Role of pollen morphology in taxonomy and detection of adulterations in crud drugs

Kshirsagar Sanjay Ragho*
Post Graduate, Department of Botany, Shri Shivaji Vidya Prasarak Sanstha’s Late Karmveer, Dr. P.R. Ghogrey Science College, Maharashtra, India

Abstract

Present paper communicates 42 species of angiosperms depicting characteristics of pollen grains as shape, color, exine ornamentations, and type of apertures. Pollen morphological characters are very important in plant identifications in field. Pollen surface features plays significant role in taxonomy and detection of crud drugs. Firsthand information is gathered from field and provided in this research article.

Introduction

The use of herbal medicine for the treatment of diseases and infections is a safe and traditional therapy.

Pollen morphological characters are used to identify adulterations in crud drugs or dry herbs of some medicinal plants as pollen grains are very minute and are adhered in any part of the crud drugs.

In developing countries, medicinal plants are attaining greater importance in the primary health care of individuals and communities. Medicinal plants form a large group of economically important plants that provide the basic raw materials for indigenous pharmaceuticals.

Pollen characters are useful in solving complicated problems of interrelationships between various taxa and assessment of their status in the classification, particularly with reference to the families, subfamilies, tribes, genera, species, and subspecies. Pollen morphology is conducted as an aid to the morphological study and a significant tool for modern taxonomist for the delimitation of species. Mature pollen grain size, exine sculpturing, and number of pores are the most distinctive features. Palynological data has been useful at generic and specific level. This analysis also helps in qualitative analysis of drug powder and the correct identification of drug. It plays an important role in our daily life as well. Aerobiology has received much attention due to its wide application in allergology, forestry, agriculture, horticulture, archaeology, and plant geography.

Pollen morphological characters were fully appreciated by authors such as Lindley, von Mohl & Fritzsche as early as 1830-1840. But generally, these characters are overlooked by taxonomist due to lack of sufficient data. Recently, however, considerable attention is being paid to pollen morphology, and the science of palynology (study of spores & pollen grains) has entered into current taxonomic thinking.

first comprehensive book on palynology was written by Wodehouse (1935) & subsequently Erdtman contributed a treatise on pollen analysis (1943). The first manual, Pollen Morphology and plant Taxonomy, appeared in 1952 which deals with angiosperm [1]. This book provided a summary of pollen morphological characteristics of all angiosperm families. As result of the work of these early authors there has recently been a great increase in the comparative analytical studies of pollen morphology and wall structure. Results of considerable systematic and phylogenetics value have been obtained and the conclusions drawn from such studies are generally in agreement with those drawn from other fields of study.

Characters of pollen grains & their role as plant identification in taxonomy and pharmaceutical value as detection of adulterations in crud drugs

The main characters of taxonomic value in pollen grains are
number & position of furrows, number, position of complexity of apertures & form of sculpturing of the exine. Variations is also shown in size & general types.

Most angiospermous pollen grain fall into only two general types, Uniaperturate & triaperturate, from which some less common types have been derived. Uniaperturate pollen grain have a single germinal furrow or pore situated at the proximal or distal position. The proximal form of apertures is always found in pteridophyta but in pteridosperms, the position is reported to be either proximal or distal (Potonie, 1967). The proximal aperture is sometimes found in primitive angiosperms (Nair, 1968), but the distal position is predominant in flowering plants. Uniaperturate pollen grains are characteristics of the monocotyledon & some members of Magnoliidae.

Triaperturate pollen grains have three germinal furrows, either radiating like the lines of a trilete mark from a common point or forming a triangle at the distal position. Various other numbers of furrows & other types of apertures are situated along the equatorial line (zonal position) or distributed over the entire surface (global distribution). The triaperturate or triaperturate-derived pollen grains occur in the bulk of dicotyledons & are unknown elsewhere. Thus, along with the zonal & global position of apertures, evolved many aperturate condition also.

The taxonomic & evolutionary importance of pollen morphology may be at specific, generic or higher levels. In many cases the types of pollen of a taxon is characteristic & constant. Such a taxon is termed stenopalynous unipalynous [2], & may be exclusive of that group, e.g. thick walled grains of the Gyrostemonaceae of Australia. In other cases, the types of pollen may vary considerably in size, aperture, stratification of exine, etc. Such taxa are termed euirypalynous or multipalynous. Stenopalynous taxa are generally considered to be very natural. Asclepiadaceae, Cruciferae, Gramineae, Labiatae, etc. are some of the stenopalynous families. Europalynous taxa, on the other hand, are taken to be heterogeneous, at least in certain instances. Palynological data are particularly useful in the delimitation of europalynous taxa. Families such as Rubiaceae, Acanthaceae, and Verbenaceae are highly europalynous and a revised classification of some of these has been proposed by some taxonomists (Bremekamp, 1944, 1950.)

**Methodology**

The pollens were prepared for light microscopy by standard method. Pollen materials were separated from their anthers with the help of forceps and needle under a dissecting microscope. The pollen grains ready for microscopic observations by acetylation method and were placed on slide. The measurements were based on 15-20 readings for every specimen. Pollen characteristics of pollen grains as shape, color, exine ornamentations, type of apertures.

Regular field tours were arranged to collect the plants in flowering condition for preparing pollen grain slides. Collected plants from the fields were identified with the help of floras [3-5].

Pollen grains mounted & observed under microscope, light microscope, research trinocular & binocular microscopes. Pollen grains were identified with the help of some published literature [1,2,6-9].

In the present work 42 angiosperm plants species are arranged systematically with their botanical names followed by family and characteristic of pollen grains viz. shape, color, exine ornamentation and type of aperture [9,10] (Table 1).

**Discussion**

In present study, pollen grain morphology of 42 plant species studied. The microscopic observations under light microscope revealed that pollen grains of plants are psilate, rugate to spinulose, verrucate, reticulate, bacculate (bottle shape), spiny, psilate (with smooth surfaces).

The evaluation of crude drug which eventually enters the commercial market is obviously of considerable importance. The pharmacognostic studies consist of the collection of various parts of these plants, their identification, standardization, and authentication through various taxonomic markers and macro- and microscopic characters. Companies involved in the crude drug sale generally avoid special recommendations on the use of a product. There are no applicable standards of quality for crude drugs, and they are not usually standardized with respect to the concentration of active components. So, it is necessary to target such crude drugs to various standards of quality, purity, and safety, if acceptable consumer usage is to be achieved. To authenticate crude drugs it is very necessary to go through microscopic scientific studies e.g palynological data.

**Conclusion**

Present work will be very helpful for writing pollen flora of local, regional, state & even pollen flora of the country. This work is important for researchers, palynologist & graduate & post graduate students for identification of plant on the basis of simply pollen grains. This palynological work is most important for forensic science to detect the crime on the basis of pollen grains & spores. Pollen morphology has been regarded as a taxonomic character of high significance & used the character along with basic chromosome numbers as a basis for circumscribing groups of genera. This palynological work is also very important for evolutionary studies and to detect adulterations in crude drugs of plant origin.
### Table 1: Systematic Enumeration of the plants studied.

| Sr. No. | Botanical Names | Family             | Characteristics of Pollen Grains |
|--------|----------------|--------------------|----------------------------------|
| 1      | *Quisqualis indica* L. | Combretaceae       | Shape: Elliptical, Color: Light brown, Exine ornamentation: Psilate, Types of apertures: Colpate |
| 2      | *Pedilanthus tithymaloides* (L.) Poit. | Euphorbiaceae       | Shape: Rounded, Color: Brown yellow, Exine ornamentation: Psilate(smooth), Types of apertures: Porate |
| 3      | *Stachytarpheta jamaicensis* (L.)Vahl | Verbenaceae         | Shape: Elliptical, rod, rounded, circular in outline, Color: White, Exine ornamentation: Psilate, Types of apertures: Porate, colpate, Colpate |
| 4      | *Spathodea campanulata* Beauv. | Bignoniaceae        | Shape: Circular, irregular in outline, Color: Light brown, Exine ornamentation: Psilate, Types of apertures: Porate, (trizonoporate, Colpate) |
| 5      | *Crossandra undulifolia* Salib. | Acanthaceae         | Shape: Rod shaped, Color: Light red & yellow, Exine ornamentation: Spinulose, Types of apertures: Bicolpate |
| 6      | *Ixora parviflora* Vahl. | Rubiaceae           | Shape: Rounded, circular, Color: Light yellow, Exine ornamentation: Psilate (smooth), Types of apertures: Colporate |
| 7      | *Hypit s suaveolens* (L.) Poit. | Lamiaceae           | Shape: Rounded, circular in outline, Color: Brownish yellow, Exine ornamentation: Psilate, Types of apertures: Porate |
| 8      | *Moringa concanensis* Nimmo ex Dalz. & Gibs. | Moringaceae         | Shape: Elliptic, oval, Color: Faint cream, Exine ornamentation: Psilate, Types of apertures: Colpate (monocolpate) |
| 9      | *Cleome viscosa* L. | Cleomaceae          | Shape: Elliptic, Color: Light yellow, Exine ornamentation: Psilate, Types of apertures: Colpate(bicolpate) |
| 10     | *Rhynchosia minima* (L.) DC. | Papilionaceae       | Shape: Slightly triangular in shape, circular, Color: Brown, Exine ornamentation: Psilate, Types of apertures: Porate (Trizonoporate) |
| 11     | *Lantana camara* L. | Verbenaceae         | Shape: Rounded, Color: Yellow, Exine ornamentation: Psilate, Types of apertures: Porate |
| 12     | *Azadiract a indica* A. Juss. | Meliaceae           | Shape: Rounded, elliptical, Color: Hyaline, Exine ornamentation: Psilate, Types of apertures: Colpate (bicolpate) |
| 13     | *Thevetia peruviana* (Pers.) Shetty & Singh | Apocynaceae         | Shape: Triangular, semi-circular, trichotomous, Color: Light yellow, Exine ornamentation: Psilate, Types of apertures: Porate (trizonoporate) |
| 14     | *Euphorbia indica* Lam. | Euphorbiaceae       | Shape: Elliptic, Color: Light yellow, Exine ornamentation: Psilate, Types of apertures: Colpate |
| 15     | *Pyrostegia venusta* Miers. | Bignoniaceae       | Shape: Quadrangular, circular, oval, Color: Light yellow, Exine ornamentation: Psilate, Types of apertures: Porate, (tricolpate) |
| 16     | *Euphorbia milii* Des. moul. | Euphorbiaceae       | Shape: Elliptic, circular, oval, Color: Light brown, Exine ornamentation: Psilate (thick eticulate), Types of apertures: Colpate (bicolpate) |
| 17     | *Tecoma stans* (L.) Juss. Ex Kunth | Bignoniaceae       | Shape: Rounded, elliptical, circular, Color: Yellow brown, Exine ornamentation: Psilate, Types of apertures: Colpate (tricolpate) |
| 18     | *Justicia gendarussa* Burm. f. | Acanthaceae         | Shape: Elliptic, oval, circular in outline, Color: Light yellow, Exine ornamentation: Psilate, Types of apertures: Porate, colpate (triporate) |
| 19     | *Ipomoea obscura* (L.) Ker.-Gawl. | Convolulaceae       | Shape: rounded / circular in outline, Color: Light brown, Exine ornamentation: Spiny, Types of apertures: Porate (Pantoporate) |
| 20     | *Sonchus oleraceus* L. | Compositae          | Shape: Quadrangular triangular, Color: Light yellow, Exine ornamentation: Spinulose, Types of apertures: Porate (Pantoporate, trizonoporate) |
| 21     | *Clitonia ternatea* L. | Papilionaceae       | Shape: Quadrangular, triangular, Color: Light gray, Exine ornamentation: Psilate (thick), Types of apertures: Porate (Broad colpi) |
| 22     | *Datura innoxia* Mill. | Solanaceae          | Shape: More / less rounded, Color: Light gray, Exine ornamentation: Psilate (thick), Types of apertures: Porate (Trizonoporate) |
| 23     | *Jatropha panduriformis* Andr. | Euphorbiaceae       | Shape: Circular / rounded, Color: Light yellow, Exine ornamentation: Rugulate, reticulate (thick), Types of apertures: Porate |
| 24     | *Alternanthera sessilis* (L.).R.Br. ex DC. | Amaranthaceae | Shape: More / less circular in outline, Color: Light yellow, Exine ornamentation: Psilate, Types of apertures: Porate (Trichotomous) |
| 25     | *Launaea Procumbens* (Roxb.) Ramayya & Rajgopal | Compositae | Shape: Triangular, Semi circular, Color: Light yellow, Exine ornamentation: Verucate (reticulate), Types of apertures: Porate (Trichotomoporporate) |
| 26     | *Plumbago zeylanica* L. | Plumbaginaceae      | Shape: Rounded, Color: Light yellow, Exine ornamentation: Psilate, Types of apertures: Porate (Trizonoporate) |
| 27     | *Ocimum sanctum* L. | Labiatae            | Shape: Rounded, Color: Light yellow, Exine ornamentation: Short Spiny, Types of apertures: Porate |
| 28     | *Ocimum basilicum* L. | Labiatae            | Shape: Rounded, Color: Cream white blackish /Hyaline, Exine ornamentation: Reticulate, Types of apertures: Porate (Pantoporate) |
| 29     | *Portulaca quadrifida* L. | Portulaceae          | Shape: Rounded, circular (double layer), Color: Yellowish, Exine ornamentation: Spiny, Types of apertures: Porate (Pantoporate) |
| 30     | *Sida cordifolia* L. | Malvaceae           | Shape: Rounded, Color: Brown, Exine ornamentation: Spiny, Types of apertures: Porate (Pantoporate) |
| 31     | *Rhoeo discolor* (L.) Hance | Compositae          | Shape: Rod shape, Color: White, Exine ornamentation: Psilate, Types of apertures: Colpate |
| 32     | *Hibiscus rosa-sinensis* L. | Malvaceae           | Shape: Rounded or circular in outline, Color: Light brown, Exine ornamentation: Bacculate(bottle shape), Types of apertures: Porate (Pantoporate) |
| 33     | *Sida acuta* Burm.f. | Malvaceae           | Shape: More/less rounded, Color: Light brown, Exine ornamentation: Rugate to Spinulose, Types of apertures: Porate (Pantoporate) |
| 34     | *Vinc a rosea* L. | Apocynaceae         | Shape: Rounded / circular, Color: Light yellow, Exine ornamentation: Pinkish at border, Types of apertures: Porate |
| 35     | *Bougainvillea spectabilis* Willd. | Nyctaginaceae | Shape: Rounded, Color: White brown, Exine ornamentation: Spinosus, Types of apertures: Porate (Dizoonoporate) |
| 36     | *Asystasia dalzelliana* Santapau | Acanthaceae | Shape: Rod shape / elliptical, Color: Faint white, Exine ornamentation: Psilate (smooth), Types of apertures: Porate (Dizoonoporate) |
| 37     | *Lindenbergia macrostachya* (Benth.) Benth. | Scrophulariaceae | Shape: Elliptical, Color: White-hyaline, Exine ornamentation: Psilate, Types of apertures: Colpate |
| 38     | *Vernonia cinerea* (L.) Less. | Compositae          | Shape: Circular/rounded in outline, Color: Faint brown, Exine ornamentation: Verrucate, reticulate, Types of apertures: Porate (Trizoonoporate) |
| 39     | *Tridax procumbens* L. | Compositae          | Shape: Quadrate / more or less circular in outline, Color: Light black, Exine ornamentation: Spiny, Types of apertures: Porate (Pantoporate) |
| 40     | *Euphorbia clarkeana* Hook. f. | Euphorbiaceae | Shape: Rounded, Color: Light brown, Exine ornamentation: Psilate, Types of apertures: Porate (aperture on distal position) |
References

1. Erdtman G. Pollen and spore morphology/ Plant taxonomy. Almavist & Wiksell/ Stockholm. The Ronalds Press Company. 1952.

2. Nair PKK. Pollen Morphology of Angiosperm. A historical & Phylogenetic study. Scholar Publication House. 1970.

3. Kshirsagar SR, Patil DA. Flora of Jalgaon District Maharashtra. 1st Edition. Bishen Singh Mahendra Pal Singh. 2008.

4. Patil DA. Flora of Dhule & Nandurbar districts: Maharashtra. Bishen Singh Mahendra Pal Singh. 2003.

5. Cooke T. Flora of residency of Bombay. Volume I & II. Botanical survey of India. 1958.

6. Kshirsagar SR, Borse KM. Embryology & Palynology. A textbook for T.Y. Bsc. Botany Student of North Maharashtra University. North Maharashtra Publication Dhule. 2015.

7. Naik VN. Taxonomy of Angiosperm. Tata Mc-Graw-Hill Publication Company Limited New Delhi. 1984.

8. Stuessy TF. Plant Taxonomy-The systematic evaluation of comparative data. Columbia University Press. 1990.

9. Devi S. Spores of Indian Ferns. Today & Tomorrow’s Printers & Publishers. 1977.

10. Bibi N, Hussain M, Akhtar N. Palynological study of some cultivated species of genus Hibiscus from North West Frontier Province (NWFP) Pakistan. Pak J Bot. 40: 1561-1569. 2008.

11. Fazal H, Ahmad N, Haider Abbasi B. Identification, Characterization, and Palynology of High-Valued Medicinal Plants. Scientific World J. 2013. PubMed: https://www.ncbi.nlm.nih.gov/pubmed/23844389