



Apitherapy: A conventional medical approach for human wellness

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Abstract

Honey bees are “Golden insects” that make honey and other essential honey bee products. Honey is the best-known primary product of honey bees, pollen, propolis, beeswax, royal jelly, apilarnil, bee bread are also marketable bee products. Bee products have been used by humans to cure and prevent a wide range of maladies. The use of bee products to strengthen immunity, protect and enhance health and support the treatment of certain diseases is known as apitherapy. These products have long served as both foodstuffs and remedies from healing of wound to anticancer effect due to the presence of nutrient rich composition. Honey has antibacterial and wound healing properties, whereas patients with diabetes are treated with propolis. Pollen is frequently applied on burns, allergies, and widely used to make cosmetics. Royal jelly is used to promoting reproductive health and to treat neurological diseases. Beeswax effectively acts as a coating for slow, controlled drug release. Bee venom is applied to treat the neuralgia, Parkinson’s disease and cancer. Apilarnil and bee bread are used for their advantageous effects on people. Some of the most significant medical applications of honey bee products are reviewed in this paper.

Keywords: Honey bees, pollen, propolis, bee venom, beeswax, apilarnil

Introduction

Bees are the oldest living organisms on earth. According to paleontological evidences, bees existed for 55-60 million years before primitive human appeared, during the tertiary period (Michener and Charles 2000) [22]. In ancient India, bees were regarded as sacred companions of the God. The most revered Indian God, Vishnu (the creator of the universe) was often symbolically represented as a small bee resting on the petals of a lotus. Bees were also depicted on ancient coins, highlighting their cultural and spiritual significance. Furthermore, numerous artifacts preserved in Indian museums provide evidence that bees were highly valued in this in country thousands of the years ago (Ellis and Hattie 2005). Honey bees are eusocial and beneficial insects known to the mankind since the prehistoric times. There are various bee species that are raised for their hive products. Some of the most easily collected products from honey bee farming are honey, pollen, bee wax, propolis, royal jelly, bee venom, and bee bread (Schmidt *et al* 2009) [29].

Many cultural have used the bioactive constituents in bee products, such as honey, propolis, royal jelly, pollen, bee wax, and bee venom to treat a wide range of illness for generations (Karmakar *et al.* 2025) [20]. In recent years, there has been an increase in interest in the study of natural products for the prevention or treatment of various disorders and also interest of various bee products has also increased (Fratellone *et al.* 2016) [12]. Apitherapy is the use of honey bees and their products as a preventative or therapeutic measure to control the spread of illness. Because of their nutritional value, apitherapy is now used in many nations’ complementary and integrative medicine programs. As a result, spending on various bee products, such as dietary supplements and nutraceuticals, has been increasing trend-wise (Pasupuleti *et al.* 2017) [34].

Recent studies on the pharmacological activity of honey bee products have shown a number of biological properties, and studies and clinical trials have shown their potential for treating illness and maintaining health balance (Jull *et al.* 2015) [19]. In addition to its usage in the food and cosmetics industries, apitherapy is being studied by pharmaceutical industry in an effort to develop new drugs (Berretta *et al.* 2020) [4]. This review has been written with an idea to provide information on composition, health benefits and mechanisms of action of major bee products.

History

Apitherapy has a long history. During the Vedic period (1500-500 BCE), ancient Indian scripture such as the Rigveda and the Atharvaveda documented the use of honey and other bee- derived products as substances of nutritional and medicinal importance. These texts describe honey (*Madhu*) as a natural therapeutic agent used for nourishment, health maintenance and healing practices. That indicate that bee products were recognized for their medicinal value and were incorporated into early traditional healthcare system in ancient India (Rigveda 1896; Atharvaveda 1905) [39].

According to the Hippocrates, ‘Father of medicine’ honey causes heat, clean sores and ulcers, soften hard ulcers of the lips, and heals carbuncles and running sores (Bradbear 2009) [7]. Hippocrates treated his patients’ illness with bee stings between 460 and 370 BC. Galen wrote about bee venom in his 500 medical patients between 129 and 199 AD. Ivan IV of Russia used bee sting to treat his gout in the 1500s. Monfat suggested using bee venom to strengthen the urinary tract and reduce kidney stones between 1600 and 1634. In the present era, things have accelerated. The first scientific study on the benefits of bee venom for rheumatic conditions was published in the journal ‘*Abellie Medical*’ by French physicians Dr. Desjardins in 1859.

Dr. Phillip Terc, the 'Father of Apitherapy', began immediately applying bee sting in 1888 on his birthday, March 30 that is today recognised as World Apitherapy Day. The 'Father of Modern Apitherapy', Dr. Rudolph Tertsch, presented findings on the use of bee venom to treat the rheumatic disease in 1912. Dr. Franz Kretsky invented the first injectable bee venom in 1928. Yoannovitch and Chahovitch used it to treat tumors in 1932. In 1935, Dr. Bodog F. Beck came up with phrase "Bee Venom Therapy". Apitoxin, the first injectable bee venom product, was invented in Korea by Dr. Christopher Kim in 2003 (Gokulakrishnaa and Thirunavukkarasu 2020) [15].

Bee products that are used in apitherapy

Honey

Honey is naturally occurring sweet substance that is made by honey bees from plant nectar, secretions from living plant parts, or excretions from plant-sucking insects on the living parts of plants which the bee collect, transform by combining with specific substance of their own, deposit, dehydrate, store and leave in honey combs to ripen and mature (Bogdanov and Martin 2002) [6]. Honey is mainly made up of natural sugars and small amounts of other useful nutrients, on an average, it contains about 40% fructose, 34% glucose, and around 2% sucrose. It also has small amounts of organic acids, proteins, vitamins, and minerals such as iron, copper, manganese, potassium, sodium, and phosphorus. A typical honey sample contains 17-22% water, 65-67% simple sugar, 7-8% maltose, and other disaccharides, 2-5% sucrose, about 0.57% acids, 0.26% proteins, 0.17% minerals, and around 2.2% minor components like enzymes, pigments, flavour compounds, and vitamins, which give honey is nutritional and medicinal value (Abrol 1996) [1].

According to Veda and Ayurveda, bee produce a lot of honey from medicinal plants, that has been used medicinally in India for about 4,000 years ago. Ayurveda, which means 'the science of life', but precisely 'knowledge of life' is currently regarded as an ancient Indian system of biology, hygiene, medicine and nutrition. India's culture is primarily ritualistic. In our time, a ritual is performed a short while after a kid is born. The father uses his ring finger or gold subject to give the infant butter and honey. Ayurveda said that, the same food item, plant of La Spezia has several therapeutic qualities that predispose to various surrounding factors. There are only eight types of honey that produced by bees *viz*, pouttika, bhramara, kshudra, makshika, chatra, argaeus, udalaka and gave. Only makshika is considered to be the finest option for apitherapy (Rajesh and Strukova 2018) [26].

Classical Ayurvedic texts such as the Charaka Samhita and the Sushruta Samhita reported honey as a nutritive supplement, wound healing agent, digestive stimulant and rejuvenating formulation (Rasayana) in traditional medical practices Charaka Samhita Sharma 2001; Sushruta Samhita. Bhisagratna 2006) [5, 31]. Honey has historically been used in traditional medical system of Egyptians, Greek, Roman, and Chinese civilizations to treat respiratory ailments, including cough and sore throat, as well as for ear infections (Rao *et al.* 2016) [27]. Honey lessens pain, edema and inflammation in injured tissues. It speeds up the tissue repair processes and reduces the synthesis of inflammatory mediators (Waili *et al.* 2011) [38]. Digestive diseases, gastric ulcers and stomach ulcers can all be treated with honey, it encourages the repair of damaged stomach lining and shield the gastric mucosa (Samarghandian *et al.* 2017) [28].

Bee pollen

Bee pollen is a naturally occurring product that honey bees collected from male reproductive organs (anther) of flowers. Pollen grains are collected by worker bees, mix them with nectar and salivary secretions and compress them into tiny pellets that are taken to hive on their hind legs (pollen basket or corbicula). It includes protein (20-35%), which contain vital amino acids such as lysine, leucine, and valine that are critical for tissue growth and metabolic processes. Carbohydrates (30-55%) are mostly found as glucose, fructose, and sucrose, providing a quick source of energy. It also contains lipids (1-13%) that include important fatty acid such as linoleic, oleic, and palmitic acids. Additionally, it is rich in minerals (2-6%) like potassium, calcium, magnesium, iron, zinc, and vitamins (A, C, E and B-complex) and various bioactive compounds like flavonoids, phenolic acids, carotenoids, and enzymes. These components support bee pollen's high nutritional and medicinal benefits for human health. Bee pollen functions as an immunostimulant by boosting immune cell activity and antibody synthesis. The body's inherent defense against infections and be strengthened by regular ingestion (Stefan 2017) [34].

Flavonoids and phenolic substances have potent antioxidant and anti-inflammatory qualities. These compounds protect cells from harm and promote tissue regeneration by neutralizing free radicals, lowering oxidative stress, reduce pain, swelling, and inflammation in a number of inflammatory disorders (Campos *et al* 2008; Suarez *et al.* 2010) [8, 36]. By increasing antioxidant enzyme activity and lowering oxidative damage in liver cells, bee pollen has been shown to protect the liver from toxic chemicals (Denisow *et al.* 2016) [9]. Bee pollen functions as a natural nutritional supplement that enhances, lessens fatigue, and promote general body regeneration because of its high protein, amino acid, vitamin, and mineral content (Pascoal *et al.* 2014) [24].

Bee venom

Bee venom is a complex biological substance produced by worker honey bees' venom glands which is injected into a target through the stinger as a defensive strategy. It is an acidic, colourless liquid that contains a variety of bioactive substances such as amines, phospholipase A₂, hyaluronidase, peptides (melittin, apamin, adolapin), and other low- molecular- weight substances. Bee venom has drawn scientific attention and plays a significant role in colony defense. It has pharmacological, anti-inflammatory, antibacterial, and therapeutic qualities which are used in apitherapy to treat various human diseases (Khalil *et al.* 2021) [21].

It consists of peptides, enzymes, and biologically active amines. Melittin (40-60%) is the major component present in the bee venom, responsible for many of the biological and pharmacological effects. Other significant peptides that play important role in neurotoxicity, anti- inflammation and analgesic effects of bee venom include apamine (2-3%), mast cell degranulating (MCD) peptide (2-3%), and adolapin (about 1%). Enzymes such as phospholipase A₂ (10-12%) and hyaluronidase (1-3%) which helps in membrane degradation and venom's transmission through tissues. It also contains small amounts of biogenic amines like histamine, dopamine, and norepinephrine (around 1-2%), as well as other minor substances that play important role in its medicinal and regenerative features. Melittin has

strong cytotoxic effects on various cancer cells *viz.*, kidney, lung, prostate, bladder, breast, liver and leukaemia. It stops the growth of tumor cells, triggers apoptosis, and rupturing cancer cell membranes by activating caspases.

Bee venom suppresses inflammation by suppressing inflammatory mediators like COX-2, TNF- α , and IL-1 β . As a result, it provides therapeutic benefits in long term inflammatory diseases. Bee venom therapy tempers immunological responses and reduces inflammatory cytokines. Patients with rheumatoid arthritis experience less edema, swelling and less joint inflammation. Parkinson's disease and other neurological diseases have been shown to benefit from bee venom. It protects dopaminergic neurons and decreases neuronal inflammation. In traditional medicine, bee venom acupuncture is used to treat musculoskeletal pain, chronic pain, and neuralgia. It decreases pain by adjusting nerve signals and inflammatory mediators. It promotes cell regeneration, fibroblast activity, tissue repair, and collagen synthesis, lowers the oxidative stress which helps in skin renewal as well as skin suppleness by fast wound healing (Gajski *et al.* 2024) ^[14].

Royal Jelly

Royal jelly is milky-white, thick secretion produced by the hypopharyngeal and mandibular glands of young worker honey bees (*Apis mellifera* L.) that is used as a nutritive diet to the larvae during first few days of growth and only for the queen bee throughout her life. It has high content of bioactive substances present in their composition, including lipids like 10-hydroxy-2-decenoic acid (10-HDA), peptides such as royalisin, royalactin, jelleines and aspimin, flavonoids, and polyphenols primarily phenolic acids, which are crucial for the growth, longevity and differentiation of queen. Royal jelly is composed mainly of water (60-70%), which form the largest portion of its composition. It contains proteins (9-18%), carbohydrates (7-8%), and additionally, it is made up of lipids (3-8%) including unique fatty acid 10-hydroxy-2-decenoic acid (10-HDA). There are also small quantities of vitamins, amino acids, minerals, and other bioactive substances (1-3%). These components support to the therapeutic and nutritional qualities of royal jelly (Viuda *et al.* 2025) ^[37].

Royal jelly decreases inflammation in tissues and chronic diseases by inhibiting inflammatory mediators and cytokines due to the presence of 10-hydroxy-2-decanoic acid (10-HDA). Royal jelly controls cellular signalling pathways and oxidative stress, which play an important role in delay aging processes, improve life and promote health. It has hypotensive, anti-hypercholesterolemic, and antidiabetic properties that helps to control blood pressure, cholesterol levels, and blood sugar. It also exhibits estrogen like action and may decrease menopausal symptoms while promoting the reproductive system health. Royal jelly components can stop proliferation of tumor cell and cause cancer cells to undergo apoptosis indicating possible application in cancer treatment and prevention. Phenolic compounds and bioactive peptides neutralize free radicals and promote oxidative homeostasis, protecting cells from harm and averting degenerative illnesses. By stimulating immune cell and controlling the production of cytokines, it enhances the host defensive mechanism. Royalisin and jelleines peptides prevent the growth of fungi, bacteria and viruses. Royal jelly speeds up the wound healing and regeneration of tissue by stimulating proliferation of fibroblast, epithelial cell migration, and collagen synthesis. Bioactive substances enhance memory, promote neuronal survival, and may help avert neurodegenerative diseases (Orsolich *et al.* 2024) ^[23].

Propolis

Propolis is a resinous substance collected by bees from plant buds and exudates and combine it with wax and bee enzymes. The word propolis is derived from Greek language pro means in defense and polis means city, shows its importance to smooth out internal walls, defend the colony from infection and cover the carcasses of invaders who died inside the hive, preventing their decomposition (Bankova *et al.* 2000) ^[3].

Propolis consists of plant resins and balsams (50-55%), which are rich in flavonoids and phenolic compounds that provide it most of its biological activities. It also contains 25-35% beeswax, which is secreted by honey bees and combined with plant resin to make propolis. It includes essential and aromatic oils about 5-10%, which provide it its distinctive aroma. About 5% pollen is present, which provides minerals, proteins, and amino acids. Flavonoids terpenoids, phenolic acids, steroids, and other chemical substances make up the remaining 5%. Additionally, there are traces of minerals, carbohydrates, sugars, and enzymes (Stojanovic *et al.* 2020) ^[35].

Propolis shows strong antiviral, antifungal, and antibacterial properties against various pathogenic microorganisms, including *Staphylococcus aureus* and *Candida* species. It stops microbial growth by disrupting microbial cell. It decreases the inflammation by blocking inflammatory mediators including cytokines and prostaglandins. It helps in tissue damage and inflammatory illnesses. Due to the presence of flavonoids and phenolic compounds, propolis scavenges free radicals and protect cells from oxidative stress, which is helpful for prevention of degenerative diseases. It is used in mouthwashes, toothpaste and dental preparations for the prevention of periodontal disorders, dental cavities and gingivitis. It has the ability to inhibit the growth of tumor cells and activate apoptotic cascade in cancer cells. Propolis speeds up the healing of wounds by encouraging collagen formation, regeneration of tissue and epithelialization. Additionally, it keeps wound sites from becoming infected. It increases the synthesis of antibodies and activates macrophage to stimulate the immune response. It improves the mechanism of host defense and helps to control the immune system. Propolis encourages regenerations of skin, defense against infections, and also used in dermatological treatments for ulcers, burns and skin diseases (Sforcin 2016) ^[30].

Beeswax

Beeswax is produced by special glands located on the underside of bee's abdomen, which is used by bees to make hexagonal cells that build the hive. Naturally, it is white or translucent but it turns yellowish when mixed with pollen or propolis. The makeup of beeswax varies with its origin and is complex, it contains up to 300 distinct compounds, that mainly include acids, ester, long chain alkanes, polyesters, fatty acid esters, hydroxy esters, and other long chain alcohols (Gajic and Pastor 2023) ^[13].

Beeswax is composed of fatty acid esters and long chain alcohols (70-75%), hydrocarbons (12-16%), mostly straight chain alkanes which lend the wax its stability and water repelling properties. Free fatty acids such as oleic and palmitic acids (12-14%), diesters and hydroxyl monoesters (1-5%) along with free fatty alcohols (about 1%). There is also small amount of propolis remnants, pigments, and aromatic substances. Due to of its unique composition,

beeswax is a useful component in cosmetic products, serving as a humectant, consistency regulator and exfoliator. It has been utilized in variety of items, including wood and leather polishes, candles, waterproofing agents and lubricants (Diaz *et al.* 2025) ^[10].

Beeswax plays an important role to promote regeneration of damaged skin tissue and wound healing. It includes β -carotene, a precursor to vitamin A, that promote collagen synthesis of skin and epidermal cell division. This activity enhances healing of damaged tissues and speed up the regeneration of epithelial cells. Microorganisms includes *Staphylococcus aureus*, *proteus vulgaris*, *Salmonella enterica*, *Bacillus subtilis* and *Candida albicans* are all inhibited by beeswax. The presence of bioactive compounds such as flavonoids, fatty acids, squalene, and other constituents produced from plants that damage microbial cell membrane and prevent their growth is mainly responsible for these antimicrobial effects. Due to the presence of natural lipids and propolis remnants, it has been conventionally used to treat the burns, cracked skin, bruises, and inflammation. These components help to repress inflammatory mediators, lower swelling and redness, and save skin from oxidative stress and irritations. Beeswax is frequently used to treat numerous skin infections including wounds, psoriasis, atopic dermatitis, boils, and pediatric dermatitis. A combination of honey, beeswax, and olive oil has also been shown in clinical studies to be successful in treating fungal and bacterial skin problems. As a natural ointments and moisturizer, beeswax keeps skin hydrated and soft. By creating a lipid barrier on the skin surface that retains moisture within epidermis, it lowers trans-epidermal water loss. The skin is shielded by this barrier function from environmental stresses like pollution and UV radiations. These qualities make beeswax a popular ingredient in lotions, lip balms, creams, and cosmetic formulas meant to protect and restore skin (Gupta and Anjali 2023) ^[17].

Bee bread

Bee bread is a fermented product of bee pollen, nectar or honey, and bee salivary enzymes that is stored by worker bees in honeycomb cells. Bees mix honey and enzymes to the pollen after it has been collected and packed into the comb cells. The mixture then goes through lactic acid fermentation by microorganisms which improves its nutritional importance, digestibility and preservation (Zuluaga *et al.* 2014) ^[40].

Bee bread is a nutrient rich fermented food. Its composition depending on origin of flowers and fermentation circumstances. It contains protein (20-244%), which supplies vital amino acids important for larval growth and colony expansion. About 24-35% are made up of carbohydrates, including fructose, glucose, and other sugars derived from honey and nectar added during storage. It also contains lipids (1-11%), moisture (11-29%), and minerals (2-3%) including magnesium, iron, calcium, and phosphorus. There are small amounts of organic acids, bioactive compounds, enzymes, and vitamins are present. This composition making it an essential food necessary for the growth and development of young larvae and younger bees (Didaras *et al.* 2022) ^[11].

The composition makes rich in phenolic components, carotenoids and flavonoids, bee bread helps protect human cells from oxidative stress and neutralize reactive oxygen species. This antioxidant effect prevents aging and chronic

diseases by shielding body from cellular harm. By enhancing blood parameters and lowering inflammatory markers linked with oxidative damage, bee bread has demonstrated preventive effects against anaemia, atherosclerosis, haematological, and cardiovascular diseases such as liver and kidney harms. It contains vitamins, polysaccharides and bioactive peptides that boost immunological response and improving the body's defense against infections and diseases. Polyphenols, phytosterols, and fatty acids can promote apoptosis, or programmed cell death, and prevent the growth of cancer cell, indicating a potential use as an adjuvant in cancer treatment. Because of its rich nutritional content, antioxidants, and bioactive substances that assist cell growth and healing processes, bee bread supports repair, and regeneration of tissues (Llie *et al.* 2024) ^[14].

Apilarnil

Apilarnil is a bee product with biological activities, obtained from trituration and filtering of drone larvae that are 3-7 days old from cells of drone. It tastes harsh and has a uniform and milky yellowish grey tint. During the pupal phase, nutritional makeup of larvae changes once its cells have closed. In order to preserve the maximum quality nutritional form, larval stage is appropriate to collect apilarnil. Since the larvae will perish while harvesting, larvae should be eaten or processed rapidly to avoid disrupting the protein in their structure (Silici 2019) ^[32].

It contains moisture 65.0-78.5%, which lowers to 3.0-5.0% after lyophilization. Protein ranges from 4.6-13.2% in fresh apilarnil to 32.0-52.4% in lyophilized form, which is most abundant nutrient. Lipids mainly fatty acids including, oleic, palmitic, and stearic acid, make up the 1.2-8.38% of fresh apilarnil and 4.8-24.2% of lyophilized apilarnil. It also contains carbohydrates 6.22-12.2%, after drying it ranges from 9.30-38.9%., while predominant sugar is glucose, with small amounts of fructose, and sucrose. Mineral content ranges from 0.7-4.1%, while in lyophilized samples, it varies between 2.7 to 4.1%. overall, apilarnil is a nutrient rich bee product with substantial levels of proteins, essential amino acids, lipids, carbohydrates, vitamins, minerals, and bioactive compounds that support its biological and medicinal properties (Silici 2023) ^[33].

Apilarnil contains number of significant hormones. Testosterone, estradiol, androgen, progesterone, and prolactin are the major hormones. Estradiol and progesterone are female sex hormones, while testosterone acts as a male hormone. These hormones play an important role in reproductive development and function in both males and females. Androgens play significant role in development of muscles, bone density, and red blood cell formation, puberty maturation, desires, and sexual functions. It also plays an important role to prevent the osteoporosis in women and regulating menstruation. Progesterone have been found in cortical and sub cortical areas of brain. This hormone effectively promotes neurone regenerations, myelination, and has neuroprotective properties. Estradiol is a hormone that effectively regulates the production, release, and metabolism, whereas prolactin is responsible for development of breast tissue and production of milk. By boosting immune cell and strengthening body defenses against infections and diseases, bioactive substances present in apilarnil, contribute to an improved immunological response (Silici 2023) ^[33].

Conclusion

Apitherapy harnesses honey bee products such as honey, royal jelly, beeswax, propolis, bee bread, and bee venom for therapeutic benefits. It is the one of the few natural remedies that maintained its popularity over a long period of time. Patients are dissatisfied with synthetic drugs for treating chronic, hard-to-heal, and prolonged diseases, particularly cancer. The demand for these products has increased as a result of the research's encouraging findings. Public has been using it as a healing source. Scientific research has shown its antioxidant, antibacterial, antifungal, antiviral, anti-inflammatory, anti-tumour, and immune modulating properties. In order to strengthen this area governments can fully recognize traditional medicine while overcoming challenges like providing efficacy, protecting indigenous knowledge, and ensuring safe use by implementing straightforward policies, regulations, standards, clinical practices, research, education, and information sharing. All these steps must align under the guiding theme of "Standardization with evidence-based approaches" to create reliable, effective system that benefit everyone safely and fairly.

References

1. Abrol DP. Bee and Beekeeping in India. Kalyani publishers, Ludhiana, India, 1996, 223-262.
2. Ajibola A, Idowu GO, Amballi AA, Oyefuga OH, Iquot IS. Improvement of some hematological parameters in albino rats with pure natural honey. Kathmandu University Medical Journal,2007;3:305-309.
3. Bankova V, Castro SL, Marcucci MC. Propolis: recent advances in chemistry and plant origin. *Apidologie*,2000;31:3-15.
4. Berretta AA, Silveira MAD, Capcha JM, Jong D. Propolis and its potential against SARS-CoV-2 infection mechanisms and COVID-19 disease. *Biomedicine and Pharmacotherapy*, 2020, 131-110622.
5. Bhisagratna KK. Sushruta Samhita. Chaukhamba Sanskrit Series Office. Varanasi, UP, India, 2006.
6. Bogdanov S, Martin P. Honey authenticity: a review. *Mitteilungen aus Lebensmitteluntersuchung und Hygiene*,2002;93:232-254.
7. Bradbear N. Bees and their role in forest livelihoods: A guide to the services provided by bees and the sustainable harvesting, processing and marketing of their products, 2009, 119-21. www.fao.org
8. Campos MG, Bogdanov S, Muradian LB, Szczesna T, Mancebo Y, Frigerio C, *et al.* Pollen composition and standardisation of analytical methods. *Journal of Apicultural Research*,2008;47(2):154-161.
9. Denisow B, Pietrzyk M. Biological and therapeutic properties of bee pollen: a review. *Journal of the Science of Food and Agriculture*,2016;96(13):4303-4309.
10. Diaz YA, Cassotta M, Suárez JM. Chemical Composition of Beeswax. *Bee Products-Chemical and Biological Properties*, 2025, 495.
11. Didaras NA, Karatasou K, Dimitriou TG, Amoutzias GD, Mossialos D. Antimicrobial activity of bee products and their potential use in medicine. *Nutrients*,2022;14:3579.
12. Fratellone PM, Tsimis F, Fratellone G. Apitherapy products for medicinal use. *Journal of Alternative and Complementary Medicine*,2016;22(12):1020-1022.
13. Gajic JS, Pastor K. Honey and bee products emerging food authentication methodologies using GC/MS, 2023, 137.
14. Gajski G, Leonova E, Sjakste N. Bee venom: composition and anticancer roperties. *Toxins*,2024;16:117.
15. Gokulakrishnaa R, Thirunavukkarasu S. Apitherapy: A valuable gift from honey bee. *Journal of Entomology and Zoology Studies*,2020;8(5):2317-2323.
16. Griffith RTH. *Rigveda*, 1896.
17. Gupta G, Anjali K. Environmentally friendly beeswax: properties, composition, adulteration, and its therapeutic benefits. *Earth and Environmental Science*, IOP Publishing, 2023.
18. Ilie CI, Spoiala A, Geana EI, Chircov C, Ficai A, Ditu LM, *et al.* Bee bread: a promising source of bioactive compounds with antioxidant properties. *Antioxidants*,2024;13(3):353.
19. Jull AB, Cullum N, Dumville JC, Westby MJ, Deshpande S, Walker N. Honey as a topical treatment for wounds. *Cochrane Database of Systematic Reviews*,2015;(3):CD005083.
20. Karmakar R, Soni S, Soni V, Patil UK. Potential of apitherapy in the management of cardiovascular diseases. *European Journal of Medicinal Chemistry Reports*,2025;13:100256.
21. Khalil A, Elesawy BH, Ali TM, Ahmed OM. Bee venom: from venom to drug. *Molecules*,2021;26(16):4941.
22. Michener CD. *The bees of the world*. Johns Hopkins University Press, Baltimore, Maryland, 2000, 19-25.
23. Orsolio N, Jembrek M. Royal jelly: biological action and health benefits. *International Journal of Molecular Sciences*,2024;25(11):6023.
24. Pascoal A, Rodrigues S, Teixeira A, Feas XS, Estevinho LM. Biological activities of commercial bee pollens. *Food and Chemical Toxicology*,2014;63:233-239.
25. Pasupuleti VR, Sammugam L, Ramesh N, Gan SH. Honey, propolis, and royal jelly: a comprehensive review of their biological actions and health benefits. *Oxidative Medicine and Cellular Longevity*,2017;(1):1259510.
26. Rajesh VS, Strukova TA. The value of honey in Indian Ayurveda, 2018, 43-207.
27. Rao PV, Krishnan KT, Salleh N, Gan SH, Gan SH. Biological and therapeutic effects of honey produced by honey bees and stingless bees: a comparative review. *Revista Brasileira de Farmacognosia*,2016;26(5):657-664.
28. Samarghandian S, Farkhondeh T, Samini F. Honey and health: A review of recent clinical research. *Pharmacognosy Research*,2017;9(2):121-127.
29. Schmidt JO, Buchmann SL. Other products of the hive. *Journal of Basic and Applied Engineering Research*,2009;3(1):2350-77.
30. Sforcin JM. Biological Properties and Therapeutic Applications of Propolis. *Phytotherapy Research*,2016;30:894-905.
31. Sharma PV. *Charaka Samhita*. Chaukhamba Orientalia, Varanasi, 2001.
32. Silici S. Chemical content and bioactive properties of drone larvae (apilarnil). *Mellifera*,2019;19(2):14-22.

33. Silici S. Drone larvae homogenate (apilarnil) as natural remedy: scientific review. *Journal of Agricultural Sciences*,2023;29(4):947-959.
34. Stefan B. Bee pollen: composition, health, medicine. *Bee Product Science*, 2017.
35. Stojanovic ST, Najman SJ, Popov BB, Najman SS. Propolis: chemical composition, biological and pharmacological activity—a review. *Acta Medica Medianae*, 2020, 59(2).
36. Suarez JM, Tulipani S, Romandini S, Bertoli E, Battino M. Contribution of honey in nutrition and human health: a review. *Mediterranean Journal of Nutrition and Metabolism*,2010;3(1):15-23.
37. Viuda M, Gonzalez R, Alvarez JA, Fernandez J. *Bee Products—Chemical and Biological Properties*. Springer Nature, Switzerland, 2025, 313-336.
38. Waili N, Salom K, Butler G, Ghamdi A. Honey and microbial infections: A review. *Journal of Medicinal Food*,2011;14(10):1079–1096.
39. Whitney WD. *Atharvaveda*, 1905.
40. Zuluaga CM, Serrato JC, Quicazan MC. Chemical, nutritional and bioactive characterization of Colombian bee-bread. *Chemical Engineering Transactions*,2014;43:175–180.