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Review

Honey: Single food stuff comprises many drugs

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ABSTRACT

Honey is a natural food item produced by honey bees. Ancient civilizations considered honey as a God gifted prestigious product. Therefore, a huge literature is available regarding honey importance in almost all religions. Physically, honey is a viscous and jelly material having no specific color. Chemically, honey is a complex blend of many organic and inorganic compounds such as sugars, proteins, organic acids, pigments, minerals, and many other elements. Honey use as a therapeutic agent is as old as human civilization itself. Prior to the appearance of present day drugs, honey was conventionally used for treating many diseases. At this instant, the modern research has proven the medicinal importance of honey. It has broad spectrum anti-biotic, anti-viral and anti-fungal activities. Honey prevents and kills microbes through different mechanism such as elevated pH and enzyme activities. Till now, no synthetic compound that works as anti-bacterial, anti-viral and anti-fungal drugs has been reported in honey yet it works against bacteria, viruses and fungi while no anti-protozoal activity has been reported. Potent anti-oxidant, anti-inflammatory and anti-cancerous activities of honey have been reported. Honey is not only significant as anti-inflammatory drug that relieve inflammation but also protect liver by degenerative effects of synthetic anti-inflammatory drugs. This article reviews physico-chemical properties, traditional use of honey as medicine and mechanism of action of honey in the light of modern scientific medicinal knowledge.

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1. Introduction

Honey is a super saturated solution or semi-solid natural product synthesized from necter of flower by honey bees (Aljadi and Kamaruddin, 2004; Dashora et al., 2011; Hilary et al., 2017). Honey bees collect nectar, secretion of flowers or other living parts of plants and excretions of plant sucking insects. Honey bees then transform these substances by combining with specific substances of their own. These are deposited, dehydrated and kept in the honey comb for ripening and maturing(Alimentarius, 2001). Honey is the oldest food stuff. It has been used as a major sweetener in the ancient world until sugar cane was cultivated. This is why since ancient times humankind introduced honey and honeybees with much gratitude for their value (Samarghandian et al., 2017; Dewey, 2004).

1.1. Physical properties of honey

Different physical parameters like color, pH, enzyme activity, ash contents, electrical conductivity and even taste of honey varies with honeybee species, geographical origin and presence of impurities (Terrab et al., 2003). The color of honey varies from pale yellow to darkish red to black depending upon plant source. The darkness mostly occurs due to change in temperature (Lawal et al., 2009). The tendency of granule formation is the character of honey which makes it differ from other sweeteners (Bogdanov et al., 2004). Like other physical parameters, the pH of honey also indicates the purity or crudeness of honey but it depends upon the geography of the area. The pH range for Pakistani honey is about 2.4–4.7 (Khaliq UrrRhman et al., 2013). Moisture is the most important determinant of honey solidity. High moisture content is additionally a novel property of honey and is generally ranges from 13–20% (White and Honey, 1978; Jaafar et al., 2017). Like other Newtonian fluids, viscosity of honey depends upon its moisture content and temperature. At 24 °C with 18.9% moisture, the viscosity of honey is approximately 9.9 psa (Zaitoun et al., 2001; Sopade et al., 2003; Yanniotis et al., 2006). Beside all these properties, honey is resistant to spoilage on account of its high sucrose contents. Therefore, it was used as a preservative for other food substances (Lawal et al., 2009).

2. Chemistry of honey

Like physical properties, the chemistry of honey also varies depending upon the geography and purity of the sample. There is no standard scale globally. However, generally honey has a content of 80–85% carbohydrates, 15–17% water, 0.3% proteins, 0.2% ashes and minor quantities of amino-acids, phenols, pigments and vitamins (Bogdanov et al., 2008; Miguel et al., 2017). Beside these other components are also found in minor concentration. The trace elements of honey were determined in mg kg^{-1} as following: Ca (221.9), Mg (54.15), K (579.6), Na (351.4), Fe (8.3), Cu (0.2), Cr (0.5), and Pb (1.1) (Serra, 1989). Cantarelli et al. (2008) analyzed different varieties of honey from different parts of Argentina. They identified a vast range of trace elements in different samples of honey. The major trace elements in μg g^{-1} of honey were: P (1.17–100.66), Fe (1.13–10.32), Al (0.02–13.04), Mn (0.07–0.68), Zn (0.14–3.87), Cu (0.05–0.68), Ca (18.60–136.14), Mg (6.01–46.57), Na (6.10–89.98) and K (90.92–1955.75).

The concentration of trace elements in honey samples collected from Spain, Italy, Turkey and Egypt were also in the same range (Cantarelli et al., 2008). The concentration of trace elements was found in a vast range in honey samples collected from different regions of Poland especially Lead (Pb) ranged from 0.007 to 1.21 mg kg^{-1} (Rostkowski and Omieljaniuk, 1989). Different methods were used to identify diverse elements in honey. Lvanov (1989) developed a method to identify sugars in honey containing lower levels of reducing sugars and higher levels of sucrose (Lvanov, 1989). Similarly Navel methods have been employed to identify the ascorbic acid, nitrogen and protein contents of honey (Men et al., 1989; Siegfried, 1989).

The carbohydrate components of honey contain various types of mono and disccharides. The average concentration of Fructose, Glucose, Sucrose and reducing sugars are 38.38%, 30.31%, 1.31% and 76.65% respectively. Irrespective of the origin or variety of honey, Fructose/Glucose ratio remains the same (i.e. 1.23) (White et al., 1996). Beside these, more than 22 other sugars have been found in honey in which dextrose and laevulose are major ones. Ten disaccharides have been identified in honey including Maltose, Sucrose, Maltulose, Turanose, Isomaltose, Laminaribiose, Nigerose, Kojibiose, Gentiobiose and B-trehalose. Some trisaccharides are also found in honey such as Maltotriose, Erlose, Melezitose, Centose 3-α5 Isomaltosylglucose, l-Kestose, Isomaltotriose, Panose, Psopanose and Theanderose. All these sugars are present in very small quantities (Bogdanov et al., 2004).

The total polyphenol and vitamin C contents in different honey varieties are similar. The polyphenol contents of the honey samples from south Nigeria was found to be in the range of 36.26–102.80 mg 100 g^{-1} with an average of 65.31 mg 100 g^{-1}, while vitamin C contents were observed to be within the range of 13.89 and 27.32 mg 100 g^{-1} with an average of 21.15 ± 3.99 mg 100 g^{-1}. A variety of phytochemicals, as well as other substances including organic acids, vitamins, and enzymes; some of which may serve as sources of dietary antioxidant are also present in honey (Gheldof and Engeseth, 2002; Cantarelli et al., 2008). About 8–11 proteins have been found in various honey sources among which four proteins are common to all varieties of honey. These are originated from honey bee instead of the feeding substance. Honey's proteins are mainly in the form of enzymes (Omafuvbe and Akanbi, 2009). The honey bees add different enzymes during the process of honey ripening. The enzymes added include diastase (amylase), which digest starch to maltose and is relatively stable to heat and storage, and invertase (saccharase or α-glucosidase), which catalyses the conversion of sucrose to glucose and fructose. The invertase also catalyses many other sugar conversions and is mainly responsible for the sugar patterns of honey. Glucose oxidase and catalase are two other enzymes added by the honey bees, which regulate the production of hydrogen peroxide H_2O_2. The H_2O_2 produced serve as one of the anti-bacterial factor of honey (Amir et al., 2010). The differences observed between the total protein contents of honey samples may be attributed by the botanical origin of the honey. Later on it was reported that the diastase and the invertase enzymes differ in wide limits depending on the botanical origin of honey (Khalil et al., 2014). The range of protein contents of honey reported by Bosi and Battalglini is 0.01–0.04 g

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