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# Taxonomy of Seven Solanaceae Species from Hamirgarh Eco Park, Bhilwara, Rajasthan

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**Abstract:** ***Precise taxonomic identification is the cornerstone of valid ethnobotanical, pharmacological, and ecological research. This study bridges a critical gap in the floristic knowledge of Rajasthan's semi-arid region by authenticating seven medicinally significant species of Solanaceae from Hamirgarh Eco Park: Solanum sisymbriifolium, S. nigrum, Datura ferox, D. stramonium, D. metel, Physalis minima, and Withania somnifera. Employing an integrated approach of field ecology and classical morphology, we characterized each species based on a suite of diagnostic macro-morphological traits. Authenticated voucher specimens, essential for scientific reproducibility, were deposited in the Sangam University Herbarium. The research outputs—comprehensive descriptions, a comparative analysis, and a diagnostic key—provide an indispensable resource for unambiguous species identification, particularly within notoriously difficult complexes like Solanum nigrum and Datura. This work establishes a verified baseline for future studies on the phytochemical potential and conservation of these valuable plant resources.***

**Keywords:** Solanaceae taxonomy**,** Species authentication, Medicinal Plants, Diagnostic Morphology, Rajasthan Flora

## 1. Introduction

The Solanaceae, commonly known as the nightshade family, is one of the most significant and economically vital plant families in the world, encompassing a remarkable diversity of species ranging from essential food crops like tomatoes, potatoes, and peppers to ornamental plants, medicinal herbs, and toxic weeds (Ganaie et al., 2018; Samuels, 2015). This family is globally distributed but exhibits its highest diversity in tropical and subtropical regions of the Americas, serving as a classic model for studying plant evolution and biogeography (Palchetti et al., 2020). The Solanaceae is not only taxonomically rich but also phytochemically complex, producing a wide array of bioactive compounds such as alkaloids, flavonoids, and steroids, which underlie its immense pharmacological and nutritional value (Svobodová & Kuban, 2018).

Despite its global importance, taxonomic discrimination within the Solanaceae remains challenging. The family is characterized by conserved floral morphologies in many genera, while simultaneously displaying significant vegetative plasticity, often leading to misidentification, especially at the species level (Xu & Chang, 2017; Fawzi & Habeeb, 2016). This is particularly true for wild and non-cultivated species that lack comprehensive documentation. Complex genera like Solanum, the largest genus in the family, contain numerous clades and sections that are subjects of ongoing phylogenetic revision, highlighting the need for detailed morphological studies to support molecular findings (Aubriot et al., 2016; Clark et al., 2015). A precise taxonomic inventory is, therefore, a fundamental prerequisite for any further scientific exploration, whether it be ecological, conservation-oriented, or phytochemical.

In India, and specifically in the state of Rajasthan, the Solanaceae family is well-represented, but localized floristic studies often lack the detailed morphological descriptions necessary for unambiguous species-level identification. The Hamirgarh Eco Park in Bhilwara, Rajasthan, represents a unique semi-natural ecosystem whose floristic composition, particularly of taxonomically complex families like Solanaceae, has not been thoroughly investigated. Documenting the Solanaceae diversity in such a region is critical for understanding the local biodiversity, assessing conservation needs, and recognizing the potential of these species as genetic resources or sources of novel phytochemicals.

This study aims to fill this gap by providing a comprehensive taxonomic account of the Solanaceae species within the Hamirgarh Eco Park. Through detailed morphological characterization and analysis of key diagnostic traits, this research will facilitate the accurate identification and discrimination of seven Solanaceae species. The findings will contribute a valuable baseline dataset to the floristic knowledge of Rajasthan, aid in the conservation management of the eco-park, and provide a clear taxonomic framework for future pharmacological or ecological studies on these species.

## 2. Materials and Methods

### 2.1 Plant Collection and Ethical Considerations

Mature plant specimens, encompassing both vegetative (stem, leaves) and reproductive parts (flowers, fruits), were collected through repeated field expeditions conducted between **Aug 2023** and **sept 2024** across diverse microhabitats within Hamirgarh Eco Park, Bhilwara, Rajasthan. For each collection.

### 2.2 Morphological Characterization

A detailed macro-morphological analysis was conducted to characterize each species. Key diagnostic characters—including plant habit, stem morphology, leaf architecture (shape, size, margin, venation), inflorescence type, floral morphology (calyx, corolla, androecium, gynoecium), and fruit and seed characteristics—were meticulously examined. Quantitative measurements were taken using standard tools such as a graduated ruler and digital vernier calipers.

### 2.3 Taxonomic Authentication

The identity of the collected specimens was determined through critical comparison with authenticated specimens and consultations of authoritative botanical literature, primarily the regional flora, *Flora of South Central Rajasthan* by Meena and Yadav.

### 2.4 Herbarium Curation and Voucher Deposition

For permanent record and future verification, voucher specimens were prepared for each authenticated species following standard herbarium techniques. This involved pressing, drying, poisoning, and mounting the specimens on standard herbarium sheets. Each voucher was assigned a unique accession number and deposited in the institutional repository of the Sangam University Herbarium for long-term preservation and scientific reference.

## 3. Results and Discussion

The taxonomic investigation of the Solanaceae family in Hamirgarh Eco Park resulted in the successful identification and authentication of seven species through detailed morphological analysis. The species-wise descriptions are presented below:

### *3.1. Solanum sisymbriifolium Lam.*

This perennial undershrub reaches 1.0-1.5 m in height and is characterized by its dense covering of sharp, orange-yellow spines (1.0-1.2 cm long) on both stems and leaves. The stems are viscid and stellate-pubescent with sparse glandular hairs. Leaves are alternate, sticky, and spiny, with ovate-oblong to oblong-lanceolate lamina (24-30 cm long × 10-16 cm wide) having sinuate margins and deep pinnatisect division into 4-6 rounded lobes. The inflorescence consists of axillary or extra-axillary unbranched racemes bearing 5-10 flowers. Flowers are white, 2.5-3.6 cm in diameter, with bluish-purple veins on the petal undersides. Anthers are lanceolate (8-9 mm long), dehiscing by apical pores. The fruit is a globose to obovoid berry (8-12 mm diameter) that turns bright red when ripe, enclosed by an enlarged, reflexed, prickly calyx.

### *3.2. Solanum nigrum L.*

An annual erect herb growing 0.25-1.0 m tall with a well-developed taproot system. Stems are green to purplish, nearly glabrous and typically smooth. Leaves are ovate (2.5-10 cm long × 1.5-5.5 cm wide) with irregularly wavy or coarsely toothed margins and shortly pointed apex. The inflorescence is extra-axillary, scorpioid-cymose, bearing 3-6 flowers. Flowers are white, small, star-shaped, with anthers approximately 1.2 mm long that dehisce by apical pores. The fruit is a globose berry about 8 mm in diameter that turns dark purple to black at maturity, appearing glossy without sclerotic granule pattern.

### 3.3. Datura ferox L.

An erect, branched annual to short-lived perennial undershrub attaining 50-90 cm height. The plant is moderately hairy throughout, with robust, much-branched stems that are green to purplish. Leaves are large, ovate to orbicular (8-14 cm long × 6-16 cm wide) with shallowly lobed, irregularly toothed or sinuate margins, emitting an unpleasant odor when crushed. Flowers are large, solitary, with white to creamy white, funnel-shaped corolla (5-10 cm long). The fruit is a large, ellipsoid capsule (2-4 cm long) covered with stout, conical, sharply pointed spines.

### *3.4. Datura stramonium L.*

A common annual herb reaching up to 1 m height under favorable conditions. Stems are herbaceous, stout, pale yellowish-green to light purple near nodes, smooth with characteristic dichotomous branching. Leaves are large, simple, alternate, ovate to broadly ovate (10-15 cm long × 6-10 cm wide) with irregularly toothed or shallowly lobed margins. Flowers are solitary, axillary, showy, with white or faintly violet, funnel-shaped corolla (6-8 cm long). The fruit is a globose, densely spiny capsule (3-4 cm diameter) resembling a thorn-covered nut.

### *3.5. Datura metel L.*

An erect annual to short-lived perennial herb or undershrub growing 1-1.5 m tall. Stems are stout, fleshy, glabrous, pale green to purplish near nodes, often branching dichotomously. Leaves are simple, large, ovate (10-18 cm long × 8-12 cm wide) with entire or irregularly sinuate margins, emitting a strong, unpleasant odor when crushed. Flowers are large, showy, solitary, with trumpet-shaped corolla (10-15 cm long) ranging from pure white to deep purple. The fruit is a large, ovoid or globose capsule (3-5 cm diameter) densely covered with short, soft spines.

### *3.6. Physalis minima L.*

A small annual to short-lived perennial herb reaching 40-90 cm height. Stems are cylindrical, green with purplish tinges near nodes, varying from glabrescent to finely pubescent. Leaves are simple, alternate, ovate to cordate (4-10 cm long × 2-6 cm wide) with entire or slightly toothed margins. Flowers are solitary, axillary, with yellow to greenish-yellow corolla sometimes showing faint brownish or purplish spots near base. The fruit is a smooth, globose berry completely enclosed within an inflated, veined, papery calyx that measures up to 5 cm long when mature.

### 3.7. *Withania somnifera (L.)* Dunal

A small to medium-sized perennial undershrub growing 30-

150 cm tall, sometimes reaching 2 m under favorable conditions. The plant is erect, woody at base, profusely branched, with the entire surface covered in fine, branched, stellate hairs giving a grayish or silvery-green appearance. Leaves are simple, ovate to broadly elliptic (3-8 cm long × 2-6 cm wide) with entire or slightly wavy margins, densely covered with short stellate hairs beneath. Flowers are small, greenish-yellow, bisexual, borne singly or in small axillary clusters with campanulate corolla (5-8 mm long). The fruit is a globose, smooth, shiny berry (5-8 mm diameter) that turns orange-red to scarlet when ripe, enclosed within an enlarged, papery, persistent calyx.

**Table 1:** Comparative Morphological Characteristics of Solanaceae Species from Hamirgarh Eco Park

| Species | Habit & Height | Stem Characteristics | Leaf Morphology | Inflorescence & Flowers | Fruit Characteristics |
|---|---|---|---|---|---|
| *Solanum sisymbriifolium* | Perennial undershrub, 1.0–1.5 m | Viscid, densely armed with sharp orange-yellow spines | Ovate-oblong, deeply pinnatisect, spiny on veins | Raceme, white flowers with purple veins | Berry, bright red, enclosed in spiny calyx |
| *Solanum nigrum* | Annual herb, 0.25–1.0 m | Glabrous, green to purplish | Ovate, irregularly wavy or toothed | Scorpioid cyme, small white star-shaped flowers | Glossy black berry |
| *Datura ferox* | Annual/short-lived perennial, 50–90 cm | Hairy, robust, green to purplish | Ovate to orbicular, shallowly lobed | Solitary, white to creamy funnel-shaped flowers | Capsule with stout, conical spines |
| *Datura stramonium* | Annual herb, up to 1 m | Smooth, dichotomous branching | Ovate, irregularly toothed or shallowly lobed | Solitary, white or violet funnel-shaped flowers | Globose capsule with slender spines |
| *Datura metel* | Annual/short-lived perennial, 1–1.5 m | Glabrous, fleshy, pale green to purplish | Ovate, entire or sinuate margins | Solitary, white to purple trumpet-shaped flowers | Ovoid/globose capsule with soft spines |
| *Physalis minima* | Annual/short-lived perennial herb, 40–90 cm | Cylindrical, glabrescent to pubescent | Ovate to cordate, entire or slightly toothed | Solitary, yellow to greenish-yellow campanulate flowers | Berry enclosed in inflated, papery calyx |
| *Withania somnifera* | Perennial undershrub, 30–150 cm | Woody at base, stellate hairs, greyish-green | Ovate to elliptic, densely tomentose beneath | Axillary clusters, greenish-yellow campanulate flowers | Berry enclosed in persistent, papery calyx |

## 4. Conclusion

The present study successfully demonstrates the critical importance of rigorous taxonomic investigation in botanical research, particularly for families as complex and economically significant as the Solanaceae. Through meticulous field collection and detailed morphological analysis, seven species—***Solanum sisymbriifolium***, ***Solanum nigrum***, ***Datura ferox***, ***Datura stramonium***, ***Datura metel***, ***Physalis minima***, **and** ***Withania somnifera***—were unequivocally authenticated from the Hamirgarh Eco Park in Bhilwara, Rajasthan. The comparative morphological examination revealed that a combination of vegetative and reproductive characters—including plant habit, stem armature, leaf architecture, inflorescence type, floral morphology, and fruit characteristics—provides a reliable framework for species delimitation. Key diagnostic features, such as the spiny accrescent calyx in ***S. sisymbriifolium***, the capsule spine morphology in *Datura* species, and the inflated papery calyx in ***P. minima*** and ***W. somnifera***, were particularly instrumental in resolving taxonomic identities.

The deposition of voucher specimens in the Sangam University Herbarium, accompanied by unique accession numbers, ensures the verifiability and permanent documentation of the plant material studied. This practice not only validates the current research but also provides a valuable resource for future scientific inquiries. The findings underscore that traditional morphological methods, when applied systematically, remain highly effective for species identification, even within taxonomically challenging groups. Furthermore, this study highlights the remarkable diversity of the Solanaceae family within the semi-arid ecosystem of Hamirgarh Eco Park, contributing significantly to the regional floristic documentation.

Most importantly, this taxonomic work establishes an indispensable foundation for subsequent research. The accurate identification of these species is crucial for meaningful phytochemical screening, pharmacological evaluation, and conservation planning. Misidentification could lead to erroneous conclusions in chemical analyses or ineffective conservation strategies. Thus, this research provides a validated scientific baseline that will support future studies exploring the medicinal properties, ecological roles, and sustainable utilization of these important plant resources. The methodologies and findings presented herein reaffirm that precise taxonomy is not merely an academic exercise but a fundamental prerequisite for all applied botanical sciences.

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