER TREATMENTS

Most of the cancer research has been done in animal models (see chapter 7). The use of honey in clinical cancer treatments has been reviewed in 2008 by Bardy²⁷ and in 2009 by Orsolic¹¹⁵

The first reported use of honey in oncology patients was the topical application of 'household' honey to 12 patients with wound breakdown following radical excision of vulval carcinoma. Clearance of infection was observed within 3-6 days, and improved healing rates were recorded⁴¹. In a report from the Russian Academy of Medical Science, patients with uterine cancer undergoing radiotherapy and treated with 'honey laminolact' showed a significant decrease in the severity of radiation-induced intestinal morbidity¹⁴⁶

Honey treatment for prevention of oral mucositis

This topic has been reviewed in 2008 by Bardy. It has been pointed out that honey may be used for radiation-induced mucositis, radiotherapy-induced skin reactions, hand and foot skin reactions in chemotherapy patients and for oral cavity and external surgical wounds²⁷.

Bardy et al tested the effect of active manuka honey on radiation-induced mucositis. A total of 131 patients diagnosed with head and neck cancer who were having radiotherapy to the oral cavity or oropharyngeal area were recruited into the study, and were randomly allocated to take either manuka honey or placebo (golden syrup) 20 ml 4 times daily for 6 weeks. Mucositis was assessed according to the Radiation Therapy Oncology Group (RTOG) scale at baseline, weekly during radiotherapy, and twice weekly thereafter until the mucositis resolved. The patient's weight was recorded at the same time as the mucositis was assessed. Throat swabs to identify bacterial or fungal infections were taken at baseline, and during and after radiotherapy. There was no significant difference between honey and golden syrup in their effects on mucositis. Active manuka honey did not improve mucositis, but both the honey and the syrup seemed to be

associated with a reduction in bacterial infections. Compliance was a problem after the onset of mucositis, which may have affected the findings²⁸.

Honey has a supportive effect on human patients who have undergone a cancer radiation therapy, decreasing radiation mucositis. Patients with head and neck cancer treated with radiation therapy were given honey. There was a significant reduction in the symptomatic grade 3/4 mucositis among honey-treated patients compared to controls; i.e. 20 versus 75%. The compliance of honey-treated group of patients was better than controls. Fifty-five percent of patients treated with topical honey showed no change or a positive gain in body weight compared to 25% in the control arm, the majority of whom lost weight³¹.

Patients with head and neck cancer treated with radiation therapy were given honey. There was a significant reduction in the symptomatic grade 3/4 mucositis among honey-treated patients compared to controls; i.e. 20 versus 75%. The compliance of honey-treated group of patients was better than controls. Fifty-five percent of patients treated with topical honey showed no change or a positive gain in body weight compared to 25% in the control arm, the majority of whom lost weight³¹.

A randomized controlled clinical trial was conducted on 90 patients with acute lymphoblastic leukemia and oral mucositis grades 2 and 3. The mean age of enrolled patients was 6.9 years. The patients were assigned into 3 equal treatment groups: Honey, HOPE (honey, olive-oil propolis), and control groups. Recovery time in grade 2 mucositis was significantly reduced in the honey group as compared with either HOPE or controls ($P < .05$). In grade 3 mucositis, recovery time did not differ significantly between honey and HOPE ($P = 0.61$) but compared with controls, healing was faster with either honey or HOPE ($P < .01$). Generally, in both grades of mucositis, honey produced faster healing than either HOPE or controls ($P < .05$). Based on our results that showed that honey produced faster healing in patients with grade 2/3 chemotherapy-induced mucositis, we recommend using honey and possibly other bee products and olive oil in future therapeutic trials targeting chemotherapy-induced mucositis³

Honey reduces chemoradiotherapy-induced mucositis in pediatric cancer patients⁷

Pediatric oncology

In paediatric oncology patients, the immune system is often suppressed by cytotoxic antineoplastic agents or radiation therapy and wound healing is impaired. In the Department of Paediatric Oncology at the Children's Hospital in the University of Bonn, Medihoney™ has become a readily accepted treatment with a positive impact on patient and parent satisfaction¹⁴¹.

Honey and chemotherapeutic drugs in combined supportive therapy

This use of honey has been reviewed⁸¹. Honey has been used to support chemotherapeutic action and reduce its side effects in myelosuppression, neutropenia etc.

Side effects of treatments of other cancers

Febrile neutropenia is a serious side effect of chemotherapy. Honey was administered to chemotherapy patients with neutropenia and was found that it reduced the need for colony-stimulating factors¹⁶³.

Therefore, the use of honey gauzes can be considered for the treatment of radiotherapy-induced dermatitis by radiotherapy of breast cancer patients¹⁰⁵

Topical application of honey can be used for the management of chemotherapy induced oral stomatitis⁹⁸

The antitumor activity of honey can be explained by the antibacterial, antiinflammatory, immunomodulating, antioxidant and probiotic effects of honey.

HONEY IN GASTROENTEROLOGY

According to the Muslim holy book "The Holy Hadith", dating back to the 8th century AD the prophet Mohamed recommended honey against diarrhoea¹¹. Also, the Roman physician Celsus (ca. 25 AD) used honey as a cure for diarrhoea⁴². The use of honey for prevention and treatments of gastro-intestinal disorders such as peptic ulcers, gastritis, gastroenteritis has been reported in various books and publications from

Eastern Europe^{81, 89, 96, 145} and from Arab countries¹³⁶ The applications of honey in traditional and modern medicine were reviewed in 2010¹

Ulcers and Gastritis

Honey is a potent inhibitor of the causing agent of peptic ulcers and gastritis, *Helicobacter pylori*^{8, 21, 92, 117} In rats honey acted against experimentally induced gastric ulcers^{18, 20, 66, 78}.

Honey is not involved on prostaglandin production, but has a stimulatory effect on the sensory nerves in the stomach that respond to capsaicin^{9, 16}. As a second mechanism of action has been postulated that this effect is due to the antioxidant properties of honey. Honey intake in rats prevented indomethacin-induced gastric lesions in rats by reducing the ulcer index, microvascular permeability and myeloperoxidase activity of the stomach¹¹⁰. In addition, honey has been found to maintain the level of non-protein sulfhydryl compounds (e.g. glutathione) in gastric tissue subjected to factors inducing ulceration^{9, 16, 19}. A third mechanism of the gastroprotective effect of honey has been suggested by Beretta et al. It involves the salivary reduction of nitrate (NO₃⁻) to nitrite (NO₂⁻) and the intragastric formation of nitric oxide (NO), the latter involved in the preservation of the gastric mucosa capillaries and in boosting mucous production. Honeys contained NO₂ and NO₃, the concentration in honeydew honeys being higher than that of blossom honeys²⁹

Ingestion of dandelion honey was shown to reduce gastric juice acidity by 56%²⁶. The gastric emptying of saccharides after ingestion of honey was slower than that of a mixture of glucose and fructose¹²³

The effect of honey under clinical condition on more than 40 gastric ulcer patients was studied in a Russian hospital. Control treatments were with water. It was found that ingestion of 120 ml of 33 % honey solution by gastric ulcer patients improves the micro capillary blood circulation, which can beneficially influence the gastric ulcers. Ingestion of 120 ml of 33 % honey warm honey solution decreases the acidity of the gastric juice, while the ingestion of the same amount and concentration of a cold honey solution increased the acidity of the gastric juice. The sleep of the gastric ulcer patients was also improved by ingestion of 50 g honey before sleep. In order to decrease gastric juice acidity the author recommends the intake of warm honey solution 40 to 60 minutes before eating. The function of the gall bladder is improved by the ingestion of cool solution of 100 ml 50 % honey (13-15 °C) The author concludes that ingestion of warm honey ev. in combination with propolis ingestion, is a good way to treat gastric ulcers⁵⁴.

A Bulgarian clinical study with dispeptic patients showed that honey consumption more than once weekly led to lower *Helicobacter pylori* rates of the patients³⁸

There are reports on healing of patients of suffering from gastritis, duodenitis and duodenal ulcers by intake of 30 ml of honey¹³⁶.

Clinical and animal studies have shown that honey reduces the secretion of gastric acid. Additionally, gastric ulcers have been successfully treated by the use of honey as a dietary supplement. An 80% recovery rate of 600 gastric ulcer patients treated with oral administration of honey has been reported. Radiological examination showed that ulcers disappeared in 59% of patients receiving honey⁷⁸.

Laxative effects and constipation

In certain cases, consumption of relatively large amounts of honey (50 to 100 g) can lead to a mild laxative effect in individual with insufficient absorption of honey fructose⁸⁴. Fructose is less readily absorbed in the intestinal tract than fructose together with glucose¹³². The mild laxative properties of honey are used for the treatment of constipation in Eastern Europe, China and the Near East. *However one should not give honey against constipation of infants younger than 1 year old because of the children botulism risk.*

Against acute gastroenteritis in children

A clinical study of honey treatment in infantile gastroenteritis was reported by Haffejee and Moosa. They found that by replacing the glucose (111 mmol/l) in the standard electrolyte-containing oral rehydration solution recommended by the World Health Organisation/UNICEF as well as the solution of electrolyte composition 48 mmol/l sodium, 28 mmol/l potassium, 76 mmol/l chloride ions, with 50 ml/l honey (29), the mean recovery times of patients (aged 8 days to 11 years) were significantly reduced. Honey was found to shorten the duration of diarrhoea in patients with bacterial gastroenteritis caused by organisms such as Salmonella, Shigella and E. coli. They recommended that honey was a safe substitute for glucose as long as

it provided 111 mmol/l each of glucose and fructose. The high sugar content of honey means that it could be used to promote sodium and water absorption from the bowel⁶⁸.

In a later study in Egypt honey added to oral rehydration solution promoted rehydration of the body and sped recovery from vomiting and diarrhea²

Against alcohol abuse

Positive effects of honey on ethanol intoxication such as disappearance in blood increase and of ethanol elimination rate has also been confirmed in studies with humans^{113, 114}.

Ingestion of both honey (2 g/kg body weight) and fructose, prevented the ethanol-induced transformation of erythrocytes of mice¹⁶²

Animal experiments have shown that the administration of a honey solution via a tube in the stomach of rabbits prior to them being administered with 0.5 g ethanol per kg body weight, accelerated alcoholic oxidation. Honey administered subcutaneously or orally before oral administration of ethanol affords protection against gastric damage and reverses changes in pH induced by ethanol¹⁷

A controlled clinical trial demonstrated the use of fructose in the treatment of acute alcoholic intoxication. A small but significant increase occurred in the rate of fall of blood-ethanol levels and it was concluded that fructose may be beneficial in shortening the duration of alcoholic intoxication³⁹.

Treatment of reflux oesophagus and heartburn

Honey has high density, high viscosity, and low surface tension, and therefore, can stay longer in the oesophagus as a coating on the mucus membrane, and can be used against reflux oesophagus^{93, 142} and against heartburn⁹³

Hepatitis and liver health

A positive effect of honey on hepatitis A patients was found after ingestion of clover and rape honey, causing a decrease of alanine aminotransferase activity (by 9 to 13 times) and of bilirubin production by 2.1 to 2.6 times²⁶.

Honey for good digestion

Supplementation of honey in concentration of 2, 4, 6 and 8 g/100 g to protein fed to rats improved the protein and lipid digestibility¹⁴³.

The anti gastric ulcer and anti-gastritis effect of honey can be explained by its antibacterial and anti-inflammatory action, as well as with its inhibitory effect on the acidity of the gastric juice. The positive effect of honey on nutrition function is also due to its prebiotic effect.

CARDIOVASCULAR HEALTH

The effects of ingestion of 75 g of natural honey by humans compared to the same amount of artificial honey (fructose plus glucose) or glucose on plasma glucose, plasma insulin, cholesterol, triglycerides (TG), blood lipids, C-reactive proteins and homocysteine, most of them being risk factors for cardiovascular diseases were studied in humans. Elevation of insulin and C-reactive protein was significantly higher after dextrose than after honey.

Dextrose reduced cholesterol and low-density lipoprotein-cholesterol (LDL-C). Artificial honey slightly decreased cholesterol and LDL-C and elevated TG. Honey reduced cholesterol, LDL-C, and TG and slightly elevated high-density lipoprotein-cholesterol (HDL-C). In patients with hyperlipidemia, artificial honey increased LDL-C, while honey decreased LDL-C¹³.

A similar study has been recently carried out in normal and overweight persons carrying a higher risk for a cardiovascular disease. These patients were given 70 g honey for 30 days. Results showed that honey caused a mild reduction in body weight (1.3%) and body fat (1.1%). Honey reduced total cholesterol (3%), LDL-C (5.8), triacylglycerole (11%), FBG (4.2%), and CRP (3.2%), and increased HDL-C (3.3%) in subjects with

normal values, while in patients with elevated variables, honey caused reduction in total cholesterol by 3.3%, LDL-C by 4.3%, triacylglycerole by 19%, and CRP by 3.3% ($p < 0.05$). The conclusion of the authors is that consumption of natural honey reduces cardiovascular risk factors, particularly in subjects with elevated risk factors, and it does not increase body weight in overweight or obese subjects¹⁶¹. Honey decreases also platelet aggregation and blood coagulation⁵

The above cited studies suggest small effects of honey on arteriosclerosis risk factors such as cholesterol, LDL-c and TG, the first studies being carried out with only 9 patients.

In a study with 30 persons and 30 controls it was shown that no significant decrease of cholesterol HDL and TG was encountered after ingestion of 75 g honey daily for a period of 14 days. While there were no effects in men, in women HDL values were increased in the controls having ingested sucrose, while in the honey group no increase was encountered, pointing out that honey has a positive effects in women¹⁰⁹

The effect of honey intake on the blood risk factors was tested in diabetes 2 patients (controls with no intake). Body weight, total cholesterol, low-density lipoprotein-cholesterol and triglyceride decreased, while and high-density lipoprotein-cholesterol ratio increased significantly²⁵.

Honey can contain nitric oxide (NO) metabolites which are known cardiovascular disease risk indicators. Increased levels of nitric oxides in honey could have a protecting function in cardiovascular diseases. Total nitrite concentration in different biological fluids from humans, including saliva, plasma, and urine was measured after ingestion by humans of 80 g of honey. Salivary, plasma and urinary NO metabolites concentrations showed a tendency to increase^{11, 13}. Different honey types contained various concentrations of NO metabolites, darker or fresh honeys containing more NO metabolites than light or stored honey. After heating, NO metabolites decreased in all the kinds of honey^{11, 13}.

The cardiovascular effects of honey can be explained by its antioxidant and anti-inflammatory effects.

HONEY AGAINST COUGH

Small doses of honey, 1 to 2 tablespoons intake has been found to influence favourably cough^{50, 71, 156, 157} and also sleep¹⁵⁷ of children.

The dose of honey used was ½ tsp for 2-5 year olds, 1 teaspoon for the 6 to 11 year-olds and 2 tsp for 12 to 18 year-olds. Buckwheat honey was chosen in this study because of its high antioxidant properties. The same study shows that honey is more effective than a chemical anti cough syrup¹¹⁹ These results were confirmed with 3 honeys (eucalyptus, citrus and labiatae) for the improvement of sleep in children (1-5 year old) with upper respiratory tract infections⁴⁴.

A review of the conducted clinical trials in the literature by Oduwole et al. in 2012 made the following conclusions: Honey may be better than 'no treatment' and diphenhydramine in the symptomatic relief of cough but not better than dextromethorphan. There is no strong evidence for or against the use of honey¹¹²

A double-blind randomised controlled trial was conducted from 2008 to 2011 in Iran. Included in the study were 97 adults who had experienced persistent post-infectious cough (PPC) for more than three weeks. The participants were distributed into three groups. A jam-like paste was prepared which consisted of honey plus coffee for the first group ('HC'), prednisolone for the second group (steroid, 'S'), and guaifenesin for the third group (control, 'C'). The participants were told to dissolve a specified amount of their product in warm water and to drink the solution every eight hours for one week. Honey plus coffee was found to be the most effective treatment modality for PPC. The recipe for the honey-coffee mixture : 500 g honey mixed with 700 g instant coffee powder. The daily dose was 23.7 g of the mixture, taken 3 times a day¹²⁸.

Intake of 90 ml milk with 10 g honey was tested in Italy on children with non-specific acute cough, resulting in improvement, similar to the one achieved by standard anti-cough drugs⁹⁷

Honey relieved the cough in a clinical test with 568 children better than diphenhydramine but less than dextromethorphan⁷³

HONEY AND THE BRAIN

Al-Hymyari conducted a five-year pilot study involving 2290 cognitively intact subjects and 603 with mild cognitive impairment aged 65 and older. They were randomized to receive either one daily tablespoon of Middle East honey or placebo. They found that only 95 subjects who received honey compared to 394 who received placebo developed dementia. The study concluded that honey and its properties act as natural preventive therapies for both cognitive decline and dementia¹²

A study using Tualang honey was conducted on 102 healthy postmenopausal women randomly assigned to one of three groups; untreated control, estrogen plus progestin therapy and Tualang honey. The participants in Tualang honey and estrogen plus progestin therapy groups received 20 g Tualang honey supplement and Femoston conti 1/5 (1 mg 17- β estradiol and 5 mg dydrogesterone), respectively, daily for 16 weeks. The participants' memory and oxidative stress status were assessed pre- and post-intervention. Postmenopausal women who received Tualang honey showed improvement in their immediate memory but not in immediate memory after interference and delayed recall. This result was comparable with the memory improvement seen in women receiving estrogen plus progestin therapy¹¹⁸

The neurological effects of honey have been recently reviewed¹²⁹. The review points out that different honey components, mostly polyphenols, have neurological effects on the brain. There is also direct evidence: according to the original references cited in this review honey has following effects:

1. Honey is reported to be an important component of Brahma rasayan, an Ayurvedic formulation that is prescribed to extend the lifespan and improve memory, intellect, concentration, and physical strength
2. Postmenopausal women who received honey showed improvements in their immediate memory but not in immediate memory after interference or in delayed recall.

It has been claimed for a long time that honey influences beneficially human sleep, but there were no experiments to prove the claims. Ingestion of one to two table spoons of buckwheat honey (10-20 g) by children of 6 to 18 years (6-11 years old- one table spoon, 12-18 years old 2 table spoons) improved also the sleep of coughing children^{119, 157}.

According to a theoretical model for the influence of honey on sleep honey stabilizes blood sugar levels and contributes to the release of melatonin, the hormone required for recovery and rebuilding of body tissues during rest⁹⁴

HONEY AGAINST DIABETES ?

A clinical trial in Egypt showed that that long-term consumption of honey might have positive effects on the metabolic derangements of type 1 diabetes⁴

OTHER HEALTH ENHANCING EFFECTS

Influenza and common cold

An Iranian study claims that intake of 50 g of honey daily reduces the length of the common cold by two days¹²⁶.

The Ukrainian doctors Frolov and Peresadin reported on a unique long term honey intake experiment. Frolov is the chair of the department of infectious diseases in the medical university of Luganska. All members of the department took 3 times a day, a total of 40-45 g of honey added to lukewarm tea. In the whole experiment 26 people took part in this unique experiment (n and number of years): n 5 for 20 y; n 6 for 15 y; n 8 for 10 y; n 5 for 5 to 10 y. During the whole experiment no other prophylactic was used. During the last 8 years of the experiment the department was in close contact with 40-60 patients with influenza and inflammation of the upper respiratory organs or with other infectious diseases like virus hepatitis, dysentery and even cholera. During the 20 year duration of the experiment no department member had any of the described diseases. In the immunological blood test it was found that the skin and the blood had an increased bactericidal activity, combined with very low microbial counts on the skin, while there were no pathogens in the whole area of the upper respiratory organs. And there was a control group to this experiment: a medical department, which was in close proximity of Frolov's test group, which had influenza or sore throat 3 to 4 times a year. This shows that a long term honey intake increases the anti-infectious immunity⁶³.

Hay fever and allergic rhinitis

Another controversial possible application of honey is its use for preventing hay fever. Beekeepers claim that eating honey in the pre-vegetation season (i.e. during winter) will prevent or weaken hay fever symptoms.

A report by Croft presented evidence that daily ingestion during winter time of 10-20 g of honey resulted in improvements of hay fever symptoms in 16 out of 21 patients⁴⁷.

Münstedt and Kalder found a positive effect of honey ingestion on hay fever by means of questionnaire filled out by 29 beekeepers¹⁰⁸.

In another study it was shown that honey to which birch pollen were added was more effective of treating rhinitis against birch pollen than conventional honey¹³⁴.

A 2002 clinical trial did not confirm the positive effects of honey ingestions, but honey was taken during the hay fever season and not before it¹³⁰.

Ingestion of 1 g/kg weight Tualang honey for 4 weeks by allergic rhinitis patients, complemented by an antihistamine drug treatment resulted in a significant improvement of allergic rhinitis of the honey supplemented group as compared to placebo (sugar plus antihistamine drug) treated controls²⁴.

As hay fever is increasing in developed countries this issue should be faced with more clinical trials, carried out in a correct way. More research is necessary to clarify this possible effect of honey.

Fertility

In a preliminary announcement at the 2nd International Conference on the Medicinal Use of Honey in 2010 there is a preliminary announcement that intracervical injection of honey in women with chronic endocervicitis was of positive therapeutic value both in terms of clinical cure and fertility enhancement¹. At the same conference it was reported that honey has positive effect on the mechanical properties of the fetal membranes, may be through "collagen promoting action"².

Supplementation of honey to cryoprotectant solution results in enhancement of overall human male sperm quality⁶¹.

Against alcohol abuse

Positive effects of honey on ethanol intoxication such as disappearance in blood increase and of ethanol elimination rate has also been confirmed in studies with humans^{113, 114}.

Ingestion of both honey (2 g/kg body weight) and fructose, prevented the ethanol-induced transformation of erythrocytes of mice¹⁶².

Hepatitis

A positive effect of honey on hepatitis A patients was found after ingestion of clover and rape honey, causing a decrease of alanine aminotransferase activity (by 9 to 13 times) and of bilirubin production by 2.1 to 2.6 times²⁶.

Anaemia

Remy Chauvin reviews different early works carried out on 4-8 old infants. The dose given was one tea to one soup spoon in warm milk per day. The increase of blood haemoglobin was seen after one week of intake⁴³.

These clinical results are confirmed by experiments by Haydak et al. with rats, placed on a diet with milk and poor in iron. Only dark honeys, e.g. calluna, were capable of bringing blood haemoglobin values back to normal, while light honeys failed to do so⁷⁰.

Menopause

An daily ingestion of table spoon of sunflower honey (about 20 g) for a period of 14 days by breast cancer patients improved the menopausal symptoms of 68 % of the patients, while a placebo effect of 25 % was expected¹⁰⁷.

Longevity

A representative sub-sample of 665 men within the Caerphilly Cohort kept a weighed dietary record for seven days. Risk factors for vascular and other diseases in 41 men who recorded eating honey suggest that these men were on the whole healthier than the 624 men who had not recorded honey consumption. All-cause mortality during 25 years of follow-up was considerably lower in the men who had consumed honey, the hazard ratio, adjusted for a number of possible confounding factors, being 0.44 (95% confidence limits 0.23, 0.86; $P < 0.017$). Because of the small number of subjects and of deaths in this study, further data from other large cohorts will be required before any effect upon mortality and other health effects of honey consumption can be adequately evaluated⁴⁵

Obesity

As a food rich in carbohydrates eating of large quantities of honey will of course cause obesity. However, eating of honey will cause less weight increase than the same quantities of sucrose^{32, 111, 161}

THE EXPERIENCE IN RUSSIA

Ludyansky, a chief doctor in a big Russian hospital, with life-long practice in apitherapy, has summarised the apitherapy knowledge in his monograph "Apitherapia" (in Russian)⁸⁹

Ludyanski summarises the medical uses of honey in his hospital in the following table:

Treated disease	Very good and good improvement	No improvement
Alopecia	11	5
Geriatry	59	-
Impotency	21	6
Inflammation of the vagina	21	5
Neurasthenia	60	-
Pediatrics	47	12
Prostatitis	24	5
Radiculitis	47	15
Stomatology	43	16

HONEY MASSAGE



Honey massage was developed in Tibet and Russia and is extensively described elsewhere^{69, 152}

Both liquid and crystalline honeys can be used.

1-2 tea spoons of liquid honey are applied on the back. Massagist puts hands onto this area and unglues the palms. Easy at first, "ungluing" the hands becomes more difficult with every move because the tension force increases. Massage lasts until the palms no longer stick to the massaged area, and the honey disappears from it. The actual duration depends on the type and quality of honey. Generally, honey massage lasts from 30 minutes.

IMPORTANCE OF THE HONEY TYPE



Due to different proportions of the possible sources, nectar and/or honeydew coming from a great variety of plants, no honey is completely the same as another one. This variability could be a handicap, given the market requirement for a consistent product, but when properly managed, it also could represent an opportunity for enhancing honey by offering to the consumer a number of typical products with special characteristics, according to the

particular botanical origin. Indeed, unifloral honeys are regarded as a more valuable class of honey, and botanical denominations are widely employed on the European market, often achieving higher prices than honey blends. Unifloral honeys have higher prices than blend honeys. In countries like France, Italy and Spain 30 to 50 % of the marketed honey is unifloral. In non-European countries, with the exception of the Manuka New Zealand honey, unifloral honeys have a smaller importance.

Information on European honeys is compiled in the special Apidologie Issue 35 from 2004. In Europe there are more than 100 plant species that can give origin to unifloral honey, most of them having only a local importance¹²⁰⁻¹²²

Most biological and clinical studies reviewed above have been made with undetermined types of honeys and there are very few studies where comparisons have been done with different unifloral honeys. Here the fields will be reviewed where such studies have been carried out.

Unifloral honeys are used in folk medicine for different purposes. The applications given in the table below remain to be confirmed by experimental science. Indeed, in most scientifically conducted clinical studies the botanical origin of the honey was not determined. On the other hand, the antibacterial and the antioxidant activity of honey depends strongly on the botanical origin. Health enhancing effects of different unifloral honey have been claimed in different practical apitherapy books, e.g.^{32, 89, 100}. The table below has been compiled from them. At present there is no scientific explanation of many of the claimed effects.

HOW TO EXPLAIN THE USE OF HONEY IN MEDICINE

Therapeutic and health enhancing use	Biological rationale
Honey in healing of burns and wounds	Antibacterial, anti-inflammatory, antioxidant, osmotic and analgesic effects
Therapy of digestive diseases like peptic ulcers and gastritis	Antibacterial and anti-inflammatory effects
Against children diarrhoea	Antibacterial and anti-inflammatory effects
Improvement of gut microbial health and of digestion	Prebiotic effect
Improvement of immune reaction of the body	Immunoactivating effect
Regular intake improves cardiovascular health	Lowering of blood risk factors and specific heart conditions as extracystoles, arrhythmia and tachicardia
Long term ingestion of honey can reduce the risk of human cancer	Anticancerogenic effects
Positive glycemic nutritional effect. Can be used as a sweetener of people with diabetes type II and also probably type I	Some honeys have a low glycemic index: e.g. acacia honey. Other fructose rich honeys such as thyme, chestnut, heather and tupelo are good alternatives.
Use for the treatment of radiation-induced mucositis	Antibacterial and anti-inflammatory effects
Positive effect of honey ingestion on hepatitis A patients	Anti-inflammatory effect
Improvement of cough in children	Contact soothing effect, sweet substances, as a sweetener honey causes reflex salivation and increases airway secretions which may lubricate the airway and remove the trigger that causes a dry, nonproductive cough.

EVENTUAL HEALTH HAZARDS

See Chapter 8, Honey as nutrient and functional food.

QUANTITY AND TIME OF HONEY INGESTION

The health enhancing effects in human adults, described in this report were mostly achieved after ingestion of 50 to 80 g of honey per day.

The health claims of honey which are reported below are valid for intakes of following amounts of honey:

- *Adults: after ingestion of 50 to 80 g per day by adults,*
- *General (adults or infants): 0.8 to 1.2 g honey per g human weight*

The duration of honey ingestion for increase of physical performance and fitness

is very fast, and takes place already 1 to 4 hours after intake.

The health effects reported in the different publications reported above were measured mostly after 2 to 3 weeks of daily honey ingestion. Practical apitherapists suggest for health enhancing effects a daily honey ingestion for 1.5 to 2 months^{65, 89}.

The normal daily allowance for carbohydrate sweeteners is 25 grams. Considering that the recommended amount of honey is quite high, intake of other sweeteners should be avoided. A normal intake of about 20-25 g per day will rather have a long term health enhancing effect.

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