

## PROPERTIES OF HONEY: A REVIEW

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**ABSTRACT:** Honey is a most important natural product obtained from beekeeping and produced from the nectar of blossoms of flowers collected and processed by the honey bees. Honey might be the first sweetener used by the ancient man in the human history. Honey predominantly contains sugars (glucose, fructose, etc.) with many other compounds like proteins, amino acids, vitamins, and minerals, etc. More than 400 different substances were reported to be found in honey. The properties of honey show a discrepancy as per the source of the geographical and floral origin of honey. It was described in many studies that, since from the religious and ancient history, honey has been used comprehensively as a food and medicine by civilization. Besides its nutritional value, honey shows many functional properties such as antimicrobial activities, anti-inflammatory effect, and antioxidant properties. Owing to its functional properties honey can be used as a drug or a preventing agent in many disorders. These functional properties of honey may be due to the rich phytochemical profile of honey. In this paper, the various properties of honey are discussed to enlighten the importance of honey as a food and medicine.

**KEYWORDS:** Honey, antioxidant, antibacterial, physical, chemical

### INTRODUCTION

Honey may be called as the most important and primary product obtained from beekeeping. It is said that the first bee product used by humankind in ancient times is honey. There were many shreds of evidence found in history that honey was used extensively as a symbol employed in religious, magic and therapeutic ceremonies (Krell R., 1996). Honey is a natural product which is the semi-solid and supersaturated solution synthesized by the honey bees from the nectar of flower (Khan et al., 2018). Honey may be defined as “it is the natural and sweet substance produced from the nectar of blossoms or secretions of plants after ripening by honey bees” (BIS 1994-2002).

Honey bees gather the nectar of blossom, some natural secretions of living parts of plants or flowers and excretions of plant-sucking insects. These substances thus collected, were transformed to honey by honey bees by adding their own specific secretions followed by deposition, dehydration, and keeping in the honeycomb for ripening and maturing (Alimentarius, 2001).

Honey contains more than 400 different substances (Fredijs Dimins et al. 2006). Unsurprisingly honey is considered as a valuable source of energy. It is also recognized as a medicine owing to its antioxidant and antimicrobial agent (Amel Boussaid et al., 2018)

### PHYSICAL PROPERTIES OF HONEY

Depending on the species of honeybees, various environmental factors, geographical origin, floral origin, treatment of beekeepers, and presence of impurities, different physical properties of honey such as taste, color, pH, ash content, moisture content, and activity of enzymes of honey varies (Khan et al., 2018; Mudasar Manzoor et al., 2013). Some physic-chemical properties are even useful for determining the floral and geographical origin of honey. It is reported that many physic-chemical properties are observed to be different in their values for the honey samples from different geographical origins. Ash content is the measure of mineral present in the honey (Diego Gomez et al., 2012).

Preference of consumer, quality, and acceptance of honey are highly influenced by the color of honey and it plays a very important role in the commercialization of honey (Priscila da-Silva et al., 2016). The dark color of honey may be developed during storage and may be related to the storage temperature and composition of honey. Color and flavor of honey are also related to the mineral content. The mineral content and acidity of honey are in a linear relationship with the electrical conductivity of honey (Sahinler and Gul, 2005).

According to the botanical origin, honey varies in taste. The typical taste of honey is mainly due to its sugar content. The aroma of honey mainly depends on the amino acids and the acids present in honey. Volatile compounds also contribute to aroma significantly. It was reported that more than 500 volatile compounds have been identified in different varieties of honey. Polyphenols are a very important group of compounds present in honey and contribute to the taste and aroma. (Stefan Bogdanov, 2017).

The water content of honey is one of the most important characteristics. Moisture content greatly influences the preservation properties of honey. It affects other properties of honey such as color, flavor, taste, crystallization, Viscosity, specific gravity, and solubility. Electrical conductivity, acidity and ash content are interrelated (Diego Gomez et al., 2012; Priscila da-Silva et al., 2016).

### CHEMISTRY OF HONEY

The sugars such as fructose, glucose, sucrose, and maltose are the chief constituents of honey. In addition to this tri-saccharide melezitose and other low-molecular-weight oligosaccharides, minerals, proteins, amino acids, vitamins, polyphenols, and aromatic compounds are also present in a small amount. In the previous study, it was reported that a furanic compound 5-hydroxymethylfurfural (5-HMF) forms in honey due to heating or storage for a long time as a result of Maillard reaction. Practically HMF is not present or present in a very low amount in fresh honey. It was reported that due to the cytotoxic, mutagenic, genotoxic, and carcinogenic effect of 5-HMF, heated honey can prove toxic (Misato Ota et al. 2019; Amel Boussaid et al., 2018; Diego Gomez et al., 2012). It was concluded from the study that the HMF content increased above the permitted limit and the diastase activities decreased below the standard value when honey samples were stored above 35<sup>0</sup>C temperature for more than six months (Korkmaz & Kuplulu, 2017). The level of diastase, a natural enzyme of honey, depends on the freshness as well as the floral and geographical origin of the product. Thus both HMF and diastase activity are the indicators of freshness and aging of honey (Susana Gomes et al., 2010).

Codex Alimentarius has given the honey specifications which vary as per the country of origin. Indian standard extracted honey specifications decided by the Bureau of Indian Standards (BIS 1994-2002) are given in the table

Besides these above nutrients Sodium, Potassium, Calcium, Magnesium, Phosphorus, Zinc, Iron, Copper, Manganese, Selenium, and Chromium are the minerals found in honey. In addition to these other trace elements such as Aluminium, Arsenic, Barium, Boron, Bromine, Cadmium, Cobalt, Iodine, etc. are present in honey. Honey contains vitamins B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>5</sub>, B<sub>6</sub>, B<sub>9</sub>, K, and C in a considerable amount. The amount of vitamins and minerals vary according to floral origin (Stefan Bogdanov, 2017).

S N	Characteristics	Minimum/Maximum	Special Grade	A Grade	Standard Grade
1	Specific gravity at 27 <sup>0</sup> C	Min	1.37	1.37	1.37
2	Moisture, % by mass	Max	20	22	25

3	Total reducing sugar, % by mass	Min	70	65	65
4	Sucrose, % by mass	Max	5	5	5
5	Fructose: Glucose Ratio	Min	1.0	1.0	1.0
6	Ash, % by mass	Max	0.5	0.5	0.5
7	Acidity % by mass	Max	0.2	0.2	0.2
8	Hydroxymethylfurfural (HMF), mg/kg of honey	Max	80	80	80
9	Total count of pollens and plant elements/ gram of honey	Max	50000	50000	50000
10	Optical density, in % at 660 nm	Max	0.3	0.3	0.3
11	Fiehe's test	--	Negative	Negative	Negative

### FUNCTIONAL PROPERTIES OF HONEY

The prime functional properties of honey are its antimicrobial and antioxidant activity. These activities protect the host from oxidative substances and microbial infections respectively. Honey also shows antitumor, anti-inflammatory, antibrowning and antiviral activities to a considerable extent. The bioactive components of honey, responsible for its functional properties, are affected by the flora and the geographical origin of the product.

Honey serves as a source of some probiotic. Probiotic are the substances or organisms which contribute to the intestinal balance. They are useful to prevent pathological conditions. The oligosaccharides of honey have the potential to show probiotic activity. These compounds support the growth of beneficial microorganisms, such as *Lactobacillus* and *Bifidobacterium* in the GI tract (Luchese R L et al., 2017).

#### Antimicrobial Properties

The common micro flora found in honey mostly contains the spore-forming bacteria and yeast. Honey shows antimicrobial properties against many microorganisms by preventing their growth. The exact reason behind the antimicrobial activity of honey is not known yet. However, it was reported by many researchers that the microbial growth is inhibited by the number of different factors such as the high concentration of sugar, generation of hydrogen peroxide, low pH, and presence of phenolic, proteinaceous, or other unidentified compounds (Khan S U et al., 2018).

There was a good correlation found between the capacity of honey to produce peroxide and the inhibition against microorganisms (Stefan Bogdanov, 2017). It was reported that honey shows the antibacterial activity against many species such as *Bacillus cereus*, *Staphylococcus aureus*, *aeruginosa*, *E. coli*, *Pseudomonas aeruginosa*, *S. aureus*, and *Escherichia coli P* (Emad Nafea et al., 2011). *Salmonella typhimurium*, *Vibrio cholera*, *Staphylococcus aureus*, *Listeria monocytogenes*, *Escherichia coli*, *Mycobacterium tuberculosis*, *Salmonella typhi*, *Shigella sp.*, and *Helicobacter pylori* are some pathogens against which honey shows the inhibitory properties. It was stated that honey supports the probiotic microorganisms such as *Lactobacillus acidophilus*, *Streptococcus thermophilus*, *Lactobacillus delbrukeii subsp bulgaricus*, and *Bifidobacterium bifidum* in their growth (Ismail M M, 2017).

Honey also shows its inhibitory activities against some species of fungi. It was stated that some honey bacteria produce antibiotic-like antifungal peptide compounds (Stefan Bogdanov, 2017). It was revealed from some studies that the antifungal activity is due to the ethanolic extract of honey (Khan S U et al., 2018).

#### **Antioxidant properties of honey**

The major death-causing chronic diseases such as diabetes mellitus, cancer, hypertension, Alzheimer's disease, and atherosclerosis are closely related to oxidative stress. The supplementations of antioxidants are useful to prevent oxidative damage. Honey is a natural product which shows the antioxidant properties.

The study demonstrated the antioxidant and antidiabetic effect of honey in rats (Omotayo et al., 2012). Phenolic acids, flavonoids, and certain enzymes present in honey are served as antioxidants. Study shows that there is an increasing demand for antioxidants in the food. Since honey is rich in other antioxidants such as organic acids, carotenoid derivatives, ascorbic acid, proteins, amino acids, and some enzymes like glucose oxidase & catalase, with than phenolic acids and flavonoids, honey is becoming popular as a source of antioxidant (Khalil et al., 2010; Roy and Ganguly, 2014; Moussa et al., 2012).

It was reported that honey can prevent the spoilage caused in foods due to oxidation reactions, such as enzymatic browning of fruits and vegetables and lipid oxidation in animal meat. The antioxidants are found to be very effective against several diseases like inflammatory disorders, neurological degeneration, cancer, wound healing, infectious diseases, cardiovascular diseases, and aging. Antioxidants neutralize free radicals to maintain health (Khalil et al., 2010; Roy and Ganguly, 2014).

#### **CONCLUSION**

It is concluded from the study that honey is a natural substance extensively used by humans as food and medicine. The physical and chemical properties of honey vary with the variety of honey. The geographical, as well as the botanical origin of honey, influences its properties. Honey shows many functional properties such as antimicrobial properties, antioxidant properties. It also acts as an anti-tumor and anti-inflammatory agent. The numerous properties of honey are due to the presence of more than 400 substances such as sugars, proteins, amino acids, and flavonoids. Thus there is a need for more research to explore various hidden properties of honey.

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