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An Overview of "A Comparative Study of the Multifaceted Role of Honey: From Historical Uses to Modern Therapeutic Applications and Physiochemical Properties"

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ABSTRACT

Honey, a natural product with a rich history, has been utilized for both food and medicinal purposes for thousands of years. The substance, primarily produced by honeybees from floral nectar, is complex in composition and varies in quality based on environmental, seasonal, and floral factors. Composed mainly of carbohydrates, such as fructose and glucose, and containing small amounts of proteins, amino acids, minerals, and vitamins, honey exhibits diverse biological activities. This natural product has garnered significant attention in modern medicine due to its potential therapeutic effects, including anti- inflammatory, antioxidant, antimicrobial, anti-cancer, anti-diabetic, and wound-healing properties. These effects are attributed to honey's chemical constituents, such as phenolic compounds, flavonoids, and hydrogen peroxide, which contribute to its broad-spectrum antimicrobial activity. The pharmacological benefits of honey, particularly in gastrointestinal disorders, inflammation, cancer therapy, and diabetes management, highlight its significant potential in clinical applications. Additionally, honey's ability to support wound healing, along with its natural low glycemic index, makes it a versatile and valuable substance in both traditional and modern medicine. As the scientific community continues to explore the properties of honey, its role in human health and disease management remains a subject of significant interest. This review discusses the composition, physicochemical properties, and pharmacological activities of honey, emphasizing its diverse applications in health and medicine.

KEYWORDS: Honeybees, various species, Apiculture, pharmacological effects, Natural product, Floral nectar.

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INTRODUCTION

Since ancient times, our predecessors have used honey extensively for a variety of purposes. Since the beginning of time, it has been utilized as a food and medicine [1]. There is historical proof that wild honey gathering has been practiced for 10,000 years. Nonetheless, honey was utilized as a natural food source and as a component in a variety of food preparations by 2400 BC, when beekeeping was a well-established craft in Egypt at the very least [2–6]. A naturally occurring substance, honey is made by honeybees from the sweet, fragrant, viscous liquid nectar of flowers [1, 7]. A number of environmental factors, including temperature, humidity, nectar condition, and flavour, affect the honey's composition and quality. The type of flower from which the nectar was extracted will affect the flavour of the honey [6]. The science of raising or maintaining colonies of bees and their hives is termed as Apiculture which is a technical term for beekeeping. Natural products, especially honey, have reignited

attention in the medical world, which has acknowledged its diverse potential in a range of clinical applications [8, 9]. Russia is the top honey-producing nation, followed by Mexico, India, Iran, Romania, the Republic of Korea, New Zealand, Poland, Kenya, and Australia, according to the Food and Agriculture Organization [6, 10]. The physical and chemical components of honey, such as its moisture content, sucrose content, reducing sugars, pH value, EC, ash content, free acidity, diastase activity, and HMF concentration, are the main evaluation criteria for honey quality [11]. Honey has a longer shelf life and can be stored at room temperature without refrigeration since its composition contains less moisture. Daily honey eating is recommended due to its therapeutic efficacy in Ayurveda and its beneficial health-promoting attributes [11]. Furthermore, using honey in drinks is becoming more and more common [12, 13]. These days, general magazines, journals, and leaflets about natural products contain information on the use of honey to treat a wide range of human ailments. These encompass wound healing, anti-inflammatory, antioxidant, antibacterial, antidiabetic, respiratory, gastrointestinal, cardiovascular, and nervous system effects [13–20]. The only naturally occurring substance derived from insects that is used in an extensive range of industries, cosmetics, medicine, and as a food source is honey [9].

BIOLOGICAL SOURCE OF HONEY

Honey bees use nectar for the production of honey, a naturally occurring sweet, viscous liquid. The production of honey involves a number of different species of honey bees. Despite the fact that there are actually over 20,000 species of bees, only seven to eleven of them are classified as honey bees and belong to the genus 'Apis'. Although they are most recognized for their black-and-yellow stripes, their ability to sting occasionally, their ability to produce tasty honey, and their busy, noisy life in their buzzing hives, bees are actually a remarkably diversified bunch of insects. Many of them are stingless, and they come in a wide variety of colors. Hundreds of meticulously planned hexagonal forms are used for constructing honey combs. With the least amount of effort and resources, this shape probably holds the most honey. In addition to honey, which is a consequence of honey bees' nectar consumption, honey bees are also the producers of propolis, bread, royal jelly, and beeswax [21].As there are various species of Honey bees, some of them are mentioned in the following table 1.

Table-1: Different species of Family "Apidae"

S.No.	Species	Common Name	Geographical Source	Reference
1	**Apis dorsata** 	Giant honey bee/ Rock honey bee	Throughout the southern countries of Aisa, including Malaysia, Indonesia and Philippines	https://en.wikipedia.org/wiki/Apis_dor sata
2	**Apis laboriosa** 	Hiamalyan giant honey bee/ Cliff honey bee	Foothills of Himalaya and neighbouring mountainous regions	https://en.wikipedia.org/wiki/Apis_laboriosa
3	**Apis mellifera** 	Western honey bee/ European honey bee	Europe, Middle east and Africa	https://en.wikipedia.org/wiki/Western_honey_bee
4	**Apis cerana** 	Eastern honey bee/ Asiatic honey bee/ Asian honey bee	Primorsky Krai in Russia in north to Eastern Indonesia in south and Japan in east to as far as highlands of Afghanistan in west	https://en.wikipedia.org/wiki/Apis_cer ana

5	**Apis florea** 	Dwarf honey bee/ Red dwarf honey bee	Southern Asian countries especially in Thailand, Iran, Oman, United Arab Emirates, India, Myanmar and some parts of China, Combodia, Vietnam and also in Sudan	https://en.wikipedia.org/wiki/Apis_flor ea
6	Melipona iridipennis 	Dammer bee/ Stingless bee	From Sinaloa and Tamaulipas (Mexico) to Tucuman and Misiones (Argentina), Brazil and Peru, African continent (Madagascar), Southeast Asia, Australia and Tropical America	https://en.wikipedia.org/wiki/Melipona

TAXONOMIC HEIRARCHY OF HONEY BEES

Kingdom	· Animalia
Subkingdom	· Bilateria
Infrakingdom	· Protostomia
Superphylum	· Ecdysozoa
Phylum	· Arthropoda
Subphylum	· Hexapoda
Class	· Insecta
Subclass	· Pterygota
Infraclass	· Neoptera
Superorder	· Holometabola
Order	· Hymenoptera
Suborder	· Apocrita
Infraorder	· Aculeata
Superfamily	· Apoidae
Family	· Apidae
Subfamily	· Apinae

Figure-1: Taxonomic hierarchy of honey bees [42]

CHEMICAL COMPOSITION

A complex blend consisting of various nutrients and components, honey's percentages vary [43]. varying species and the sources from which they extract the nectar that is used to make honey have varied compositions. In addition to the source, it also depends on the processing conditions, seasonality, and environmental factors [1]. Changes in geographic and environmental conditions, the source from which nectar is being collected, and other factors can all affect its composition. Only about 80% of the physical and chemical composition of most honeys is shared. These subtle differences would cause the honey to have distinct colors, viscosities, tastes, and characteristics [43, 44].

The primary components of honey are water and carbohydrates; comparatively lesser quantities of proteins, amino acids, enzymes, polyphenols, and other minerals may also be present. Overall, carbohydrates make up about 80% of the honey's makeup, with monosaccharides like fructose and glucose being responsible for the majority (75%) of this [43, 45].

Additionally, honey may include trace amounts of minerals including potassium, sulphur, chlorine, calcium, phosphorus, magnesium, sodium, iron, copper, and manganese, as well as vitamins like riboflavin, pantothenic acid, niacin, thiamine, pyridoxine, and ascorbic acid. These might originate from pollutants in the environment or from natural sources [43, 46, 47].

Since nectar is the raw material used by honeybees to make honey, the end product's composition will be significantly impacted by the nectar's composition. The sugar concentration of nectar itself varies widely, and depending on the amount of water available, many bees would prefer nectars with higher sugar content [43, 48]. The produced honey would have a higher concentration of carbohydrates if the collected nectar or honeydew had higher sugar content [43, 49].

Many different kinds of carbohydrates, including glucose, fructose, and sucrose, as well as numerous additional disaccharides and higher sugars in different amounts, are found in honey. Compared to the other components listed in Table 2, honey has higher carbohydrate content.

Nectar and pollen, which are essential components of plants, provide the proteins found in honey. Honey contains proteins in the form of simple molecules, such as amino acids, or in the form of very complex structures [1, 50]. Nearly all of the physiologically significant amino acids are present in honey, which has a relatively modest protein and amino acid concentration [1]. Glutamic acid, cysteine, phenylalanine, tyrosine, tryptophan, lysine, glutamine, aspartic acid, asparagine, histidine, arginine, serine, proline, glycine, isoleucine, threonine, valine, leucine, and histidine are among its constituents. Proline is the most prevalent amino acid found in honey of all those listed.

Honey also contains minerals and other trace components. The concentrations of these are extremely low. They contain a range of minerals and vitamins with different compositions. Some harmful heavy metals may be present in honey due to environmental factors including pollution. Table-3, Table-4 and Table-5 include information on these Amino Acid, vitamins and minerals.

Table-2: Average composition of honey [6, 46]

S. No.	Component	Average (%)	Range (%)
1	Water	17.00	12.2-22.9
2	Fructose	38.40	30.9-44.3
3	Glucose	30.30	22.9-40.7
4	Sucrose	1.30	0.2-7.6
5	Other disaccharides	7.30	2.7-16.0
6	Higher Sugars	1.40	0.1-3.8
7	Free acid as gluconic	0.40	-
8	Lactone as gluconolactone	0.20	0.0-0.37
9	Total acid as gluconic	0.60	0.17-1.17
10	Dietary fibres	0.20	-
11	Ash	0.20	-
12	Nitrogen	0.04	0.0-0.13
13	Proteins	0.30	-
14	Minerals	0.17	0.02-1.03

Table-3: Amino Acids present in Honey [46]

S. No.	Amino acids	Chemical Formula
1	Alanine	$C_3H_7NO_2$
2	Arginine	$C_6H_{14}N_4O_2$
3	Serine	$C_3H_7NO_3$
4	Proline	$C_5H_9NO_2$
5	Glycine	$C_2H_5NO_2$
6	Isoleucine	$C_6H_{13}NO_2$
7	Threonine	$C_4H_9NO_3$
8	Valine	$C_5H_{11}NO_2$
9	Leucine	$C_6H_{13}NO_2$
10	Glutamic acid	$C_5H_9NO_4$
11	Cysteine	$C_3H_7NO_2S$
12	Phenylalanine	$C_9H_{11}NO_2$
13	Tyrosine	$C_9H_{11}NO_3$
14	Tryptophan	$C_{11}H_{12}N_2O_2$
15	Lysine	$C_6H_{14}N_2O_2$
16	Glutamine	$C_5H_{10}N_2O_3$
17	Aspartic acid	$C_4H_7NO_4$
18	Asparagine	$C_4H_8N_2O_3$
19	Metheonine	$C_5H_{11}NO_2S$
20	Histidine	$C_6H_9N_3O_2$

Table-4: Minerals present in Honey [51, 52, 53]

S.No.	Elements	Amount (mg/100g)	S.No.	Elements	Amount (mg/100g)
1.	Sodium (Na)	1.6-17	16.	Bromine (Br)	0.4-1.3
2.	Calcium (Ca)	3-31	17.	Cadmium (Cd)	0-0.001
3.	Potassium (K)	40-3500	18.	Chlorine (Cl)	0.4-56
4.	Magnesium (Mg)	0.7-13	19.	Cobalt (Co)	0.1-0.35
5.	Phosphorus (P)	2-15	20.	Fluoride (F)	0.4-1.34
6.	Selenium (Se)	0.002-0.01	21.	Iodide (I)	10-100
7.	Copper (Cu)	0.02-0.6	22.	Lead (Pb)	0.01-0.03

8.	Iron (Fe)	0.03-4	23.	Lithium (Li)	0.225-1.56
9.	Manganese (Mn)	0.02-2	24.	Molybdenum (Mo)	0-0.004
10.	Chromium (Cr)	0.01-0.3	25.	Nickel (Ni)	0-0.051
11.	Zinc (Zn)	0.05-2	26.	Rubidium (Rb)	0.040-3.5
12.	Aluminium (Al)	0.01-2.4	27.	Silicon (Si)	0.05-24
13.	Arsenic (As)	0.014-0.026	28.	Strontium (Sr)	0.04-0.35
14.	Barium (Ba)	0.01-0.08	29.	Sulphur (S)	0.7-26
15.	Boron (B)	0.05-0.3	30.	Vanadium (V)	0-0.013

*Some of these heavy metals are toxic in nature and might be present in honey due to environmental factors that affects the quality of nectar that honey bees feed upon

Table-5: Vitamin composition in Honey [51, 52, 53]

S. No.	Vitamins	Amount (mg/100g)
1	Thiamine (B1)	0.00-0.01
2	Riboflavin (B2)	0.01-0.02
3	Niacin (B3)	0.10-0.20
4	Pantothenic acid (B5)	0.02-0.11
5	Pyridoxin (B6)	0.01-0.32
6	Folic acid (B9)	0.002-0.01
7	Ascorbic acid (C)	2.2-2.5
8	Phyllochinon (K)	0.025

PHYSICOCHEMICAL PROPERTIES OF HONEY

The characteristics of honey that are influenced by its chemical makeup and the source— whether it be the species that produces it or the flowers that the bees feed upon—are known as its physicochemical attributes. These characteristics include honey's physical, chemical, and biological characteristics.

Different honey bee species have different physicochemical characteristics, and it is necessary to research these characteristics to guarantee the honey's quality. Of the 20,000 species, some are still unidentified, and many species remain unstudied even after they have been recognized. Six species of honey bees—Apis dorsata, Apis laboriosa, Apis mellifera, Apis cerana, Apis florea, and Melipona iridipennis—are featured in this review. Scientists have conducted a number of physicochemical property research on the aforementioned species, and this review contains a summary of all the information gathered.

Physical Properties

The different chemical components that make up honey have an impact on these qualities. These usually include the honey's specific gravity, electrical conductivity, pH, moisture content & appearance.

The table 6 below documents the behaviour of several species in addition to their physical characteristics.

Table-6: Behaviour and Physical properties of honey [22-38, 41]

Behavior and Physical Properties	Apis dorsata	Apis laboriosa	Apis mellifera	Apis cerana	Apis florea	Melipona iridipennis
Honey production, kg/colony/year	50-80 kg	55-132 kg	25-40 kg	6-8 kg	200-900 g	600-700 g

Commencement of Activity, ºC	18 ºC	10 ºC	6.57-20 ºC	20-35 ºC	27-38.5 ºC	22-34 ºC
Relative humidity (%)	20-94.4%	55-90%	55-90%	20.7-96.8%	27.6-89.7%	67%
Appearance of Honey	Dark amber colour	Spring/ Red / Autumn honey	Dark brown / Light dark brown	Light to dark amber with reddish tones	Dark brown / Light dark brown	Amber brown
Moisture content (%)	22.1-22.7%	21.14-25.13%	17.7-18.8%	20.1-21.2%	20.1-21.2%	24.9-30.8%
pH	3.34-4.02	2.77-4.30	3.10-4.10	3.11-3.76	3.54-3.95	3.60-3.86
Electrical conductivity, mS/cm	0.16-0.96 mS/cm	0.30-1.45 mS/cm	0.15-0.75 mS/cm	0.13-0.74 mS/cm	0.38-0.65 mS/cm	1.64-8.77 mS/cm
Specific gravity, g/m	1.37-1.43 g/m	1.3 g/m	1.37-1.41 g/m	1.36 g/m	1.28 g/m	1.30-1.32 g/m

Chemical Properties

Climate, floral origin, soil properties, bee species, honey maturation, and colony health are some of the variables that might affect the composition of honey. Whether honey originates from plant or insect secretions or nectar from flowers, these volatile components can provide information about its origin [54,55,56].

The chemical features of honey include total reducing sugars, ash value, hydroxymethyl furfural (HMF), and free acidity. These features aid in distinguishing between different types of honey and their attributes.

For instance, honey needs a high content of total reducing sugars since it serves as a preservative and keeps honey from spoiling. The fermentation of the honey's carbohydrates, which is necessary for its flavor, firmness, and softness, results in acidity [52]. A crucial factor in assessing honey is its ash concentration, which establishes its characteristics [52]. Commercial conversion of sucrose into invert sugar produces hydroxymethyl furfural (HMF), an aldehyde containing a furan ring [52]. It is a substance that is used to assess honey's purity. The quality of the honey decreases as the HMF value increases [1].

Therefore, these chemical characteristics are crucial in defining the grade of honey that various bee species produce. All of the information about the chemical characteristics of honey from various honey bee species can be reviewed in the table 7 below.

Table-7: Chemical properties of honey [32,35-41]

Chemical Properties	Apis dorsata	Apis laboriosa	Apis mellifera	Apis cerana	Apis florea	Melipona iridipennis
Total reducing sugars (%)	53.77-71.52%	61.82-67.89%	62.32-76.86%	60.15-74.16%	64.63-71.06%	63.1-74.8%
Ash value (%)	0.57-1.15%	0.42%	0.07-0.37%	0.66%	1.15%	0.20-0.60%
HMF value, mg/kg	0.59-1.75 mg/kg	0.71-3.75 mg/kg	0.65-5.90 mg/kg	0.75-13.72 mg/kg	0.68-2.03 mg/kg	1.2-17.1 mg/kg
Free acidity, aw	0.47-0.61 aw	N/A	0.44-0.53 aw	0.54-0.56 aw	0.63 aw	0.51-0.52 aw

PHARMACOLOGICAL ACTIVITY OF HONEY

There are various pharmacological effects possessed by honey. Some of these effects are as follows:

Gastro-Intestinal Activity

Gastritis, duodenitis, and gastric ulcers brought on by bacteria and rotavirus are among the gastrointestinal infections that honey is used to treat and prevent [6, 57–61]. Bacterial attachment to mucosal epithelial cells is thought to be the first step in the development of gastrointestinal tract bacterial infections. Indigestion, peptic ulcers, vomiting-accompanied diarrhoea, coughing, asthma, hiccups, and anorexia are among the gastrointestinal conditions that honey can help with. In order to properly treat gastrointestinal disorders, these honey formulations can be administered in conjunction with a variety of other naturally occurring, traditionally used ingredients, including ginger juice, lemon juice, cumin seed powder, roasted clove powder, curd, rock salt, pomegranate juice, and many more [6].

Anti-Inflammation Activity

Honey exhibits immunomodulatory and anti-inflammatory properties via lowering the activity of cyclooxygenase-1 and cyclooxygenase-2 [62, 63]. Additionally, consuming diluted natural honey demonstrated a decrease in the levels of prostaglandins, including prostaglandin E2, prostaglandin F2α, and thromboxane B2, in the plasma of healthy people, demonstrating that honey's anti-inflammatory properties were just as strong as those of the reference medication prednisolone [64, 65]. Additionally, honey has an anti-inflammatory impact devoid of any negative side effects, such as slowed tissue growth and immunological response, stomach ulcers, etc. [66].

Antioxidant Activity

Strong antioxidant capacity has been demonstrated by honey, and its activity is closely linked to the amount of total phenols, including quercitin, hesperetin, and chrysin, as well as the Maillard products known as melanoidins [1]. Flavonoids, glucose oxidase, catalase, ascorbic acid, and carotenoid are among the other compounds found in honey that have antioxidant properties both in vitro and in vivo [43]. Cellular damage and genetic structure disruption are the outcomes of oxidative stress, which is caused by an imbalance in the chemical reactions between the generation of free radicals and our body's natural defenses. Honey meets the growing need for antioxidants in diet because it suppresses the transcription factor, avoiding the phosphorylation and activation process that free radicals cause in cells [1].

Anti-Cancer Activity

Drugs that cause the malignant cells to undergo apoptosis are typically used in the treatment of cancer. Similar effects of honey include depolarizing the mitochondrial membrane and promoting caspase 3 and 9 production in cancer cells, which results in death [67]. Additionally, it lowers protein expression levels in human fibrosarcoma cells and causes apoptosis, or programmed cell death, in human osteosarcoma cells [68]. Another notion is that honey's antimutagenic properties against chemical and physical mutagens prevent cancer. Honey reduces bacterial cell mutations during division by inhibiting the faulty repair process in bacterial cells [69]. Moreover, it has been demonstrated that the proteins in honey cause macrophages to release tumor necrosis factor α (TNFα). Reactive oxygen species (ROS) are released as a result of this rise in TNFα, and the immune system reacts to eliminate the malignant cancerous cells [70–73].

Wound Healing Activity

One of the natural therapies that has been used to treat wounds is honey, which has a cleansing effect on wounds, promotes tissue regeneration, and lowers inflammation [74–76]. Due to its regenerative tissue growth and epithelization properties, honey accelerates wound healing with minimal scarring and contracture [1, 74, 77].

Anti-Diabetic Activity

Prior researches have reported that honey increases the concentration of hemoglobin, improves the lipid profile, and stimulates the release of insulin, which lowers blood glucose levels [78,79]. That said, extensive research on the use of honey has revealed that it has a low glycemic index, which helps to decrease the absorption of digested food and lower the rise in plasma glucose levels in diabetic subjects [6, 80]. Because of its low glycemic index, people with Type I and Type II diabetes can both consume it. Additionally, it lowers blood cholesterol, which improves the lipid profile. Patients with hyperlipidemia may benefit from it [74,81].

Anti-Microbial Activity

Honey has potent antibacterial properties. It is a broad-spectrum antibiotic that is strong enough to neutralize a variety of bacterial species, including pathogenic and non- pathogenic bacteria, aerobic and anaerobic bacteria, and Gram-positive and Gram-negative bacteria. Hydrogen peroxide, phenolic chemicals, low pH, high sugar content, and antimicrobial peptides all aid in fighting against various forms of pathogenic organisms and, eventually, tissue regeneration [43, 82].

In addition to its antibacterial properties, honey has antifungal properties that have not yet been investigated but have been shown to be effective against Rhodotorula and Candida species [43, 83, 84]. In addition to its antibacterial and antifungal properties, honey has been shown to have antiviral properties and can be used topically to skin lesions brought on by the Simplex virus, which causes herpes. Compared to the commonly prescribed antiviral acyclovir, honey has demonstrated a quicker recovery period [43, 85, 86].

List of Microorganisms and disease caused by them that are sensitive to Honey Table-8.

Table-8: List of Microorganisms and disease caused by them that are sensitive to Honey [51, 66, 87, 88]

S.No	Microorganism	Diseases
1	*Actinomyces pyogenes*	Chronic Bacterial Infection (Actinomyces).
2	*Bacillus anthracis*	Anthrax.
3	*Campylobacter coli*	Inflammation of the stomach and intestines (Gastroenteritis) and cause nausea, vomiting, diarrhea, and abdominal pain.
4	*Pseudomonas aeruginosa*	Pneumonia, urinary tract infections, bloodstream infection.
5	*Rubella virus*	Mild fever and a rashes (Rubella).
6	*Salmonella cholerae-suis*	Systemic infections and bacteremia(the presence of bacteria in the bloodstream) in human.
7	*Campylobacter jejuni*	Bacterial diarrhea.
8	*Salmonella typhi*	Typhoid fever.
9	*Candida albicans*	Fungal infection.
10	*Salmonella typhimurium*	Inflammation of the stomach and intestines.
11	*Corynebacterium diphtheria*	Diphtheria .
12	*Serrata marcescens*	Urinary tract infections , pneumonia.
13	*Echinococcus parasite*	Hydatid disease or Echinococcosis.
14	*Shigella species*	Bacterial infection of the intestines(Shigellosis).
15	*Enterococcus avium*	Inflammation in inner lining of the heart's chambers and valves(Infective endocarditis) and bone infection.
16	*Enterococcus faecalis*	Urinary tract infections , bloodstream infection.
17	*Enterococcus faecium*	Urinary tract infections , bloodstream infection and wound infections.
18	*Enterococcus raffinosus*	Bloodstream infection and rarely cause intra-abdominal infections and meningitis.
19	*Staphylococcus aureus*	Skin and soft tissue infections.
20	*Streptococcus agalactiae*	Pneumonia and meningitis.
21	*Streptococcus dysgalactiae*	Tissue death in connective tissue beneath the skin and surrounding muscles(Necrotizing fasciitis) and toxic shock syndrome.
22	*Streptococcus faecalis uberis*	Inflammation of the mammary gland in dairy cows.
23	*Epidermophyton floccosum*	Fungal infection in skin and nails.
24	*Escherichia coli*	Pneumonia and diarrhoea and dysentery.
25	*Streptococcus mutans*	Tooth decay and infection of the heart valves.
26	*Streptococcus pneumonia*	Pneumonia , bloodstream infection and meningitis.
27	*Haemophilus influenza*	Pneumonia and meningitis.
28	*Streptococcus pyogenes*	Necrotizing fasciitis and streptococcal toxic shock syndrome.
29	*Helicobacter pylori*	Peptic ulcers and stomach cancer.
30	*Klebsiella pneumonia*	Pneumonia and urinary tract infections.
31	*Streptococcus uberis*	Inflammation of the mammary gland in dairy cows.
32	*Serrata marcescens*	Urinary tract infections, wound infections and pneumonia.
33	*Leishmania parasite*	Leishmaniasis and black fever.
34	*Trichophyton mentagrophytes var*	Nail and scalp infection.

35	*Microsporum canis*	Fungal Infection in scalp and body.
36	*Trichophyton mentagrophytes*	Mycotic infections or Dermatophytosis and superficial fungal infection of the skin, hair and nails.
37	*Microsporum gypseum*	Mycotic infections or Dermatophytosis .
38	*Mycobacterium tuberculosis*	Tuberculosis.
39	*Trichophyton tonsurans*	Scalp infection.
40	*Nocardia asteroids*	Nocardiosis.
41	*Proteus species*	Urinary tract infections.
42	*Trichophyton rubrum*	Fungal nail infections (onychomycosis).
43	*Vibrio choleriae*	Cholera.

CONCLUSION

Honey has long been recognized for its therapeutic and nutritional benefits, with recent research affirming its medicinal value. Its complex composition of bioactive compounds, including carbohydrates, proteins, amino acids, vitamins, and minerals, provides a wide range of health benefits, such as antimicrobial, anti-inflammatory, antioxidant, wound- healing, anti-diabetic, gastrointestinal, and anti-cancer effects. The quality of honey is influenced by environmental factors and bee species, which contribute to its physicochemical properties.

While honey's benefits are clear, its quality depends on its source and authenticity, with potential contaminants like heavy metals affecting its purity. However, when sourced responsibly, honey offers significant health benefits, making it a valuable natural remedy.

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