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FILFIL SIYAH (*PIPER NIGRUM* L.): AN INCREDIBLE MEDICINAL SPICE IN UNANI SYSTEM OF MEDICINE

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ABSTRACT

Black pepper (*Piper nigrum* L.), commonly referred to as *Filfil Siyah* in Unani medicine, is one of the most widely consumed spices worldwide. Beyond its culinary importance, it has been traditionally employed in several systems of medicine, including those practiced in India and China, for a wide range of ailments. Therapeutically, it has been used for the management of conditions such as fever, indigestion, flatulence, toothache, common cold, cough, asthma, and hemorrhoids. The present review aims to systematically compile and discuss the available information on *Piper nigrum* L., covering its introduction, geographical distribution, macro- and microscopic characteristics, temperament (*Mizaj*), phytochemical composition, therapeutic actions, toxicity profile, corrective agents (*Musleh*), formulations in which it is used, and evidence from modern pharmacological investigations. *Filfil Siyah* (*Piper nigrum* L.) exhibits a broad spectrum of pharmacological activities, including anti-inflammatory, antioxidant, anticancer, neuroprotective, antimicrobial, and antidepressant effects. Its major bioactive alkaloids comprise piperine, chavicine, piperidine, and piperetine. The present review consolidates traditional knowledge and recent scientific findings on *Piper nigrum*, with a focus on its phytochemistry and therapeutic potential. This compilation is expected to serve as a valuable reference for future investigations aimed at isolating active constituents and exploring their pharmacological mechanisms.

INTRODUCTION

Black pepper (*Piper nigrum* L.), commonly known as *Filfil Siyah* in Unani medicine, is a globally recognized spice valued for its culinary and medicinal properties. Often referred to as the "King of Spices," (Nisha, 2009) it has been used for centuries not only to enhance flavor in foods but also in perfumery and cosmetic preparations. In systems such as Tibb-Unani, Ayurveda, and Chinese herbal medicine, black pepper has long been regarded as an essential ingredient. The spice is obtained from the fully matured, dried fruits of *Piper nigrum* L.(family Piperaceae), a perennial climbing plant cultivated extensively in regions such as Konkan, Kerala, and parts of Assam in India. Depending on local climate, the fruits ripen between December and March and are generally harvested from December through April. (Anonymous, 2007) The distinctive aroma and pungency of black pepper are primarily attributed to piperine, along with volatile oils and oleoresins. (Butt, 2013) It is also a component of several herbal formulations used to manage ailments such as fever, asthma, and certain types of cancer. (Salehi, 2019)

Methodology:

For this review, information on *Filfil Siyah* (*Piper nigrum* L.) was compiled from classical Unani literature and modern scientific studies. A comprehensive search of electronic databases—including PubMed, ScienceDirect, Google Scholar, Scopus, and Web of Science—was carried out for publications from their inception up to June 2023. Keywords such as "Black pepper," "*Piper nigrum*," "Filfil Siyah," "Piperine," and "Unani" were used to retrieve data on its pharmacognosy, traditional uses, phytochemistry, and therapeutic potential.

Taxonomic classification: (ITIS Report)
Kingdom: Plantae
Sub-kingdom: Tracheobionta
Super-division: Supermatophyta
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Magnoliidae
Order: Piperales
Family: Piperaceae
Genius: Piper L.
Species: P. nigrum L.
Vernacular Names: (Anonymous, 2007)
English: Black Pepper
Urdu: Filfil Siyah, Kalimirch
Arabic: Filfil Aswad
Hindi: Kalamirch
Persian: Filfil Siyah
Gujarati: Kalimor
Bengali: Golmorich, Kalamorich, Morich

Tamil: Milagu
Marathi: Kalamiri
Punjabi: Galmirich, Kalimirch
Telugu: Miriyalu, Marichamu
Kannad: Menaru, Karimonaru

Geographical distribution:

The cultivation of *Piper nigrum* requires a consistently warm and humid climate. This perennial vine adapts to a range of environments, from coastal plains to elevated regions, and thrives in a variety of soils as long as sufficient moisture is available. Black pepper is primarily distributed across tropical and subtropical zones, with its growth pattern strongly influenced by seasonal temperature and rainfall. The most active phases of the plant—flowering, fruit development, and ripening—coincide with periods of heavy rainfall, making adequate humidity and water supply essential for good yield. Optimal growth occurs within 20° latitudes north and south of the equator, at temperatures ranging roughly between 10 °C and 40 °C. India, particularly the biodiversity-rich Western Ghats, is regarded as the center of origin and the only known natural reservoir of wild germplasm for this species. (Salehi, 2019), (Hao, 2012) But nowadays its plantation is extended to other parts of the globe too like Vietnam, Ceylon, Malaysia, Indonesia, Singapore, Acheen and Lampong districts of Sumatra, Sri Lanka, France, Thailand, South America, and West Indies and Brazil. (Butt, 2013), (Anonymous, 1987), (Nadkarni, 1989)

Morphological features:

The black pepper vine (*Piper nigrum* L.) is a perennial climber that spreads with the help of specialized aerial and underground roots. Mature plants may reach a height of 8–10 m with a crown spread of about 1.5 m. Two types of roots are produced: aerial adhesive roots that arise from the nodes and attach to supporting structures, and deeper feeding roots that penetrate the soil to absorb nutrients and water. These feeding roots may extend 3–4 m laterally and up to 1–2 m deep, while the aerial roots are short, typically 3–5 cm in length. (Wulandari, 2021)The stem of the plant is cylindrical with distinct nodes and internodes. Older stems become woody with a diameter of 4–6 cm, whereas young stems remain green and flexible. The vine exhibits two growth forms: vertical climbing shoots that bear only roots and no fruits, and lateral plagiotropic branches that produce flowers and fruits. In addition, “hanging” and “ground-running” shoots can develop from climbing branches; these do not bear fruits and are usually pruned during cultivation. (Wulandari, 2021)

Leaves are simple, alternate, and broadly ovate with a tapering tip and asymmetrical base. They measure about 10–19 cm in length and 5–10 cm in width, with a petiole of 1.8–2.6 cm. Venation consists of a prominent midrib and 3–4 pairs of curved lateral veins. (Eleonora, 2020)

The inflorescence consists of pendulous, unbranched spikes opposite the leaves, each 3–25 cm long and carrying more than 100 small flowers. The flowers are yellowish-green and may be male, female, or hermaphroditic, although the species is largely protogynous. The female flowers have a single ovule, a trilobed stigma, and are surrounded by short stamens in male or hermaphrodite flowers. (Wulandari, 2021), (Turrini, 2020)

The fruits (peppercorns) are small, spherical to slightly oval drupes, turning from green to orange-red as they mature. The pericarp is thin (1–2 mm thick) and firm when unripe but becomes soft at maturity. Inside, the drupe contains a single seed rich in oleoresins, piperine, and essential oils, which are responsible for the characteristic aroma and pungency of black pepper.

Macroscopic: Fruits grayish-black to black, hard, wrinkled 0.4-0.5 cm in diameter, odour aromatic, taste pungent.

Microscopic: Microscopically, the black pepper fruit consists of a thick pericarp surrounding a central mass of perisperm that encloses a minute embryo. The pericarp is differentiated into three layers: epicarp, mesocarp, and endocarp. The outer epicarp is made up of a single layer of slightly wavy, tabular epidermal cells. Beneath this is a zone of one to two layers of elongated, lignified stone cells supported by clusters of parenchymatous tissue. The mesocarp is broad, with its inner region containing a row of oil cells, while the outer region is composed of tangentially arranged parenchyma interspersed with isolated oil cells and traversed by a few fibrovascular bundles. The endocarp consists of a beaker-shaped layer of stone cells. The testa, which lies just beneath, is a single layer of thick-walled, yellowish sclerenchyma. Within the seed, the perisperm is formed of parenchyma containing scattered oil globules and numerous simple as well as compound starch grains, mostly oval to round, ranging from 5.5 to 11 µm in size. Small aleurone grains are also present, often in groups of two to three. (Turrini, 2020)

Chemical constituents: Alkaloids, Aromatic and volatile compounds etc.

1. **Alkaloid:** Piperine, Chavicine;-Piperidine, Piperetine (Anonymous, 2007)
2. **Aromatic and volatile compounds:** (Meghwal, 2013)

a. **Monoterpenes:** α-Thujene, α-Pinene, Sabinene, ß-Pinene, 1,8-Cineole, Limonene, Camphene

b. **Sesquiterpenes:** α-Copaene, ß-Caryophyllene, ß-Bisabolene, Caryophyllene oxide, α-Cis-Bergamotene, α-Trans- Bergamotene, ß-bisabolene

c. **Other compounds:** Eugenol, Methyleugenol, Myristicin, Benzaldehyde, Cinnamic acid, Phenyl acetic acid, Piperonal

Afa'al (Functions): Externally, rubifecient (*muhammir*), roughening (*mukhashshin jild*) and stimulant to skin. And internally Aphrodisiac (*Muqawwi bah*), detergent (*Jali*), dessicant (*Jazib*), stimulant, carminative (*kasir riyah*), diuretic, anticholerin, sialogogue (*muwallid luab duhan*), bechic, antiasthmatic, removal of viscid humour (*akhlat*) (Kabiruddin, 1966) diuretic (*mudir baul*), emennogogue (*mudir haiz*), analgesic (*musakkin dard*), expectorant (*munaffis balgham*), tonic for stomach and liver (*muqawwi asaab meda wa jigar*), antidote (*Tiryaq sumoom barida*), antipyretic (*dafe bukhar naubati*), anti inflammatory (*muhallil warm*), digestive (*hazim*) (Anonymous, 2007), (Nadkarni, 1989), (Anonymous, 2002)

Uses: Abdominal fullness, adenitis, abdominal tumors, asthma, broncho-pulmonary disorders, bronchitis, cancer, cholera, cold, coughs, colic, constipation, diarrhea, dysentery, dyspepsia, epilepsy, fever, food poisoning, flatulence, gastric cancers, headache, hemorrhoids, intestinal diseases, kidney stone, leucoderma (*Bars*), nasal congestion, pityriasis (*bahaq*), rheumatism, sore throat, sinusitis, skin inflammations, toothache, vomiting, venereal diseases, used with ginger and *Piper longum* for viral hepatitis etc. (Khare, 492)

Doses: 500 mg to 1 g (3 *ratti* to 1 *masha*) (Ramlubha, 2013)

Mizaj (Temperament): *Hot* 3º, *Dry* 3º (Hussain, 2004)

Muzir (Toxic): In person with *Haar* mizaj (Ramlubha, 2013)

Musleh (Corrective): Coriander (*Coriandrum sativum L.*) (Ramlubha, 2013)

Murakkabat **(Compound drugs):** *Jawarish Jalinoos*, *Jawarish kamooni*, *Itrifal kabir*, *Anqaroya Sagheer*, *Jawarish Biswasa*, *Jawarish Safarjali*, *Jawarish Zarauni ambary ba nuskha kalan*, *Habbe papeeta*, *Majoon Talkh*, *Majoon Jograj gogul* etc. (Ramlubha, 2013)

Pharmacological Actions

A. Role as a Bioavailability Enhancer:

Piperine, the principal active alkaloid in *Piper nigrum* L., is well documented for its ability to improve the bioavailability of numerous therapeutic agents. This effect is attributed to its capacity to enhance intestinal absorption and reduce drug metabolism. The compound exhibits a high permeability coefficient and a relatively low rate of clearance, which facilitates better absorption through possible alterations in lipid membrane dynamics and modulation of intestinal enzyme conformation. Experimental findings suggest that piperine influences the activity of enzymes such as leucine aminopeptidase and glycyl-glycine dipeptidase by modifying their kinetics. Being a non-polar molecule, piperine is thought to interact with hydrophobic regions of the intestinal membrane and nearby lipids, possibly leading to changes in enzyme structure and function. (Atal, 1985) Ultrastructural studies have revealed that administration of piperine causes a marked increase in the number of free ribosomes and ribosomes attached to the endoplasmic reticulum within enterocytes, along with elongated microvilli. Ultrastructural studies show that giving piperine to enterocytes significantly raises the number of free ribosomes and ribosomes connected to the endoplasmic reticulum, along with elongated microvilli.

These changes indicate that piperine may influence protein synthesis and membrane turnover, thereby facilitating improved drug absorption. (Meghwal, 2013), (Bajad, 2003)

Various studies related to bioavailability enhancer are listed below::

1. Co-administration of piperine with nimesulide significantly enhanced its plasma concentration compared to nimesulide alone, likely due to inhibition of metabolic biotransformation. (Gupta, 1998)
2. Piperine enhanced serum concentration, absorption and bioavailability of curcumin in both rats and humans.
3. Elevated blood levels of vasicine and sparteine were noted when combined with piperine, attributed to improved gastrointestinal absorption and/or by first-pass metabolism in the liver.
4. Combined administration of piperine increased plasma levels of coenzyme Q10 in human subjects.
5. Piperine supplementation enhanced serum levels of ß-carotene in healthy rat and human subjects.
6. It also facilitated ß-carotene uptake, which can help in managing vitamin A deficiency. (Meghwal, 2013)
7. Increased bioavailability of vasicine and sparteine as a result of Piper/piperine treatment in human.
8. Significant enhancement of systemic availability of drugs like propranolol and theophylline has been observed in humans when taken with piperine.
9. Piperine lowered the metabolic activity of aflatoxin B1, a fungal toxin in rat, which led to increased plasma retention.
10. Increased serum concentration of curcumin by concomitant administration of piperine (human).
11. Coadministration of piperine in humans results in elevated plasma levels of coenzyme Q10.
12. Delayed elimination of phenytoin, an anti-epileptic drug, was noted in mice treated with piperine. (Srinivasan, 2007)

These findings demonstrate that piperine acts as a natural bioavailability enhancer, an attribute of significant clinical value given its widespread use as a dietary spice.

B. Anti-inflammatory activity

Piperine has demonstrated significant anti-inflammatory properties in animal studies. It was shown to reduce both acute inflammatory responses and chronic granulative changes, with the mechanism partly mediated via activation of the pituitary–adrenal axis in rat models. (Mujumdar, 1990)

C. Antioxidant activity

Experimental evidence suggests that piperine can mitigate oxidative stress. In a study where rats received piperine (0.02 g/kg body weight) for 10 weeks, there was a marked reduction in thiobarbituric acid reactive substances (TBARS) and preservation of endogenous antioxidant systems such as superoxide dismutase, catalase, glutathione peroxidase, glutathione-S-transferase, and glutathione. This indicates its potential to counteract oxidative damage associated with high-fat diet consumption. (Vijayakumar, 2004)

D. Anti-degenerative effects

Piperine has shown promising effects in preventing neurodegeneration and improving memory deficits. Administration of piperine (5, 10, and 20 mg/kg) for two weeks to adult male Wistar rats resulted in a significant reduction in lipid peroxidation and inhibition of acetylcholine esterase activity in the hippocampus, thereby improving cognitive function. (Chonpathompikunlert, 2010)

E. Anti-carcinogenic and anti-mutagenic properties

Studies have revealed the chemopreventive role of piperine in reducing oxidative and molecular damage. In albino mice, piperine administration (50 mg/kg body weight) decreased lipid peroxidation, protein carbonyl content, nucleic acid alterations, and carcinogenesis, suggesting its protective role by limiting protein damage and suppressing cell proliferation. (Selvendiran, 2004) Furthermore, extracts of black pepper have demonstrated tumor inhibitory effects. In a study on mice bearing Ehrlich ascites tumors, oral administration of black pepper extract increased life span by approximately 65%, indicating its potential role as an anti-tumor and anti-cancer agent. (Unnikrishnan, 1990)

F. Antimicrobial potential

Extracts of *Piper nigrum* have shown broad-spectrum antimicrobial activity. Specifically, growth inhibition was observed against *Staphylococcus*, *Bacillus*, and *Streptococcus* species, with minimum inhibitory concentrations (MIC) reported as 125, 250, and 500 ppm, respectively. (Butt, 2013)

G. Neuroprotective potential

The primary methods that black pepper protects neurons are through its antioxidant and cytoprotective actions. Piperine alleviates the effects of chronic mild stress by improving behavioral parameters such as sucrose preference, plasma corticosterone levels, and locomotor activity. These antidepressant-like effects are believed to arise from its ability to protect neural cells and regulate hippocampal progenitor cell proliferation. (Butt, 2013)

Result and Discussion:

This review underscores the significance of black pepper (*Piper nigrum L.*, *Filfil Siyah*) as one of the most valued culinary spices with diverse medicinal applications. Native to India, this perennial climbing plant thrives in hot, humid environments, particularly in the biodiversity-rich Western Ghats. The spice is obtained from the dried, hard, wrinkled, grayish-black fruits, which are characterized by a pungent taste and a distinctive aromatic odor. Microscopic examination of the fruit shows a thick pericarp enclosing an inner mass of perisperm, which in turn contains a small embryo. Phytochemical studies indicate that black pepper contains bioactive constituents such as alkaloids (piperine, chavicine, piperidine, piperetine), volatile oils, and aromatic compounds, including monoterpenes (e.g., α-thujene), sesquiterpenes (e.g., α-copaene), and phenolic compounds like eugenol.

Pharmacologically, *Piper nigrum* exhibits multiple therapeutic actions, functioning as a stimulant, carminative, diuretic, anti-inflammatory, antioxidant, anti-degenerative, anti-carcinogenic, antimicrobial, and neuroprotective agent. Piperine, the major alkaloid, plays a crucial role by markedly enhancing the bioavailability of various drugs. It achieves this by improving gastrointestinal absorption and modulating enzyme kinetics in the intestine. This bioenhancing property has been validated in several studies, particularly with compounds such as curcumin, coenzyme Q10, and beta-carotene, highlighting its clinical importance in improving therapeutic efficacy.

CONCLUSION

Black pepper (*Piper nigrum L.*, *Filfil Siyah*) is a highly versatile spice valued not only for its culinary appeal but also for its wide spectrum of medicinal benefits. The principal bioactive constituent, piperine, contributes significantly to its therapeutic potential by enhancing the bioavailability of various drugs and exhibiting multiple pharmacological effects, including anti-inflammatory, antioxidant, anti-carcinogenic, antimicrobial, and neuroprotective activities. Traditionally, Filfil Siyah has been employed in the management of diverse health conditions such as fever, asthma, cancer, gastrointestinal disturbances, respiratory disorders, rheumatism, skin inflammations, and toothache. These diverse properties highlight its importance as a valuable component of both traditional systems of medicine and modern pharmacological research.

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