Molecular and Morphological Characterization of South Indian Cucurbitaceae Species

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Abstract

Critical checklists for the Cucurbitaceae of southern India have not been updated in 30 years. Taxonomic borders and regional ranges have been revised as a result of molecular-phylogenetic investigations, online specimen pictures and taxonomic literature, and botanical exploration since then. Here we offer a Cucurbitaceae taxonomic checklist for southern India, including 400 important names and including data on herbaria and collecting sites for each species. A total of 94 species from 31 genera are welcome here, with 10 of those being indigenous. We emphasize gaps in the existing understanding of South Indian cucurbit diversity by providing geographic distribution inside and outside of India, links to online photos of herbarium or living specimens, and information on publically available DNA sequences for approved species. Although DNA sequences from South Indian material are rare, 79% of the 94 species have been added to GenBank. Trichosanthes has 22 species, Cucumis has 11 (all but two of which are wild), Momordica has 8, and Zehneria has 5. The diversity of lineages found in southern India, including several that are ancient and phylogenetically distinct, makes the region intriguing from an evolutionary perspective. From a phytogeographic perspective, the variety of Cucurbitaceae is highest in the northeastern and peninsular regions, and it is lowest in the Jammu and Kashmir and Himachal regions. We acknowledge that our checklist may not capture the whole extent of South Indian Cucurbitaceae variety, but it should assist in directing research towards understudied species and areas.

Keywords: ***Characterization, Molecular, South Indian, Morphological, Cucurbitaceae Species.***

1. Introduction

In addition to being one of the most significant families, the Cucurbitaceae family is commonly recognized for the vegetables that it produces. This family is comprised of approximately 110 genera and close to 850 species, the majority of which are found in tropical and subtropical regions of the world. The country of India has been reported to have approximately 37 genera and 100 species. For the purposes of food, edible fruits, and medicinal applications, it is a significant family.

The Cucurbitaceae family of flowering plants, also known as the gourd family, which is a member of the order Cucurbitales and includes over 975 species of both edible and ornamental plants, is comprised of 98 genera. Plants such as cucumbers, gourds, melons, squashes, and pumpkins are examples of members of the family. These plants can be either annual or perennial and are native to both temperate and tropical regions. Because the majority of species are particularly sensitive to temperatures that are close to freezing, their geographic distribution and the area in which they may be cultivated are both restricted. Cucurbits, in general, have a poor nutrient content; however, winter squashes, namely particular kinds of Cucurbita maxima, C. moschata, and C. pepo, are an exception to this rule. For a list of plants belonging to the Cucurbitaceae family, see also.

Figure 1: Cucurbitaceaes

Long-stalked palmate leaves that alternate along the stem are characteristic of the majority of species, which are either prostrate or climbing vines that develop quickly. When it comes to annual species, there is a basic tendril that is spirally coiled and frequently branched that is located at the side of the leafstalk. In the opinion of the vast majority of botanists, it is a modified shoot that serves the purpose of providing support for the vine stems. The majority

of species have flowers that are unisexual, with five petals that are either white or yellow, and are borne in the axils of the leaves. There are five sepals in each flower; male flowers can have up to five anthers, which are sometimes merged or linked in a complicated manner; and female flowers typically have three carpels. A pepo is the name given to the fruit of the majority of species, which is a fleshy berry with many seeds and a strong rind that can frequently grow to a significant size. The seeds are flattened, and some of them, like the ones produced by the Javan cucumber (Alsomitra macrocarpa), have lovely wings that help them spread during the process of migration.

2. Literature Review

Kavita Devi et al., (2014) Standardization of Cucumis melo sub sp. agrestis was carried out in accordance with the guidelines provided by the World Health Organization (WHO). This included macroscopy and microscopy, ash value, extractive values, loss on drying flurescences analysis, swelling index, foaming index, and detection of volatile oil content. Extracts of powdered seeds made with methanol and water were analyzed for a variety of phytoconstituents in order to bring the study to a successful conclusion. These investigations offer the identification and standardization of this plant material with useful information that may be used for both purposes.

Nirmala and Pandian (2013)examined the physical characteristics as well as the taxonomic characteristics of Kedrostis foetidissima. The proliferative effect of this plant was another aspect that they investigated. conducted research on the anatomical characteristics of the entire plant of Kedrostis foetidissima, which is a member of the family Cucurbitaceae and can be found in 14 distinct geographical conditions. The K. foetidissima strain exhibits vascular bundles that are bicollateral. Both reticulate venations and a large number of hairs are present on the lamina. It was found that the epidermal cells contained chemical compounds.

Kumar et al., (2010) intended to determine the pharmacognostical profile of the leaves of the plant known as Momordica tuberosa? For the purpose of establishing the comprehensive profile of this plant, morphoanatomy of its leaves was investigated. This was done to facilitate the identification of the plant and to prevent confusion among taxonomic taxa. There is a pronounced midrib and the lamina on the leaf of Momordica tuberosa, which is a dorsiventral configuration. Cystolith entities composed of calcium carbonate are regularly observed in the mesophyll tissue of the leaf. The cystolith may take the form of a round body that is situated within lithocytes, which are cells that have been enlarged.

Ismail et al., (2015) Colocynthis, Cucumis, Cucurbita, Citrullus, and Luffa are the five genera that belong to the family Cucurbitaceae. In order to gain a better understanding of the evolution of anatomical variety, the anatomical characteristics of these five genera were researched. Similarities were found in the root, stem, and leaf transverse sections of all genera with regard to the distribution of cells and tissues, the differentiation of tissues, and the number of layers of individual cells and tissues.

Shabeena et al., (2014)possess knowledge of the trichome of the Citrullus collocynthis plant. There are many cells present in the trichomes of Citrullus colocynthis. There are instances in which the wall of the trichomes of C. collocynthis is impregnated with either calcium or silica. Because they induce irritation when they are touched, the trichomes of Citrullus are known to be stinging trichomes.

3. Molecular Characterization

DNA barcoding is an amazing asset for animal groups ID in view of short, normalized DNA successions from a particular locale of the genome. On account of plants, a well-known focus for barcoding is the chloroplast quality rbcL (ribulose-1,5-bisphosphate carboxylase/oxygenase enormous subunit). This quality is maternally acquired and develops at a generally sluggish rate, making it reasonable for recognizing species while limiting intraspecific variety.

3.1. DNA Barcoding

DNA barcoding is a sub-atomic method utilized for species recognizable proof and separation. It includes sequencing short, normalized areas of DNA, commonly in the

mitochondrial or chloroplast genome, which display adequate variety among species while keeping up with protection inside species. For Cucurbitaceae species, ordinarily utilized DNA barcoding locales incorporate parts of the rbcL (Ribulose-1,5-bisphosphate carboxylase/oxygenase huge subunit) and matK (maturase K) qualities in the chloroplast genome.

Figure 2:DNA Barcoding

The cycle starts with DNA extraction from examples of interest, trailed by PCR (Polymerase Chain Response) enhancement of the objective DNA barcode district. The enhanced DNA pieces are then sequenced, and the subsequent arrangements are contrasted with reference successions in DNA barcode databases like the Barcode of Life Data Systems (BOLD) or the National Center for Biotechnology Information (NCBI) GenBank. By breaking down succession likeness, specialists can precisely distinguish and separate between firmly related Cucurbitaceae species, helping with scientific classification, biodiversity appraisal, and preservation efforts.

3.2. Microsatellite Analysis

Microsatellites, otherwise called simple sequence repeats (SSRs) or short tandem repeats (STRs), are short DNA sequences comprising of rehashed themes, commonly 1-6 base matches long. Microsatellite investigation includes PCR intensification of these monotonous DNA locales utilizing preliminaries intended to flank the microsatellite loci. The subsequent PCR items are then broke down utilizing gel electrophoresis or slim electrophoresis to decide the length of the microsatellite alleles.

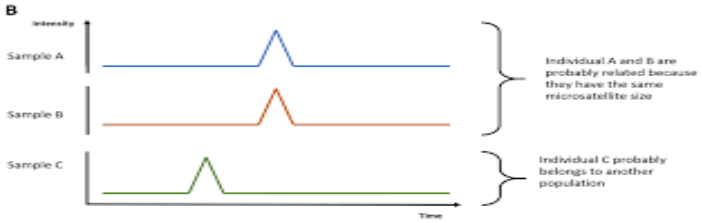

Figure 3: Microsatellite Analysis

Microsatellites show elevated degrees of polymorphism because of varieties in the quantity of recurrent units, making them significant markers for evaluating hereditary variety inside and between populaces of Cucurbitaceae species. By breaking down allele frequencies and hereditary distances, specialists can deduce populace structure, quality stream designs, and developmental connections among various Cucurbitaceae populaces. Microsatellite markers are especially valuable in protection hereditary qualities, plant rearing, and germplasm the board, as they give experiences into the circulation of hereditary variety and assist with distinguishing populaces of preservation concern or reproducing lines with positive attributes. Generally, DNA barcoding and microsatellite examination are strong atomic devices that complete one another in the sub-atomic portrayal of Cucurbitaceae species, working with ordered grouping, hereditary variety evaluation, and protection prioritization efforts.

4. Morphological Characterization

Morphological characterization includes an itemized assessment of different plant designs to gather significant ordered information for recognizable proof and grouping. This study centers around key Cucurbitaceae structures: leaves, blossoms.

4.1. Stems

Analyzing stem qualities like surface, variety, expanding example, and presence of thistles or hairs can give significant information about the plant species.

Figure 4: Stems

For instance, the presence of woody stems versus herbaceous stems can be characteristic of various plant families or genera.

4.2. Roots

Root morphology, including root length, breadth, expanding example, and presence of root hairs, can fluctuate significantly among plant species. A few plants might have taproots, while others might have stringy underground roots.

Figure 5: Roots

Concentrating on root morphology can be especially valuable for distinguishing plants that are hard to separate in light of over the ground attributes alone.

4.3. Seeds

Seed morphology can differ broadly among plant species and can be utilized as a demonstrative trademark for distinguishing proof.

Figure 6: Seeds

Seed size, shape, variety, surface, and presence of members (like wings or hairs) are highlights that can be inspected to recognize different plant taxa.

4.4. Bark

For woody plants, bark morphology can be a significant indicative component.

Figure 7: Bark

Qualities like bark surface, variety, thickness, and presence of lenticels or different markings can assist with distinguishing species or genera.

4.5. Reproductive structures

For the motivation behind aiding the ID of plants, it is possible to morphologically portray elective conceptive designs, like cones (in gymnosperms) or spore-bearing designs (in greeneries and other non-blooming plants), notwithstanding blossoms and natural products.

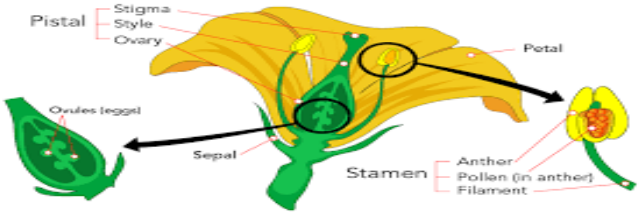

Figure 8: Reproductive structures in plants

This is finished to give a more far-reaching comprehension of the plant.

Generally, morphological characterization includes cautious perception and documentation of different plant designs to distinguish key qualities that can be utilized for ordered grouping and species separation.

5. Conclusion

All in all, the atomic and morphological portrayal of South Indian Cucurbitaceae species has given significant experiences into the variety and scientific classification of this plant family in the area. Through the joined examination of DNA groupings, leaf morphology, blossom designs, and natural product qualities, specialists have had the option to recognize and arrange various species, explain their transformative connections, and survey their hereditary variety. This thorough methodology has added to how we might interpret the biodiversity and protection status of Cucurbitaceae species in South India, and can illuminate future examination and preservation endeavors pointed toward safeguarding these significant plants and their natural surroundings.

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