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MORPHOLOGICAL STUDIES ON SOME SPECIES OF SOLANUM L. IN UTTAR KANNADA DISTRICT

Botany

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ABSTRACT

The present study documented the morphological and traditional knowledge of some species of the genus *Solanum* viz, *S. anguivi* Lam., *S. torvum* Sw. , *S. nigrum* L., *S. indicum* Linn., *S. Seaforthianum* Andrews., *S. xanthocarpum* Schrad & Wendl., and *S. virum* Dunal. All these species are valuable in having medicinal importance. The Solanum species were collected from Malnad region in Uttar Kannada District.These were identified and nomenclature updated. Micro and macro-morphological data of leaves, hairs, prickles, flowers and fruits were studied, with the help of light microscopy and taking photographs. This study indicates that good taxonomic tools can be used to differentiate between species of this genus growing in Uttar Kannada District (Former North Canara). Apart from these differences in plants of same species growing in different climatic conditions are also noted. This study will be helpful to herbalist and pharmacologists to identify and to find these species.

KEYWORDS

Morphological variation, Solanum anguivi, tomentose, ramification

I. INTRODUCTION:

The genus *Solanum* L. contains about 2,500 species (K. Chidambaram 2022). Several species are important food crops, yielding edible fruits and leaves whereas others are ornamentals or weeds. The genus is widely distributed throughout the world with main species representation in America, Australia and Africa. Many species of *Solanum* L. are found in plains and foothills throughout India including Western Ghats in Karnataka. Western Ghats are classified into three regions, viz., South (81N to 121N), Central (121N to161N) and North (161N to211N) Western Ghats (Dahanukar et al., 2004). The Central Western Ghats range includes the Karwar (former North Canara) and some parts of Udupi and Dakshin Kannada (former South Canara) districts. Uttar Kannada district has diverse of species because of Western Ghats towards east (Malnad region) and narrow coastal belt of Arabian Sea towards west.

India map locating Karnataka

Map showing locations of study area in Malnad and coastal area of Uttar Kannada in Karnataka

The genus *Solanum* L was first studied by Dillenius and later by Linnaeus . Since 1753 the genus has been reclassified innumerable times and a multitude of varieties, subspecies and species have been named, especially in the section *Solanum* L. For example, Dunal (1813) in his monograph of the genus, described 60 species belonging to section *Solanum* L. Bitter was the second worker to attempt to monograph the genus. D'Arcy (1972) provided a modern classification of the genus *Solanum* L. into subgenera, sections and series, and his classification is widely accepted today. Major 12 clades are identified in *Solanum* L. based on ndhF sequence data (Lynh Bohs, 2005). Although the above major works and others attempted to streamline the taxonomy of *Solanum* L., the genus is taxonomically difficult to classify due to various factors. More detailed studies are required to taxonomists to distinguish the members of *Solanum* L. The responsibility to minimize ambiguity caused by numerous species, overlapping features, ecological distributions , similar genomes and their various growing habitats fall on the researchers (Levin et al, 2005; Oyelana and Ugborogbo, 2008). Therefore, it is an attempt to compare some species of which *Solanum* L. appears identical, but differs in morphological data of stem, leaves, hair and prickles. Establishing facts on these morphological parts could shed more light into their taxonomy and identification to distinguish different species in the genus *Solanum* L.

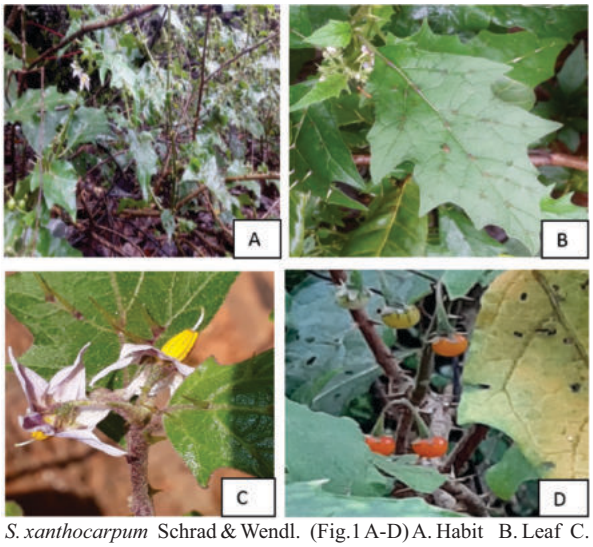
II. MATERIALS AND METHODS

Plant species *S. anguivi* Lam., *S. torvum* Sw. , *S. nigrum* L. , *S. indicum* Linn., *S. Seaforthianum* Andrews., *S.xanthocarpum* Schrad & Wendl., and *S. viarum* Dunal *of* genus *Solanum* L. are surveyed in different areas of Malnad regions of Uttar Kannada District since December 2016. These species are identified and photographed in their natural habitat. To study morphological characters stem, leaves, prickles and hairs of each species are collected from five identified areas surrounding in Sirsi – Honnavar road in the Western Ghat. Flower buds are fixed in FAA in spot to study pollen grains under microscope. Leaves are pressed to prepare herbarium sheets. Hairs mounted on microscope for their micro morphological studies. For light microscopy and photography ProGress c5 ZEISS imager bright field/florescent modular and Nikon DSLR camera used. To figure out more about these wild species communicated with localites and survey of literature done.

Solanum xanthocarpum Schrad & Wendl

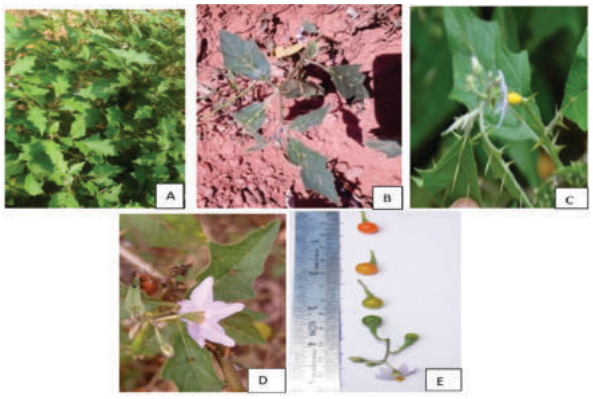
Common name; Kantakari, Nelagulle, Plant is found on hilly region near Kavalakki in Honnavar. Identified by our Professor, Karnataka University, Dharwad. Plant is photographed in its natural habitat. A very prickly perennial herb, somewhat woody at the base about 1m height; stem is somewhat zigzag; branches are numerous, prickles are compressed, straight, yellow, glabrous and shining, often exceeding 1-3cm. Leaves are usually 5-10 in numbers and 3 to 6 cm in length, ovate or elliptic, sinuate or subpinnatified, obtuse or sub acute, stellately hairy on both sides, armed on the midrib and often on the nerves with long yellow sharp prickles, base usually rounded and unequal-sided; petiole 1.3-2.5 cm long. Flower is bluish purple ebracteate pedicellate, bisexual pentamerous regular complete. Corolla is gamopetalous,

lobes deltoid, acute, hairy,1-2cm long. Calyx persistent and is nearly 1.3 cm long, densely hairy and prickly; tube short, globules. Lobes are 11 mm long, linear-lanceolate, acute and hairy outside. Filaments are 1.5mm long, glabrous; anthers 8 mm long. Ovary is ovoid, glabrous; style glabrous. The berries are green when young but changes yellow to orange when mature. Seeds are 2.5 mm in diameter and glabrous. *Solanum xanthocarpum* is the one of the constituent of Dashmula



S. xanthocarpum Schrad & Wendl. (Fig.1 A-D) A. Habit B. Leaf C. Hairs on stem and leaf D.Fruits

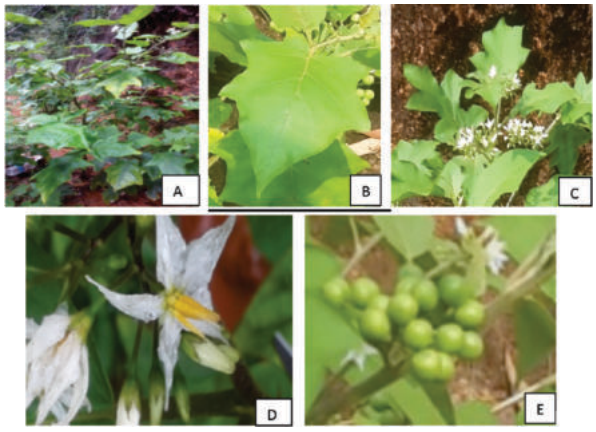
***Solanum anguivi* Lam.** *(*African eggplant*):*



***Solanum anguivi* Lam.(** Fig.2 A-E) A. Habit B. Morphological variations in leaf in young plant. C. Flowering twig D. Flower E. Fruit colour changes from green to orange

A prickly under shrub commonly found in Africa, and is very rare in India, collected in Areangadi near Gerusoppa. Identified by our professor well versed botanist who worked on medicinal plants of Karwar District. It is 1.5-2.0m tall, with dense tomentose parts. Stem is prickly, bearing small, sessile, stellate hairs with 4-8 arms., Leaves are alternate, simple, sinuate to distinctly lobed lanceolate. Prickles on veins of both the surface of leaf are up to 10mm long. Inflorescence is extra- auxiliary chyme with 3-15 bluish-purple flowers. Corolla is stellate 6-12mm in diameter. Plant with white or pale purple flowers are found. Calyx is companulate, with stellate hairs. Corolla is 6-12mm in diameter, limb 18-20mm broad lobes, acute. Anthers 6-7mm long; filaments glabrous. Ovary and style filose pubescent. Stamens are yellow about 6mm. Berry globose green turns yellow when ripe. It is variable species. It exhibits tremendous variation in prickliness and pubescence and in its inflorescence due to change in weather. In young plant, some leaves without prickles also found.*Solanum torvum* Swartz

Common name; Sundakkai. Bhurat
Turkey berry is a broadleaved, evergreen, shrub or small tree commonly found in wastelands in coastal to plain regions. These plants found at roadside in Hadinbal at different stages are photographed in October 2017. Plants can grow to 4-5 m in height. The stems are armed with stout, straight or lightly curved prickles. The alternate leaves are elliptical. Leaves are up to 25 cm long, about 15 cm wide, wavy along the margins and have prickles on the veins. *Solanum torvum* has small, white flowers that occur in large, branched clusters. This plant reaches about 1 to 1.5 m in height and flowers throughout year. The fruits are small green berries that turn yellow when ripe.

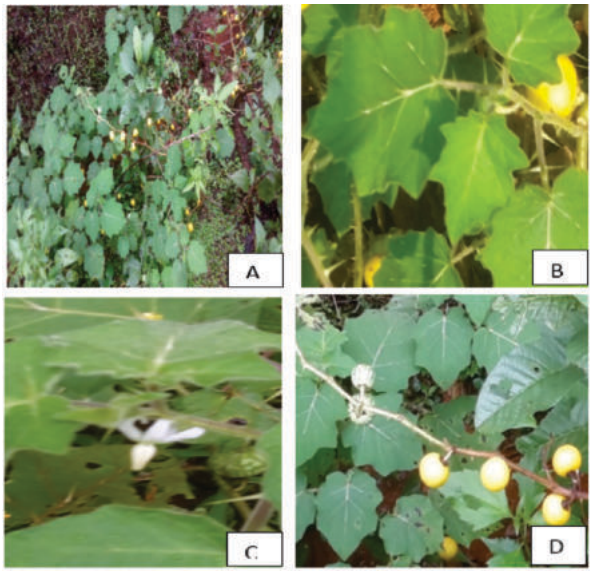


Solanum torvum Swartz. (Fig.3 A-E) A. Habit B. Leaf C. Flowering twig D. Flower E. Fruit

Solanum viarum Dunal.
common name;Tropical Soda apple

It is a perennial woody night shade found near roadside. It is about 1m height having leaves irregular lobbed with 3-5 rounded lobes, lobes usually reaching middle and having prickles on the viens on both surface. Petiole is about 3-7cm. Stellate hair found on stem and leaves. Prickles found on the nerves of the leaf are long straight and upto 2cm long. The prickles on stem are wide based and curved at tip and upto 5mm long.

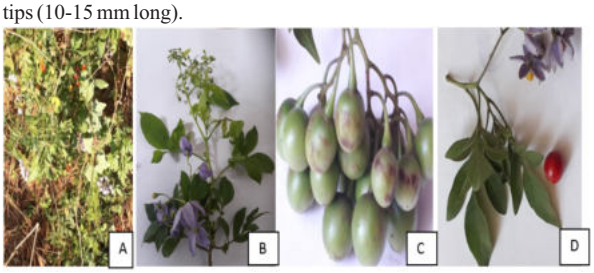
It has white medium sized flowers with narrow corolla lobes about 8-10mm long curve backward. The flowers are in cluster. Infloroscense raceme having 1-5 flowers. It has typically young berries with white and green patches and turns yellow when ripen.



Solanum viarum Dunal. (Fig 4 A-D) A. Habit B. Leaf with prickles C.Flower D.Fruit

***Solanum seaforthianum* Andrews.**
Common name: Brazilian night shade ,Vining *solanum*
A perennial vine with climbing or sprawling stems, covering fences or shrubs, reaching up to 5 m in height found at Dasankoppa in Sirsi. It is an Italian Jasmine a flowering evergreen vine of the *Solanum* family native to tropical South America. Named after Lord Seaforth, who sent a specimen to England from west India. It blooms in the mid to late summer with clusters of star-shaped purple inflorescence followed by scarlet marble-sized berries. The plant is highly heat resistant, but

cannot tolerate frost conditions. The sprawling stems with tendrils which can climb to a height of 5-6 m if it was given enough room . The stems are green and mostly glabrous. It is characterized by clusters of four to seven leaves alternately arranged the base and have triangular tips (10-15 mm long).

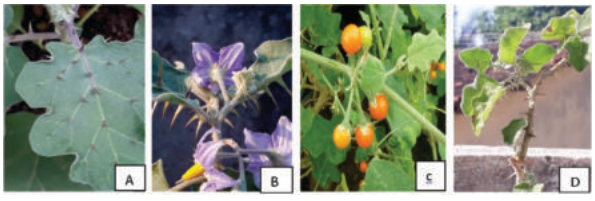


***Solanum seaforthianum* Andrews**. (Fig.5 A-D) A. Habit B. Pinnate leaves and flowers C. Green young fruits in bunches D. Leaf

***Solanum indicum* Linn.**

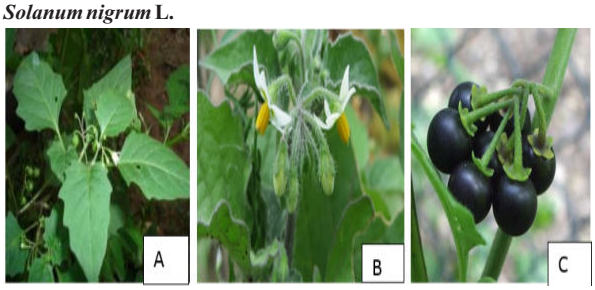
Common name : Brihati, Bari Kateri

Plant is collected at roadside of NH66 Honavar-Kumta. Seeds collected from identified plant sown in pot in our garden. Observations are photographed and note down. Plant is stiff, erect first and branched later, prickly purplish shrub growing upto a height of 1–1.5 m. Prickles are sharp, often recurved. These have broad compressed base located on stem and leaves. Leaves are ovate in shape, sinuate. Prickles are found on both sides on nerves. Stem and branches are covered with hair. They are clothed with stellate hairs intermixed with small hairs, while small stellate hairs cover them on the lower surface. Petiole is prickly and about 1.3–2.5 cm long .



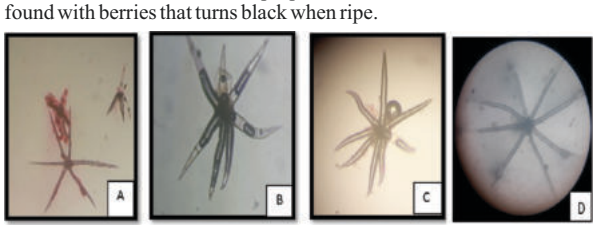
***Solanum indicum* *Linn*.** (Fig.6 A-D) A. Plant with erect stem B. Leaf with prickles C. Flowering twig with tomentose parts D.. Fruits turns orange

***Solanum nigrum* L.**



Solanum nigrum (Fig. 7 A-C) A. Habit B. Flowering twig C. Ripened black fruit

Black nightshade is a common herb or short-lived perennial shrub, found in many wooded areas, as well as disturbed habitats. It reaches a height of 30 to 120 cm leaves 4.0 to 7.5 cm long and 2 to 5 cm wide; ovate to heart-shaped, with wavy or large-toothed edges; both surfaces hairy or hairless; petiole 1 to 3 cm long with a winged upper portion. The flowers have petals greenish to whitish, recurved when aged and surround prominent bright yellow anthers. The berry is mostly 6 to 8 mm in diameter, dull black or purple-black. In India, another strain is found with berries that turns black when ripe.



Stellate hair/Trichomes on leaf (Fig. A-D) stellate hair with 6 projections in *S. indicum* B.stellate hair with 7 vacuolated projection in *S.xanthocarpum* C. stellate hair with 7 filled projections in *S. anguivi* D. Stellate hair with 8 projection in *S. torvum*

RESULT AND DISCUSSION

Morphology of Leaf, Trichome and Prickle:-Some distinctive characters like leaf shape, size, venation, prickles size, shape, arrangement on leaf, trichome type, number of ramification have been studied and summarized in table 1,2 and 3.

Table No.1

No.	Species	Leaf venation	Leaf length	Leaf width	Leaf form
1	*S. anguivi*	Eucamptodromous	4-15cm	3.5-9cm	Rhombic ovate /elliptic/lanceolate 2-4 pair lobes
2	*S. torvum*	Eucamptodromous	15-25cm	13-23cm	Ovate, orbicular
3	*S.nigrum*	Eucamptodromous	4-7.5cm	2-5cm	Ovate
4	*S. indicum*	Eucamptodromous	5-15cm	2.5-7.5cm	Ovate
5	*S.xanthocarpum*	Eucamptodromous	2.5-5.7cm	3.5-6.2cm	Ovate/elliptic/sub-pinnatified
6	*S. viarum*	Eucamptodromous	18-20cm	13-15cm	Oblong ovate. 3-5 unequal lobes
7	*S.seaforthium*	Pinnatified	4-13m	2-15cm	Pinnate

Table No. 2

No.	Species	prickles arrangement pattern on leaf	Prickle length on leaf	Prickle length on stem	Prickle shape
1	*S. anguivi*	both sides of midrib and veins	5mm	3mm	Recurved, erect
2	*S. torvum*	lower surface of midrib	3mm	2mm	Stout
3	*S.nigrum*	No prickles			
4	*S. indicum*	both sides of midrib and veins	7mm	5mm	Curved
5	*S.xanthocarpum*	both sides of midrib and veins	9mm	7mm	Straight, curved
6	*S. viarum*	both sides of midrib and veins	10mm upto 2cm	5mm	Straight, curved
7	*S.seaforthium*	No prickles			

Table No. 3 Morphology of trichome/hair

No.	Species	Stellate hair	No. of ramification of stellate hair	Type of Trichome on leaf
1	*S. anguivi*	Present	6-8	Glandular and non glandular trichomes on both surface
2	*S. torvum*	Present	7-8	non glandular and glandular on both surface
3	*S.nigrum*	Present	3-8	Glandular on upper surface, non glandular stellate on both surface
4	*S. indicum*	Present	5-8	Non glandular and glandular on both surface
5	*S.xanthocarpum*	Present	7-8	Non glandular and glandular on both surface
6	*S. viarum*	Present	5	Non glandular on both surface
7	*S.seaforthium*	Absent	-	Non glandular and glandular trichome

Wild species of *Solanum* L. are *S. torvum* Sw. *, S.nigrum* L. *, S. indicum* Linn.,

S.xanthocarpum Schrad & Wendl., and *S. viarum* Dunal commonly found on road sides, field, forest and coast lands of Malnad region of Karwar district. Above Table 1,2&3 will help to differentiate these species. *S.torvum* found in Malnad region near hills having large fruit measures diameter upto 12mm grown in October. *Solanum torvum* has bright green leaves, green stem and is about 4-5 m in height in wet lands. Same species has dark green leaves with brownish stem in dry area in Haveri. Fisher woman called it as kadubadane and explained about its prickles preparation. Fruits are gathered when green and cooked as vegetable. These are chewed as remedy for coughs and chest pains. The roots are used to treatment of astama.

Solanum anguivi , Solanum indicum and *Solanum xanthocarpum* have purple pentamerous, flower but varies in size and shape . Flowers are *Solanum anguivi, Solanum indicum, Solanum xanthocarpum* arranged in the ascending order in their size. *Solanum indicum* and *Solanum xanthocarpum* are erect plants (Fig.1A & Fig.6A) but *Solanum xanthocarpum* has woody stem. Stem of *Solanum indicum* is purplish in colour. *Solanum anguivi* has bushy stem height is about 1to 2 m., but its characteristic, lanceolate shaped leaves helps to differentiate it from above other two species.(Fig.2B). *Solànum indicum , Solanum anguivi* and *Solanum xanthocarpum* leaves having prickles on the mid rib and veins on both surfaces. *Solanum indicum* leaves are ovate and clothed with stellate hairs. *Solanum xanthocarpum* leaves are ovate but subpinnatified(Fig.1B) . Prickles on leaves in *Solanum xanthocarpum* are dense, straight sharp and yellowish . Prickles on *Solanum indicum* are purplish .

Prickly plant with sharp long prickles on leaves *Solanum viarum* have large leaves with 18 to 20 cm. length and 13 to 15 cm. width Prickle's size varies from 18 mm to 2 cm long. *Solanum viarum* is short plant compared to white flowered species *Solanum torvum*. *Solanum torvum* has white branched clustered inflorescence green coloured bunch of fruits. *Solanum viarum* has white flowers but fruit are green with white patches when it is young turns yellow when ripens.

Solanum indicum and *Solanum torvum ,* commonly occurred in Karwar and *Solanam seaforthianum* is rare in Uttar Kannada district . *Solanum xanthocarpum* are found in malnad region of Uttar Kannada district, but not in coastal belt. Size of hair/trichome and number of projections in hair varies from species to species . Size of prickles on leaf is more than that of on stem, in *solanum* xanthocarpum, S*olanum torvum*, *Solanum anguivi* and *Solanum indicum*. In *Solanum anguivi*, leaves show variation in morphology.

III. CONCLUSION

This study of comparison of night shades found in Western Ghats in Uttar kannada District will be helpful to herbalist and pharmacologists to identify and to find species of the genus *Solanum* viz, *S. anguivi* Lam.*, S. torvum* Sw. *, S. nigrum* L.*, S. indicum* Linn., *S. Seaforthianum* Andrews., *S. xanthocarpum* Schrad & Wendl., and *S. viarum* Dunal. Morphological data of stem, leaves, hair/trichome and prickles, collected from these species and their comparative study details assist to differentiate them effortlessly.

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