

**Review Article****Beekeeping and Bee Products; Boon for Human Health and Wealth**Bhalchandra Waykar<sup>1</sup>, Yahya Ali Alqadhi<sup>2</sup><sup>1</sup> Professor, Department of Zoology, Dr Babasaheb Ambedkar Marathwada University, Aurangabad, India<sup>2</sup> Department of Zoology, Dr Babasaheb Ambedkar Marathwada University, Aurangabad, India**ARTICLE INFO:****Article history:**

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**ABSTRACT**

The cross-fertilization by bee increases average agricultural yield by 20 to 25 percent. Its products like honey, pollen, royal jelly, propolis, bee venom have immense medical importance. Honey is useful for healing the wounds, helps to build up hemoglobin, used as laxative blood purifier, preventive against cold, cough, sore throat, eye ailments, burns and gastrointestinal disorder etc. Honey has antibiotic property and is effective in reducing the risk of heart disease, cancer and diabetes. Pollen lowers blood pressure, increases hemoglobin and erythrocyte content, useful in pernicious anemia, sterility, hypertension, in complaints of the nervous and endocrine system. Royal jelly has antimicrobial, anti-inflammatory, anti-aging, vasodilative and hypotensive, antioxidant, antihypercholesterolemic and antitumor property. Royal jelly has a diuretic effect, prevents obesity, builds up resistance to infection, regulates the functioning of the endocrine glands and is good for arteriosclerosis and coronary deficiency. Bee venom acts as antibiotic and useful for lowering of blood pressure, in neural disorders and rheumatoid arthritis and acute rheumatic carditis, treating certain eye diseases, hypertension and gynecological and children's diseases. Propolis, a resinous substance has pharmacologically active constituents as flavonoids, phenolics and other various aromatic compounds. Propolis has antibacterial, antifungal, antiviral, antioxidant and anti-inflammatory properties. It is used to treat mouth and gum disorders, gum decay, resistance to general illness, cure burns and fungal skin complaints. Beeswax is used to prepare polishes, waterproofing, electrical insulation, cosmetics, cold creams etc. It is also useful in engineering, pharmaceutical and confectionary industries.

**Introduction**

Apiculture deals with the rearing of honey bees in order to obtain honey, beeswax and also to increase the crop production by their efficient service of cross pollination. The beekeeping is a feasible way to help people to work their way out of poverty, while at the same time maintaining natural biodiversity. Issues facing our world include poverty, climate change, and deforestation, loss of biodiversity, water shortages, unemployment, pollution and urban sprawl. While beekeeping cannot cure all of these it offers a feasible and wholly environmentally beneficial activity that helps fight against these problems. Economy of the country mainly depends on agriculture in the rural areas. So the necessity of beekeeping, its expansion and development is sustainable and its potentiality is vast in favor of the agriculture based rural

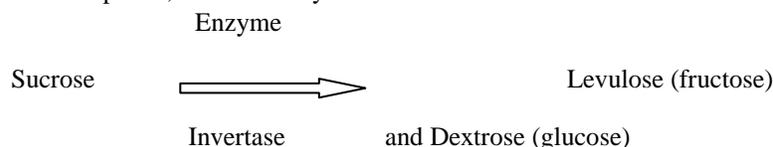
economy of India. The cross-fertilization by bee increases average agricultural yield by 20 to 25 percent. Many of our Indian oilseed crops, vegetables, and horticultural plants require cross pollination via honey bees to affect fruit or seed setting and also improving the quality of seed and fruit. Beekeeping is a model activity that has many advantages for sustainable rural development. In India environment is suitable for beekeeping, bees are a free, renewable resource. They convert otherwise unused floral nectar into honey, a product with high cultural value as a medicine as well as a desirable food and trade item. Start-up costs with local hive bees are low and profits can be realized quickly. Beekeeping is a particularly relevant activity for the rural poor because land ownership is unnecessary. As honey bees collect floral

resources over a wide area, they pollinate flowers, thereby increasing the number and quality of numerous fruit and vegetable crops. Many of these are cash crops in their own right, and increasing crop quality and yields through better pollination results in additional profits. In addition, honey bees have a large role in forest ecology through the pollination of trees and other natural vegetation. Cultural activities, such as the adoption of more sustainable honey harvesting techniques that improve the conservation of bees, can indirectly aid the conservation of forest ecosystems. Beekeeping contributes to

### Honeybee products

#### Honey

Honey is the most wonderful gift of God and Mother Nature to mankind. Honey is held in high esteem next only to Amrita, the Ambrosia. Honey is sweet liquid gathered by honeybees from nectar or other secretions of plants, which they



all four fundamentals of sustainability: (1) to environmental sustainability, as the beekeepers come to understand the link between beekeeping and forest conservation; (2) economic sustainability, by being a low-input rural activity that provides strong economic returns; (3) cultural sustainability, by being an activity that integrates well with other agricultural activities and that can be practiced by men, women, and youths; and (4) social sustainability, by reducing poverty and enhancing quality of life[1-5].

transform, by addition of enzymes and evaporation of water in it. Honey has a delightful variety of tastes, which are dependent on the nectar sources, and the soils of the growing area. Bees select the plant species, which are with more than 20% sugar content. To change the nectar to honey, the bees convert complex sugar sucrose to simple sugars, fructose and glucose using enzyme produced by special salivary glands.

Water is removed from the nectar by evaporation until the sugar content is rich.

#### Chemical constituents of honey

Constituents	Composition %
<b>Total Dissolved solids</b>	<b>70-80</b>
<b>Sugars</b>	
Fructose (Laevulose)	38
Glucose (Dextrose)	37
Sucrose	2
Other higher sugars	0.5
Water	20
<b>Minerals</b>	
(Honey contains 11 minerals and 17 trace elements, include potassium, calcium, magnesium, iron, copper, manganese, hosphorous, sulphur, chlorine and traces of chromium, nickel, tin, silver, gold etc.)	0.5
Acids (include acetic, buteric, citric, formic gluconic, maleic, lactic, succinic, tartaric etc),	0.2
proteins and amino acids (Include proline, phenylalanine, aspartic acid, glutemic acid, asperigin, leucine, phenylalnine, valine, isoleucin)	0.25
<b>Enzymes</b>	
(Include invertase, amylase, or diastase glucose oxidase, catalase, acid phosphatase)	Traces
Vitamins (include vitamin B-1 or thiamine, vitamin B-2 or riboflavin, niacin or nicotinic acid, Vitamin B-6 or Pyridoxine Pantothenic acid and vitamin- C or ascorbic acid)	Traces

Besides the above, aromatic compounds, colloids, pollens etc contribute to the colour, taste, and flavours of honey.

## Economic importance of honey

### Food value

Honey provides instantaneous replenishment of energy losses. It is estimated that 1kg of honey contains 3350 calories. The ingredients of honey like sugars, minerals, vitamins A, B, and C are easily absorbed by alimentary canal. The best-known advantages of honey lies in its predigested form, hence, even an infant can get direct benefit from it. Honey is taken by healthy as well as by ill persons.

### Medicinal value

Honey is a natural product of honey bees formed from nectar collected from blossoms. Honey can be considered as a dietary supplement as it contains some important components including carbohydrates, minerals,  $\alpha$ -tocopherol, ascorbic acid, vitamins, organic acid, flavonoids, phenolics, enzymes and other phytochemical compounds [1]. Natural honey has worldwide been known for its curing potency, e.g. antibacterial [2], antiseptic [3], antiviral [4] and has widely used to treat wounds [5]. Honey helps to build up hemoglobin of blood. Honey is used as laxative blood purifier, a preventive against cold, cough and fever, curative for sores, eye ailments, ulcers on tongue, sore throat, burns and gastrointestinal disorder etc [6,7]. Honey is effective in reducing the risk of heart disease, cancer, immune system decline, cataracts, indigestion, diabetes and different inflammatory processes etc [8]. However, since some of these diseases are a consequence of oxidative damage, it seems that part of the therapeutical properties of honey products is due to their antioxidant capacity [9]. Many studies have shown that honey reduces the secretion of gastric acid [10] as well as it is effective in the treatment of wounds [11] and conjunctivitis [12]. Honey protects liver against oxidative damage [13]. Recently, honey has been shown to improve sperm parameters and serum testosterone level [14]. It is postulated that honey could improve the impaired testicular function by possibly reducing the testicular damage and oxidative stress. Recommended doses of honey are 10-15gm for child, 30-35gm for youth, 30-50gm for healthy man and 20-30gm

for old persons per day. For patients as recommended the physician.

## Importance of other honeybee products to mankind

### Pollen- method of collection, constituents and uses

Bees may collect nectar, pollen or both. While collecting nectar from a flower, forager bees gets smeared with pollens which are brushed to a pellet and packed in the pollen basket present on the hind legs; setting up on involuntary fertilization (pollination) chain when she flies to the next plant. The bee then takes it back into the hive and scrapes it off her legs into a pollen storage cell. Pollen grains are situated round the brood.

### Collection of pollen

By installing a specially made pollen trap at the entrance of beehive, pollen can be collected from the hind legs of incoming forager bees. Pollen, thus falling into a tray is collected by the beekeepers. About 60gm of pollen can be collected per day from one colony. It is necessary to remove the pollen every day. A colony on an average yields 3-5kg pollen annually. Fresh pollen contains high moisture and thus is liable to fungal attack. It is therefore dried by passing hot air and preserved in airtight containers of glass or plastic. All the pollens are not safe. To screen poisonous or allergic pollen, microscopic analysis is done.

### Constituents of pollen

The chemical composition of pollen varies according to kinds of flowers. Pollen contains carbohydrates, proteins, fats, minerals, amino acids, vitamins, enzymes, potassium, phosphorous, calcium, magnesium and iron, growth accelerating substances, antibiotic components, pigments and moisture etc. Pollen, besides being a rich source of protein, contains all the essential amino acids required for human life. Many oligosaccharides not found in honey and royal jelly is found in pollens. Moreover fibrous substances and pectin are found only in pollen, which make it more valuable than honey and royal jelly as "Complete food".

## Nutritional value of pollen

Composition	Percentage
Carbohydrates	35%
Proteins	20%
Fats	5%
Water (air dried pollen)	7%
Minerals	Trace
Vitamins	B <sub>1</sub> , B <sub>2</sub> , B <sub>3</sub> , B <sub>5</sub> , B <sub>6</sub> , B <sub>7</sub> , B <sub>8</sub> , B <sub>9</sub> , B <sub>12</sub> , A, C, D, E.
Enzymes	Trace
Antibiotic components	Trace
Growth accelerating substances	Trace

### Uses of pollen

In the Western and advanced countries, pollens are made into grains, powder, paste, capsule or tablets and used as a protein supplement by the vegetarians. When taken by human, it is

variously claimed to act as a stimulant for those recovering from illness or surgery. Pollen has been found useful in lowering blood pressure and increasing hemoglobin and erythrocyte content of the blood. The discovery of

gonadotrophic hormones in the pollen of date palm confirms its use by the Bedouins for treating sterility. Pollen has shown beneficial effects on chronic prostatitis due to flavonoids or phytosterols present in pollen [15, 16, 17]. Pollen increased effectiveness of chemotherapy when given simultaneously [18]. Pollen ingestion in the form of Cernilton by humans also resulted in a reduction of atherosclerosis lipid factors [19]. [20] mentioned that bee pollen used successfully to treat gastritis, impotency, anaemia and posttraumatic stress disorder in humans. Pollen is also used in cosmetic preparation with claims of rejuvenating and nourishing effects for skin. Pollen is biological stimulator and the rejuvenating properties attributed to honey are due to the presence of pollen in it. In folk medicine pollen was considered an all purposes remedy and tested clinically in several illnesses and found it particularly effective when mixed with honey (1:1) for treating hypertension, in complaints of the nervous and endocrine system. Pollen normalizes the activity of the intestine (especially in cases of colitis or chronic constipation), improves the appetite and increases the fitness for work. Pollen has been found useful in pernicious anemia. Clinical tests prove pollen to be an energizer, appetizers and general stimulant (with euphorizing effect). Pollen is responsible for functional rebalancing and it also acts as general detoxifier.

b) Royal jelly-method of collection, constituents and uses  
Royal jelly is a milky secretion produced by hypopharyngeal and mandibular glands of nurse bees which is strongly acidic and highly nitrogenous substance.

#### **Chemical constituents**

It is highly complex chemical substance containing 18% protein, amino acids including 8 essential amino acids, 10-17% sugar, 5.5% fat, 2-3% minerals, vitamins E, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub>, B<sub>7</sub>, PP and H but very little vitamin C, A (carotene) and D [21]. Royal jelly also contains hormone rich substance (testosterone), enzymes, and antibiotic components. It also has an abundance of nucleic acid-DNA and RNA [22].

#### **Collection of royal jelly**

Royal jelly can be collected by cutting off queen cells, removing the larvae and scooping out the royal jelly contents, which can be stored long term in the freeze. Specialist techniques need to be used to produce large numbers of excess queen cells to do this and commercial royal jelly production is likely to be 28.35 grams of royal jelly collected from 100 or more queen cells. It can also be harvested by artificial queen rearing method, collected by suction pump acting like a miniature vacuum cleaner, can also harvest it. About 200 to 300mg of royal jelly can be extracted from three-day-old cells. Thus in year 500 grams royal jelly can be extracted per hive.

#### **Uses of royal jelly**

Royal jelly has been determined to exhibit a variety of pharmacological activities including antitumor [23], antioxidative [24], antimicrobial [25], vasodilative and hypotensive, anti-fatigue, and anti-allergy [26] antihypercholesterolemic and anti-inflammatory activities [27]. Royal jelly, stimulated cell survival, cell growth and cell differentiation and it also had a cytotoxic effect on the carcinoma cells [28]. Royal jelly (RJ) was reported to have a

protective role against oxidative damages due to its antioxidant potency and free radical scavenging capacity [29]. Royal jelly shows beneficial effect in the treatment of hypercholesterolemia [30], diabetes [31], male infertility [32], as well as paediatrics, geriatrics and anti-cancer treatments [33]. [34] mentioned role of royal jelly in successful treatments of hypertension, hypotension, sexual dysfunction, cerebral insufficiency and menopausal symptoms. Additionally, RJ is thought to alleviate many aging-related diseases including postmenopausal symptoms. A few studies have investigated the effects of RJ on bone metabolism and related cellular activities. RJ showed weak estrogen-like activity in cultured osteoblasts [35]. Post-menopausal osteoporosis is mainly caused by reduced production of estrogen; therefore, RJ's estrogen-like activity may help to alleviate post-menopausal osteoporosis. Furthermore, RJ enhanced the migration of dermal fibroblast and increased collagen production [36]. According to [37], RJ stimulates antibody production and proliferation of immunocompetent cells and depresses humoral immune functions. RJ is also effective against the hematopoietic dysfunction observed in X-irradiated mice, promoting macrophage activity and proliferation of hematopoietic stem cell [38]. Royal jelly has been reported as a possible immunomodulatory agent in Graves' disease [39]. Preliminary evidences show that it has cholesterol-lowering, anti-inflammatory, wound-healing, and antibiotic effects. Researches also suggest that the 10-Hydroxy-2-Decenoic Acid (10-HDA) found in RJ may inhibit the vascularization of tumors. Royal jelly is said to improve fertility in both men and women, in men by increasing the quality of their sperm and in women by increasing the quality of their ovules. Royal jelly has a reputation as a panacea; aphrodisiac and rejuvenator. Royal jelly is used to treat disorders of the cardio-vascular system and gastrointestinal tract. Royal jelly normalizes metabolism, has a diuretic effect, can be used to prevent obesity and emaciation, builds up resistance to infections, regulates the functioning of the endocrine glands and is good for arteriosclerosis and coronary deficiency. Royal jelly is a tonic restoring energy, getting rid of the feeling of indisposition and improver appetite. It is known to contain acetylcholine, which dilates the blood vessels and is therefore used to treat hypertension. It is said to improve body resistance against influenza, illness or infection and some believe that it stops you growing older. For this reason, for more than 30 years, royal jelly has been used commercially in medical products, healthy foods and cosmetics to a wide extent.

#### **Bee venom-method of collection, constituents and uses**

To ward off the enemies, bees sting and inject bee venom into the invader. The sting remains in the body of the enemy and bees die due to bleeding after stinging. The sting consists of acid and alkali glands, the secretions of the both glands together form the venom and stored in poison sac, which opens into stinging apparatus. Adult worker produces about 0.3mg of venom.

### Chemical constituents of bee venom

Bee venom is transparent, with bitter burning taste, acidic and contains formic acid, hydrochloric and orthophosphoric acid, histamine, tryptophan, sulphur, volatile oils, magnesium sulphate, traces of copper, calcium and other substances. It also contains some peptide groups called melittins, which are responsible for haemolysis of blood. The enzyme hyaluronidase, phospholipase and other substances are also present. At ordinary room temperature venom dries up, it is soluble in water and acid, activity is reduced by oxidizing agents like potassium permanganate and when kept dry. Toxicity retains for several years.

### Bee venom collection

An improved method is by passing a weak electric current through a special device fitted at the bee entrance of the hive. As the bees pass through entrance, they receive a mild shock and release their venom which fall into a piece of glass placed there for the purpose, the venom rapidly dries and forms the crystals which could be picked up. Most workers in this way retain their stings, without any damage and can be milked again. On an average 20 strong colonies must be milked at a time to obtain 1gm of venom. Dried venom, which is crystalline white, can be collected by razor or be removed by using solvents. It must be preserved properly.

**Uses of bee venom:** From a pharmacological point of view bee venom is the most potent bee product. The most interesting application of bee venom in humans is in treatment of rheumatoid arthritis and a success rate is between 70% and 90% [40]. Another promising application of bee venom may be against multiple sclerosis [41]. Bee venom may also have some potential in the treatment and prevention of cancer. Beekeepers have been reported to have a slightly lower cancer incidence and a significantly lower incidence of lung cancer compared to the general population [42]. Many examples could be cited in which patients with hypertensive conditions improved soon after they began to work in an apiary. Bee venom acts as antibiotic and used in different diseases. Bee venom causing a lowering of blood pressure, haemolysis and contraction of muscles and block nerve muscle and ganglia synapses. Bee venom is also useful in neural disorders affecting the sciatic, femoral and other nerves. In folk medicine, bee venom has long been used to treat certain eye diseases as iritic (inflammation of iris). Some beekeepers and even medical workers consider that all illness can be treated with the bee venom and used it in gynecological and children's diseases. Bee venom must be used with care and only under medical supervision, especially when treating children's and elderly people, who are very sensitive to it.

### Propolis (Bee glue)-method of collection, constituents and uses

Propolis is a natural dark sticky resinous material collected by worker bees from buds and barks of the trees. It is used for filling cracks holes in a hive to protect from cold weather and other predators. It is used as sterilizer of cells where bees

apply a thin coat of propolis before queen lays eggs in them. A mixture of bee wax and propolis is much stronger than beeswax alone and is used for embedding already killed insects to prevent putrefaction as propolis contains natural antibiotics, which protect the colony from brood diseases including bacterial and fungal growths.

### Chemical constituents of propolis

The chemical composition of propolis is extremely complicated, containing more than 300 components such as flavonoids, phenolic acids and their esters, alcohols, ketones, amino acids, and inorganic compounds [43]. Vitamins A and B are also present. The propolis contains cinnamic acid, benzoic acid and its esters, substituted phenolic acids and their esters, bee wax and caffeic acid phenethyl ester (CAPE) [44].

### Collection of propolis

Propolis can be collected by scraping frames or the walls of the hives. Another method is by placing plastic /wood/stainless steel mesh or screen on the hive for the bees to fill them with propolis. About 30 gm propolis can thus be collected per hive per year. It needs to be kept in air tight opaque container for effectively storage. Only *Apis mellifera* bees produce this propolis.

### Uses of propolis

Numerous investigators have demonstrated that propolis has antimicrobial, antiparasitic, antiviral, anti-inflammatory, antitumor, antioxidant, antibiotic, unaesthetic and cicetrizing properties [45]. These properties make it a grand success in natural medicines both for external and internal applications and also as a natural healing agent. It is progressively being used in veterinary products, varnishes and cosmetics etc. It is popular in folk medicine for removing corns. Propolis ointment prevents skin reaction to radiation in patients. Inhalation of propolis in diseases of the upper respiratory tract and the lungs (e.g. bronchitis and tuberculosis) has given good results [46]. Propolis can also be used in paediatric diseases, radiculitis, polyradiculoneuritis, gastric ulcers and baldness [47]. Propolis has been successfully used to treat tuberculosis, psoriasis, skin mycosis, and inflammations of the stomach and duodenum [48]. In humans, it has been used for treatment of surgical diseases [49], wounds [50] and minor burns [51]. Propolis is very widely used in dentistry [52]. Propolis is good anesthetic in dental medicine. Propolis inhibits in different pathogenic microbes of mouth such as bacteria, fungi and viruses [53] and can be successfully applied against the different stomatological pathologic conditions: stomatitis, paradontosis, gingivitis and caries [54]. One major threat for women in under developed countries is the most frequent human papilloma virus (HPV) infection which can lead to cervical cancer. But even in Western countries there are many HPV-associated dysplasias which require surgery by means of cervical conisation or even hysterectomy. Studies have shown that propolis-containing local therapy can eradicate HPV infections within six months. In a randomized trial, HPV infections were present after three months of treatment in 28% of patients treated with propolis compared to 90% in the control group [55]. Similarly, another study described an improvement in cytological PAP smears (Papanicolaou test) of

76% with the use of propolis [56]. Here, treatment with bee products offers an interesting approach which could avoid invasive surgery.

#### Beeswax-method of collection, constituents and uses

The worker bees through wax glands situated in their abdomen secrete beeswax used in constructing the combs. Wax producing is highly energy consuming as it takes about 4kg of honey to make 1kg of wax by the bees. Beeswax is highly complex mixture of normal paraffin. It has 16% hydrocarbons, 31% monohydric alcohol, 31% fatty acids and 13% hydroxy acids and other substances.

Uses of beeswax: Beeswax is utilized in many industries to prepare polishes to shoes, furniture's, waterproofing, cosmetics, cold creams and cleansing creams etc. The basic recipe for creams and ointments has consisted of a mixture of beeswax and oil in various proportions according to the desired consistency. Beeswax has unique properties that make it an ideal substance for skin creams and ointments. It builds stable emulsions; improves water binding of creams; reinforces the action of detergents, giving the skin a protective layer and improving its elasticity; improves the protective action against ultraviolet light of sun creams; does not provoke allergy and has antibiotic and warming properties. These properties have made beeswax an irreplaceable ingredient of cosmetic creams and ointments. It is also useful in engineering industries, railway transport and pharmaceutical industries. Beeswax has also many uses in military and atomic research. Beeswax was used for caryons, ink, carbon paper, electrical insulation, water proof canvas and paper, lubricants and in laboratory for microtomy. Wax is also useful in preparation of soaps, plasters and ointments. Beeswax is rich in vitamins and vitamined sweets can be prepared that retain their value for several months. It is also used in horticulture for grafting. Beeswax candles are the finest candles and burn a long time. Recent industrial applications of beeswax include density, electronic, mechanical moulds etc.

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