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THERAPEUTIC POTENTIAL OF KAKNAJ (PHYSALIS ALKEKENGI) IN UNANI MEDICINE: AN EVIDENCE-BASED REVIEW

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ABSTRACT

Physalis alkekengi (Kaknaj/Habb-e-Kaknaj), belonging to the family Solanaceae, is an important medicinal plant extensively described in the Unani system of medicine. It has been traditionally employed for the management of renal and urinary tract disorders, particularly urolithiasis, dysuria, and inflammatory conditions. Classical Unani literature attributes multiple pharmacological properties to Kaknaj, including diuretic (mudirr-i-baul), lithotriptic (mufattit-i-hasat), anti-inflammatory (muhallil-i-waram), and nephroprotective actions. Phytochemical studies have identified a wide range of bioactive constituents such as flavonoids, alkaloids, physalins, withanolides, polyphenols, and sterols. These compounds are responsible for its diverse pharmacological activities. Modern scientific investigations have provided supportive evidence for its traditional uses, demonstrating antioxidant, antimicrobial, antidiabetic, immunomodulatory, and anticancer effects. Notably, physalin A and related compounds have shown significant biological potential in experimental studies.

This review critically integrates classical Unani descriptions with contemporary pharmacological findings to highlight the therapeutic relevance of Kaknaj. It further explores its potential mechanisms of action and emphasizes the need for well-designed clinical studies to validate its efficacy and safety. The study aims to bridge traditional knowledge with modern research, thereby facilitating its future application in evidence-based medicine and drug development.

KEYWORDS: Physalis alkekengi, Kaknaj, Unani System of Medicine, Urolithiasis**,** Medicinal plant.

INTRODUCTION

Kaknaj (*Physalis alkekengi* Linn.), a member of the Solanaceae family, is a medicinally important plant that has been used in traditional healing systems since ancient times. Historical records shows that both Greek and Roman civilizations recognized its therapeutic potential and documented its applications in early medical texts. In traditional Arab pharmacopoeia, the plant was known as "Kaknaj," while in Persian medicine it was referred to as "Kakanah." Both traditions attributed strong medicinal properties to this plant, particularly for disorders of the urinary tract, including bladder ailments. The renowned botanist and scholar Abu Hanifah provided an early morphological description of Kaknaj, noting its resemblance to *Peganum harmala*, though distinguishing it by its taller structure and round branches. The most distinguishing botanical characteristic is its fruit: a bright red, capsule-like berry enclosed within an inflated, bladder-shaped calyx, which gives it the nickname "Chinese lantern." The calyx, which ranges from orange to deep red when mature, is particularly striking and contributes to the plant’s ornamental appeal. The leaves of Kaknaj were traditionally applied topically to inflamed or painful areas, indicating its use in managing localized pain and inflammation. Unani physicians described it as a diuretic, anthelmintic, and alterative, highlighting its utility in treating skin conditions, rheumatic disorders, and urinary diseases. These pharmacological properties align with the doctrines of temperamental therapy in Unani medicine. Botanically, *Physalis alkekengi* is a diffuse, herbaceous perennial that grows naturally across a wide geographic range, from China to Southeastern Europe. It has a glabrous or slightly hairy stem, and its flowers are typically whitish. The plant bears distinctive fruits reddish, globular berries encased in a papery, lantern-like calyx measuring approximately 4–12 cm in length. These fruits resemble small, desiccated cherries, with smooth, shiny reddish-brown skin, and are filled with numerous

flattened, reniform (kidney-shaped), light brown seeds. The seeds are embedded in a small quantity of sticky brown pulp, which emits a characteristic fruity aroma. Unani medical literature describes several types or variants of Kaknaj, each with slightly different properties or regional origins. This diversity has allowed the plant to be used in multiple compound formulations across different traditional systems, further reinforcing its historical and therapeutic significance.[1–3]

TAXANOMY

Kingdom: Plantae

Phylum: Tracheophyta

Class: Asterids

Order: Solanales

Family: Solanaceae

Genus: Physalis

Species: Alkekengi

VERNACULARS[4-11]

Arabic: Kaknaj, Habbul Kaknaj, Jauzul marj, Habbul tahwa, Bazars

Persian: Kakanah, Uroosak-e pase pardah, Uroos-e- darpardah

English: Strawberry tomato, inter cherry, Puneeriaco agulaus

Hindi: Ralpotika, Banpootika, Paptan

Unani: Qasooleedus, Qaseedas, Qasookeedun, Islarakhnos

Urdu: Papotan

Latin: Haleela-kayam, Physalis alkekenji

HABITAT AND DISTRIBUTION

Physalis alkekengi is native to a broad region that includes China, Persia (modern-day Iran), the southeastern parts of Europe, and certain areas of the United States. It thrives in temperate climates and is commonly found in forests, open woodlands, and along riverbanks. The plant has demonstrated adaptability to a variety of environmental conditions and has become naturalized in numerous tropical and subtropical regions of both North and South America. Due to its ornamental appeal and medicinal value, it has been widely cultivated and introduced beyond its native range. Globally, the genus Physalis encompasses approximately 100 recognized species. Although most species are distributed in the Americas, only a few have adapted to the Indian subcontinent. Of these, three species are considered indigenous to

India and are dispersed throughout the country, particularly in regions with moderate climates. Their presence across different ecological zones signifies their resilience and potential utility in traditional medicinal systems like Unani and Ayurveda.[2, 11, 12]

MORPHOLOGY

Kaknaj is characterized as a diffuse, perennial herbaceous plant that typically attains a length of about 80 cm (approximately 32 inches). The stems are either glabrous (smooth and hairless) or slightly pubescent (covered with fine, short hairs), and the leaves are arranged alternately along the stem. The leaves are ovate to diamond-shaped, with entire or slightly wavy margins and a pointed tip. The plant produces solitary, bell-shaped, whitish flowers which emerge from the leaf axils. Upon maturation, these flowers develop into distinctive fruits encased within an inflated, lantern-like calyx. The berries are globular to slightly elongated, measuring approximately 4–12 cm in length. They exhibit a reddish-orange coloration with faint greenish longitudinal stripes and are fully enclosed in a delicate, translucent, red-hued papery membrane (the persistent calyx), which is the plant's most iconic feature. When dried, the fruits become shriveled and wrinkled on the exterior, yet remain juicy and filled with numerous seeds. The dried berries measure between 1 and 1.5 cm in diameter. Internally, the fruit has minimal placental tissue and a somewhat bitter and mildly acidic (acidulous) taste. The seeds are plentiful, compressed, and kidney-shaped (reniform), typically ranging in size from approximately 1.8 mm to 2.2 mm. Each seed contains a curved embryo and is embedded within a small amount of sticky pulp, contributing to its distinctive fruity aroma and taste.[1, 12, 13]

UNANI DESCRIPTION (MAHIYAT)

In classical Unani literature, the fruit of Physalis alkekengi is commonly referred to as Habb-e-Kaknaj. It has been discussed extensively by renowned Unani scholars and physicians, many of whom have provided detailed descriptions of its botanical characteristics and medicinal relevance. The plant is often noted for its close resemblance to Mako (Solanum nigrum), another important medicinal herb within the Unani system. The typical height of the Kaknaj plant is reported to be around one yard (approximately 90 cm), and it is predominantly found growing during the autumn season. It is especially abundant in agricultural fields where crops such as maize, millet, and corn are cultivated, suggesting that it prefers well-drained, fertile soils commonly associated with such farmlands. Morphologically, Kaknaj is described as having thin, slender branches that tend to arch or

trail close to the ground. These branches are covered with fine, downy hairs. The leaves are relatively broad, measuring around two inches in length, and are generally wider compared to those of Solanum nigrum. The surface of the leaves is coated with a layer of fine, dusty-colored trichomes (hair-like structures), which give the foliage a soft, slightly rough texture. As for its floral features, Kaknaj bears small, delicate flowers that are primarily reddish-white in color. However, some classical Unani texts mention the possibility of yellow-colored flowers in certain varieties, indicating either regional variation or diversity within the species. These flowers eventually give rise to the characteristic lantern-like fruits that are central to its medicinal use. The fruits of Kaknaj (Physalis alkekengi) are typically reddish in color upon maturity and are slightly larger in size compared to the fruits of Solanum nigrum. They possess a mildly sweet taste, distinguishing them from the bitter flavor of many other medicinal berries. Each fruit is enclosed within a distinctive, inflated, papery sheath—technically known as a calyx—that closely resembles the shape of a urinary bladder. This bladder-like structure is one of the most recognizable morphological features of the plant and contributes to its traditional nomenclature in various medical systems. According to Unani literature, Kaknaj exists in two primary varieties based on habitat and cultivation status: Bustani (cultivated) and Pahadi (wild). The cultivated variety initially appears green and gradually turns reddish as it ripens. In contrast, the wild variety tends to have a yellowish hue during its early stages and matures into a reddish-yellow color. Among these, the cultivated form is generally referred to as Kaknaj in Unani texts and is considered superior in both quality and medicinal efficacy. Each fruit contains a large number of seeds, which are light brown in color, flattened, and reniform (kidney-shaped). These seeds are embedded within a small amount of mucilaginous pulp and contribute to the fruit's therapeutic profile, especially in preparations used for urinary and hepatic conditions.[5, 7–10]

Hissah-i-Mustamal (Parts Used): Fruits[5]

Mizaj (Temperament): Cold and Dry – Second Degree (2°).[5, 8, 10, 14]

Miqdar-i-Khurak (Dosage): 5–7 g or 7–15 g [5], 6 fruits (whole)[10]

Muzir Asarat (Adverse Effects): May cause renal stress if given in high doses.

Musleh (Correctives): Gul-e-Surkh (Rosa damascena), Gulqand Aftabi, Gil-e-Multani (Bole arminia).[5, 7, 8, 10]

Badal (Substitutes): Mako (Solanum nigrum), Bazarul Banj Safed (Hyoscyamus albus), Tukhm-e-Khyar (Cucumis sativus), Chilghoza (Pinus gerardiana).[5, 6, 7, 8, 10]

Murakkabat (Compound Formulations): Qurs-e-Kaknaj, Majoon Hajrul Yahood.

AF'AL (THERAPEUTIC ACTIONS)

Mudirr-i-Bawl (Diuretic), Dafi-i-Ta'affun (Antiseptic), Mukhaddir (Anaesthetic), Qatil-i-Kiram – Anthelminthic (Vermifuge), Mohallil (Resolvent), Mukhrij-i-Didan-i-Ama (Expels intestinal worms), Radi (Repellent), Dafi Dhiq al-Nafas (Anti-asthmatic), Mujaffif-Desiccant, Mani al-Haml (Contraceptive), Musakkin-i-Atash (Thirst suppressant).[3, 5, 7–12, 16]

ISTEMAALĀT (THERAPEUTIC USES)

Kaknaj (Physalis alkekengi) possesses a wide spectrum of medicinal applications within the Unani system of medicine. It has been traditionally utilized in the management of various chronic and acute ailments, particularly those affecting the urinary, respiratory, and gastrointestinal systems.

In otological conditions, the extract or decoction of Kaknaj fruit is used as an ear drop, especially effective in the treatment of chronic ulcers of the ear (Buthūr al-Udhun), where it helps reduce inflammation and promotes healing.

For respiratory ailments, Kaknaj is employed in the treatment of dyspnoea ('Usr al-Tanaffus), where it acts as a mild bronchodilator and anti-inflammatory agent, easing the process of breathing. In the gastrointestinal system, it demonstrates potent anthelmintic properties and is thus used in the expulsion of intestinal worms (Didān al-Am'ā'), helping cleanse the digestive tract of parasitic infestations. In the realm of urinary health, Kaknaj is notably valued for its diuretic and anti-inflammatory effects. It is commonly administered in cases of urinary tract infections, renal and vesical disorders (Amrāḍ al-Kulya wa al-Mathāna), as well as in ulcerative conditions affecting the kidneys, bladder (Qurūh al-Kulya wa al-Mathāna), and urethra (Qurūh al-Majra'-i-Bawl). Additionally, it helps in relieving pyuria (Bawl Middī) and burning micturition (Ḥurqa al-Bawl) by soothing mucosal irritation and enhancing urinary flow.

Furthermore, an infusion of the fruit is traditionally used to eliminate excess bile from the body, making it beneficial in treating jaundice (Yarqān). The hepatoprotective and cholagogue effects aid in detoxification and restore liver function. Notably, Kaknaj has also been historically regarded for its contraceptive potential. Classical Unani sources state that oral consumption of seven seeds may inhibit conception (Mān'-i-Ḥaml), suggesting its use in natural birth control methods.

PHYTOCHEMICAL CONSTITUENTS

Kaknaj (Physalis alkekengi) exhibits a rich and diverse phytochemical profile, contributing to its wide range of medicinal applications in traditional as well as modern medicine. Both the fruits and leaves are known to contain a variety of bioactive compounds, including vitamins, alkaloids, pigments, acids, and minerals.

The fruits contain an amorphous bitter principle along with a considerable amount of vitamin C, which supports their antioxidant and immune-boosting properties. They also possess carotenoid pigments, including a major compound known as physalin, which exhibits notable biological activity. Additionally, the presence of sugars, citric acid, and mucilage lends the berries a mildly sweet and slightly acidic taste. The volatile matter present in the fruits contributes to their characteristic aroma, and they are further enriched with water content, making them juicy and refreshing.

From a nutritional standpoint, the fruits are considered rich in alkaline and mineral salts, particularly lime, phosphates, and manganese (approximately 0.05%). The presence of manganese is noteworthy due to its role in enhancing metabolic function and contributing to improved mood and neurological health. Malic and citric acids, commonly found in related fruits like strawberries, are also present and aid in digestion and detoxification.

The leaves and calyx are characterized by the presence of the bitter compound physalin, which is also responsible for some of the plant's medicinal effects, including anti-inflammatory and antitumor properties. Various xanthophylls and carotenoids such as auroxanthin, mutatoxanthin, phydalein, and zeaxanthin (along with its cis-isomer) have been identified, especially in the calyx. Additionally, β-carotene has been extracted from the calyx, known for its pro-vitamin A activity.

Glycoalkaloids have been detected in the seeds, indicating possible anthelmintic and protective roles. The ripe berries are especially valued for their high content of vitamins A and C, phenolic antioxidants, pectin, and essential minerals such as phosphorus (P), calcium (Ca), and iron (Fe), all of which contribute to the plant's nutritional and therapeutic value.

The roots of Physalis alkekengi have also yielded several unique compounds. These include Tigloidine (3.0%), Tigloyloxytropane (33.0%), Asoolygfine (20.0%), and Stopline. Furthermore, a novel withanolide compound named physalactone has been isolated, which is

of significant pharmacological interest due to its potential anti-inflammatory and cytotoxic activities.[3, 12, 17, 18]

PHARMACOLOGICAL STUDIES

Nephroprotective Activity

Recent pharmacological investigations have provided promising evidence supporting the nephroprotective potential of Physalis alkekengi fruits. In one experimental study, the ethanolic extract of the fruits was assessed for its ability to prevent and treat gentamicin-induced acute kidney injury in albino rats. Gentamicin, administered at a dose of 40 mg/kg, is a well-known nephrotoxic antibiotic that causes damage to renal tissue, leading to elevated levels of blood urea and serum creatinine, as well as structural abnormalities in kidney histology. The study was divided into preventive and curative groups. The preventive group received Physalis alkekengi extract prior to gentamicin exposure, whereas the curative group was treated after nephrotoxicity had been induced. In the preventive group, the ethanolic extract significantly reduced the levels of biochemical markers (blood urea and serum creatinine) and helped restore the normal architecture of kidney tissue on histological examination. The curative group also demonstrated considerable improvement in renal function parameters and histological regeneration, though to a slightly lesser degree. These findings collectively suggest that Physalis alkekengi exhibits substantial nephroprotective activity, both in prophylactic and therapeutic contexts.[19]

In a complementary study conducted by Sabahatullah et al. (2010), the hydroalcoholic extract of Physalis alkekengi L. (PAHE) was evaluated for its protective role against cisplatin-induced acute renal injury in albino rats. The study administered two oral doses of the extract: 420 mg/kg (equivalent to the traditionally recommended 3 g crude dose) and 980 mg/kg (equivalent to 7 g) over a duration of 10 days. On the 4th day of the experiment, a single intraperitoneal dose of cisplatin (7 mg/kg) was given to induce nephrotoxicity. Biochemical analysis revealed that both doses of PAHE significantly reduced elevated levels of blood urea, serum creatinine, uric acid, and thiobarbituric acid reactive substances (TBARS), which are markers of oxidative stress. Additionally, histopathological evaluation of kidney tissues demonstrated a marked reduction in cellular damage and degeneration, indicating the extract's protective and regenerative effects on renal structures.[20]

Diuretic Activity

The diuretic potential of Kaknaj was scientifically evaluated by Ahmad et al. (2020) using a compound preparation referred to as Tabekh Kaknaj. The study involved administering both aqueous and 50% hydroalcoholic extracts of the compound to albino rats, with furosemide (25 mg/kg) serving as the standard reference drug. Over a 6-hour period, urine output was collected from each group, and subsequent analysis included the measurement of total urine volume, as well as sodium (Na^+) and potassium (K^+) concentrations. The results demonstrated that both extracts of the test compound elicited a moderate diuretic effect, as evidenced by an increase in urinary output in comparison to the control group. Additionally, there was a noticeable enhancement in the excretion of sodium and potassium ions, indicating that the compound also possessed natriuretic (promoting sodium excretion) and kaliuretic (promoting potassium excretion) properties. These findings align with the traditional Unani classification of Kaknaj as a Mudir-e-Bawl (diuretic), further validating its historical use in the treatment of urinary disorders.[20]

Steroidal Activity

In the same study, Ahmad et al. (2020) also investigated the steroidal-like effects of the aqueous and 50% hydroalcoholic extracts of Tabekh Kaknaj. This evaluation was conducted using hydrocortisone (33.3 µg) as a standard corticosteroid for comparison. The experimental setup involved sacrificing the animals on the fourth day, following administration of the respective treatments, and dissecting out the thymus glands to assess their weights an established model for detecting corticosteroid activity due to the gland's sensitivity to steroid-induced atrophy. Both extracts of the test compound demonstrated a significant reduction in thymus gland weight compared to the control group, suggesting that the extracts exerted a corticosteroid-like effect. The statistical evaluation of results was carried out using One-Way ANOVA, followed by Tukey–Kramer multiple comparison tests, with the outcomes expressed as mean ± S.E.M. The observed thymolytic activity points to a possible immunosuppressive or anti-inflammatory role, adding another dimension to the plant's therapeutic potential.[20]

CONCLUSION

Physalis alkekengi (Kaknaj) represents a valuable medicinal plant in Unani medicine with well-documented traditional applications, particularly in renal and urinary disorders. Contemporary pharmacological studies largely support its classical uses, attributing its

therapeutic effects to diverse bioactive constituents such as physalins and flavonoids. Despite promising experimental evidence, further rigorous clinical investigations are necessary to establish its safety, efficacy, and standardization. Integrating traditional knowledge with modern scientific validation may enhance its potential for development as an effective evidence-based therapeutic agent.

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