

## The Beneficial Effects of Honey on the Human Heart, Cardiovascular System, and Non-Cardio Conditions

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### Abstract

Honey is produced all over the world and contains small amounts of sugars, enzymes, amino acids, minerals, trace elements, vitamins, scent molecules, and polyphenols. All generations and civilizations, ancient and modern, recognize it as food and medicine. Honey has been consumed in various ways, including a sugar substitute and flavoring ingredient. Carbohydrates, such as monosaccharides, fructose, and glucose, are the essential elements in honey. Honey has a plethora of additional compounds at minuscule levels that have antiviral, antiparasitic, anticancer, anti-inflammatory, antimutagenic, antioxidant, immunosuppressive, and antibacterial properties. It can also be used as an antidiabetic and weight management supplement. Alongside its therapeutic properties, it also functions as a prebiotic, promoting the development of probiotic bacteria. Honey's importance has been recognized in scientific papers, and there is compelling evidence to support its therapeutic use. This review aims to present the history of honey and investigate its role in medicine and cosmetics.

**Keywords:** Amino Acids; Antibacterial Properties; Immunosuppressant; Natural Cardiovascular Cures; Natural Diabetes Treatment; Trace Elements; Weight Management

### Abbreviations

BP: Blood Pressure; CAGR: Compound Annual Growth Rate; CRP: C-Reactive Protein; LDL: Low-Density Lipoprotein; ROS: Reactive Oxygen Species; VF: Ventricular Fibrillation; VT: Ventricular Tachycardia; WHO: World Health Organization

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### Introduction

The term honey conjures up memories of warmth and reminiscence. Honey is connected with kindness, which is why humans consume it. It is thick, golden, transparent, and “pure” in appearance [1]. In their review, Eteraf-Oskouei, *et al.* (2013) reported honey as sweet, which is more significant than its texture and look. This specific character results from floral nectar and the upper aerodigestive tract of honey bees, which is concentrated inside the hive through a dehydration process [2]. According to Samarghandian, *et al.* (2017), it is one of the most highly valued and respected natural products presented to civilization [3].

Honey was widely used as a medication, according to prehistoric scriptures such as Sumerian Clay Tablets (6200 BCE), Egyptian papyri (1900 - 1250 BCE), the Vedas (Hindu literature) 5000 years, the Bible, and Holy Koran [3]. Furthermore, historical texts reveal that the Chinese, Greeks, Assyrians, Mayans, Babylonians, and Romans used honey for nutritional and therapeutic purposes [2]. The following are some of the health benefits of honey that ancient ethnicities have used:

- According to Ayurvedic scriptures, honey is beneficial for the health of teeth and gums and for people with poor digestion. Honey has also been reported to be quite effective in managing numerous eye diseases and troublesome coughs [2].
- In pre-Ancient Egyptian times, honey was used externally to cure injuries [4]. The Smith papyrus, an Egyptian book spanning sometime between 2600 and 2200 B.C., describes a typical wound salve. The description was written in hieroglyphic symbols and depicted as a mixture of wax, honey, and fibers. The ancient Egyptians used honey for its antibacterial properties. They offered honey to their gods as a sacrifice and used it to mummify the deceased [2].
- In ancient Greece, honey was used as a traditional treatment for gout and specific neurological diseases [2]. The ancient Greek scientist Hippocrates (460–377 BCE) quoted: “I consume honey and use this in the cure of many ailments since honey provides additional nourishment and wellness” [4]. Hippocrates advised an elemental diet, preferring honey with vinegar for pain, honey with water for dehydration, and a combination of honey, water, and several pharmaceutical compounds for acute fevers. He also used honey to cure alopecia, infertility, tissue regeneration, laxative effect, asthma, hoarseness, eye diseases, external antisepsis, and scar prevention therapy [2]. Furthermore, according to Aristotle, “consuming honey lengthens lifespan” [5].
- According to various Roman authors (such as Bassus, Cato, and Athenaeus), honey was used as a flavoring ingredient in recipes throughout the Roman Empire. Some of these recipes can be found in the writings of Roman Cookery [4].
- Honey is considered a beneficial beverage in Islamic medicine. The holy Qur’an powerfully depicts honey’s significant healing effect. For example, the Muslim prophet advocated using honey to heal diarrhea. A renowned Iranian scholar and physician, Avicenna, suggested that honey was one of the most remarkable cures for tuberculosis about 1000 years ago [2,5].
- King Solomon, according to the Christian sacred book, the Bible, stated: ‘consume honey, my son, since it is excellent.’ Likewise, honey was considered by the Buddha to be among the five essential remedies and foods [5,6].

Box 1 shows other early recorded applications of honey by famous scholars, while Box 2 shows honey’s earliest storage and conservation.

**Box 1** "Honey might be used as a therapy for a stomach ailment, wounds with filth, hemorrhoids, and medical management to prevent coughing," stated Pedanius Dioscorides, a Roman army medic. Pythagoras is claimed to have subsisted chiefly on honey and bread. The mortal remains of his compatriots who perished far from the country were occasionally mummified in honey [1].

**Box 2** Around 2500 BCE, there were records of honey being preserved in ceramic jars in southern England [7]. The ancient honey remnants have so far been discovered in Georgia. According to archaeologists, archaeologists have found honey remnants on the inside layer of earthenware containers uncovered from an old tomb dated from 4700–5500 years ago, according to archaeologists [8]. The Chinese surpassed the rest of the globe in conserving, eating, and gathering honey. They were among the first to bring beekeeping to the world [4].

Box 1 and 2

### Discussion

Honey is available in both raw and processed forms. Raw honey is extracted directly from the honeycomb. Due to the honeycomb detritus (residue), it is intuitively fuzzier than processed honey [9]. Particles, wax, other unwanted elements, and yeast are removed from processed honey, although it includes additional sweets such as high-fructose corn syrup. Figure 1 shows the basic workflow for traditional honey production [10].

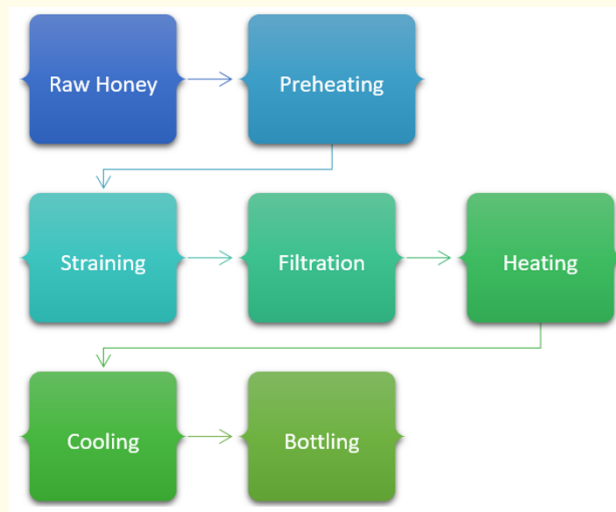


Figure 1: Conventional method of processing honey. Adapted from [10].

There are different varieties of honey, as indicated in Table 1, depending on their origin and manufacturing [1,11-14].

Honey types according to production	
<b>Comb Honey</b>	Honey is kept by bees in the compartments of newly constructed broodless combs and sold in sealed whole or sectioned combs.
<b>Extracted Honey</b>	De-capped broodless combs are centrifuged to get honey. This honey is sold throughout the world.
<b>Crystallized honey</b>	Honey in which some of the glucose content has spontaneously crystallized from solution as the monohydrate. Also called “granulated honey” or “candied honey”.
<b>Ultrasonicated honey</b>	Ultrasonication was used to process it (non-thermal processing).
<b>Dried honey</b>	Moisture is removed from the granules, leaving them entirely solid and non-sticky.
<b>Creamed honey</b>	Has a significant number of tiny particles that inhibit the creation of bigger crystals, which can happen in raw honey.
Honey types referring to honey origin	
<b>Blossom/Nectar/ Floral honey</b>	<ul style="list-style-type: none"> <li>✓ Honey is made by bees collecting nectar from flowers.</li> <li>✓ It comes in around 320 distinct types, each originating from a distinct botanical source.</li> <li>✓ Depending on where the honey bees forage the honey color varies between light brown to dark brown and consists of the following:                             <ul style="list-style-type: none"> <li>▪ Multifloral (plurifloral) honey includes pollen from various plant varieties' liquid, with no single species of plants dominating.</li> <li>▪ Honey produced only from solitary botanical species is known as unifloral (mono-floral) honey (45%). These honeys are highly valued for their consistent physico-chemical and organoleptic characteristics (presence, color, flavor, and deliciousness).</li> </ul> </li> </ul>
<b>Non-floral</b>	Extra-floral nectaries and honeydew are examples of major sources apart from flowers.

**Table 1:** Different varieties of honey. Adapted from [1,11-14].

Honey production worldwide is currently 1.2 million tons per year, accounting for less than 1% of the global sugar supply. Honey is enjoyed worldwide, but its consumption varies significantly from nation to nation. China and Argentina are the two biggest honey generating nations, with 0.1 to 0.2 kilograms/capita yearly usage rates. In industrialized countries, where domestic supply often does not adequately meet demand, honey demand is more significant.

For example, the annual per capita consumption of honey in the EU varies from 0.4 kg in the UK, Portugal, France, Denmark, and Italy to 1.8 kg in Switzerland, Germany, Austria, Greece, and Hungary. In contrast, the annual consumption of honey in the United States, Australia, and Canada is 0.8 kg [11]. In India, honey intake is only 50 grams per year [15].

Honey substances, such as crystalline honey or honey flakes, are effective sugar alternatives in various products. For example, honey could replace sugar in the preparation of fruit spreads. There are commercially available honey-peach and honey-apricot spreads.

When the honey powder was used in food preparation, such as cakes, pies, and bread, it increased the market value and the flavor, color, fragrance, texture, and quality of a product [16].

Another well-known consumer product is honey candy. Honey candy, often made from various materials, is ingested as a natural antioxidant or for medicinal reasons such as bronchitis and coughing [16,17]. Figure 2 shows an overview of the multiple possibilities of honey in the foodservice industry [18].

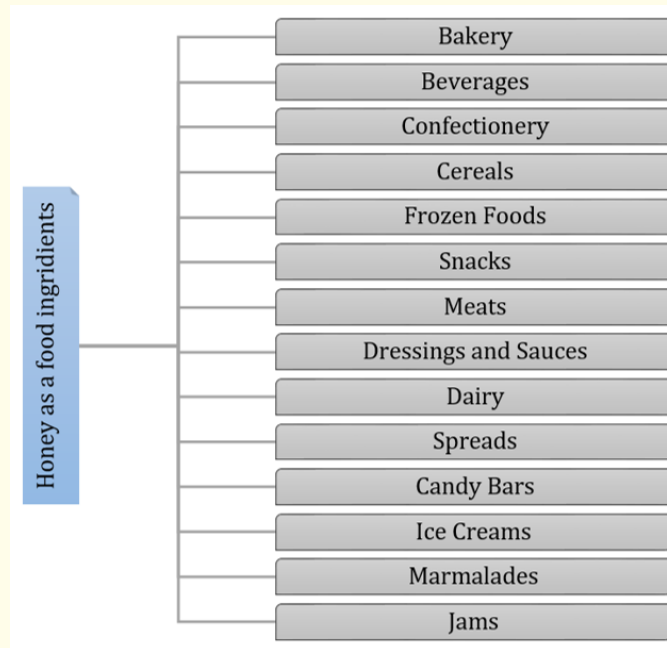


Figure 2: Applications of honey in the foodservice industry. Adapted from [18].

According to Bobiş, *et al.* (2019), honey can be used to partially or wholly substitute brown sugar or processed sugar (white sugar). As a flavor enhancer, honey has a complex structure but has a lower glycemic index and energy value than sugar. On the other hand, sugar is derived from several natural sources but through a technical process that results in a somewhat pure compound (between 95% and 98%).

White sugar is almost wholly sucrose with meager amounts of other ingredients. At the same time, honey is a substantial sweetener with more than 80% of simple sugars from the fundamental chemical components (fructose: 32.55 to 38.3%; and glucose: 28.55 to 31.4%).

The rest of the honey comprises moisture, pigment, and microelements [19]. The chemical compositions of brown sugar, processed sugar, and honey are compared in Table 2 [20,21].

Nutrients	Raw Sugar/Brown Sugar	Refined Sugar/White Sugar	Honey
Energy	377 kcal	387 kcal	300 kcal
Glycemic index	60	65	58
Carbohydrates	97.33 g	99.98 g	82.4 g
Sugars	96.21 mg	99.91 mg	80 mg
Dietary fiber	-	-	0.2 g
Fat	-	-	0.02 g
Protein	-	-	0.3 g
Water	1.77 g	0.03 g	17 g
Thiamine (Vit. B1)	0.008 g	-	-
Riboflavin (Vit. B2)	0.007 mg	0.019 mg	0.038 mg
Niacin (Vit. B3)	0.082 mg	-	0.121 mg
Vitamin B6	0.026 mg	-	0.024 mg
Folate (Vit. B9)	1 microgram (µg)	-	2.0 µg
Calcium	85 mg	1 mg	6.0 mg
Iron	1.91 mg	0.01 mg	0.42 mg
Magnesium	29 mg	-	2.0 mcg
Phosphorus	22 mg	-	4.0 mg
Potassium	346 mg	2 mg (0%)	52 mg (1%)
Sodium	39 mg	-	4 mg (0%)
Zinc	0.18	-	0.22 (2%)

**Table 2:** Average chemical composition of honey compared to raw and refined sugar. Adapted from [19-21].

Since most honey contains monosaccharides, such as fructose and glucose, the human system quickly absorbs and digests them [2]. However, unlike glucose, fructose is digested more slowly, resulting in a more consistent and extended release of energy into the circulation and, ultimately, in an antidiabetic effect.

Honey reduces gastrointestinal irritation during exercise as various transporters process monosaccharides within the digestive tract [22].

Raw honey is a potent prebiotic that stimulates beneficial bacteria within the intestinal tract and promotes healthy digestion. Honey also includes nondigestible oligosaccharides that are not digested by the gastrointestinal tract. Instead, these oligosaccharides are transported to the colon, where they can ferment.

This pathway produces short-chain fatty acids, which aid in the proliferation of bifidobacterial species, helping to break down fiber, avoid GI infections, and produce vital digestive vitamins.

Other purported advantages include greater retention of probiotics in the GI tract, increased concentrations of SCFA, enhanced resistance to infections, and supporting the growth of more beneficial bacteria in the GI tract [22,23].

Organic honey includes around 200 different chemical components. It consists of various amino acid residues, vitamins, minerals, enzymes, monosaccharides, and fructooligosaccharides.

Almost all natural honey contains flavonoids (such as pinocembrin, apigenin, hesperetin, chrysin, quercetin, galangin, and kaempferol)- and phenolic acids (such as pinobanksin, p-coumaric acid, isorhamnetin, caffeic acid, pinocembrin, ferulic acid, chrysin, pinobanksin, and gallic acid).

These chemicals interact synergistically, offering antioxidant, bactericidal, antibacterial, anti-inflammatory, antiatherogenic, antiplatelet, immunological modifying, and anesthetic actions [2,24].

Meo SA., *et al.* (2017) have reported that honey contains vitamins B2, B4, B5, B6, and B11, which aid in testosterone production, while honey bee pollen is known to increase reproductive performance, ovulation, and fertilization [25].

### Pharmacological benefits of honey

#### Wound healing

Honey is the oldest tissue regeneration agent in the world. Honey stimulates leukocytes to produce cytokines, which initiates tissue healing pathways. It also provokes immunological resistance to infection. Honey has also been shown to stimulate other parts of the immune reaction (production of B and T cells and phagocyte activation). Honey stimulates the production of antibodies. It first has a relaxing effect and then rapidly healing burns. Furthermore, honey improves skin graft adhesion and has antibacterial and anti-inflammatory properties that promote faster healing. According to one study, honey dramatically reduces the infection rate on the fifth day after an accident and reduces both the discomfort and duration of hospital stays [2,3,5].

#### Cancer

Honey has anticancer qualities because it interferes with many cell signaling systems, including those inducing apoptosis and mutagenic activity. Honey alters immunological responses. Honey has been shown to inhibit cell growth, induce cell death, alter cell migration, and cause mitochondrial membrane depolarization in a variety of cancer cells (including melanoma, cervical, endometrial, liver, colorectal, bladder, prostate, epithelial, human non-small cell lung, osteoblast, and oral squamous cell) [3].

#### Asthma

In herbal preparations, honey is widely used to alleviate discomfort, congestion, and fever. In animal models, oral honey ingestion treated lung problems and respiratory infections. According to research, honey therapy successfully prevented ovalbumin-induced inflammatory responses by reducing asthmatic-related histological alterations in the airway and decreasing asthma development. Honey intake has also been shown to successfully treat mucus-secreting goblet cell hyperplasia [3].

#### Cardiovascular diseases

Antioxidants in honey, such as flavonoids, polyphenolics, vitamin C, and monophenolics, may be linked to a lower risk of cardiac failure. The potential health benefits of honey in cardiovascular diseases are due to three main mechanisms: a) enhancing coronary vasodilation, b) minimizing the potential of blood platelets to clot, and c) inhibiting low-density lipid oxidation [3,26].

#### Eye infections

Blepharitis, corneal scarring, conjunctiva, retinal damage, thermal and chemical eye injuries are among the ailments that honey is used to cure worldwide. Honey decreased redness, inflammation, liquid discharge, and duration of bacterial elimination in infective conjunctivitis [2].

### Neurological diseases

Honey has anxiolytic, depressive, anticonvulsant, and antinociceptive properties, as well as the ability to reduce the oxidative load of the central nervous system. Numerous research studies on honey polyphenols indicate nootropic and neuroprotective characteristics. Raw honey and honey polyphenols reduce microglia-induced neuroinflammation caused by neurotoxins in the antibody response or ischemic damage. Most notably, honey polyphenols inhibit inflammation in the hippocampus. Moreover, honey polyphenols protect against memory problems and stimulate memory formation at the cellular level [3].

### Diabetes

In type 1 and type 2 diabetes, honey consumption was correlated with a much lower glycemic score than glucose or sucrose in usual diabetes. Studies have reported that in diabetic patients, honey generated a considerably smaller increase in glucose concentrations than dextrose, resulting in lower blood lipids, homocysteine, and C-reactive protein (CRP) levels in healthy and hypocholesterolemic patients [2,5].

### Fungal infections

Pure honey suppresses spore germination, and it seems that dissolved honey can reduce the generation of toxins. The antifungal action has been demonstrated in yeast, *Aspergillus*, *Penicillium* species, and other significant dermatophytes. Candidiasis, a yeast infection that occurs due to *Candida albicans*, might react to honey. Honey has been reported to be effective against epidermal and superficial mycoses such as ringworm and athletes' foot [2,5].

### Other applications

Honey is possibly beneficial for various GI problems, including periodontal and other dental illnesses, dyspepsia, duodenitis, and stomach ulcers. According to *in vitro* research, honey has antibacterial action against *Helicobacter pylori* [2,5].

### Planetary benefits of honey (bee) farming on the environment

Bees are excellent pollinators because they spend most of their life collecting nectar and pollinating agricultural plants. Bees significantly impact biological interactions, ecological protection and stabilization, genetic mutations of the plant community, floral variety, specialization, and evolution.

Bees pollinate about a third of all plants and other natural products consumed by humans, either wholly or partly. Bees visit more than 90% of the world's leading 107 crops. Bee-pollinated crops have been shown to provide higher yields and better quality than increasing agricultural seed yield, often at no additional expense to the farmer [27,28].

Kouchner, *et al.* (2019) reported that honey is one of the most environmentally friendly foods available. Its manufacture does not require the exploitation of land, and carbon dioxide emissions are minimal. Because beekeeping is a viable industry, more people are interested in becoming involved for a long-term living. Many farmers in various locations begin beekeeping with minimal funding, depending on climatic adaptability and its relatively booming industry [29].

Data from India show that the projected general development of purchasing beekeeping can range from 2143 to 4410 USD [30], while the total cost of sugarcane production (which produces sugar) can reach USD 1153 per hectare [31].



However, it needs about 2 - 3 times the energy required for production than honey [32]. In terms of revenue, analysis has revealed that honey has a benefit-cost ratio of 1.83 [33]. On the other hand, sugarcane can produce profits of up to 1.18 times the investment cost [34].

The primary benefit of honey over sugar or artificial sweeteners is its medicinal characteristics and may be used to make cosmetics, soaps, and body-wash products [16].

**Antibiotic, pesticide, microbial contaminants, and adverse effects of honey**

Al-Waili, *et al.* (2012) reported that if honey is made from some toxic plants, it can be highly hazardous. Consuming honey without recognizing where it came from or how safe or hazardous it could be [35].

Today, honey products are created in an atmosphere that has been contaminated by several sources of pollution (Figure 3). Pesticide exposure can cause birth deformities, cancers, genetic alterations, blood and nerve diseases, reproductive problems, and sometimes even paralysis or death. Antibiotics may increase the number of resistant infections in humans or animals. Organic pollutants can harm the hormonal, reproductive, and immune systems [35,36].

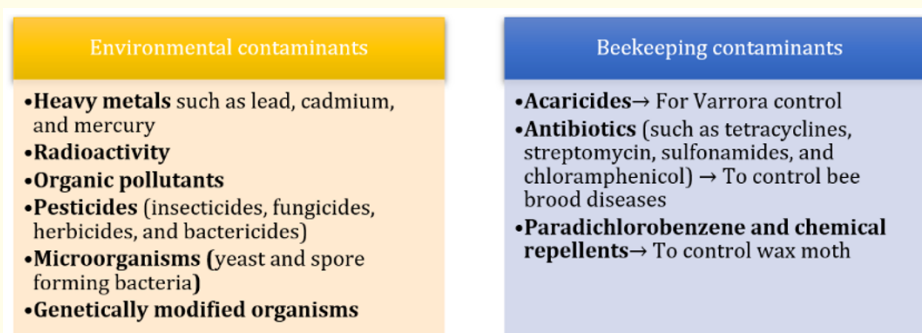


Figure 3: Types of honey contamination. Adapted from [35,36].

Heavy metal residues may also be left behind if honey is stored in the wrong containers. Various inorganic elements can contaminate honey during storage by diffusing it from the inner side of paraffin-decorated, corroded, and painted jars. Infectious honey has been blamed for several cases of newborn botulism [2,35].

When honey is applied topically, it can cause a slight tingling sensation. Honey allergy is uncommon, although an allergic response to pollen or honeybee proteins in honey is possible. Extensive honey administration can cause tissue dehydration. Because honey includes sugar and is adhesive, it can cause long-term dental problems if one does not thoroughly clean the mouth after drinking honey. The high amount of toxic substances in honey can cause diseases in humans. When applied to a large open incision in diabetics, the hypothetical danger of increased blood sugar levels is always present [2,37].

**Honey: food safety and regulations**

The European Honey Commission and the Codex Alimentarius Guidelines for Honey provide international standards for honey. The proposed measures include criteria and procedures for determining humidity, ash, pH, HMF, apparent sugar concentration, apparent sucrose, diastase activity, and water-insoluble content. Figure 4 shows the quality parameters that high-grade honey must meet [36].

Quality criteria	Codex draft	EU draft
<b>Moisture content</b>		
General	≤ 21 g/100g	≤ 21 g/100g
Heather, clover	≤ 23 g/100g	≤ 23 g/100g
Industrial or bakery honey	≤ 25 g/100g	≤ 25 g/100g
<b>Apparent sucrose content</b>		
Honeys not listed below	≤ 5 g/100 g	≤ 5 g/100 g
Robinia, Lavandula, Hedysarum, Trifolium, Citrus, Medicago, Eucalyptus cam., Eucryphia luc, Banksia menz., Rosmarinus**	≤ 10 g/100 g	≤ 10 g/100 g
Calothamnus san., Eucalyptus scab., Banksia gr., Xanthorrhoea pr. honeydew honey and blends of blossom with honeydew honey	≤ 15 g/100 g	-
<b>Hydroxymethylfurfural content</b>		
Aprocessing and/or blending (Codex)	≤ 60 mg/kg	
For all retail honey (EU)		≤ 40 mg/kg
<b>Apparent reducing sugars content</b>		
Honeys not listed below	≥ 65 g/100 g	≥ 65 g/100 g
Honeydew honey or blends of honeydew and blossom honey	≥ 45 g/100 g	≥ 60 g/100 g
Xanthorrhoea pr.	≥ 53 g/100 g	≥ 53 g/100 g
<b>Water-insoluble solids content</b>		
General	0.1 g/100 g	≤ 0.1 g/100 g
Pressed honey	0.5 g/100 g	≤ 0.5 g/100 g
<b>Mineral content (ash)</b>		
General	≤ 0.6 g/100 g	≤ 0.6 g/100 g
Honeydew or blends of honeydew and blossom honey or chestnut honey	≤ 1.2 g/100 g	≤ 1.2 g/100 g
<b>Acidity</b>		
	≤ 50 meq/kg	≤ 40 meq/kg
<b>Diastase activity (diastase number in Schade scale)</b>		
After processing and blending (Codex)	≥ 8	≥ 8
General for all retail honey (EU) honeys with natural	≥ 3	≥ 3

Figure 4: Honey quality standard according to the Codex Alimentarius and the EU draft. Adapted from [36].

In terms of packaging, FSSAI said that honey should be labeled according to the floral or botanical source if it originates from a specific origin and possesses sensory properties, physicochemical, and microscopic characteristics associated with that source. In the example of “monofloral honey”, the authority stated that plant species have a minimum pollen concentration of >45% of the total pollen content, and the pollen concentration of some plant species in “multi-floral honey” should be <45% of the total pollen concentration [38].

### Future of honey consumption

During the forecast period (2022 - 2027), the global natural honey market is expected to grow at a compound annual growth rate (CAGR) of 7.4%. The worldwide natural honey market is likely to develop at a CAGR of 7.4% during the forecast period. (2022 - 2027). Consumer preferences for healthier, natural remedies to sugar substitutes and increased knowledge of the advantages of honey are propelling the worldwide honey industry forward.

Honey usage in the beauty and medical sectors adds to the increase in the predicting period. As a result, honey has been promoted as an essential dietary element and a valuable medical substance by international bodies. The World Health Organization (WHO), for example, has endorsed it as a safe and efficient natural therapy for congestion in children and persistent cough in adults [39].

### Summary

Honey consumption is promoted as beneficial for cardiovascular disease. Numerous studies have been published to support these CV benefits. Polyphenols in honey improve CV diseases through a variety of pathways, such as by improving endothelial function or coronary vasodilation, inhibiting platelet aggregation, reducing inflammatory responses, blood pressure (BP), oxidative stress, or oxidation of low-density lipoprotein (LDL) [40].

Honey offers a broad spectrum of cardioprotective benefits, such as antiarrhythmic, atrial fibrillation inhibition, relaxation of blood vessels, reduction of blood pressure, reduction of LDL, antiatherogenic, and antithrombotic [41].

Antioxidants in honey have been shown to lower body weight and improve lipid profile abnormalities in rats and hyperglycemic patients [40].

A prospective study by Zhang, *et al.* (2020) involving approximately 4 561 adults over the age of 40 found that light to moderate honey consumption was associated with a decreased risk of hypertension in women [42].

In another observation study by Khalil, *et al.* (2015), Tualang honey exerted a cardioprotective effect by inhibiting oxidative stress and reducing serum cardiac troponin I, creatine kinase-MB, LDH, aspartate transaminase, and alanine transaminase levels [43].

Ahmad, *et al.* (2009) evaluated the formation of reactive oxygen species (ROS) by neutrophils and macrophages stimulated by bovine thrombin in the presence of honey. The results revealed that honey suppresses ROS formation for both neutrophils and macrophages induced by thrombin compared to the control group [44].

In a randomized experiment, Yaghoobi, *et al.* (2008) revealed that honey had a cardioprotective impact on individuals' lipid profiles. They discovered that honey induced a slight decrease in weight and abdominal fat. In participants with normal cholesterol levels, honey lowered total cholesterol by 3%, LDL-C by 5.8%, triacylglyceride by 11%, FBG by 4.2%, and CRP by 3.2%. In contrast, honey also reduces bad cholesterol by 3.3%, LDL-C by 4.3%, triacylglyceride by 19%, and CRP by 3.3% in individuals with abnormal characteristics ( $p < 0.05$ ) [45].

Najafi, *et al.* (2011) investigated the cardioprotective potential of honey beyond serum lipids and oxidative stress. Following ischemia, reperfusion with honey reduced the frequency of ventricular tachycardias (VT), ventricular ectopic beats, and the occurrence of VT and ventricular fibrillation (VF). Furthermore, honey (2%) was found to dramatically reduce the prevalence and severity of reversible VF [46].

Although honey has several cardioprotective properties, eating wild honey (mad honey) produced by bees from certain rhododendron species can cause heart arrhythmias. However, more research is needed on the toxic effects of wild honey on humans [41,47].

### Conclusion

Honey's color, sensation, and content vary depending on the botanical origin. It is made up mainly of monosaccharides. Honey is a high-nutrient food with antioxidant, anti-inflammatory, and antimicrobial effects, with cough relieving and wound healing abilities, used alone or in conjunction with other compounds to cure various diseases. It also has the unique and invaluable feature of enhancing the properties and activities of the medicinal drugs with which it is combined.

### Conflict of Interest Statement

The authors declare that this paper was written without any commercial or financial relationship that could be construed as a potential conflict of interest.

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