



Apitherapy: Knowledge and usage of bee products as natural medicine

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Abstract

Natural products have been used in traditional medicine since time immemorial and are historically used worldwide for the prevention and treatment of various diseases. One such natural medicine which has gained popularity and fascinated scientists worldwide is apitherapy. It has attracted attention as modern medicines are not soul remedies of infections and also produces wide array of side effects

Keywords: apitherapy, bee products, natural medicine

Introduction

Apitherapy refers to the medical use of bee products such as honey, propolis, royal jelly, pollen and bee venom for disease prevention or treatment purposes and also enhance the resistance of the human body (Apimondia 1989) [6]. It can be also described as “the science (and art) of the use of honeybee products, to maintain health and assist the individual in regaining health when sickness or accident interferes” (Baltuskevicius, 2003; Trumbeckaite *et al.*, 2015) [7, 51].

History

Bee products were used as natural remedies for health maintenance by human beings from ancient times. The history of apitherapy can be traced back to ancient Egypt, Greece, and has been practiced in China for 3-5000 years (Rose, 1994) [44]. There are records that Romans also used bee products for medicinal purposes.

Use of honey dates back to about 4000 thousands and clearly documented in several religious books including the Veda, Bible and Quran (Molan, 1999) [35]. In the Sanskrit Veda of ancient India, honey is a remedy for many disorders. The Bible also has many references, and in Islam, honey was described as a precious medicine. According to the Ayurveda classic Ashtanga hridaya, written about 500 AD, honey can be used against many diseases, e.g. healing and cleaning the wounds, against different internal and external infections. In India, Lotus honey has been traditionally used to treat eye infections and other diseases. Honey was also extensively used in ancient Egypt. Honey was particularly used in treating wounds and also to embalm the dead (Broffman, 1999) [10]. Ancient Greeks athletes used honey to boost energy (Broffman, 1999) [10].

Apitherapy was also practiced since times immemorial. Hippocrates, the great Greek physician renowned as the "father of medicine," used bee venom to treat joint pain and arthritis. He also listed the physical effects of honey, “honey and pollen cause warmth, clean sores and ulcers, soften hard ulcers of the lips, heal carbuncles and running sores” (Manjo 1991) [32]. Moreover, Hippocrates, Aristotle and Galen also prescribed the use of honey and bee venom as a

cure for baldness (Gupta and Stangaciu, 2014) [22]. Galen, the great Roman physician, considered honey an all-purpose remedy and recommended it to treat many kinds of poisoning and intestinal ailments, in particular gangrenous stomatitis. Early thinkers such as Homer, Pythagoras, Ovid, Democritus, Hippocrates and Aristotle mentioned that people should eat honey to preserve their health and vigour. Greeks described bees making propolis, a gummy material from trees, on vases and ornaments (Molan, 1999) [35]. Pliny- a Roman scholar, has written about healing properties of propolis in his book, claiming that it reduces swelling, soothes pain, and heals sores (Stangaciu, 1999) [49]. He also writes that honey is good for mouth diseases, pneumonia, pleurisy and snake bites. Royal jelly has been used in traditional Chinese medicine for 70-80 years. Royal Jelly was highly valued by Chinese monarchs as a way to increase longevity and sexual power.

Nowadays, apitherapy is an established form of alternative therapy and is practiced worldwide. More recently, the bee products have been incorporated into modern medical practice, where the focus of attention is mainly the illness and its prevention (WHO, 2013) [54]. Studies have shown that complementary and alternative medicine and some dietary supplements including herbal, mineral, and biological (including apitherapy) were effective in the prevention of some common diseases (Robinson *et al.*, 2002; Zhang *et al.*, 2015) [43, 55].

In honey, propolis, and royal jelly, phenolic compounds are commonly present as flavonoids. These phenolic compounds contribute to the functional properties of bee products, including their antioxidant, antimicrobial, antiviral, anti-inflammatory, antifungal, wound healing, and cardioprotective activities (Biesalski *et al.*, 2009; Pasupuleti *et al.*, 2017) [8, 39].

Bee Products and Therapeutic Uses

Honey

Properties

Honey is a natural sweet substance and is produced by honeybees from the nectar of blossoms, from secretion of living parts of plants. Honeybees collect this material,

transform and combine it with specific substances of their own, store and leave in the honey comb to ripen and mature (White and Landis, 1980) ^[53]. Freshly extracted honey is a viscous liquid, has a greater density (1.5 g/cm³) than water (1 g/cm³ at 4 °C), having a strong hygroscopic character, relatively low heat conductivity, low surface tension and various colours that are basically all variances of yellow amber (Jusbin, 1996) ^[29]. Natural honey is composed of 82.4% carbohydrates, 38.5% fructose, 31% glucose, 12.9% other sugars, 17.1% water, 0.5% protein, organic acids, multiminerals, amino acids, vitamins, phenols, and a myriad of other minor compounds. Honey consists of minor amounts of bioactive components, including phenolic acid, flavonoid, and α -tocopherol, ascorbic acid, proteins, carotenoids, and certain enzymes, such as glucose oxidase and catalase (Moniruzzaman *et al.*, 2012; Pasupuleti *et al.*, 2017) ^[36, 39]. Honey also contains small amounts of several compounds having antioxidant properties, such as chrysin, pinobanksin, vitamin C, catalase and pinocembrin. The specific composition of any batch of honey depends on the flowers available to the bees that produced the honey (Gheldof *et al.*, 2002) ^[20].

Therapeutic Uses

Honey has innumerable application. Most commonly, honey is used cure sore throat as it coats the inner lining of the throat and destroys the harmful microbes while simultaneously soothing the throat (Gupta and Stangaciu, 2014) ^[22]. Honey is also found superior to other treatments for cough induced by upper respiratory infections, as compared to drugs such as dextromethorphan and diphenhydramine (Shadkam *et al.*, 2010) ^[46].

Honey helps to improve digestion as it contains some nutrients, such as minerals, phytochemicals, and flavonoids (Ajibola, 2012) ^[2]. Honey is also known to promote the growth of many important intestinal beneficial microbes including *Lactobacillus acidophilus*, *L. plantarum* and *Bifidobacteria* as honey contains prebiotic ingredients in such as inulin, oligofructose, and oligosaccharides (Cardarelli *et al.*, 2008) ^[11].

Honey validates its efficacy as a promoter to cure prolonged skin diseases (Pasupuleti *et al.*, 2017) ^[39]. Honey mixed with beeswax and olive helps to reduce the incidence of skin infection in psoriasis, due to presence of nitric oxide metabolites in honeys (Al-Waili, 2003) ^[4]. Pure honey also has bactericidal properties against pathogenic bacteria and enteropathogens, including *Salmonella* spp, *Escherichia coli*, *Shigella* spp, and many other Gram-negative species (Adebolu, 2005) ^[1].

It has wonderful wound-healing capabilities and an antimicrobial agent (Molan, 2006) ^[34]. Honey therapy has shown miraculous results for the treatment of Diabetic Foot Ulcer (Falanga, 2005) ^[18]. Honey can be effectively used in wound management, such as patients with locally infected wounds non healing ulcers, DFU, Charcot foot ulcerations, and complex comorbid conditions that have failed hospital management (Dunford and Hanano, 2004; Mohamed *et al.*, 2014) ^[15, 33].

Honey can be effectively used in treatment of oral diseases. The antibacterial and anti-inflammatory properties of honey can stimulate the growth of granulation tissue, leading to the repair of damaged cells (Anyanechi and Saheeb, 2015) ^[5] and periodontitis caused by a Gram-negative bacteria *Porphyromonas gingivalis* (Eick *et al.*, 2014) ^[16]. It is also

effective against stomatitis as honey penetrates into the tissues very rapidly (Song *et al.*, 2012) ^[48].

Most importantly, honey have been identified as a potent inhibitor for gastritis and the peptic ulcer causing agent, *Helicobacter pylori* (Header *et al.*, 2016) ^[24] and many infectious agents, such as *Salmonella*, *Shigella*, and *Clostridium* causing gastroenteritis (Halligan *et al.*, 2014) ^[23].

Recently, Bose and Acharya (2015) ^[9] described that honey consist several biologically active compounds and have efficacies which exerts anti-inflammatory, antioxidant, anti proliferic, anti tumour, metastatic and anti cancer effect. It is used in the treatment of various types of cancers such as breast cancer, liver and prostate cancer.

Propolis Properties

Propolis is one of the most important product of beekeeping industry. It is composed mainly of resin (50%), wax (30%), essential oils (10%), pollen (5%) and other organic compounds (5%) (Gomez-Caravaca *et al.*, 2006). The important organic compounds present in propolis include phenolic compounds, esters, flavonoids, terpenes, beta-steroids, aromatic aldehydes, and alcohols (Huang *et al.*, 2014) ^[26]. Volpi (2004) ^[52] detected many compounds in propolis extracts by capillary zone electrophoresis such as twelve different flavonoids, namely, pinocembrin, acacetin, chrysin, rutin, luteolin, kaempferol, apigenin, myricetin, catechin, naringenin, galangin, and quercetin; two phenolic acids, caffeic acid and cinnamic acid; and one stilbene derivative called resveratrol have been. Propolis also contains important vitamins, such as vitamins B1, B2, B6, C, and E and useful minerals such as magnesium (Mg), calcium (Ca), potassium (K), sodium (Na), copper (Cu), zinc (Zn), manganese (Mn), and iron (Fe).

Theraupetic uses

Propolis is also a natural product having many biological properties including antioxidant, anti-inflammatory and anticancer, activities. It is effectively used in the treatment of vatiuous gastrointestinal diseases. It is effectively used in the treatment of *Giardia duodenalis*. It is reported that propolis ethanolic extract inhibit the growth and adherence and promotes the detachment of the trophozoites of *G. duodenalis* (Freitas *et al.*, 2006) ^[19].

Propolis due to its anti- bacterial, antifungal, antiviral properties is used in various preparations (toothpaste, mouth sprays, tablets, capsules, etc.). Salatino *et al.* (2005) ^[45] reported that propolis can also used in human medicine to treat common cold, flu-like infections, wounds, sore throat, and herpes simplex infection. It also has potent antimicrobial properties and used in both gram positive (*Staphylococcus aureus*) and gram negative (*E. coli*) bacterial stains (Przybylek and Karpinski, 2019) ^[41]. Propolis is an antacid and has antihistaminergic, anti-inflammatory properties. It also has anti-*H. pylori* activities that can be used to treat gastric ulceration (Paulino *et al.*, 2015) ^[40].

Royal Jelly Properties

Royal jelly consists of water (50%–60%), proteins (18%), carbohydrates (15%), lipids (3%–6%), mineral salts (1.5%), and vitamins (Nagai, 2004). It consists of approximately

185 organic compounds. Among them, Royalactin is the most important protein present in royal jelly. Apart from these, Sugiyama *et al.* (2012) reported that royal jelly contains significant number of bioactive compounds, including 10-hydroxy-2-decenoic acid (HAD), having immunomodulatory properties. Later, Ramadan and Al-Ghamdi (2012) [42] also reported fatty acid, proteins, adenosine monophosphate (AMP), acetylcholine, polyphenols, and hormones such as testosterone, progesterone, prolactin, and estradiol are other useful bioactive components in royal jelly.

Therapeutic Uses

Royal jelly enhances the immune system. It has immunomodulatory activity, antioxidant and antimicrobial activities (Trumbeckaite *et al.*, 2015) [51]. It is known to stimulate cellular regeneration, the enzyme system and haematopoiesis. Royal jelly also has hepatoprotective, remineralizing, anti-anaemic, anti-leucemic and anti-tumoral properties (Bose and Acharya, 2015) [9].

Pollen

Properties

Bee pollen contains about 250 substances including amino acids, lipids (triglycerides, phospholipids), vitamins, macro- and micronutrients, and flavonoids (da Silva *et al.*, 2014) [13]. Pollen also contains enzymes, hormones, growth factors, reducing sugars (palein, fructose), non-reducing sugars, azotate compounds (xantine, hypoxantine, geranine, trimethylamine), lipids, organic acids (citric, tartaric, malic, malonic, succinic, acetic, fumaric and alpha-ceto-glutamic), proteins, essential amino-acids, liposoluble vitamins (A, D, E and K), B vitamins complex, C vitamin, minerals (calcium iron, magnesium and zinc), ribose, deoxyribose, pectine, pigments, inositol, enzymes (amylase, invertase, protease lipase, phosphatase, catalase and lactase (Trumbeckaite *et al.*, 2015) [51].

Therapeutic uses

Bee pollens are used as natural medicine due to its potential medical and nutritional applications. It is antifungal, antimicrobial, antiviral, anti-inflammatory, hepatoprotective, anticancer immunostimulating, and local analgesic. It also facilitates the granulation process in burn wound healing (Almaraz-Abarca *et al.*, 2004; Komosinska-Vassev *et al.*, 2015) [3, 30]. Bee pollen has a strong anti-inflammatory effect because of presence of flavonoids, phenolic acids, fatty acids and phytosterols which are responsible for inhibiting the activity of enzymes causing inflammation (Choi, 2007) [12]. Pollen ethanol extracts have quite a strong antibiotic activity, effective on the pathogen for human Gram-positive bacteria such as, *Staphylococcus aureus*, and Gram-negative bacteria, including *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and on fungi such as *Candida albicans*. (Erkmen and Ozcan, 2008) [17]. Recent studies have shown that pollen has antiallergic activity. It prevents the degranulation of mast cells and protect it from releasing histamine (Ishikawa *et al.*, 2008) [27]. Pollen also stimulates cellular regeneration, haematopoiesis and has antioxidant, antianemic and anti leukemic effects (Bose and Acharya, 2015) [9].

Bee venom

Properties

Bee venom is transparent liquid, bitter taste, pH5.0-5.5, density 1.1313gm/cm³, soluble in water. It is a complex mix of a variety of peptides and proteins and contains many biologically active compounds, some of which have strong neurotoxic and immunogenic effects (Park *et al.*, 2014) [38].

Therapeutic Uses

Bee venom, also called apitoxin, have anti-inflammatory properties, pain-relieving effects and promote healing. Bee venom therapy is the use of live bee stings or injectable venom to treat various diseases. The two important constituents of bee venom are melittin and sulfur. Melittin has powerful anti-inflammatory, anti-bacterial, anti-viral properties, whereas, sulfur is main elements which protects the body from infections as it induces the release of cortisol from the adrenal glands. It is widely used for the treatment of various diseases such as arthritis, rheumatism, back pain, skin diseases, multiple sclerosis, lupus, sciatica, back pain, and tennis elbow etc. It is reported that bee venom therapy is effective treat pain, psoriasis, parkinson's disease, alzheimer's disease frozen shoulder and arthritis (Lee *et al.*, 2014; Park *et al.*, 2014; Doo *et al.*, 2015) [31, 38, 14].

More recently, some studies have also shown beneficial effects of bee venom in neuralgia (Janik *et al.*, 2007) [28], swine flu (Singla and Bhat, 2010) [47], fibromyalgia and multiple sclerosis (Helal *et al.*, 2014; Bose and Acharya, 2015) [25, 9].

Conclusion

Natural bee products including honey, propolis, royal jelly, pollen and bee venom contain many bioactive compounds, attributing to the functional properties of bee products, including their antioxidant, antimicrobial, antiviral, anti-inflammatory, antifungal, wound healing and anticancer properties.

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