Chapter 6

Summary and Highlights

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The flora of any region is of immense importance as it refers to the availability and proper utilization of all the plants in that region. Apart from the monumental work of Hooker (Flora of British India) in which the floristic elements of Gujarat are represented, only G. L. Shah (1978) ventured to prepare a flora of Gujarat. A large number, of regional floras of Districts and Talukas are prepared by scholars of different Universities and research institutions of the State. A flora with elaborative illustrations of all the plants will facilitate greatly the proper recognition of all the plant taxa. But, there is no illustrated flora available for any student of taxonomy to refer to. Therefore, in the present work proper illustrations, description and micromorphological studies have been done on all the plants. The significance of micromorphological characters, such as trichomes, glands, stomata types, nectaries, etc. in providing additional aid for identification and descriptions is understood of late and these characters are highlighted in a large number of scientific papers appeared in recent botanical journals. These characters, when present in a vegetative organ would aid in the identification of a plant even in a vegetative state. Since, in our studies we have found a number of taxa showing many variations in characters from the type specimens mentioned in earlier floras and that these variations, which are passed on from generations to generations and being cumulative may lead to formation of smaller categories and later, higher categories like species. The overexploitation of useful plants by indiscriminate collection, make them threatened and even endangered. Since, the related plants may produce the same compounds or similar compounds to the chemicals in question, Bioprospecting in which biologically related plants are screened for quality phytochemicals also is done at many places.

With the above objectives in mind, in the present research project, 400 plants collected from regions of Baroda and Panchmahal Districts have been subjected to a detailed study on morphological and micromorphological characters such as stomatal types, types of trichomes, glands and corolline nectaries, both in the vegetative

as well as reproductive parts. Detailed line drawings of these plants and their micromorphological characters are prepared and compiled. Variations in characters from the standard descriptions given in a flora were noted. In addition, 11 plants have been studied for bioprospecting of chemical compounds such as quinones (*Aloe* flowers, fruit walls and seeds); volatile oils (*Stemodia serrata, Stemodia viscosa* and *Ageratum houstanianum*); flavonoids (*Alternanthera bettzickiana, A. sessilis, Ageratum conyzoides, Riedleia corchorifolia* and *Hygrophila schulli*); mucilage (calyx of *Bombax ceiba* flower); and fixed oils (*Aloe* seeds and *Balanites aegyptiaca*)

The objectives of the project were the following:

1. To study flora of Baroda and Panchmahal district with special emphasis on all the morphological and micromorphological characters of the plants collected.
2. To prepare diagrammatic illustrations of the plants studied.
3. To look for variations, if any, in morphological characters in plants which may give any idea of trends in speciation.
4. Bioprospecting of certain plants for useful chemicals.

Methodology

1. Collection of plants from different locations of Baroda and Panchmahal Districts.
2. Detailed study of plants for its morphological and micromorphological characters using simple and compound microscopes.
3. Comparing the descriptions thus prepared with those of a standard flora and noting down variations.
4. Analysis of plants for useful chemicals by standard methods of extraction and analysis.

Results and Discussion

The line drawings of 400 plants containing the details of plants including the micromorphological characters of these plants were prepared, that resulted in a total of

655 line drawings. On comparison with the data of available floras it is found that Twenty-nine plants showed variations in some or the other characters from the standard descriptions.

The plants and their variations are the following:

Name of plants	Reported characters	Variations observed
1.*Mollugo oppositifolia* Linn.	Stamens usually 3	Stamens 4-5.
2.*Peristrophe bicalyculata* Nees.	Stem 6-angled. Ovary hairy at the tip. Filaments hairy	Stem 5-angled. Ovary glabrous. Filaments glabrous.
3. *Solanum nigrum* Linn.	Calyx glabrous Calyx not enlarged in fruit. Filaments hairy.	Calyx hairy. Calyx enlarged in fruit Filaments glabrous.
4. *Physalis minima* Linn.	Filaments glabrous	Filaments hairy.
5. *Oxalis corniculata* Linn.	Stigma papillose	Stigma not papillose.
6. *Cassia occidentalis* Linn.	Staminodes 3	Staminodes 4-6.
7. *Vicoa indica* DC.	Ray floret epappose	Ray floret pappose.
8. *Hygrophila serpyllum* Anders.	Flowers in spikes	Flowers axillary in 2-3 clusters.
9. *Haplanthus tentaculatus* Nees.	Bract, bracteole smaller than calyx	Bract, bracteole absent.
10. *Basella rubra* Linn.	Bracteole adnate to perianth. Perianth bi-lipped.	Bracteoles free from perianth. Perianth cup shaped.
11. *Caesulia axillaries* Roxb.	Pappus scale-2	Pappus absent.
12. *Euphorbia microphylla* Heyne.	Limb of involucre-gland inconspicuous	Limb of involucre-gland conspicuous.
13. *Euphorbia pilulifera* Linn.	Limb of involucre-gland inconspicuous.	Limb of involucre-gland conspicuous.
14. *Ficus hispida*Linn.	Gall flower and female	Gall flower and female

	flower with 0 perianth. male flower without bract.	flower with perianth. Male flower with 2 bracts.
15. *Nymphaea alba*L.	Stigmatic rays 16. Flower colour white.	Stigmatic rays 10. Flower colour light yellow.
16. *Parthenium hysterophorus* Linn.	Pappus present. Male flower tubular with 5 lobe.	Pappus present only in ray florets. In case of disc floret pappus is absent.
17. *Corchorus trilocularis* Linn.	Capsule hairy when young with stiff stellate hairs. 3-4 angled capsule. Seed trigonous black.	Capsule glabrous, without any stiff stellate hair. Capsule cylindrical. Seed truncate at both ends.
18. *Biophytum sensitivum* DC.	Dimorphism in flower	No dimorphism was noticed.
19. *Spergula arvensis* Linn.	Styles 5. Capsule 5 valved.	Very often 3-4 style. Capsule 3- valved.
20. *Stemodia viscosa* Roxb.	Both the cells of stamen fertile.	One cell aborted.
21. *Bauhinia purpurea* Linn.	Fertile stamens 3 staminodes 2-7	All stamens fertile. stamens 5, no staminodes.
22. *Ficus glomerata* Roxb.	Stigma clavate	Stigma minute, entire and indistinct.
23. *Amaranthus viridis* Linn.	Style 2-3	Style 3, each style branches to give distinct stigma
24. *Grewia salvifolia* Heyne.	Petal obtuse, with notch. Gland hairy, 1/3rd of the petal	Petal not obtuse and notch divide its tip in unequal half gland 1/4th of the petal.
25. *Aristolochia bracteolata* Lam.	Leaf usually obtusely acuminate. Flower few in axillary racemes. Bract small ovate,	Leaf apex obtuse with a slight notch. Flower axillary solitary. Bract small obtuse , rounded. acuminate.
26. *Martynia diandra* Glox.	Anther cell confluent	Anther divaricate.
27. *Coix lachryma-jobi* Linn.	Glumes 4.	Glumes 3.
28. *Bonnaya brachiata* Link.	Staminode short pubescent.	Staminode glabrous.
29. *Panicum colonum* Linn.	Glumes 4.	Glumes 6.

Apart from these variations, certain additional characters which were not reported earlier also were observed. They were as follows; *Digera arvensis* (fleshy outgrowth on fruit); *Oxalis corniculata* (show articulations like that of bone joints on pedicels and petiole); *Celosia argentea* (show connate filaments with infoldings); *Heylandia latebrosa* (projections or outgrowth at the base of petal); and *Chenopodium alba* (filaments connate at the base).

Almost all the plants studied contained trichomes in leaves or stems and these trichomes vary form glandular to eglandular. Glandular trichomes were of many different types such as with unicellular stalk and unicellular head; unicellular stalk with multicellular head or multicellular head with multicellular stalk. Non-glandular trichomes also varied in sizes ranging from unicellular to multicellular ones, and were filamentous branched or unbranched. Floral glands or nectaries were also of varied nature and sizes with equal diversity as that of the trichomes of the vegetative organs. The line diagrams were prepared on all these type of vegetative as well as reproductive trichomes and a key is prepared as an aid to the identification of plants.

Along with these characters several types of silica bodies were observed in almost all the graminaceous plants which had been studied like *Panicum colonum; Coix –lachyrma-jobi; Desmostachya bipinnata* and *Dinebra retroreflexa.*

Studies in Bioprospecting resulted in identification or quantification of a number of economically and pharmacologically important phytochemicals. They are the following:

The seed oil of *Balanites aegyptiaca* was found to be 45% of the kernel. Mucilage in calyces of *Bombax ceiba* was estimated to be 20.06% and it contained galacturonic acid and galactose as sugars. *Ageratum houstanianum* yielded a volatile oil containing precocene-II; demethoxy ageratochromene; caryophyllene and alpha-cubebene as the principal component in abundance, and this is a new source of linalool. *Stemodia viscosa* yielded volatile oil rich in eugenol and aceteugenol. *Stemodia serrata* yielded a volatile oil containing eugenol and aceteugenol as the principal components. *Alternanthera bettzickiana* showed the presence of steroids ecdysterone and β-sitosterol and bioflavonoids (antioxidants) such as kaempferol, iso-rhamnetin, and quercetin.

Alternanthera sessilis flower showed presence of 4'OMe Luteolin. The phenolics acids were *cis* and *trans*- ferulic acid, vanillic acid and syringic acid. In addition, ecdysterone also was present in flowers. *Ageratum conyzoides* leaves contained two flavones, 6-hydroxy 4'-methoxy apigenin, and 6-hydroxy, 7, 4'-dimethoxy apigenin. The phenolic acid located was vanillic acid. The blue flowered *Hygrophila schulli* yielded luteolin, 4'-OMe luteolin and 3',4'-diOMe luteolin from leaves, while that of the white flowered plant contained luteolin and apigenin. The stems of these two plants also differed in their flavonoids. The stem of blue flower plant contained apigenin, and acacetin, whereas, the stem of the later plant, possessed luteolin, 4'-OMe luteolin and 3', 4'-diOMe luteolin. Leaves of *Riedleia corchorifolia* contained quercetin, kaempferol and acacetin and a glycoflavone, o-C glucosyl acacetin. *Aloe barbadensis* flowers, fruit walls and seeds showed presence of aloin and emodin.

The highlights of the presence investigation are the following:

1. **Line drawings of 400 plants** showing distinct and characteristic features of each plant will help any student of taxonomy to understand the plant correctly and group them. Most of these illustrations are made for the first time.

2. **An elaborate and extensive database on the micromorphological characters of 400 taxa** are made available for the first time. This data will be of immense importance in identifying almost all these plants even in the vegetative states. In case, of economically useful plants such as drug plants or narcotics, these characters will be of great significance in identifying the raw material or adulteration, as in the case of our paper entitled 'Micromorphological characters as biomarkers for some of the medicinal plants of Gujarat". (*Herbal Technology:Recent Trends and Progress* (M. Daniel Ed.) Scientific Publishers, Jodhpur (2007) *77- 84.*'

3. The **micromorphological characters especially those of trichomes are found to be of great use in classifying and identifying taxa at various levels of hierarchy** as evidenced by the two papers published; 1) Foliar trichomes of some members of the family Acanthaceae and their taxonomic utility (*Int. J. Pharma and Bio* Sci. **2** (3), 2011,

231-235.) and 2) Foliar micromorphological studies on some members of the family Fabaceae (*Int. J. Pharma and Bio. Sci.* 2 (4), 2011, 603-611)

4. **Ten new sources of economically important products** are located during the course of bioprospecting, they are 1) new sources of volatile oils (*Stemodia serrata, Stemodia viscosa* and *Ageratum houstanianum*- new sources of eugenol in the first two plants), 2) new sources of bioflavonoids (*Alternanthera bettzickiana, A. sessilis*, *Ageratum conyzoides*, *Riedleia corchorifolia* and *Hygrophila schulli*), 3) mucilage (*Bombax*), 4) quinones- in flowers of *Aloe* and 5) fixed oils from (*Aloe* seeds and *Balanites aegyptiaca*).