Floral anatomy of *Solanum grandiflorum* Ruiz. & Pav. indicates its specialized nature among *Solanums*

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The vascular organization in the flower of *Solanum* reveals that the pedicellar vascular cylinder sequentially provides single trace each to the sepal, petal and stamen, allowing the formation of petal–staminal tube. The ovary is bicarpellary and bilocular without any residual bundle. However, a deviating pattern is encountered in *S. grandiflorum*, which differs distinctly from the typical *Solanum* type. The peculiar distinguishing features characterizing this species are discussed in the context of structural floral organization patterns, and in relation to the other species of *Solanum*.

THE peculiar organization of carpellary features and placenta (swollen and oblique) with a range of varied types in Solanaceae has attracted the attention of floral morphologists and anatomists. During the course of investigation on floral organization covering various species of *Solanum*, a deviating vascular structural pattern in *S. grandiflorum* was revealed. The present communication is aimed to provide the constituent peculiar anatomical features attendant in this particular species, *vis-à-vis* its comparison with other *Solanums* and evolutionary implications.

Twenty-two species of the genus *Solanum*, namely, *S. indicum*, *S. tuberosum*, *S. surattense*, *S. jasminoides*, *S. torvum*, *S. nigrum*, *S. grandiflorum*, *S. macranthum*, *S. pseudocapsicum*, *S. melongena*, *S. erianthum*, *S. khasianum*, *S. sisymbrifolium*, *S. triquatrum*, *S. gigantium*, *S. mandonis*, *S. glaucum*, *S. indica*, *S. ptendran*, *S. biflorum*, *S. trilobatum* and *S. viarum*, were examined for their floral anatomy. The flowers were fixed in FAA and processed as usual for microtomy. The serial transverse sections cut at 8 μm thickness were stained in safranin/fastgreen combinations. Camera lucida drawings were made for analysis and comparison.

Except *S. grandiflorum*, in all of the species examined, the pedicellar vascular cylinder sequentially provides single trace each to the sepal, petal and stamen (Figure 1 *c*). Each of the carpels is supplied by one dorsal and two inversely oriented ventral bundles which are arranged on alternate radii. The petal–staminal tube extends till the emergence of ovular locule (Figure 1 *e*). The ovary does not show the existence of any residual bundle. The gynoecium is usually bicarpellary but tricarpellary condition sometimes exists as in *S. melongena* and *S. tuberosum* (Figure 1 *n*).

However, in *S. grandiflorum* several vascular branches emerge in the peripheral region which are organized at higher level into three traced sepal (Figure 1 *f*,*g*). The sepal–petal–staminal tube with its traces run together till the emergence of ovular locules (Figure 1 *g*,*h*). The carpellary dorsals separate along with sepal traces, whereas ventrals, ovary wall bundles, residual bundle, and petal, stamen–bundles, separate simultaneously (Figure 1 *i*). The ventrals lie close to the dorsal and supply the placenta, while submarginals and the residual bundle do not supply any organ. The ovary is tetralocular due to the formation of false septum (Figure 1 *l*). The four placentae appear to originate from the dorsal side of the swollen ovary bearing numerous ovules which are oriented in different directions on each placenta (Figure 1 *l*,*k*).

All the floral organs in the genus *Solanum* receive their supply independently and directly from the vascular cylinder. There is no adhesion or cohesion of vasculature despite the organs showing both adhesion and cohesion among themselves[1].

Sepals in all species receive single trace, but for *S. grandiflorum*, wherein sepal receives three traces. Such a three traced sepal is otherwise widely attained in the various other taxa of family Solanaceae and has been described as a specialized condition[2]. The vascular supply to the carpel in the various species of the genus shows hypogynous condition of the flower. But in *S. grandiflorum* the carpellary vasculature originates along with the sepal trace. Here, the vasculature slightly traverse downward and later extend upward into the carpel, simulating perigyny – a unique feature among *Solanums*. Further, the increase in number of carpellary locules in this species accrue as a consequence of the spurious outgrowth arising from the placenta, which extends up to the wall of the ovary leading to the formation of false septum, in a fashion also mentioned by others[3,4].

The carpellary vasculature in *Solanum* clearly shows the occurrence of axile placentation. However, the presence of ventrals in close proximity just below the dorsals in *S. grandiflorum* gives a (false) impression of parietal placentation. But, since the dorsal and ventral bundles are not present on alternate radii as required[5–7], this impression is ruled out, thus confirming anatomically an axile placentation in *S. grandiflorum* too. In this species the two margins of the carpel have involutely folded to the extent that they have reached very close to the dorsals due to the spurious growth of the false septum. This is substantiated from the fact that the ventral bundles are inversely oriented fused marginals supplying the two halves of the placenta. The floral organization in *S. grandiflorum* reveals another interesting feature with respect to the orientation of ovules on four placentae. It has been suggested[8,9] that each placenta is a double structure (i.e. made up of two halves with ovules arranged in opposite directions on each half). This would mean that for a tetralocular

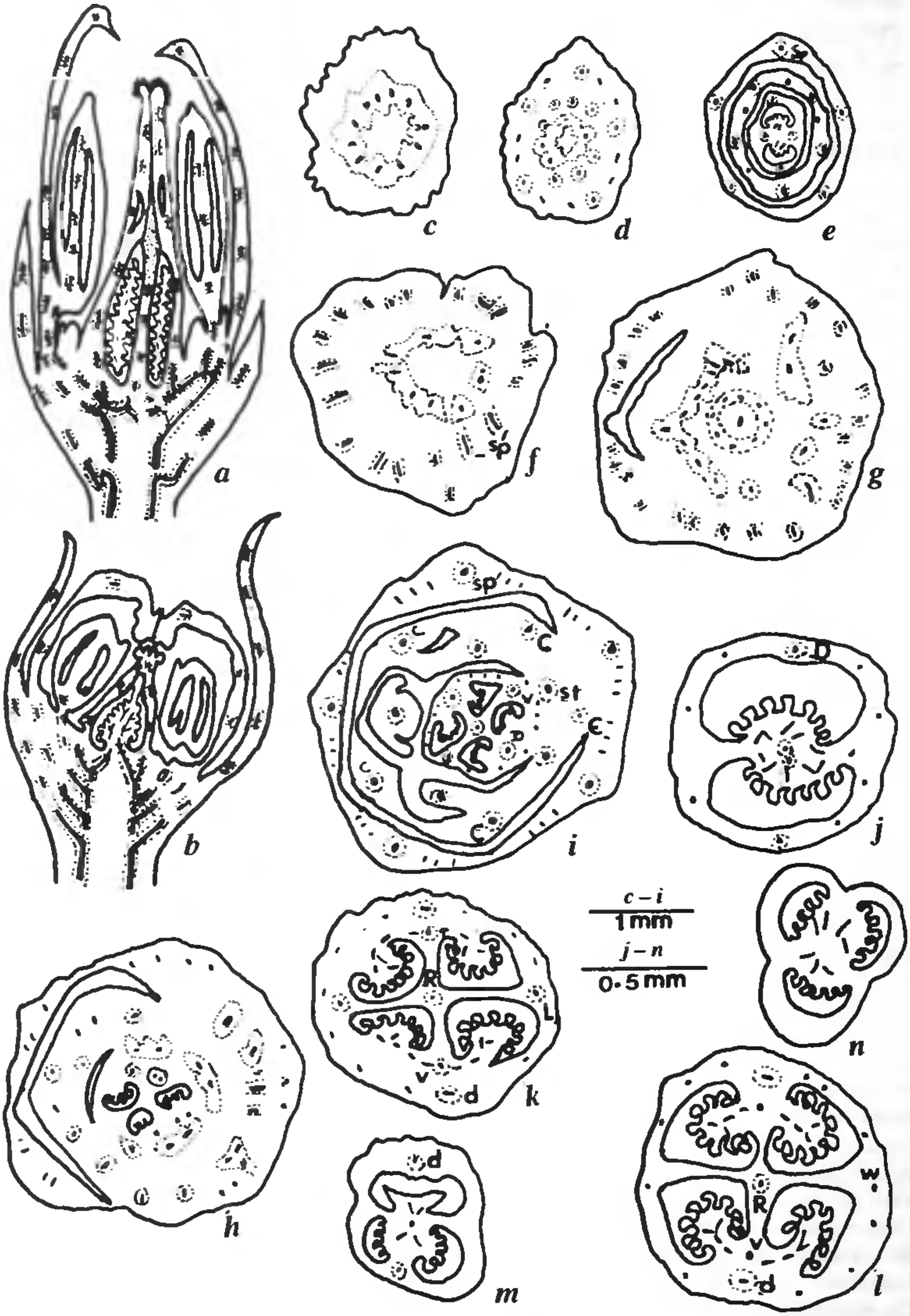

Figure 1a–n. Floral anatomy of *Solanum*. *a–b*, diagrammatic representation of L. S. of flower: *a*, *S. grandiflorum*; *b*, *S. indicum*; *c–i*, serial transverse sections through various floral organs showing vascular supply. *c*, main vascular cylinder, *d–i*, separation of vascular traces for different floral organs. (*d*, *e*, *S. indicum*. *f–i*, *S. grandiflorium*); *j–m*, T. S. of ovary showing ovular orientation. *j*, *S. indicum*; *k*, *l*, *m*, *S. grandiflorum*; *n*, T. S. of *S. melongena* showing tricarpellary condition. sp, sepal trace; c, petal trace; st, staminal trace; d, dorsal bundle; w, wall bundle; R, residual bundle, L, lateral bundle.

ovary, the ovules should be borne on four distinct groups, each representing a part of half placenta. But in *S. grandiflorum* with four distinct placentae, the ovular orientation is in opposite direction on each half of the placenta (Figure 1 *l–k*), which is at variance with the usual orientation (Figure 1 *i*) as generally advocated[8]. Nevertheless, Puri's view[8] of half placenta can get support in *S. grandiflorum* only when its gynoecium is taken as tetracarpellary–a situation which is not commensurate with the existence of only two dorsals as observed against the four expected.

The existence of a residual concentric vascular bundle in the centre of the ovary in *S. grandiflorum* is another interesting feature, not found in other species of the genus. But this bundle certainly does not belong to the residual floral apex, as its morphological nature does not resemble the structure, i.e. endarch, conjoint and bicollateral. Nevertheless, its origin may be assumed from the congenital fusion of the four submarginal bundles of the two carpels forming one concentric bundle, which does not supply any organ but is consumed in the placenta itself.

From the foregoing discussion it is clear that floral anatomy of *S. grandiflorum* presents certain unique features which indicate its specialized nature among *Solanums*. The occurrence of perigynous condition, three traced sepal, sepal–petal–staminal tube, formation of false septum imitating tetracarpellary/tetralocular condition, a morphological tendency towards parietal placentation (with a unique type of placenta) and existence of a central carpellary residual bundle, all represent a sort of specialized condition for this species.

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An 18 mer sequence in a rat 1.3 kbp *Eco*RI repeat detects genetic polymorphism in humans

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DNA fingerprinting involves the typing of an individual's DNA content to produce somatically stable, individual-specific DNA fingerprints. This technique often uses hypervariable minisatellite (HVMS) sequences as the fingerprinting probe and has found extensive use in several disciplines. Recently, we sequenced a 1.3 kbp *Eco*RI repetitive DNA fragment, shown to harbour the meiotic DNA repair site(s) of rat pachytene spermatocytes. This 1.3 kbp clone contained four sequences sharing high homology to the various HVMS sequences reported in the literature. Here we show that one of the sequences can indeed detect polymorphism in human individuals and can be used for DNA fingerprinting.

HYPERVARIABLE minisatellite (HVMS) sequences are highly prevalent in eukaryotic genomes of a number of species including humans. Minisatellites consist of short G+C repeats present in tandem to form arrays. They display strand asymmetry, in that one strand has a high G content[1]. Though no overall sequence consensus has been noted, several families of minisatellites identified contain a consensus 'core' sequence of 10 to 15 bp (ref. 2). Minisatellite sequences display considerable polymorphism in terms of the number of repeats present in an array and also in the sequence composition of each individual repeat within the array. Taking advantage of the genetic polymorphism detected by these sequences at several loci in the genome, Jeffreys and coworkers[2,3] developed the principle of DNA fingerprinting. This technique initially utilized the core sequences of HVMS as probes to generate somatically stable, individual-specific DNA fingerprints. More recently, Ehtesham *et al.*[4] developed a novel probe for human DNA fingerprinting which contained chi-like sequences. DNA fingerprinting has found wide-spread application in several disciplines including forensics, paternity testing, ecological genetics, immigration laws and transplant screening to name a few. Over the years, this technique has undergone considerable refinement. Polymerase chain reaction (PCR) amplification of hypervariable loci, has considerably increased the sensitivity of DNA typing systems and has proved extremely useful when the DNA source is limiting or degraded[5].

The mechanism of generation of polymorphism has generated considerable debate over the last several years. Owing to the high homology of the 'core' sequence of the HVMS with that of the general recombination signal of *E. coli* (chi) it has often been postulated that these