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Honey: A boon for health

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Abstract
Honey, the world's oldest sweetener, was the major sweetener until the sugarcane was cultivated on a large scale in the new world. Since ancient time honey has been using for its medicinal properties in many cultures. Pure honey chiefly contains dextrose and levulose together with water, in which these are at first dissolved. Most of the elements found in human body are present in honey in small quantity. In this review, we have described the constituents of honey and examine the information available that is supported by laboratory or clinical studies in which honey has shown positive results for the improvement of human health.

Keywords: Honey, wound healing, Ayurveda

Introduction
Honey, the world's oldest sweetener, was the major sweetener until the sugarcane was cultivated on a large scale in the new world. Since ancient times honey has been using for its medicinal properties in many cultures. Currently, information on the use of honey for the treatment of many human diseases can be found in general magazines, beekeeping journals and natural products leaflets, and suggesting a wide variety of unfounded properties. In contrast, medical reports supported by tests are few and far between. In this review, we have described the constituents of honey and examine the information available that is supported by laboratory or clinical studies in which honey has shown positive results for the improvement of human health [1]. (Amy E. *et al*., 1996; 7:43-49).

Synonyms [2] (Nadkarni A.K., 1976**).**
Samskrta [3] : Madhu, maksika, madhvika ksaudra, saragha, maksikavanta, varativanta, bhrngvanta, pusparasodbhava.

Hindi	:	Madhu
Arabic	:	Asal
Bengali	:	Madhu
Farasi	:	Shahad
Gujarati	:	Madha
Kannada	:	Jaitupp
Malavalam	:	Madha
Telugu	:	Teni
Latin	:	Mel
English	:	Honey

Composition of honey
Constituents and chemical composition [4]
Pure honey chiefly contains dextrose and levulose together with water, in which these are at first dissolved. Most of the elements found in human body are in small proportions, present in honey [5] (Nadkarni A.K., 1976). Nutrients present in honey are as shown in table no. 1.

Table 1: Nutrient values of Honey [4]

Nutrient	Average amount/ 100g
Water	17.l0g
Calories	304
Total Carbohydrate	82.40g
Fructose	38.50g
Glucose	31.00g
Maltose	7.20g
Sucrose	l.50g
Other carbohydrates	4.00g
Dietary Fiber	0.20g
Total Fat	0
Cholesterol	0
Total Protein	0.30g
Ash	0.20g
Vitamins	
Thiamin	0
Riboflavin	0.04mg
Niacin	0.12mg
Pantothenic acid	0.07mg
Vitamin B-6	0.02mg
VitaminB-12	-
Folate	2.00mcg
Vitamin C	0.50mg
Vitamin A	0
Vitamin D	0
Vitamin E	0
Vitamin K	0

Minerals	
Calcium	6.00mg
Phosphorus	4.00mg
Sodium	4.00mg
Potassium	52.00mg
Iron	0.42mg
Zinc	0.22mg
Magnesium	2.00mg
Selenium	0.80mg
Copper	0.04mg
Manganese	0.08mg

The precise composition of honey varies according to the plant species on which the bee forages, but the main constituents are the same in all honeys. The average composition of honey is given in table 2.

Table 2: Average composition of honey Component Average (%)

Moisture	17.2
Fructose	38.19
Glucose	31.28
Sucrose	1.31
Disaccharides, calculated as maltose	7.31
Higher sugars	1.5
Free acid as gluconic	0.43
Lactone as Gluconolactone	0.14
Total acid as gluconic	0.57
Ash	0.169
Nitrogen	0.041

(Data was collected from 490 samples of US honey)

In addition to those named in Table 2, the following have been identified as constituents of honey: isomaltose, nigerose, turanose, maltulose [6] (White JW, *et al*., 1959) kojibiose [7] (Watanabe T, *et al*., 1960) alpha beta-trehalose, gentiobiose, laminaribiose [8] (Siddiqui IR, *et al*., 1967); maltotriose, 1-kestose, panose, isomaltosyl glucose, erlose, isomaltosyltriose, theanderose, centose, isopanose, isomalto-syltetraose and isomaltosylpentaose [9] (Siddiqui IR, *et al*., 1968). The predominant acid found in honey is gluconic acid. Its presence in all honey originates largely from the activity of glucose oxidase which the bees add at ripening [10] (White JW, *et al*., 1973). The pH of honey ranges from 3.2 to 4.5. The mineral and vitamin content of honey is very low, 0.02 % of its weight and given the low consumption of honey they have no significant nutritional benefit to man. Honey also contains a number of amino acids, proline, phenylalanine and aspartic acid being those with a concentration of greater than 200 ppm [11] (Bosi G, *et al*., 1978). The main enzymes found in honey which are derived from the hypopharyngeal glands of worker honeybees, are invertase (which inverts sucrose to glucose and fructose); glucose oxidase (which oxidises glucose to gluconic acid and hydrogen peroxide in the presence of water); and amylase (diastase), which breakdown starch. The enzymes in honey which originate from plants are catalase (a regulator of glucose oxidase activity); acid phosphatase; and a small proportion of amylase [12, 13] (White JW. *et al*., 1975, White JW. 1978).

Varieties

Table 3: Varieties of Honey according to different texts.

Types	C.S.[14]	S.S.[15]	A.S.[16]	B.P.[17]
Pauttika	+	+	+	+
Bhramara	+	+	+	+
Ksaudra	+	+	+	+
Maksika	+	+	+	+
Chhatra	-	+	-	+
Arghya	-	+	-	+
Auddalaka	-	+	-	+
Dala	-	+	-	+

Bhramara, Pauttika, Ksaudra and Maksika varieties of honey are good in order of succession and Ksaudra and Maksika varieties of honey should be made use of as far as possible [18].

Pharmacological Properties [19, 20]

Guna - Guru, Ruksa
Rasa - Madhura, Kasaya
Virya - Sita
Action on dosa - Kaphapittahara, Vatavardhaka Tridosasamaka (Susruta) [21]

Table 4: Properties of Madhu according to different Ayurvedic Texts.

Karma	C.S. [22]	S.S. [23]	A.S. [24]	B.P. [25]
Agnidipana		+		+
Caksusya		+	+	+
Chedana				+
Hrdya		+		
Kaphahara	+	+		
Lekhana		+		+
Medhakara				+
Medohara		+		
Pittahara	+	+		
Prasadana		+		+
Rakta samaka	+			
Sangrahi		+		+
Sandhankara		+	+	
Saukumaryakara		+		+
Srotovisodhaka				+
Suksmamarganusari		+		+
Swarya		+		+
Trsnahara			+	
Vajikara		+		
Varnya		+		+
Vatahara		+		
Vatakara			+	
Vrsya				+
Visada				+
Vrana Ropaka		+	+	
Vrana Sodhana		+	+	+
Yogavahi	+	+	+	

Therapeutic uses of honey

Ayurveda

In Ayurvedic classics there are some special considerations regarding the use of honey as.

- Honey is beneficial when used cold and it is similar to poison when used hot combined with substances of hot potency, by person suffering from heat and during hot season [26].
- Honey should be taken in small quantity otherwise undigested honey is as fatal as any poison [27].
- One should never take honey, ghi, vasa (muscle fat), taila (oil) and water mixed in equal quantities in combination of two, three or all together, as they are incompatible [28].
- Honey and ghi in unequal proportion along with rain water is also incompatible [29, 30].

Modern

Antibacterial

The reasons for the antibacterial activity of honey are controversial. A laboratory demonstration of its antibacterial activity was first carried out by (Dold *et al*., 1937) who gave the name 'inhibine' [31] to the substance which inhibited bacteria. (Adock *et al*., 1962) first suggested the possibility that hydrogen peroxide was responsible for the antibacterial activity of honey since both the antibacterial activity of honey and hydrogen peroxide were destroyed by light [32, 33]. The amount of catalase necessary to destroy the antibacterial activity was found to be unexpectedly high [34, 35, 36] (Cohen G, *et al*., 1962) Many have attributed the therapeutic action of honey to just the osmotic effect of its sugar content [37, 38, 39, 40], (Seymour *et al*., 1951). Lavie found an additional group of light- sensitive, heat-stable antibacterial factors in honey which inhibited the growth of Bacillus subtilis, B. alvei,

Escherichia coli, Pseudomonas pyocyanes, Salmonella and Staphylococcus aureus. Conversely, microorganisms that survive well in honey are the sugar-tolerant (osmophilic) yeasts, mostly belonging to the genera Saccharomyces and Zygosaccharomyces [41, 42, 43] (Lavie P. *et al*., 1968) since they are very soluble in cell membranes [44, 45] (Cramer JA, *et al*., 1977).

Gastroenteritis

As in any infection, the calorific demand is increased. Pure honey has bactericidal activity against many enteropathogenic organisms, including those of the Salmonella Shigella species and enteropathogenic E. coli [46] (Jeddar A, *et al*., 1985). *In vitro* studies of Helicobacter pylori isolates which cause gastritis have been shown to be inhibited by a 20% solution of honey. Even isolates that exhibited a resistance to other antimicrobial agents were susceptible [47] (Ali AT, *et al*., 1991). In a clinical study, the administration of a bland diet and 30 mL of honey three times a day was found to be an effective remedy in 66% of patients and offered relief to a further 17%, while anaemia was corrected in more than 50% of the patients [48] (Salem SN. *et al*., 1981). A clinical study of honey treatment in infantile gastroenteritis [49] (Haffejee IE, *et al*., 1985). 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 [50] 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 [51] (Chatterjee A, *et al*., 1978] the mean recovery times of patients (aged 8 days to 11 years) were significantly reduced.

Gastric ulcer

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 [52, 53]. (Kandil A, *et al*., 1987, Ali AT, *et al*., 1991).

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 intoxication [54] (Brown SS *et al*., 1972).

Wound healing properties [55-66]

Honey is an effective treatment of wounds because it is non-irritating, non-toxic, self- sterile, bactericidal, nutritive, easily applied and more comfortable than other dressings [67] (Bulman MW. 1953). It promotes the granulation of tissue [68] Honey was also found to be more effective as an antibacterial agent against several Pseudomonas and Staphylococcus strains than the antibiotic, gentamicin [69] (Farouk A, *et al*., 1988).

Diabetes

There is a need for sweetners in the diabetic diet to improve overall dietary compliance. Since fructose is absorbed more slowly from the gastrointestinal tract than glucose and is rapidly taken up by the liver, blood sugar levels rise only minimally after fructose ingestion [70, 71] (Crapo PA, *et al*., 1980, Mann JI. 1987). Bornet *et al*. 1985 demonstrated that the sucrose or honey at breakfast have no additional acute hyperglycaemic effect over and isoglucocidic amount of bread in type II diabetic patients [72]. In addition, a clinical study by Katsilambros *et al*. 1998 [73], indicated that honey could be a suitable sweetner for the type II diabetic diet since fat-rich foods added to honey result in higher triglyceride and insulin serum concentrations.

Antioxidant [74, 75, 76] (honey act as an good antioxidant)

Honey can enhance the growth and acid production of human Bifidobacterium ssp [77, 78].

Honey may lower plasma insulin levels, C-reactive protein, and homocysteine in healthy and diabetic subjects [79].

Natural honey lowers plasma prostaglandin concentrations in normal individuals [80].

Fueling exercise with honey [81]

It is well-known that carbohydrate ingestion prior to, during and after exercise enhances athletic performance and speeds recovery. Honey is a natural source of readily available carbohydrates providing 17 grams of carbohydrates per tablespoon. Honey's unique carbohydrate composition (approximately equal amounts of fructose and glucose) may render it the perfect pre-exercise food. Recent research published in the Journal of Applied Physiology suggests that carbohydrates that are lower on the glycemic index (GI) may reduce the incidence of rebound hypoglycemia and provide sustained carbohydrate availability during exercise. In addition, preliminary data from the University of Memphis Exercise and Sports Nutrition Laboratory suggest that honey is as effective as glucose for carbohydrate replacement during endurance exercise.

Effect of processing and storage on antioxidant capacity of honey [82]

Commercial honey processing generally involves controlled heating (to destroy yeast and delay granulation) combined with fine straining or pressure filtration. There has been concern that the processing of honey may reduce the antioxidant capacity of honey.

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