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UNVEILING THE HEALING NECTAR: AN INTEGRATIVE REVIEW OF ASAL (HONEY) IN UNANI TRADITION AND MODERN BIOMEDICAL RESEARCH

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ABSTRACT: Ethnopharmacological Relevance: Honey (Asal) holds a distinguished position in Unani medicine as a tonic, digestive stimulant, anti-inflammatory agent, and general revitalizer due to its hot and dry temperament. Historically used for wound healing, respiratory ailments, cardiac health, and enhancing vitality, its traditional claims align with modern scientific evidence demonstrating antimicrobial, antioxidant, and immunomodulatory activities. **Aim of the Review:** This review aims to evaluate the ethnomedicinal relevance, phytochemical profile, pharmacological actions, and therapeutic potential of Honey (Asal) by integrating Unani concepts with current biomedical findings. **Materials and Methods:** A dual-approach literature review was conducted using classical Unani texts to document temperament, properties, and formulations of Asal, and electronic databases to collect modern scientific studies. Unani terminology and botanical information were standardized according to WHO–CCRUM guidelines. **Results:** Honey, mainly from Apis mellifera, contains ~95% sugars, organic acids, and more than 181 minor constituents including phenolics, flavonoids, enzymes, and proteins. It exhibits strong wound-healing, antimicrobial, antioxidant, cardioprotective, hepatoprotective, neuroprotective, antidiabetic, and anticancer effects. Clinical studies support its efficacy in burns, diabetic foot ulcers, cardiovascular risk reduction, and cognitive improvement. Variability due to floral source highlights the need for standardization. **Conclusion:** Honey bridges classical Unani knowledge with contemporary pharmacology. Future studies should focus on standardized honey types, therapeutic dosage optimization, and long-term safety to support its integration into evidence-based medical practice.

INTRODUCTION: Honey is a sweet natural substance formed by the honeybee (*Apis mellifera*) that collects floral nectar and alters it through enzyme activity and stores it in honey combs to ripen.

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This aging process makes the nectar more desirable and it transforms the initial product into a nutritious, resistant, and non-perishable food.

Sugars are the key components in the structure of honey and fructose and glucose are the dominant sugars; there are small quantities of water, organic acids, enzymes, and other micronutrients. Some species of bees such as the *A. mellifera*, *A. dorsata* and *A. indica* generate Asl (African rock honey). Asl has a low amount of water content and comparatively low acidity, meaning that its shelf life is long and that it is not microbially

contaminated. Besides, honey has achieved global acceptability in the medicinal field due to its antibacterial components and its wound-healing moieties. It is still the only food product derived out of insects and it still has high use in nutrition, cosmetics, medicine, and industry. It is proved that the nutritive importance and the therapeutic properties of honey have been used by people more than 5,500 years ago, as it is proved by the archaeological findings. Honey thus needs no refrigeration, instead it can just be kept in a room temp and a dry place. It has water activity of 0.56-0.62 and pH is about 3.9 parameters that ensure its stability. In comparison with ties of granulated sugar; honey is approximately 25 % sweetener, as it contains a high amount of fructose. Applications of honey pigments in drinks are increasing to show a trend of wider consumer demand of safer and healthier sweeteners [1–6].

The growing concern of the traditional medicinal systems have manifested in the modern global discourse; Unani medicine is gaining a striking profile particularly with recorded safety, natural platform, and medicinal effectiveness. In this analysis, honey (asal) has a unique place and it is the pride of a comprehensive range of health benefits. The classical Unani literature keeps restating the utility of honey as a tonic (*muqawwi*), *Nafa-e-Amraz-e-Balghamiya* (Beneficial in Phlegmatic Disorders)' digestive (*hazim*), anti-inflammatory agent (*muhallil-e-waram*), and an all-round revitalizer. It is described as a natural material with properties to increase libido, stimulate appetite, aid digestion, relieve inflammation and promote good health and well-being. These age-old assertions are even being supported more by the recent scientific research, which thus serves to further justify the multifold nature of honey in prophylactic and curative medicine.

METHODOLOGY: A thorough manual literature review of classical Unani texts was undertaken to gather detailed information on *Asal* (honey), focusing on its temperament (*mizāj*), pharmacological actions, mechanisms of action, and therapeutic uses. In parallel, an extensive search was conducted across various electronic databases including PubMed, Google Scholar, and ScienceDirect to compile data on its phytochemical profile, physicochemical characteristics, and pharmacological investigations. All relevant English-language publications available up to the year 2025 were considered. Furthermore, Urdu translations of key Unani medical compendia such *as Al-Jāmiʿ ul-Mufradāt al-Adviya wal-Aghziya* by *Ibn al-Baitar* (1197–1248 AD), *Muḥīṭ Azam* by *Hakim Mohammad Azam Khan* (1806–1902 AD), and *Khazāʾin al-Adviya* by *Najmul Ghani* (19th century) were consulted for traditional insights on honey's uses and formulations. To ensure the accurate representation of Unani concepts, the Standard Unani Medical Terminology published by the Central Council for Research in Unani Medicine (CCRUM) in collaboration with the World Health Organization (WHO) was used for terminological reference. The keywords employed in the search strategy included: "Unani Medicine," "Asal," "honey," "*in-vitro* study," "*in-vivo* study," "clinical trial," "phytochemistry," "adverse effect," and "pharmacognostic study." All traditional terms were recorded in Urdu alongside their English equivalents.

RESULTS:

Taxonomy and Nomenclature [7–9]:

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Hymenoptera

Family: Apidae

Genus: Apis

Species: *Apis mellifera*

Vernacular Names (Synonyms) [10, 11]:
Siryani: Deesa

Turky: Baal

Unani: Mali, Alqolees

Arabic: Asal, Injubin, Asatul Nahl

Persian: Shadab, Angabina, Shahdaan

Sanskrit: Madhu, Makhika, Madhvika, Saragah, Varti, Vanta

English: Honey

Punjabi: Saht

Dutch: Shahad

Hindi: Madhu, Madah, Pehapras, Shahed

Bengali: Mah

Gujarati: Madh

Kannada: Tam

Tamil: Mal

Telugu: Taenu

Sindhi: Mipanny

Burma: Pya-ya

Malayalam: Ayurmader.

History: The medicinal use of bee-derived products particularly honey has evidence which is dated back more than 8,000 years ago where there were images of the medicinal use of bee items in the Stone Age cave arts. This practice is supported by the ancient writings-Sumerian clay tablet (ca. 6200 BC), Egyptian papyri (ca. 1900 to 1250 BC), and Hindu texts also named as Vedas (ca. 5000 years ago) whose authors all referred to honey as one of the preferred treatments. There is also such a reference in the sacred literature, especially in the Holy Quran and the Bible, as well as works by Hippocrates [10, 11]. The Quran contains an entire Surah on bees called *Al-Nahl* [14]. Prophet Muhammad (PBUH) supports the use of honey as medicine vehemently according to Hadith (Bukhari). Prophet is also said to have drunk a gulp of honey liquid [15].

Geographical Source: The geographical sources of honey vary widely across the globe, with different regions producing distinct types of honey based on the local flora. Europe is well known to be diverse in honey and some of them include acacia honey in Hungary, lavender honey in Provence, France and heather honey in Scotland. Sidr honey is extremely rare and highly treasured in Yemen in the Middle East. India produces diverse types like eucalyptus and multifloral honey from Uttarakhand and Kashmir. China and Vietnam are major producers of lychee and longan honey, respectively. In Africa, Tanzania and Ethiopia are known for wild forest honey. North America, particularly Canada (Ontario, British Columbia) and the United States (Florida, California), is recognized for clover and orange blossom honey. Lastly, Australia and New Zealand are well-known for their unique Manuka honey, sourced from the native Leptospermum trees [7, 16–19].

Cultivation and Collection: Honey and beekeeping (apiculture) hence honey is grown and harvested through beekeeping (apiculture) in which colonies of honeybees are nurtured in artificial hives. These hives are placed close to various flowering plants to increase the foraging of nectar by bees by beekeepers. The journey starts by the bees gathering the nectar and then using the enzymes the bees convert the nectar into honey. This honey is then placed in the honeycombs where it is covered in bees wax. Honey is harvested in a temperate climate is in a period between spring to the early summer when floral activity is the highest. When honey is fully capped and when the cell is determined to provide sufficient stocks to ensure the survival of the hive, the beekeeper then makes a harvest, which averages 20 to 60 kg of honey within a hive per year. The liquid extracted is then filtered in a centrifugal extractor and then sieved out to clear out the particulate matter including the wax and debris material. The strained honey is kept under cool dry conditions before packaging so as to eliminate chances of fermentation. China is the biggest manufacturer in the world producing over 500,000 metric tons annually and Turkey, United States, and India are other countries that produce huge amount of honey annually in the world [20–22].

Zoological Description of Honeybee (*Apis mellifera*): *Apis mellifera*, commonly known as the western honeybee, is a eusocial insect known for its complex colony structure and honey production. It is medium-sized, with a body length of about 12–15 mm. The body is covered with fine branched hairs, aiding in pollen collection. The coloration typically includes black or dark brown with bands of yellow or orange on the abdomen.

Morphological Features of Honeybee: Head; Equipped with compound eyes, three simple ocelli,

and a pair of antennae. The mouthparts consist of mandibles for manipulation and a proboscis for nectar collection.

Thorax: Bears three pairs of legs and two pairs of membranous wings.

Abdomen: Contains wax glands (in worker bees), the sting apparatus, and internal reproductive organs.

Caste System:
Queen: the colony's lone egg-layer, capable of producing up to 2,000 eggs each day.

Worker: Sterile females that perform all tasks in the hive, including foraging, hive maintenance, and brood care.

Drone: Males whose primary role is to mate with a queen from another colony [23, 24].

Morphology of Honey [25, 26]:
Color: pale yellow to deep amber or even dark brown

Oduor: characteristic odor

Taste: Sweet, faintly acrid taste

Texture: Thick and sticky, with a smooth, syrupy texture

Microscopic: Microscopically, honey is composed of various microscopic elements, including pollen grains, air bubbles, wax particles, and sometimes small amounts of microorganisms. Pollen grains which vary in dimension and morphology according to the plant species, can be analyzed under microscope. An examination of this sort would allow one to determine the floral source of the honey involved as well as the botanical origin of the honey being the case. Air bubbles, created during the processing and handling of honey, are also visible under a microscope. Additionally, wax particles from honeycomb cells may be present, appearing as irregular, translucent fragments.

Crystals of glucose can form in honey over time, and their size and distribution can be observed when honey crystallizes. The overall microscopic structure of honey reflects its natural composition and purity [2, 25–27].

Adulterants: Artificial invert sugar [7].

Unani Concept of Asal (Honey):
Mahiyat: *Shaykh al-Raees* and *Sharheen Qanun* describe the nature of honey as an invisible dew that settles on flowers, which the bees then consume. They regard honey as a vaporous substance, initially light and evaporative, but turning into honey after condensing at night, weighed down by the cold air in mountainous regions and high places. This process causes it to resemble dew, accumulating in a thick, viscous form known as "*Angabin*." This dew-like substance often gathers on trees and occasionally on rocks. Consequently, the qualities and temperament of the honey depend on the source upon which it settles. The visible dew collected by humans is of lesser quality, while the hidden nectar absorbed by bees undergoes a transformation, resulting in honey that is warmer in temperament, more concoctive (*Munzij*), and possesses cleansing (*Jali*) properties. However, some types of honey can be pungent and toxic if bees gather nectar from poisonous plants. Pure, clean, richly sweet, fragrant, and reddish honey is considered the finest by experts. Ideally, it should have a smooth, moderate consistency neither too runny nor too thick and should not drip quickly when lifted by a finger. *Jalinoos* (Galen), in his book *Haila Al Bara*, identifies good honey as clear, distinctly reddish, fragrant, and transparent, with a deep clarity. Its taste should be rich and pleasant, while its consistency should allow it to flow easily when picked up, without being sticky or excessively runny [7, 10, 28–32].

In his work on medicinal *Materia medica Ibn Zuhr* describes the best honey as almost clear, without visible suspended matter, and of moderate thickness and pleasant odor. He even further categorises honeys based on their aromatic heights, this time mentioning unique types which are tinted with a scent of rose, thyme or asafetida [33].

Thick honey tends to contain beeswax, making it impure and harder to digest. On the other hand, thin honey is often immature and tainted with impurities. Honey that has a waxy taste or a noticeable hive odor is considered of poor quality [10, 29–31]. *Ibn Sina* and *Ibn Hubal Baghdadi* argue that the most beneficial honey is that collected in spring, in which the honey is white and of good

taste especially [30, 34]. Summer honey, gathered during warmer months in cooler regions, follows in quality. However, honey collected during the winter season is deemed inferior because it lacks movement of honeybee and is derived from fewer, less desirable flowers. Similarly, honey produced during the *Kharif* season is also considered substandard. Honey that is green, black, more than a year old, pungent, bitter, malodorous, excessively dry, or contaminated is classified as low-grade or spoiled. Prolonged use of very old honey can be harmful, potentially leading to cognitive issues, severe mental disorders, and the development of chronic diseases, as it becomes toxic over time [7, 10, 28–32].

Rang (Color): *Surkh* (Reddish) and *Safeed* (Whitish)

Boo (Smell): characteristics aromatic

Mazah (Taste): Sweet [7, 10, 28–32]

Shanakht (Identification):
First Method: Drop the honey onto the ground. The ground will not absorb it; instead, the honey will transform due to the heat.

Second Method: Take honey in a bowl and dip a piece of cotton into it. Then, set one end of the cotton on fire. The cotton will light up like a candle without producing smoke.

Third Method: Place a bee in pure honey. Its wings will not get entangled in the honey, and it will come out completely clean.

Fourth Method: Place honey on a roti (flatbread) and offer it to a dog. If the dog refuses to eat it, the honey is likely impure.

Fifth Method: Apply honey to the eye by stitching. If the honey is pure, it will cause a sensation of sharp pain and irritation, known as *"charparahat*" and "*tezi."*

Sixth Method: Heat pure honey and pure cow's ghee (clarified butter) together. If a green color appears, the honey is confirmed to be pure.

Seventh Method: Mix one milliliter of honey with five milliliters of fenugreek (*methi*) extract and heat it over a flame. Stir well, and if it forms foam like soap suds, the honey is pure [29–31].

Mustamil Ajza (Part used): Saccharine Liquid [7, 10, 28–32]

Mizaj (Temperament): Har 2° Yabis 1°(Hot 2° Dry 1°), Har 2° Yabis 2°(Hot 2° Dry 2°) [7, 10, 28–32]

Nafa- e-khas (Main Action) [7, 10, 28–32]: Nafa-e-Amraz-e-Balghamiya (Beneficial in Phlegmatic Disorders).

DegarAfaal (Other Actions) [7, 10, 28–32]: *Musakkin-e-Aujāʾa* (Pain killer), *Mughazzi* (Nutrient), *Mufatteh Sudad* (Deobstruent), *MufattehUrooq* (Vasodilator), *Mufattit-e-Ḥisāʾt* (Lithotryptic), *Muqawwi-e-Miʿda* (Tonic for stomach), *Mushtahi* (Appetizer), *Muqawwi-e-Bāh* (Aphrodisiac), *Dafʿ-e-Taffun* (Antiseptic), *Ḥādim* (Digestive), *Munaffith-e-Balgham* (Expectorant), *Musaffi-e-Dam* (Blood purifier), *Mundamil-e-Qurūḥ (Wounds Healer), Muqawwi-e-Baṣar (Eye tonic), Munqi-e-Dimāgh* (Brain cleanser), *Muqawwi-e-Dimāgh* (Brain tonic), *Muqawwi-e-Dandān* (Tooth tonic), *Mudirr-i-Labān* (Galactagogue), *Mudirr-e-Baul* (Diuretic), *Mudirr-e-Ḥaiz* (Emmenagogue), *Musakhkin* (Tranquilizer), *Mujaffif* (Desiccant), *and Mulayyin* (Laxative).

Mauqa-e-Istemal [7, 10, 28–32]: *Istisqa* (Ascites), *Qillat al baul* (Oliguria), *Laqwa* (Bell's palsy), *Falij* (Paraplegia), *Istirkha* (Atony/flaccidity), *Sual e Balghami* (Productive cough), *Khidr* (Numbness), *Qulanj* (Colic), *Dast* (Diarrhoea), *Nazul al maa* (Cataract), *Zarabwahikka* (Pruritis), *Damaa* (Epiphora), *Bayaz* (Corneal opacity), *Sayalan al-Udhun* (Otorrhea), *Sakl e samaat* (Deafness), *Taneen* (Tinnitus), *Waja al Uzn* (Earache), *Qurooh* (Wounds),*Qurooh e amaa* (Intestinal ulcer), *Kalaf* (Chloasma), *Bahaq* (Pityriasis), *Baras* (Vitiligo), *Quba/Daad* (Ring worm/dermatophytosis), *Waram e Lauzatain* (Tonsillitis), *Kutte ka kaatna* (Dog bite), *Yaraqan* (Jaundice), *Azm e Tihal* (Enlargement of spleen), *Khushunat e Halaq* (Sore throat), *Amraz e Ria* (Chest diseases), *Du'f al Bah* (Sexual debility), *Hisat e Kuliya* (Renal calculi), *Deedan e Ama* (Intestinal worms),*Qabz* (Constipation), *Usr-al baul* (Dysuria), *Amraz e raham* (Uterine diseases), *Irqunnisha* (Sciatica), *and Aqrabghazidgi* (Scorpion bite).

Muzir (Side effect) [7, 10, 28–32]:

- For Hot temperament
- For Bilious temperament

Musleh (Corrective) [7, 10, 28–32]**:**

- Lemon juice (*Citrus limon* L.)
- Pomegranate juice
- Vinegar
- Kateera (*Sterculia urens*)

Badal (Subtitute) [7, 10, 29–32]**:** Khurma (*Pheonix dactylifera* L.)

Miqdar-e-Khurak (Dosage) [7, 10, 29–31]**:** 25-50 gm.

Mashoor Murakkabat (Compound Drugs) [7, 10, 28–33]**:**

- Maa-ul-asal
- Gulqand-e-Asali
- Sikanjabeen-e-fawakeh
- Sharbat-e-ustukhuddus
- Ma'ajeen and Itrifalat

Chemical Composition of Honey: Honey could be regarded as heterogeneous, multicomponent foodstuff, the main components of which are water and carbohydrates, and sugars represent about 95 % of the dry food. The rest of the 2.1 % consists of 181 minor constituents which are organic acids, polyphenols, vitamins and minerals, alcohols, aroma compounds, colloids, carotenoid-like, and enzymes [35–37]. Among these, phenolic compounds and flavonoids stand out as key antioxidants whose profiles differ by floral source and environment [6]. Honey contains a significantly reduced range of phenolic compounds, limited to phenolic acid group members and phenolic acids (particularly hydroxycinnamic acids, e.g. caffeic acid, vanillic acid, p-coumaric), and flavonoids (the hydroxybenzoic acids, e.g. gallic acid, ellagic acid, methyl syringate and hydroxyphenylacetic acids, such as homogentisic acid) [36, 37]. Manuka honey, often used as a benchmark for antioxidant capacity, is especially rich in these components [38]. Several flavonoids (chrysin, apigenin, kaempferol, rutin, genistein) and phenolic acids (chlorogenic, gallic, ferulic, p-coumaric, syringic acids) also exhibit antimicrobial effects through various mechanisms including DNA replication inhibition and membrane disruption [39].

Honey contains over 70 identified proteins, present in relatively low concentrations (0.1–0.9 mg/g), yet these proteins play a significant role in enhancing its medicinal properties [40]. Some of the enzymes produced by the Honeybee epidermis are regarded as being central to the honey production process using: serine proteases, alpha and beta amylase, alpha glucosidase, and glucose oxidase. The activity of enzyme diastase (alpha-amylase) is widely recognized as one of the characteristics of high-quality honey since they can be decreased in a long-term storage or can be destroyed in case of adulteration or excessive heating [37, 41]. Antimicrobial peptides such as defensin-I and major royal jelly protein-I, and enzymes like glucose dehydrogenase and catalase, enhance both the antibacterial activity and shelf stability of honey, with Manuka varieties notably high in defensins [40, 42].

Diluted honey generates hydrogen peroxide *via* glucose oxidase originally termed "inhibin" which, along with polyphenol oxidation and microbial activity, underpins its peroxide-dependent antibacterial action [43]. Additionally, methylglyoxal formed from dihydroxyacetone contributes to non-peroxide antibacterial effects and has demonstrated anti-HIV activity by hindering late-stage virion assembly [39, 44].

Carbohydrates dominate honey's composition (~82.4%), primarily glucose and fructose, with a suite of di-, tri-, and oligosaccharides [39, 45]. Their unique ratios afford a lower glycaemic index (32–85), delayed gastric emptying, and insulin-independent metabolism, making honey a preferable sweetener for type-2 diabetics [46, 47].

Mineral content in honey varies significantly, with potassium being the most abundant (accounting for 45–85%), followed by calcium, magnesium, zinc, copper, iron, and other trace elements. Notably, bees help filter out harmful heavy metal contaminants such as cadmium (Cd) and thallium (Tl) [48].

Vitamins, chiefly B-complex (notably B3, B2, B9) and vitamin C, derive from pollen but can be reduced by filtration and storage oxidation; menaquinones (K_2 homologs) have also recently been identified [37, 49].

Organic acids, comprising approximately 0.5% of honey, primarily gluconic and lactic acids, play a key role in defining its flavor and antimicrobial properties [45, 50].

More than 400 volatile compounds such as terpenes, aldehydes, alcohols, and ketones contribute to the distinctive aroma profile, which evolves during Maillard browning [45].

Finally, trace residues of antibiotics, pesticides, and veterinary drugs reflect environmental contamination, while unique constituents like synephrine from citrus honey exhibit sympathomimetic and lipolytic activities [39, 51].

Pharmacological Studies on Honey:

Wound Healing Study:

Preclinical Researches: Using an in vitro corneal ulcer model, this study found that Acacia honey significantly accelerated epithelial cell migration and wound closure compared to control, suggesting its potential as a natural adjunct in corneal ulcer therapy [52]. In a rat model of intraoral wounds, topical application of honey led to faster re-epithelialization, reduced inflammation, and enhanced tensile strength versus untreated wounds, indicating honey's efficacy in oral mucosal healing [53].

Clinical Researches: A systematic review of randomized trials found that honey dressings offer healing results that are at least as good as, and in some instances better than, those achieved with silver sulfadiazine, often leading to quicker wound recovery [54]. In a controlled trial on diabetic foot ulcers, honey impregnated dressings achieved higher rates of complete healing and shorter time to closure than standard care, highlighting honey's promise as an effective, low-cost treatment for diabetic ulcers [55].

Anti-microbial Activity on Oral use:

Preclinical Researches: *In-vitro* tests showed that Manuka honey has strong anti-influenza properties, significantly lowering the ability of the virus to infect cells by more than 90% at concentrations that do not harm the cells, which is much more effective than other types of honey in preventing viral reproduction [56]. Manuka and other tested honeys showed strong antibacterial effects against multidrug-resistant *Shigella sonnei*, with minimum inhibitory concentrations ranging from 4–8% (w/v), indicating honey's potential to combat resistant enteric pathogens [57].

Clinical Researches: This pharmacological review highlighted honey's antiviral, anti-inflammatory, and immunomodulatory properties such as flavonoid-mediated ACE2 inhibition supporting its promise as an adjunctive therapy against COVID-19, though clinical trials remain needed [58].

Immunomodulatory Activity:

Preclinical Researches: Majra honey reversed the cell proliferation inhibition caused by *Juniperus procera* extract and its honey-mediated silver nanoparticles, showing selective modulation reducing cytotoxicity to normal cells while preserving anti-cancer activity in tumor cells [59].

Clinical Researches: A case report showed that topical application of Kanuka honey was effective in treating actinic keratosis without surgery, resulting in full healing of the lesions and no side effects, suggesting its possible use in skin treatments [60].

Skin-care:

Preclinical researches: Stingless bee honey affects genes related to maintaining the extracellular matrix in aging human skin cells, leading to increased collagen production and lower levels of MMP 1, which indicates it may have benefits for slowing aging and repairing skin [61]. In a veterinary case study, medical honey achieved complete skin regeneration in a cat with full-circumference leg skin loss, demonstrating honey's exceptional healing capacity even in severe dermal injuries [62].

Clinical Research: This review discusses the positive effects of honey on the skin, such as its ability to fight bacteria, protect against damage from free radicals, soften the skin, and help in healing wounds. These qualities make honey useful in managing conditions like acne, burns, and dermatitis, and in maintaining healthy skin overall [63].

Anti-cancer Activity:

Preclinical Research: In an animal model of breast cancer, Tualang honey significantly reduced tumor incidence and growth by modulating pro-apoptotic and anti-proliferative gene expression, supporting its potential as a natural anti-cancer agent [64].

Clinical Research: This clinical trial found that daily intake of Tualang honey significantly reduced cancer-related fatigue in head and neck cancer patients, improving energy levels and quality of life without adverse effects [65].

Anti-diabetic Activity:

Preclinical Research: *Geniotrigona thoracica* stingless bee honey protected pancreatic tissue in diabetic rats, reducing blood glucose, preserving islet structure, and enhancing antioxidant enzyme activity, demonstrating strong anti-diabetic and pancreatoprotective effects [66].

Clinical Researches: In a randomized controlled trial, probiotic honey significantly improved metabolic markers including fasting glucose, HbA1c, and lipid profile in patients with diabetic nephropathy, suggesting it as a supportive dietary intervention [67]. This systematic review concluded that oral honey consumption may improve lipid profiles (e.g., lowering LDL, increasing HDL) and antioxidant markers in both diabetic and non-diabetic adults, though its effect on blood glucose was inconsistent, indicating it should be consumed with caution in diabetic patients [68].

Cardio-protective Activity:

Preclinical Researches: This study found that honey significantly prolonged bleeding time in mice, indicating antiplatelet activity comparable to aspirin, and suggesting potential use of honey as a natural cardioprotective agent with fewer side effects [69]. This review of laboratory and clinical studies confirmed that honey has heart-protective benefits, such as its antioxidant properties, ability to reduce fats in the blood, and improvement of blood vessel function, which supports its use in managing cardiovascular health [70].

Clinical Researches: Compared to sucrose, natural honey reduced blood glucose, total cholesterol, triglycerides, CRP, and body weight in healthy and hyperlipidemic subjects, indicating it may help lower cardiovascular risk when used as a sugar substitute [71].

Hepato- and Nephroprotective Activity:

Preclinical Researches: Honey effectively protected the kidneys of rats from damage caused by cisplatin by lowering inflammatory markers and minimizing histological injury, suggesting that it may serve as a natural agent for kidney protection [72]. Honey alleviated cisplatin-induced liver and kidney damage by suppressing NF-κB/COX-2 signaling and modulating oxidative stress as well as apoptotic pathways (BAX/Bcl-2/caspase-3), thereby exhibiting potent hepato-renal protective activity [73].

Clinical Researches: This population-based study found that moderate honey consumption was inversely associated with non-alcoholic fatty liver disease (NAFLD), suggesting a possible protective effect, likely due to honey's anti-inflammatory and antioxidant properties [74].

Respiratory Diseases:

Preclinical Researches: The histological analysis indicated that Manuka honey induced a slight and temporary inflammation in the respiratory mucosa of rabbits, implying that it is typically safe for topical application in the respiratory tract with very little risk of mucosal irritation [75].

Clinical Researches: In a randomized controlled trial, using Manuka honey for sinus irrigation was found to significantly reduce symptoms in patients with chronic rhinosinusitis when compared to saline solution, showing that it can be an effective natural treatment option as a complementary therapy [76]. This pilot study found that oral honey reduced postoperative pain and analgesic use after tonsillectomy in adults, suggesting honey as a beneficial, low-risk option for post-surgical pain management [77].

Gastrointestinal System:

Preclinical Researches: Honey polyphenols showed significant improvement in rats with DSS-induced ulcerative colitis by changing the makeup of gut bacteria, lowering inflammation, and strengthening the gut's protective lining, suggesting they could be useful in treating inflammatory bowel diseases [78].

Honey supplementation alleviated loperamide-induced constipation in mice by altering gut microbiota, increasing beneficial bacteria, and improving intestinal motility and water content in feces [79].

Clinical Researches: In a clinical trial, patients with acute myeloid leukemia receiving honey and Ardeh experienced fewer gastrointestinal and infectious complications during chemotherapy, suggesting this combination as a supportive dietary strategy [80].

Oral Health:

Preclinical Researches: The laboratory study showed that honey led to slight loss of minerals from human tooth enamel, which was seen through electron microscopy and hardness tests, indicating that long-term exposure could potentially harm the enamel's structure [81]. In a study using a rat model, Tualang honey demonstrated significant chemopreventive properties against oral squamous cell carcinoma. It effectively reduced tumor size and influenced levels of oxidative stress and inflammatory markers [82].

Clinical Researches: Topical application of honey after tooth extraction in children significantly accelerated wound healing, reduced inflammation, and promoted better tissue regeneration compared to standard care [83].

Neuro-protective Activity:

Preclinical Researches: This laboratory study demonstrated that bee honey helped shield astrocytes from harm caused by oxidative stress, suggesting that it may have protective effects on the nervous system by acting as an antioxidant [84]. Tualang honey protected the rat midbrain and lungs from repeated paraquat-induced oxidative damage by reducing inflammation and oxidative stress, suggesting neuroprotective and pulmonary protective benefits [85].

Clinical Researches: Tualang honey supplementation in patients with schizophrenia showed improvement in cognitive function, particularly in memory and attention, suggesting it may serve as a natural cognitive enhancer for individuals with psychiatric conditions [86]. This observational report suggested that regular honey consumption may help prevent cognitive decline and dementia in Middle Eastern populations, proposing honey as a traditional neuroprotective remedy [87].

Anti-aging Activity:

Preclinical Researches: Honey extracts demonstrated strong cytoprotective effects against UVB-induced skin damage by reducing oxidative stress and DNA damage in human skin models, supporting their use in photoprotective skincare [88].

Honey and chamomile activated the KEAP1/NRF2 antioxidant pathway in keratinocytes, enhancing cellular defense against oxidative stress and suggesting their potential in skin protection and repair [89].

Clinical Researches: The review suggests that regularly consuming honey may lead to better health and possibly longer life, mentioning its antioxidant, antimicrobial, and anti-inflammatory properties, which could support healthier aging [90].

Anti-atherosclerotic Activity:

Preclinical Researches: In rats that were given a high-fat diet, adding honey helped improve their body weight, lipid levels, and liver enzyme activity, probably by changing how their liver processes nutrients and by lowering oxidative stress [91].

Clinical Researches: This randomized clinical trial found that honey consumption led to a more favorable lipid profile lower LDL and triglycerides and higher HDL compared to sucrose in healthy young adults [92]. In healthy Pakistani males, natural honey significantly reduced fasting blood glucose, total cholesterol, and LDL levels, suggesting beneficial effects on metabolic health even in non-diabetic individuals [93].

Psychological Disorders:

Preclinical Researches: Tualang honey improved memory performance and reduced depressive-like behavior in rats exposed to loud noise stress, indicating its neuroprotective and mood-enhancing effects under stress conditions [94], Tualang honey helped reduce oxidative stress and anxiety-like behaviors in rats that had their ovaries removed and were exposed to long-term stress, indicating that it may have a role in helping manage mood issues related to menopause [95].

Clinical Researches: This randomized clinical trial showed that Talbinah (a barley-based food) significantly reduced depressive symptoms in elderly individuals in long-term care, supporting its traditional use as a mood-enhancing dietary remedy [96].

Honey as Antidote:

Preclinical Researches: The antivenom-like effects of honey are due to its flavonoids, especially Chrysin, which work through antitoxin, anti-inflammatory, and antioxidant properties. Many animal studies have shown that honey can counteract the toxic effects of various substances, including heavy metals like lead and aluminum, neurotoxins such as formalin, streptozotocin, hydroxydopamine, ammonium chloride, and phenylenetrazole, cardiotoxins like cadmium, copper sulfate, and isoproterenol, hepatotoxic and nephrotoxic agents such as acetaminophen, carbon tetrachloride, bromobenzene, and cisplatin, as well as anticancer drugs like doxorubicin, mitoxantrone, and bleomycin. Additionally, honey has been found to neutralize the harmful effects of biological agents like lipopolysaccharides and ovalbumin [37, 38].

Clinical Researches: This study found that honeys from various floral origins reduced blood alcohol levels and liver damage in alcohol-exposed mice, with the protective effects strongly correlated to their antioxidant content particularly total phenolics and flavonoids [97].

DISCUSSION: As far as Unani medicine is concerned, honey has always been a favorite in the Unani system of medicine, far beyond its use as a sweetener, as it is perceived as a mild medicine, an agent restoring harmony in the humors of the body. Honey in classical texts is discussed a hot and moderately dry (Har 2, Yabis 2), and in the tradition it was taken to relieve dull digestion, disperse excessive phlegm and up ridden those affected by melancholic dispositions. It was compounded into favorite remedies such as *Majoon-e-Piyaz* and *Maa-ul-asal* by practitioners who thought that its heat and gentle astringent properties would stimulate the appetite, alleviate suffering and mend the internal order. Now we know the excellent biochemical basis of these timeless observations: naturally occurring flavonoids, phenolic acids, and glucose oxidase enzyme of honey operate as antioxidants, anti-inflammatories, and antimicrobials, and this scientific evolution puts several hundred years of Unani sage insight on to a solid biochemical footing. Advances in research keep discovering the numerous skills of honey which include accelerating the process of healing of wounds, nourishing the heart and the brain among so many others still reproving honey with all its glorious complexity. As each garden flower has a unique character, as do each honey types, variety will depend on floral source, locality, and treatment thickness of the acacia to the strong flavor of Manuka. This inherent variety poses a challenge to the researcher to conduct well planned experiments using well characterized honeys, so that we may determine the most effective doses and the complete interaction of honey with our body on a long-term basis. The need to accept these intensive studies will also be made to bring honey into the mainstream and Unani medicine more easily and allow the future generations to use the gentle yet potent effects of honey with an assurance to their betterment.

CONCLUSION: Honey (*Asal*) has a very special place in the Unani system of medicine, as not only it **i**s a highly effective therapeutic substance, but also it is an extremely important component of various compound pharmaceuticals. Honey is known as of a healthy temper (mod. hot, dry); accordingly, it is recommended, being, by virtue of its deobstruent (*Mufatteh*), resolvent (*Muhallil*), laxative (*Mulayyin*), tonic (*Muqawwi*) qualities. The use of this remedy in various diseases was amply substantiated by the classical Unani doctors such *as Ibn Sina, Zakariya Razi* among others in various diseases such as the diseases of digestive system, respiratory disorders, wounds, and debility of person having independent sex life. Such review indicates the strong correspondence legacy of Unani views with conventional pharmacological evidence, which at last proves the antioxidant, antimicrobial, immunomodulatory, and wound-healing activities of honey. Honey has multidimensional benefits, which substantially support the holistic approach of Unani medicine which largely focuses on the importance of restoring the humoral balance.

In addition, the use of the honey in famous Unani products that include *Majoon*, *Laooq*, and *Khameera* evidence the applications and safety of honey in disease therapies. Therefore, it is evident that honey proves that the eternal applicability of Unani principles in modern medicine and leads to the revival and scientific study of old solutions in the frame of integrative medicine.

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