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Unveiling the therapeutic potential of Toot Siyah (*Morus nigra* Linn.): A comprehensive review

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Abstract
Toot siyah (*Morus nigra* Linn.) is one of the efficacious Unani herbs, commonly known as black mulberry, considered the most attractive species among the mulberries belonging to the Moraceae family. *Toot siyah* is an oval-shaped, aggregated berry with a nutrient-rich, sweet taste, soft texture, and distinct flavour. *Morus nigra* tree is a deciduous or medium-sized woody perennial, monoecious tree capable of growing up to 10-13 meters tall and widely cultivated in the subtropical regions of North America, Africa and Asia (including Korea, Japan, China, and India). Traditionally, grown as a nutritional source for silkworms, it is also widely used in the production of jams, marmalades, vinegars, juices, wines, and cosmetics. The fruit is rich in primary metabolites, including carbohydrates, proteins, and essential fatty acids, which contribute to its high nutritional value. Additionally, its secondary metabolites, particularly phenolic compounds, play a significant role in reducing oxidative stress and inflammation due to their potent biological activity. In the Unani system of medicine, toot siyah has been utilised for centuries to address a range of ailments, with extensive mentions in classical Unani texts. From a pharmacological perspective, *toot* is believed to exhibit various biological activities, including antinociceptive, anti-inflammatory, antimicrobial, antidiabetic, anti-obesity, anti-hyperlipidaemic, and anticancer effects. It has also shown protective benefits for various human organs, attributed to its strong antioxidant properties. The primary objective of this review is to present data on the bioactive chemical constituents and pharmacological properties of mulberry, thereby supporting its future application in therapeutic, health-promoting interventions and management of chronic diseases.

Keywords: *Toot Siyah*, *Morus nigra*, Black mulberry, Unani, Traditional

Introduction
Herbal remedies are nature's valuable gifts that contribute to the well-being of all living beings on Earth. The practice of using plants for medicinal purposes dates back to the earliest stages of human civilisation. Various parts of plants-including roots, stems, bark, leaves, flowers, fruits, and seeds-are utilised in the preparation of herbal medicines [1].

Toot siyah (*Morus nigra* Linn.) is one of the efficacious Unani herbs, belonging to the Morus genus of the Moraceae family. It is an oval-shaped, aggregated berry with a nutrient-rich, sweet taste, soft texture, and distinct flavour, and is among the traditional plants that have been used for medicinal purposes for a very long time [2]. Numerous bioactive constituents derived from *Morus nigra* have been employed in herbal medicine for both human and veterinary purposes [3]. For millennia, mulberry-a woody plant valued for its medicinal and commercial significance-has been widely cultivated [4]. Its roots, leaves, stems, and fruits serve a variety of therapeutic and practical applications [5]. The foliage of *Morus* species holds significant value, as it forms the essential diet for the mulberry silkworm (*Bombyx mori* Linn.), which is central to the sericulture industry [6].

Nearly all types of mulberry plants have long been acknowledged in Unani medicine as food with both nutritional and medicinal benefits and are termed as *ghidhā-i-dawā'ī* (medicinal food/medicinal nutrient). This classification is based on how these substances influence *mizāj* (temperament) and physiological functions after digestion and absorption [7].

Black mulberry is commonly consumed in most European countries as fresh, dried, or processed into products such as marmalade, black mulberry yogurt, wine, syrups, canned goods, fruit juice, jam, galette, and fresh fruit cakes, various beverages and cosmetic products [3, 8-12].

History

Morus nigra, or black mulberry, is indigenous to Iran and has been cultivated for its edible fruit for over 5, 000 years. It was introduced to Europe before the Roman Empire. The name *Morus nigra* comes from the Latin words "nigra, " meaning "black, " and "mora, " meaning "delay" (8, 13). The fruit's dark colour is the main reason for its common name, "black mulberry" [5]. In Ayurvedic texts of India, mulberry is also referred to as *Kalpa Vruksha* [14, 15].

Methodology

A detailed literature survey was undertaken by accessing multiple online databases and scientific platforms, including PubMed, Elsevier, Springer, Google Scholar and other recognised sources of academic information. The search strategy employed specific keywords such as Toot, *Morus nigra*, Unani, and Traditional medicine. In addition to online material, classical Unani texts in Urdu and English were examined, along with standard pharmacological handbooks, to provide a comprehensive understanding. The botanical classification and identity of the plant were authenticated through the World Flora Online database. For accuracy in classical terminology, the officially recognised Unani medical glossary published by the Central Council for Research in Unani Medicine (CCRUM) was applied. This article highlights the plant's morphology, pharmacological functions, ethnomedicinal applications, therapeutic benefits, and nutritional value within the framework of Unani medicine.

Morphology

Morus nigra is typically a deciduous or medium-sized woody perennial, monoecious tree with 28-308 chromosomes, capable of growing up to 10-13 meters tall. It thrives in warm, humid climates and loses its leaves in winter [16]. Mulberry plants are widely cultivated in the subtropical regions of North America, Africa and Asia (including Korea, Japan, China, and India). In many Asian countries, they are primarily grown for silkworm (*Bombyx mori* L.) farming, as their leaves serve as a crucial nutritional source for silkworms [3]. *Morus nigra* is primarily cultivated in Kashmir, Deccan areas and also in parts of Darjeeling, India [6, 17].

Fig 1: *Morus nigra* tree

Fig 2: *Toot Siyah* (black mulberry fruit)

Phenology

The trees are pruned to a height of 3 to 3.5 feet above ground level during December or January, after leaf fall. This pruning promotes vigorous growth and the development of larger fruits. Flowering typically occurs between February and March, with fruits maturing by May or June as shown in fig 1 [6].

Leaves and Fruit

Leaves broadly ovate-cordate, usually undivided, sometimes 2-5 lobed; flowers dioecious or monoecious; fruit (syncarp) ovoid to oblong [6]. Its fruit is dark purple to nearly black as shown in fig 2, edible, and made up of multiple small seed clusters. When fully ripe, the fruit reaches 2-3 cm in length and has a fruiting period of 8-10 weeks. 24-29°C and 65-80% relative humidity are ideal for growth [16].

Different Morus species

There are numerous varieties of mulberry, *Morus alba* (white mulberry), *Morus nigra* (black mulberry), and *Morus rubra* (red mulberry) are widely recognized species of the *Morus* genus, known for their significant medicinal properties [14, 18].

Plant Description

1. Scientific Classification [15]

Table 1: Taxonomical classification of *Morus nigra*

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Mangnoliopsida
Subclass	Hamamelididae
Order	Urticales
Family	Moraceae
Genus	Morus
Species	nigra

2. Botanical Name: *Morus nigra* Linn. [2]

3. Vernacular names

Table 2: Common names of *Toot Siyah*

Aabic	Qoot, Hamiz [19, 20]
Persian	Toot Siyah [19]
English	Mulberry [21]
Urdu	Shahtoot [22, 23]
Unani	Soomamian [24]
French	Murier noir, mûre [13]
German	Schwarzer [13]
Hindi	tut-shah-tut [13]
Indonesian	Murbei [13]
Italian	Gelsonero [13]
Spanish	Mora negra, Morero, Morera Negra [13]

Toot siyah in Unani medicine

Morphology (*Mahiyat*)

It's a famous medium sized tree (*Mutawast*), fruits are long, irregular protruded surface (*dane dar*) some are black, some green or white [25]. One variety is sweet in taste & white which is known as *Nabti Toot*, the other one is sour & black & known as *Shami Toot*, and this one is famously known as *Shehtoot* [22]. Mostly black Toot is used for medicinal purposes. Flowers ka *khosha lagta* h. Toot are of two types, but both have similar leaves. Silkworms feed on these leaves [26].

Part used (*Ajza-i-Mustamila*)

Morus nigra L. is a deciduous, monoecious tree and different parts like roots, leaves, bark and fruits are used in medicines [6, 19, 22, 26, 27].

Temperament (*mizaj*)

In Unani medicine, *Toot siyah* (*Morus nigra*) is considered to have a temperament that is hot (*haar*) and wet (*ratab*) state [22, 26].

Corrective (*Musleh*)

Shehad (Honey) [22]:

Substitute (*Badal*)

Simaq [22]

Dose (*Miqdar-e-Khuraq*)

Most commonly used as *Sharbat Toot Siyah*- 20-50ml [28-30]

Adverse effects (*Muzir*)

- *Musakhin* [24]
- *Nafakh Shikam* (Flatulent) [24]

Actions (*Afal*)

- Deobstruent (Mufattih) [22, 27]
- Astringent (Qabiz) [22, 24, 31]
- Demulcent (Mulattif) [22, 25, 26, 32]
- Expectorant (Munaffith) [26, 32, 33]
- Blood purifier (Mussafi khoon) [25]

Therapeutic Uses (*Istemalat*)

- Various throat ailments, including dryness, irritation, scratchiness, chronic ulcers, blisters of the throat and mouth, and diphtheria [27, 31].
- It soothes and stabilises the blood humour, alleviating thirst and reducing throat inflammation caused by heat [31].
- Exerts a complementary effect on the liver, spleen, and blood vessels by dilating them and dissolving thick or viscous humours, thus clearing obstructions and acting as a deobstruent [27].

Compound Formulation (*Mashur Murakkabat*)

Sharbat-e-Toot Siyah [28, 30]

Phytochemistry of *Morus nigra*

The chemical composition of primary and secondary metabolites in plants is influenced by various geographical and environmental factors such as soil characteristics, climate, altitude, temperature, harvesting period, and post-harvest storage conditions. These environmental factors play a significant role in determining plants' concentration and diversity of bioactive compounds [5].

Primary metabolites

In the case of *Morus nigra* fruits, the primary metabolites, particularly carbohydrates, range from 5 to 10 gm per 100 g of fresh weight (FW) [5]. Mulberries are rich in neutral sugars, such as arabinose, galactose, glucose, rhamnose, xylose, and mannose [34]. In mulberries, glutamate is the most abundant amino acid, contributing about 20% of the total amino acid content. Black mulberries, in particular, contain more lysine, histidine, and proline compared to other varieties [35]. Mulberries have a very low fat content, with linoleic, oleic, palmitic, and stearic acids accounting for approximately 69.66-78.02% of the total fatty acids [36].

Secondary metabolites

M. nigra fruits are abundant in secondary metabolites with antioxidant, anti-mutagenic, and anti-carcinogenic properties, including flavonoids, alkaloids, GABA, and carotenoids [37]. The blue-purple colour of the fruit is mainly due to the high concentration of flavonoid pigments known as anthocyanins [5]. Along with anthocyanins such as cyanidin-3-glucoside, cyanidin-3-rutinoside, cyanidin-3-sophoroside, pelargonidin-3-glucoside, and pelargonidin-3-rutinoside, *Morus nigra* also contains non-anthocyanin flavonoids like quercetin-3-rutinoside, kaempferol-3-rutinoside, and quercetin-3-glucoside [18]. The fruit is rich in various organic acids such as malic, citric, fumaric, tartaric, and succinic acids, which significantly define its distinctive flavour profile [37].

Pharmacological Activities of *Morus nigra* Linn.

Morus nigra Linn., commonly known as black mulberry, has been extensively studied in both experimental and clinical research. The plant demonstrates a broad spectrum of pharmacological activities attributed to its rich content of bioactive compounds such as phenols, anthocyanins, flavonoids, alkaloids, GABA, carotenoids and high content of ascorbic acid [13, 37]. *Morus nigra* L. possesses a wide range of pharmacological properties, including antioxidant, anti-inflammatory, anticancer, antimicrobial, antifungal, skin-whitening, antidiabetic, antihyperlipidemic, anti-atherosclerotic, anti-obesity, cardioprotective, cognitive-enhancing, hepatoprotective, antiplatelet, anxiolytic, anti-asthmatic, anthelmintic, antidepressant, and immunomodulatory effects [38]. The major pharmacological effects are summarised below:

Anti-inflammatory and Antinociceptive activity

In a study, Adult male rats were administered the methylene

chloride extract of leaves, which inhibited the formation of granulomatous tissues in the chronic inflammation status, therefore showing anti-inflammatory action [39].

In another study, it was observed that the bark extract of Toot, when given to rats, also showed anti-inflammatory activity. Rat polymorphonuclear leukocytes showed that Mornigrol D, G, and H, norartocarpetin, dihydrokaempferol, albanin A and E, moracin M, and albafuran C inhibited the release of β-glucuronidase [40].

Morusin has an inhibitory effect on acetic acid-induced abdominal constriction responses & formalin-induced pain in Swiss mice treated with the acetonic extract of root bark or the methylene chloride extract of leaves of black mulberry [41, 42].

Anti-oxidant activity

Petroleum ether extract of Toot plant is used in *in vitro* as well as *in vivo* studies. In-vitro study showed, the clearance rates of hydroxyl radicals and superoxide anion radicals increased with the concentration of total flavonoids. While in-vivo administration of flavonoids resulted in a decrease in MDA levels in both serum and liver, while significantly increased the activities of antioxidant enzymes such as SOD, CAT, and GSH-Px in the blood and liver. Additionally, varying dosages influenced the presence and activation of Langerhans cells in the spleen [43].

Anti-microbial activity

In-vitro assay showed significant anti-microbial and antioxidant properties, by the ability to inhibit growth of *Streptococcus mutans*, *Escherichia coli* (*E. coli*), *Staphylococcus aureus* (*S. aureus*), and *Bacillus subtilis* (*B. subtilis*) by ethyl acetate extract of leaves [44, 45].

Conclusion

Morus nigra Linn. Commonly known as black mulberry, has attracted significant attention due to its diverse pharmacological properties and therapeutic potential. This review aims to explore the medicinal applications and biological activities of *Morus nigra*, with a particular focus on its bioactive compounds such as anthocyanins, alkaloids, flavonoids, and phenols. Based on the information extracted above, it can be concluded that *Toot Siyah* have antioxidant, antibacterial, anti-inflammatory, antinociceptive, anti-microbial, anti-tussive, cytotoxic effects against leukaemia. The review synthesises current findings on the plant's pharmacological actions, as well as its role in traditional medicine across various cultures. Furthermore, the review highlights the potential of *Morus nigra* in the treatment of conditions such as throat disorders, gastrointestinal reflux, wounds, and infections. Despite promising evidence, there remains a need for more rigorous clinical studies to substantiate its therapeutic efficacy and safety. This review provides a comprehensive understanding of the plant's medicinal value and suggests areas for future research. By examining both traditional and modern scientific perspectives, this literature review contributes to the growing body of knowledge on *Toot Siyah* role in phytotherapy and its potential for integration into contemporary medicine.

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Conflict of Interest

Not available.

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