



Health benefits and traditional uses of honey: A review

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ABSTRACT

Honey is an organic natural substance that is produced from the nectar of flowers by *Apis mellifera* and is a sweet, flavorful liquid. It contains sugars, small quantities of proteins, enzymes, amino acids, minerals, trace elements, vitamins, aroma compounds, and polyphenols. It is widely accepted as food and medicine by all generations, traditions and civilizations, both ancient and modern. Honey is heavily used by Asian countries such as Sri Lanka, India, Nepal, and Pakistan in their traditional medicinal systems. It is used as a remedy for burns, cataracts, ulcers, diabetes, wound healing, etc. Many researchers have scientifically validated most of the traditional claims (e.g., usage for diabetes, diarrhea, inflammation, gastrointestinal, and cardiovascular diseases) for honey using scientifically controlled experiments. We conclude this review by exposing the benefits and traditional usage of the honey, especially in Ayurveda medicinal system.

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INTRODUCTION

Honey is produced by honey bees, especially by the species of *Apis mellifera* [1] as blossom honey by secreting nectars of flowers and honeydew honey (forest honey) is a type of honey made from honeydew secreted by plant-sucking insects such as aphids [2]. Bees first convert the flower nectar into honey by a process of regurgitation and evaporation, then store it as a primary food source in wax honeycombs inside the beehive with the clear, golden amber color. Honey flavor will vary based on the types of flower from which the nectar was harvested. Honey can then be harvested from the hives for human consumption. According to historical evidence, there is evidence of the harvesting of wild honey, dating back 10,000 years. However, by 2400 BC, the art of beekeeping was well established in Egypt at least, and used honey as a natural food source and is also as ingredients in various food preparations [2-5]. Honey is accepted as a food source and medicine by both modern and ancient generations, traditions and civilizations [5-8]. According to the Christian holy book, the Bible, King Solomon said “eat honey my son, because it is good [9]. Furthermore, in accordance with the Bible, John the Baptist enjoyed a diet including wild honey when he was in the desert area or while traveling in the wilderness [10]. The religion of Islam recommended the use of honey, and a separate chapter was denoted in their holy book, Holy Quran for honey [11]. The Buddha considered honey to

be one of the five essential medicines and food [12]. Other popularities who were interested in honey as a medicine and food include Jews, Hindus, and Vedas [5,8].

Honey is produced in large quantities worldwide. National Honey Month is a celebratory and promotional event held annually during the month of September in the United States. The purpose of this event is to promote American beekeeping industry and honey as a natural and beneficial sweetener [13]. According to Food and Agriculture Organization, among the honey producing countries, Russia is in the top and followed by India, Mexico, Iran, Romania, Republic of Korea, New Zealand, Poland, and Kenya [14]. Honey mainly consists of sugars and water [Table 1]. Among the sugars, the highest amount was found to be fructose (~38%), followed by glucose (~31%) and sucrose (~1%). In addition, honey also contains several vitamins (mainly riboflavin, niacin, pantothenic acid, pyridoxine, folate, and vitamin C), minerals, proteins, enzymes (such as catalase, superoxide dismutase, reduced glutathione), flavonoides (such as apigenin, pinocembrin, kaempferol, quercetin, galangin, chrysin and hesperetin), and phenolic acids (such as ellagic, caffeic, p-coumaric, and ferulic acids) [15-19].

TRADITIONAL USES OF HONEY

Over 4000 years ago, honey was used as a traditional Ayurveda medicine, where it was thought to be effective to balance the

Table 1: Average composition of honey

Component	Average (%)
Water	~17
Fructose	32.56-38.2
Glucose	28.54-31.3
Other sugars*	~9.8
Proteins	~0.3
Dietary fiber	~0.2
Free acid as gluconic	~0.4
Lactone as gluconolactone	~0.2
Total acid as gluconic	0.6
Ash	~0.2
Nitrogen	~0.04
Minerals	~0.2
pH	3.2-4.5

Data adopted from [5,17,18]. Data adopted from [5,17,18]. *Other sugars include disaccharides such as maltose, sucrose, isomaltose, turanose, nigerose, melibiose, panose, maltotriose, melezitose. A few oligosaccharides are also present. Honey contains 4-5% fructooligosaccharides

three humors of the body. The ancients of Vedic civilization considered honey as one of nature's most remarkable gifts to mankind. In pre-Ancient Egyptian times, honey was used topically to treat wounds [20]. Honey is known as Madhu or Kshaudra in Ayurveda scriptures and is one of the most important medicines used in Ayurveda. Synonyms of bee's honey in Sanskrit are Madhu, Madvika, Kshaudra, Saradha, Makshika, Vantha, Varati, Bhrungavantha, and Pushparasodbhava. It is called Meepeeni in Sinhala and Thein paani in Tamil [16]. The ancient Greeks believed that consumption of honey could help one to live longer. Modern research indicates this substance does possess unique nutritional and medicinal properties. Bees honey is categorized into different types in Ayurveda medicinal system. According to Susruta Samhita of Ayurveda, there are eight different types of honey [21]. Sushruta Samhita is an ancient Sanskrit text on Ayurveda medicine and surgery. It describes ancient theories on human body, etiology, symptoms, and therapeutics for a wide range of diseases.

- Pauttika:** It has dry, hot and potency properties. Pauttika honey is formed from poisonous flowers and leads to vitiation of Vata, Pitta and Rakta (blood)
- Bhramara:** This type of honey is described as heavy, which means not easily to digest. It contains slimy and excessively sweet properties
- Kshaudra:** This type is known as light, which means easily to digest. It has cold and anti-obesive properties
- Makshika:** It is the best honey and especially used for the management of cough and asthma
- Chatra:** It has a sweet taste after digestion. Chatra honey also heavy, which means not easily to digest. It has cold and slimy properties. It is given as a remedy for bleeding disorders, leukoderma, urethritic discharges, and worm infestations
- Ardhya:** It has a pungent taste after digestion. Ardhya honey is good for eyes, eliminates vitiated Kapha and Pitta Dosh
- Auddalaka:** It has bestowed taste and beneficial for voice. It also used as remedy for skin diseases. As Ardhya honey, it has a pungent taste after digestion
- Dala:** It is dry and controls vomiting and diabetes mellitus.

According to Dash and Charaka Samhita [22] which is an ancient Sanskrit text on Ayurveda medicine and surgery, there are four different types of honey such as Makshika, Bhramara, Kshaudra and Paittaka. Makshika is the best type of honey and color is similar to sesame oil. It is produced by reddish variety of honey bees. Bhramara honey is produced by the Bhramara type of bees. It is heavy and white in color. Kshaudra honey is brown in color and produced by a small type of honey bee. Paittaka honey is produced by a large type of bees, and the color is similar to ghee [22].

There are two types of honey according to the Ayurveda properties which are named as Navina madhu (fresh honey) and purana madhu (old honey). Navina madhu: Honey that is fresh or recently collected is Navina madhu. It gives nourishment. Honey which is newly collected from bee hive increases body weight and act as a mild laxative. Purana madhu: When honey becomes old (approximately after 1 year of honey collection) is called purana madhu. It is drier than navina madu, act as a good adsorbent and reduces fat.

In Ayurvedic system of medicine, the properties of honey are Madhura (sweet) and Kashaya (astringent) in Rasa (Madhura is predominant Rasa and Kashaya is less predominant Rasa), Ruksha in Guna (property), and Sheetha in Veerya (potency). Immature honey leads to aggravations of Tridosha (this is the central concept of Ayurvedic medicine, the theory that health exists when there is a balance between three fundamental bodily substances called Vata, Pitta and Kapha. The functional aspect of the body is governed by these three biological humors. Every individual has a unique combination of these three. Vata can correlate with Air or Nerve System Humor, pitta can correlate with the Fire Humor and kapha with Water Humor) and mature honey restore this three dosha in its equilibrium state. Newly formed honey increases the body weight and old honey decreases the body fat and thus body weight [21].

Kapha dosha (humor) is the Ayurveda category for body constitutions, those with kapha dosha are of larger proportions with robust frame. According to Sushruta samhita, actions of new and old bees honey have different properties. New honey has Vrumhana guna (nourishing properties) and it does not alleviate vitiated Kapha dosha and is a laxative. Old honey is Grahi (Water absorbents and bowel binders), reduces fat and obesity (Vaidya). It should also be kept in mind that fresh honey helps to increase body mass while old honey produces constipation and decreases body mass. Therefore, old honey is better to treat obese patients. According to Sushruta, mature honey eliminates vitiated Tridosha while immature honey vitiates Tridosha and is sour in taste. Honey should not be heated or consumed warm as it causes toxic effect but in Unani medicine, they use heated honey for some preparations. Cold honey should always be preferred.

Honey incorporates into the Madhura Ghana (sweet in taste) according to Ashtangahridaya samhita, one of the ancient Sanskrit texts on Ayurveda medicine. Although, it is in sweet taste it does not increase the kapha dosha. Therefore, it has

kapha reducing property. It is the best Yogavahi substance, which means without changing its own properties; honey carries the effects of the drugs that are added to it. Therefore, honey enhances the properties and actions of the substances with which it combines [17].

Honey is very good for eyes and eye sight (vision), breaks up hard masses; it quenches thirst, balances kapha. It is useful to reduce toxicity, stops hiccups, for bleeding disorders, in urinary tract disorders and diabetes, skin diseases, worm infestations, bronchial asthma, cough, diarrhea and nausea, vomiting, cleanse the wounds, it heals wounds, helps in quick healing of deep wounds [17]. Honey which is newly collected from bee hive increases body weight and is a mild laxative, honey which is stored and is old helps in metabolism of fat and scrapes Kapha. 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 gut [15]. According to the Fundamentals of Chinese Medicine honey has balanced, sweet, non-toxic effects. It enters the lung, spleen and the large intestine meridian channels. Supplements the center and moistens the lung. Relieves pain and resolves toxins. Treats cough due to lung dryness; constipation due to dryness of the intestines; stomach pain; deep source nasal congestion, mouth sores, scalds and burns” properties [22].

In Ayurveda, honey was used for nutritional and therapeutic purposes since many centuries both internally and externally. Honey is used as Anupana (is a fluid vehicle taken with or after medicine or eating and which aids or assists the action of main ingredient) with principal drug in Ayurveda clinical practice. It is externally used for the treatment of eye diseases, cutting and burning wounds. Internally used with other herbal preparations specially for respiratory disorders such as cough, asthma and phlegm with or without fever, as a treatment for thirst, vomiting and hiccup, for diabetes, decoctions prescribed with adding bee honey, for obesity specially use old honey, for diarrhea, bee honey added to fresh herbal juice or decoctions specially in traditional medicine. It is also used as a natural preservative and sweetener in many Ayurveda or in traditional medicines such as Navaratna kalka [16]. 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. This is very common in traditional medicines in Sri Lanka specially used with pastes called Chandra Kalka in neurological disorders [23] and decoctions for diabetes mellitus [24]. It is very clear that bee honey is helpful to alleviate the vitiated dosha in the body.

Number of compound drugs such as Vishnukranthi kalka (a paste which is recommended in Ayurveda for the treatment of peptic ulcers and the kalka is made by mixing the dry powder of the whole plant of *Evolvulus alsinoides* L. with cow ghee, bee honey and common sugar in a ratio of 1:2:2:1 w/w) mentioned in Vidyasagar *et al.* [25] for Annadrava shula and Parinama shula (which were correlate with gastric ulcers and peptic ulcers in Allopathic medicine) contain honey and they conferred good results. Ayurveda preparations with bees honey possess significant gastroprotective activity and it helps to

promote healing of gastric or duodenal ulcers [26]. Further honey may be helpful in preventing gastroesophageal reflux disease [27].

Use of honey in medications for diabetes is mentioned in Ayurveda since ancient times. Honey is normally added to the prepared decoctions. Bee’s honey is beneficial for diabetic patients in two ways. One is; honey being sweeter than sugar, one may need a much smaller quantity of honey as a sweetener and honey contain lesser calories than sugar. Further, by providing vitamins B₂, B₄, B₅, B₆, B₁₁ and vitamin C, and minerals such as calcium, iron, zinc, potassium, phosphorous, magnesium, selenium, chromium, and manganese. The nutritional values of honey could be altered by feeding the bees with selective food [28].

Bee wax [Figure 1] secreted by bees in constructing their honeycomb. It appears as solid, yellowish, nonglycerine substance consist of fats and oils. It is used as a natural base when preparing creams and balms. Honey is used in most of the preparations in Ayurveda and traditional medicinal treatments and is used as a vehicle/preservative for rapid absorption of the drug [Table 2]. Sometimes, some Rasa medicines and other herbal preparations are taken with bees honey [Table 3].

PHARMACOLOGICAL EFFECTS OF HONEY

Remedy for Stomach Disorders

Many research groups have validated the traditional claims of honey using scientifically controlled experiments. Honey is used to treat and protect against gastrointestinal infection such as gastritis, duodenitis and gastric ulceration caused by bacteria and rotavirus [29-33]. Attachment of bacteria to mucosal epithelial cells is considered the initial event in the development of bacterial infections of the gastrointestinal tract. According to the literature, prevention of bacterial adherence demonstrated by honey is categorized into different mechanisms: (a) Non-specific mechanical inhibition perhaps through the coating of the bacteria by the honey (b) may alter



Figure 1: Photograph of bees wax

Table 2: Traditional and ayurveda recipes where honey act as a preservative or vehicle

Type of preparations	Mode of usage of honey
Traditional preparations Kalka Krimirupukalka, Yashthikalka, Buddharajakalka, Candrakalka, Navaratnakalka	Honey use as a preservative
Ayurveda preparations Asava and arishta e.g.: Ushirasava, Aravindasava, Kanakasava, Kumaryasava, Drakshasava, Punarnavasava Ashvagandharishta, Khadirarishta, Dashamularishta, Nimbarishta	Honey use as a preservative
Avaleha Kanthakaryavaleha, Kutajavaleha, Kushmandavaleha, Cyavanaprasha, Vasavaleha	Honey use as a preservative
Netra bindu	Honey use as a preservative
Rasa preparations Ananda bahirava rasa, Karpura rasa, Lakshmvilasa rasa, Vasantakusumakara rasa, Vasantamalati rasa, Sri jayamangala rasa	Honey use as a vehicle

Data adopted from [16,21,22]. Kalka and Avaleha are type of pastes, Asava and Arishta are type of liquids, Netra Bindu is an eye drop and Rasa preparations are Mineral Drugs. When preparing pastes (kalka), ingredients are powdered and then they grind with bee honey until it becomes to paste, e.g.: Navarathnakalka, Chandra Kalka, and Buddharajakalka. When preparing mineral preparations in Ayurveda system, ingredients convert into fine powder form and then they grind with bee honey, e.g., Saptamrutralauha. When using as a Anupana (vehicle of a drug) for oral administration according to traditional medicine, normally one teaspoonful of bee honey is added to the rest of the herbal preparation. However, most of the time oral dosage of bee honey is not mentioned in Ayurveda preparations, but practitioners are added one tea spoonful according to traditional medicine system normally.

Table 3: Traditional and ayurveda recipes with honey

Diseases	Recipes
Indigestion	Ginger (<i>Zingiber officinale</i>) juice with honey, Lemon (<i>Citrus limon</i>) juice with honey with Navaratna kalka Roasted cumin seeds powder with bee honey, Roasted cloves powder with bee honey
Peptic ulcers	Paste prepared with Vishnukranti, honey, ghee and sugar
Diarrhea with vomiting	Decoction prepared by Bark of Beli (<i>Aegle marmelos</i>) root and internal part of the mango seed with honey
Cough	Adathoda (<i>Adatoda vesica</i>) svarasa with bee honey, Decoction of Adathoda, Elabatu (<i>Solanum indicum</i>) roots and Rasakinda (<i>Tinospora cordifolia</i>) with honey, Powder of vibatika (<i>Terminalia bellirica</i>) 10 g mixed with bee honey cure Asthma and cough immediately
Asthma	Most of the rasa preparations "Buddharaja kalka" - prescribed with juice of Ambuldodam (<i>Citrus aurantium</i>), ginger, honey and the drug "Svasakuthara rasa" is given with honey
Hiccup	Curd with bee honey, Ash of peacock feathers with honey, Rasa preparation "Arogyavardhanavati" with honey
Anorexia	Pomegranate juice and rock salt with honey

Data adopted from [16,22]. Navaratnakalka, Vishnukranti, Svasakuthara rasa, and Arogyavardhanavati are traditional and Ayurvedic preparations

bacterial electrostatic charge or hydrophobicity which have been reported to be important factors in the interaction of bacteria with host cells [33-35] or (c) killing of the bacteria due to the previously mentioned antibacterial factors in honey [33]. *Helicobacter pylori* is found to be sensitive to honey with a median level of antibacterial activity due to the presence of hydrogen peroxide at a 20% concentration [31,36,37]. According to the Nasutia *et al.* (2006) honey (2 g/kg), prevented indomethacin-induced gastric lesions, microvascular permeability, and myeloperoxidase activity of the stomachs of the rats [38]. In addition, for evaluation of gastric cytoprotective properties of natural honey, perfusion of the stomach with isotonic honey resulted in a marked reduction of the area of the lesions caused by ethanol [39]. Also, it has been suggested that natural honey has curative properties for healing of antral ulcers and may be used like sucralfate in the management of peptic ulcer disease [40]. Furthermore, honey is used as a remedy for diarrhea and gastroenteritis [30,36,37] at a concentration of 5% (v/v).

ANTI-INFLAMMATION ACTION

Honey reduces the activities of cyclooxygenase-1 and cyclooxygenase-2, thus showing anti-inflammatory effects [41]

and demonstrates immunomodulatory activities [42]. Furthermore, ingestion of diluted natural honey showed reduction effect on concentrations of prostaglandins such as prostaglandin E2, prostaglandin F2 α , and thromboxane B2 in plasma of normal individuals [43]. Bilsel *et al.* (2002) have proved that anti-inflammatory activity of honey was as effective as prednisolone, reference drug [44]. Further, honey has an anti-inflammatory action free from adverse side effects [45] such as suppression of immune response and tissue growth, formation of ulcers in stomach, etc.

ANTIOXIDANT ACTIVITY

Honey has exhibited a strong antioxidant potential and its activity is strongly correlated with the content of total phenolics [46-51] and the color of honey. It was found that dark honey has a higher total phenolic content, and consequently, a higher antioxidant capacity [50,52]. Honey also inhibited oxidative stress which may be partly responsible for its neuroprotective activity [53]. Hyperlipidemia and production of free radicals are risk factors for cardiovascular diseases [54,55]. A wide range of phenolic compounds are present in honey which has promising effect in the treatment of cardiovascular diseases [56-58].

WOUND HEALING ACTIVITY

Honey has cleansing action on wounds, stimulates tissue regeneration, reduces inflammation, and honey impregnated pads act as non-adhesive tissue dressing [36,59,60]. Clinical trials have revealed that honey dressing showed better improvement (e.g., dressing in burns with amniotic membrane dressing; silver sulfadiazine dressing, and boiled potato peel dressing) and showed early healing with lesser degree of contracture and scarring [36,61].

ANTIDIABETIC PROPERTIES

The use of honey in Type I and Type II diabetes was associated with significantly lower glycemic index than with glucose or sucrose in normal diabetes. Due to the low glycemic index of the honey, it helps to reduce the absorption of digested food [62]. Honey compared with dextrose caused a significantly lower rise in plasma glucose levels in diabetic subjects. It also caused reduction of blood lipids, homocysteine levels and C-reactive protein levels in normal and hyperlipidemic subjects [36,63]. In earlier observations, it was found that honey stimulates insulin secretion, decrease blood glucose levels, elevates hemoglobin concentration [64], and improves lipid profile [65].

ANTIMICROBIAL ACTIVITY

Honey has been reported to have antibacterial activity against various bacterial species including *Bacillus anthracis*, *Corynebacterium diphtheriae*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Listeria monocytogenes*, *Mycobacterium tuberculosis*, *Pasteurella multocida*, *Yersinia enterocolitica*, *Proteus species*, *Pseudomonas aeruginosa*, *Acinetobacter* spp., *Salmonella diarrhea*, *Salmonella typhi*, *Serratia marcescens*, *Shigella dysentery*, *Staphylococcus aureus*, *Streptococcus faecalis*, *Streptococcus mutans*, *Strep. pneumoniae*, *Streptococcus pyogenes*, and *Vibrio cholerae* [36,66-68]. An antifungal action has been reported for honey against *Aspergillus*, *Penicillium*, as well as all the common dermatophytes [69,70] and *Candida albicans* [36,71]. Honey has shown antiviral effect also. The topical application of honey on recurrent attacks of herpes lesions concluded that topical honey application was safe and effective in the management of the signs and symptoms of recurrent lesions from labial and genital herpes compared to acyclovir cream [72]. In addition, honey has also been reported to have inhibitory effects on rubella virus activity [66].

CONCLUSION

Due to the adverse effects of synthetic drugs researchers pay more attention on plant based drugs. Apart from plant-based drugs, honey, a natural substance has been used since ancient time for medicinal purposes. Due to the validation of ethnopharmacological claims, scientists also accept honey as a new effective medicine for many diseases.

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