Pollendiversity of some ethnomedicinal plants of Chhattisgarh, India

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Abstract: Present paper deals about the Palynological studies of some ethnomedicnal plants used by various tribal communities of Chhattisgarh state. The significant tribes of the state are: Gond, Kamar, Oraon, Halba, Baiga, Muria, Kol and Agarias. These plants were used for the treatment of diseases and infections in a safe and traditional ethnotherapy. Morphological studies of pollen grains of 24 ethnomedicinal taxa commonly distributed in entire state, belonging to 23 genera of 18 different families was carried out microscopically. Size, Shape, number, position and character (NPC) of Aperture and nature of Exine ornamentation of pollen grains were used as parameters to identify particular plant. Most of the pollen grains are oblate-spheroidal and prolate-spheroidal in shape. Pollen grains are triporate, tricolpate and tricolporate and their nature of exine ornamentation are psilate and reticulate. The outcome of the present studies shall be applied in the detection of purity of honey through melissopalynology as well as for mapping of the diversity of ethnomedicinal plants in Chhattisgarh state of India and producing evidence in forensic investigations.

Index Terms: **Pollen Diversity, Ethnomedicinal plants, Chhattisgarh, India**

I. Introduction

Plants were used by many tribes medicinally for the treatment of diseases based on ancestor's knowledge and their own (trial and error) practices. For proper identification of medicinal plant lots of method such as chemical, physical and biological are available. Microscopic features such as spores and pollen grains are also played a significant role to identify particular plant drugs. The study of morphological characters of pollen grains and spores is termed as Palynology. Hyde and William (1945) coined the term on the basis of two Greek words "*Paluno"* meaning "to sprinkle" and "*Pale"* meaning "dust". **C**hhattisgarh, the 26th State of India is situated between 17 to 23.7 degrees north latitude and 8.40 to 83.38 east longitude. A large number of tribal communities such as Gond, Kamar, Oraon, Halba, Baiga, Muria, Kol and Agarias live in remote and inaccessible parts of the forests. Most of these tribal communities are largely dependent on plant species for curing their ailments. Morphological features of pollen grains are useful in solving complicated problems of interrelationships between various taxa and evaluation of their status in the classification, particularly with reference to the families, genera and species. Mature pollen grain size, exine sculpturing and number of pores are the most distinctive features. The palynological studies of ethnomedicinal plants of Chhattisgarh is based on the study of the morphological characters of pollen which are the size, shape, aperture numbers, aperture type and exine section. This paper deals with the diversity of pollen characters of ethnomedicinal important taxa.

II. Material and Method

The study has been carried out in remote tribal area of Bastar, Bilaspur, Dantewada, Dhamtari, Jashpur, Kanker, Korba, Koriya, Mahasamund, Raigarh, Raipur, Rajnandgaon and Sarguja district of Chhattisgarh. The pollen samples were collected from unopened anthers from January to December 2015 - 16. Collected samples of anthers were kept in glass bottle containing 70% alcohol. The pollen grains for observation were taken by teasing the anthers with the help of glass rods. The pollen grains were acetolysed in acetolysis mixture suggested by Erdtman (1952) with an amendment in the acetolysis mixture, i.e., instead of acetic anhydride, acetyl chloride has been used due to safety purposes. Pollen grains slides were prepared as per the method suggested by Erdtman (1952). For the staining of pollen grain basic fuchsine is added in the glycerine gelly. The slides were observed under the digital microscope model Leica DM 2000. Morphological characters such as size, shape, number, position and character of aperture (NPC) and exine ornamentation, have been undertaken for the identification of pollen grains. The morphological characters of pollens were analyzed using the terminology suggested by Punt et al (2007). The names of the places and Tribal community used for the present investigation have been mentioned in Table-1.

Table1: Places and Tribes of Chhattishgarh, India

No.	Name of District	Location in Latitude and Longitude	Tribal Community	Reference
1.	Bastar	19.2036769 / 81.9343855	Bhattra, Kolans, Halba, Muria	Ekka (2011), Shrivastava (2015)
2.	Bilaspur	22.0796251 / 82.1391412	Baiga	Ekka (2013)
3.	Dantewada	18.896863 / 81.3454417	Abujhmaria	Ekka (2013)
4.	Dhamtari	20.7014999 / 81.5541579	Kamar	Ekka (2016)
5.	Jashpur	22.8874202 / 84.1382368	Hill Korwa	Ekka (2013)
6.	Kanker	20.2727132 / 81.4883097	Abujhmaria	Ekka (2013)
7.	Korba	22.3594501 / 82.7500595	Pahari Korwa	Ekka (2013)
8.	Koriya	23.3875499 / 82.3885783	Kol, Gond, Baiga, Ooraw, Korwa	Khushwaha et al (2013)
9.	Mahasamund	21.1091317 / 82.0979023	Kamar	Ekka (2016)
10.	Raigarh	21.8974003 / 83.394932	Ooraw	Ekka (2011)

11.	Raipur	21.2513844 / 81.6296413	Kamar, Halba	Ekka (2011) (2016)
12.	Rajnandgaon	21.0971034 / 81.0302222	Halba	Ekka (2011)
13.	Sarguja	22.9494079 / 83.1649001	Baiga, Gond, Kol,Korwa	Shrivatava (2011)

III. Observation

Pollen morphology of these 24 medicinal plants belong to Amranthaceae, Apocynaceae , Asteraceae, Capparaceae, Caricaceae, Cuscutaceae, Convolvulaceae, Dipterocarpaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Martyanaceae, Nyctaginaceae, Papaveraceae and Plumbaginaceae families were studied and observed the diversity of pollen morphological characters under light microscope (Lieca DM 2000) (Table 3). These plants are used as medicine to cure various diseases (Table 2).

Table 2. Local name, Family, Habit and Ethnomedicinal use of plants

No.	Order	Family	Genus	Local name	Habit	Medicinal use	Reference
1.	Ranunculales	Papaveraceae	*Argemone maxicana*	Pila Dhatua	Herb	Latex apply in eyelid for Conjuctivitis	Kujur (2015)
2.	Malpighiales	Euphorbiaceae	*Euphorbia hirta*	Dudhi	Herb	Leaf for Milk secretion	Shukla et al (2015), Dixit & Chaurasia (2015)
3.	Fabales	Fabaceae	*Bauhinia purpurea*	Orra	Tree	Root to treat Syphilis	Ahirwar (2015)
4			*Butea monosperma*	Palash	Tree	Juice of stem bark for Dysentery	Kujur (2015)
5.			*Cassia occidentalis*	Kasoundi	Herb	Leaf paste applied for Eczema	Tiwari (2015)
6.			*Cassia tora*	Chokora	Herb	Root is used in Snake bite	Shrivastava (2015), Dixit & Chaurasia (2015)
7.			*Caesalpinia bonducella*	Gataran	Shrub	Leaf juice for treatment of Asthma	Kujur (2015)
8.			*Clitoria ternatea*	Aparajita	Herb	Root is used in Snake bite	Shrivastava (2015)
9.			*Delbergia sisso*	Shisham	Tree	Paste of Leaf to treat Symphilis	Ahirwar (2015)
10.			*Mimosa pudica*	Chuimui	Herb	Seed to treat Veneral disease	Ahirwar (2015)
11.	Malvales	Malvaceae (Bombacaceae)	*Bombax ceiba*	Semal	Tree	Root for Toothache	Ekka (2016)
12.		Malvaceae (Sterculiaceae)	*Helictoris isora*	Maror phalli	Shrub	Seed pounded in water given during gripping of bowel	Ekka (2011)
13.		Dipterocarpacea	*Shorea robusta*	Sal, Sarai	Tree	Fruits for Dysentery	Kujur (2015)
14.	Brassicales	Caricaceae	*Carica papaya*	Papaya	Herb	Leaves for Dengue fever	Sahu (2015)
15.		Capparaceae	*Cleome viscosa*	Hulhul	Herb	Leaf paste for heal wounds	Tiwari (2015)
16.	Caryophyllales	Amaranthaceae	*Alternanthera sessilis*	Garandi shak	Herb	Whole plant for Maleria, Leaf for Dysentery	Ekka (2011), Dixit & Chaurasia (2015)
17.		Nyctaginaceae	*Boerhavia diffusa*	Punarnava	Herb	Root in Snake bite	Shrivatava (2015)
18.		Plumbaginaceae	*Plumbago zeylanica*	Chitrak	Herb	Dysentery, Headache	Ekka (2013)
19.	Solanales	Convolvulaceae (Cuscutaceae)	*Cuscuta reflexa*	Amarbel	Climber	Juice of twinner act as antiseptic	Ahirwar (2015)
20.	Gentianales	Apocynaceae	*Halorhea antidysentrica*	Kutaj	Herb	Bark paste for Mosquito repellent	Sahu (2015)
21.	Lamiales	Lamiaceae	*Vitex negundo*	Nirgundi	Tree	Joint disease	Khushwaha et al (2013)
22.		Martynaceae	*Martynia annua*	Bicchhu	Herb	Fruit for Scorpion sting	Khuswaha et al 2013
23.	Asterales	Asteraceae	*Sphaeranthus indicus*	Gorakhmundi	Herb	Whole plant for Dysentery	Ekka (2015)
24.			*Tridax procumbens*	Ghawapatti	Herb	Piles, Cut & Wounds	Khushwaha et al (2013), Dixit & Chaurasia (2015)

IV. Result and Discussion

Palynology is one of the important taxonomical tools to identify the taxa up to species level due to their diversity in pollen morphological characters. The morphological characters of pollen grains of 24 species were studied under light microscope in 100X. The pollen grains of those recorded 24 taxa have diversity of pollen morphological characters *viz.*, shape, NPC of aperture (number, position and character) and exine ornamentation. Different kinds of pollen shape were observed (Table.3).

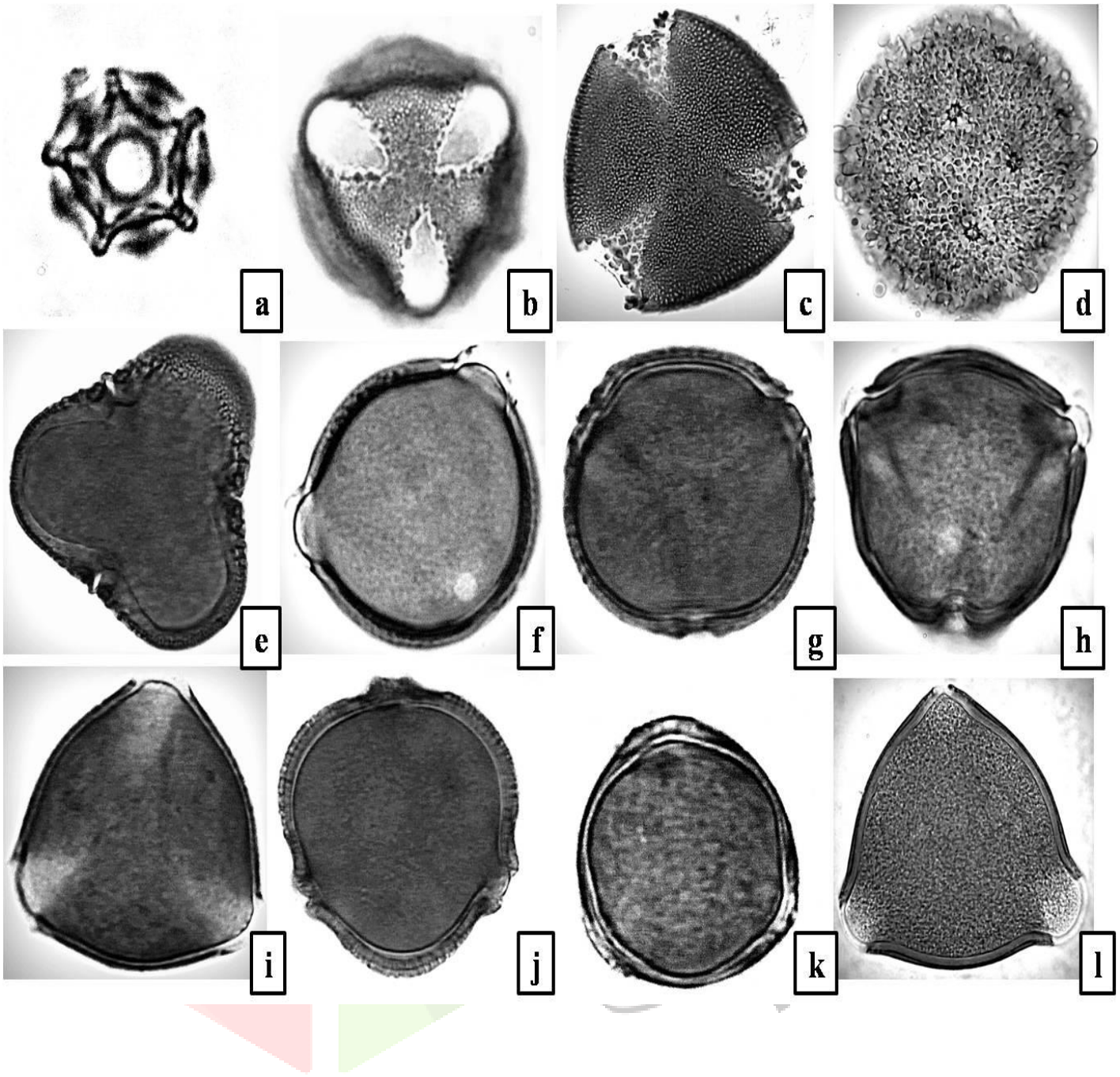
Table 3. Morphological characters of pollen of the Ethnomedicinal taxa.

No.	Name of the plant	Size µm	P/E	Shape	Aperture	Exine	Tactum	Other
1.	*Alternanthera sessilis*	11	0.73	Oblate	Polyporate	Reticulate	Smooth	Forate

2.	*Argemone mexicana*	29.7	0.96	Oblate-Spheroidal	Tricolpate	Psilate	Smooth	
3.	*Bauhinia purpurea*	82.5	0.91	Oblate-Spheroidal	Triporate	Baculate	Granular	
4.	*Boerhavia diffusa*	68.2	0.93	Oblate-Spheroidal	Polyporate	Echinate	Rough	Spine pointed apex, Broad base
5.	*Bombax ceiba*	55	0.95	Oblate-Spheroidal	Tricolpate	Reticullate	Netted, Dotted	
6.	*Butea monosperma*	31.35	1.04	Prolate-Spheroidal	Tricolporate	Psilate		
7.	*Carica papaya*	27.25	1.13	Prolate-Spheroidal	Tricolpate	Reticulate	Granular, Netted	
8.	*Cassia occidentalis*	33	1.09	Prolate-Spheroidal	Tricolporate	Punctitagillate		
9.	*Cassia tora*	48.4	1.51	Prolate	Triporate	Psilate	Rough	
10.	*Ceasalpinia bonducella*	50.6	1.15	Subprolate	Tricolpate	Reticulate	Rough, Netted	
11.	*Cleome viscosa*	28.6	1.13	Prolate-Spheroidal	Tricolporate	Psilate	Granular, Dotted	
12.	*Clitoria ternatea*	77	0.93	Oblate-Spheroidal	Tricolpate	Psilate	Rough	
13.	*Cuscuta reflexa*	37.4	0.94	Oblate-Spheroidal	Tetracolpate /Pentacolpate	Reticulate	Netted, Rough	
14.	*Delbergia sisso*	22	0.83	Suboblate	Triporate	Psilate	Rough	
15.	*Euphorbia hirta*	23.1	0.91	Oblate Spheroidal	Tricolporate	Reticulate	Granular	
16.	*Helictoris isora*	23.1	1.05	Prolate-Spheroidal	Triporate	Psilate	Rough	
17.	*Halorrhea antidysentrica*	30.8	0.94	Oblate-Spheroidal	Triporate	Psilate	Rough	
18.	*Martynia annua*	80.85	0.94	Oblate-Spheroidal	Monocolpate	Clavate	Netted	
19.	*Mimosa pudica*	11	1.17	Prolate-Spheroidal	Inaperturate	Psilate	Smooth	2 cell Dyad
20.	*Plumbago zeylanica*	81.4	1.04	Spheroidal	Tetracolpate	Clavate/Baculate	Granular,	
21.	*Shorea robusta*	26.95	1.06	Spheroidal	Tricolpate	Psilate	Rough, Granular	
22.	*Sphaeranthus indicus*	19.8	1.82	Prolate	Tricolporate	Echinate		
23.	*Tridax procumbens*	28.4	1.14	Subprolate	Tetraporate	Echinate		
24	*Vitex negundo*	26.95	1.81	Prolate	Tricolpate	Clavate/ Baculate	Rough/ Dotted	

Alternanthera sessilis is oblate, *Argemone maxicana, Bauhinia vahlii, Boerhavia diffusa, Bombax ceiba, Clitoria ternatea, Cuscuta reflexa, Holarhea antidysentrica, and Martynia annua* are oblate spheroidal. Whereas *Cassia tora, Sphaeranthus indicus* and *Vitex negundo* are Prolate and *Butea monosperma, Carica papaya, Cassia occidentalis, Cleome viscosa, Helictoris isora* and *Mimosa pudica* are prolate spheroidal in shape. *Ceasalpinia bonducella* and *Tridex procumbens* are subprolate. Pollen grain of *Plumbago zeylanica* and *Shorea robusta* are spheroidal and *Delbergia sisso* is suboblate in shape. (Figure 1,2,3)

Figure 1. Morphological features of pollen grains



(a) *Alternanthera sessilis* (b) *Argemone mexicana* L (c) *Bauhinia purpurea* Wt. & Arn
(d) *Boerhavia diffusa* Linn. (e) *Bombex ceiba* L. (f) *Butea monosperma* (Lamk.) Taub
(g) *Carica papaya* L. (h) *Cassia occidentalis* L. (i) *Cassia tora* Linn.
(j) *Ceasalpinia bonducella* Roxb. (k) *Cleome viscosa* (l)*Clitoria ternatea* Linn.

The aperture of pollen grains have important role in palynotaxonomy. These taxa exhibit diversity of aperture .,*viz.*, inaperturate, monocolpate, pentacolpate, polyporate, tetracolpate, tetraporate, tricolpate, tricolporate and triporate. In these taxa tricolpate grains are dominant where as tricolporate and triporate stand in second position.

Graph 1. Diversity in Pollen Shape

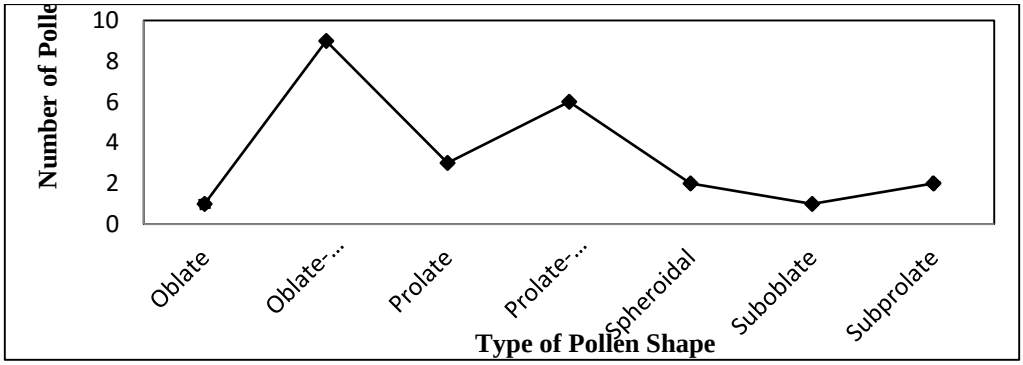
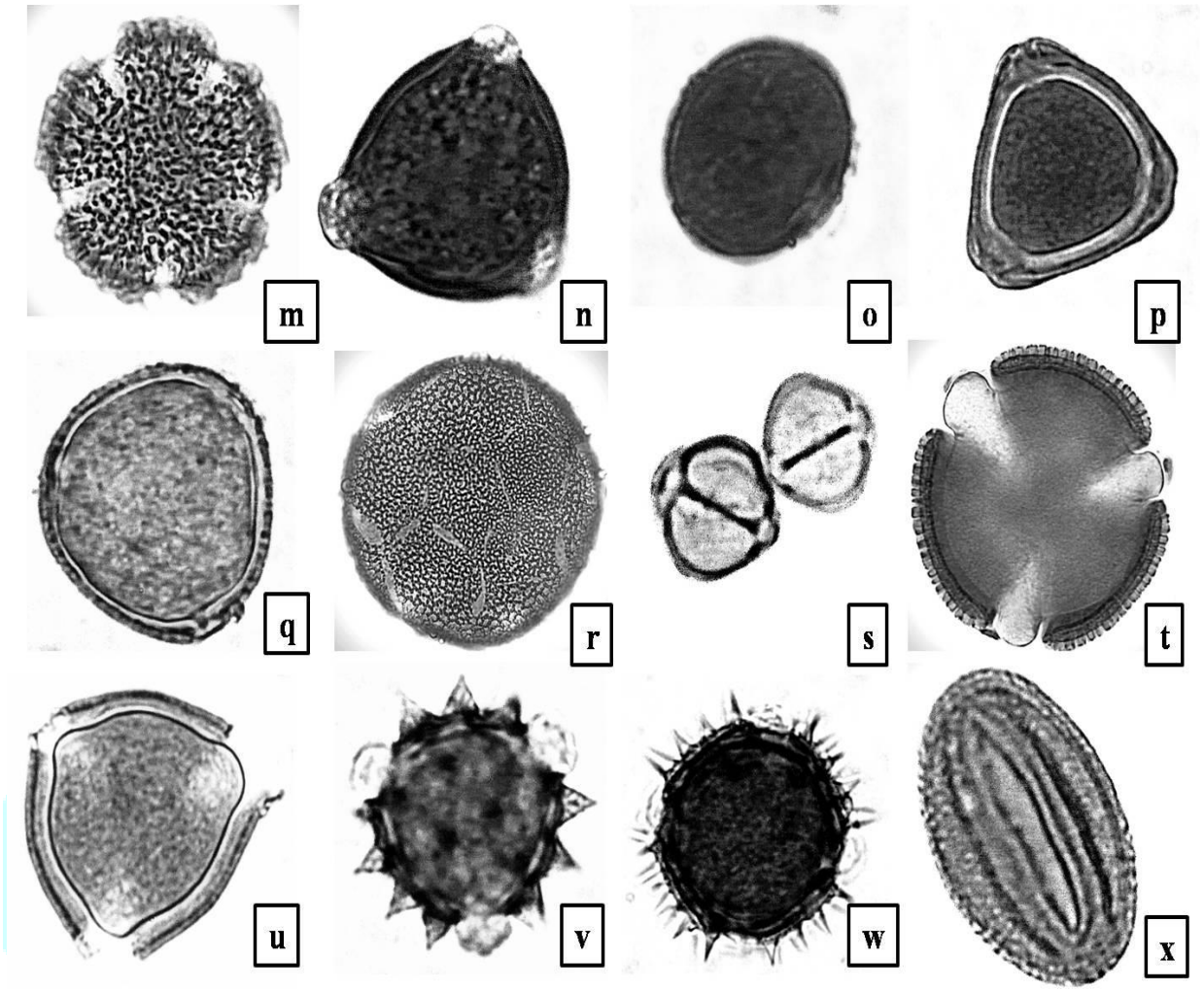


Figure 2. Morphological features of pollen grains



(m) *Cuscuta reflexa* Roxb (n) *Delbergia sisso* Roxb. (o) *Euphorbia hirta*
(p) *Helictoris isora* L (q) *Halorhea antidysentrica* (r) *Martynia annua* L.
(s) *Mimosa pudica* L. (t) *Plumbago zeylanica* L. u) *Shorea robusta* A.W. Roth.
(v) *Sphaeranthus indicus* L. (w) *Tridax procumbens* L. (x) *Vitex negundo* L

The diversity of exine ornamentation is indicated by baculate, clavate, echinate, psilate, punctitagillate and reticulate. In these recorded 24 palynotaxa 3 pollen grains have baculate, 1 pollen grains have clavate, 3 pollen grains have echinate, 10 pollen grains have psilate, 1 pollen grain has punctitagillate and 6 pollen grains have reticulate nature of exine ornamentation.

Graph 2. Diversity in Aperture.

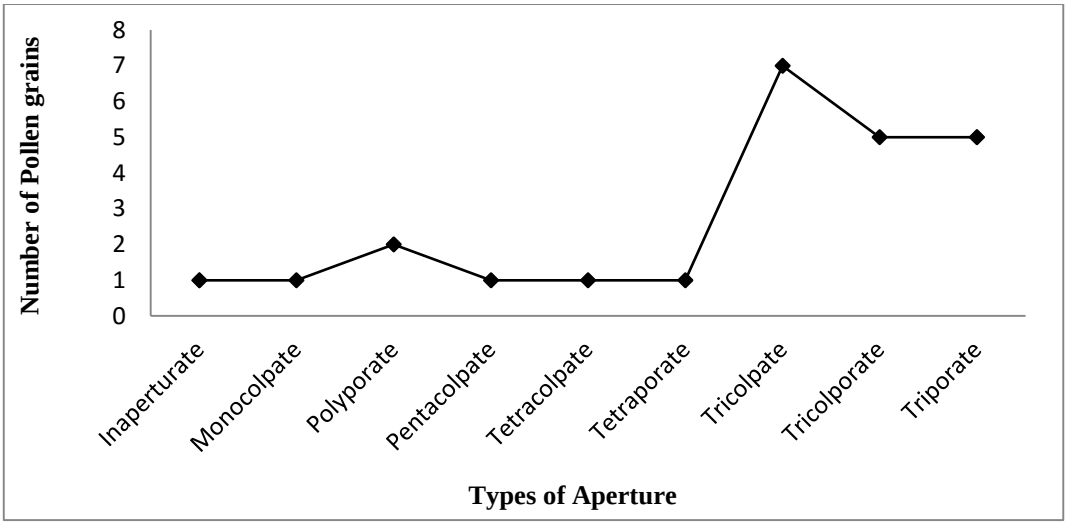
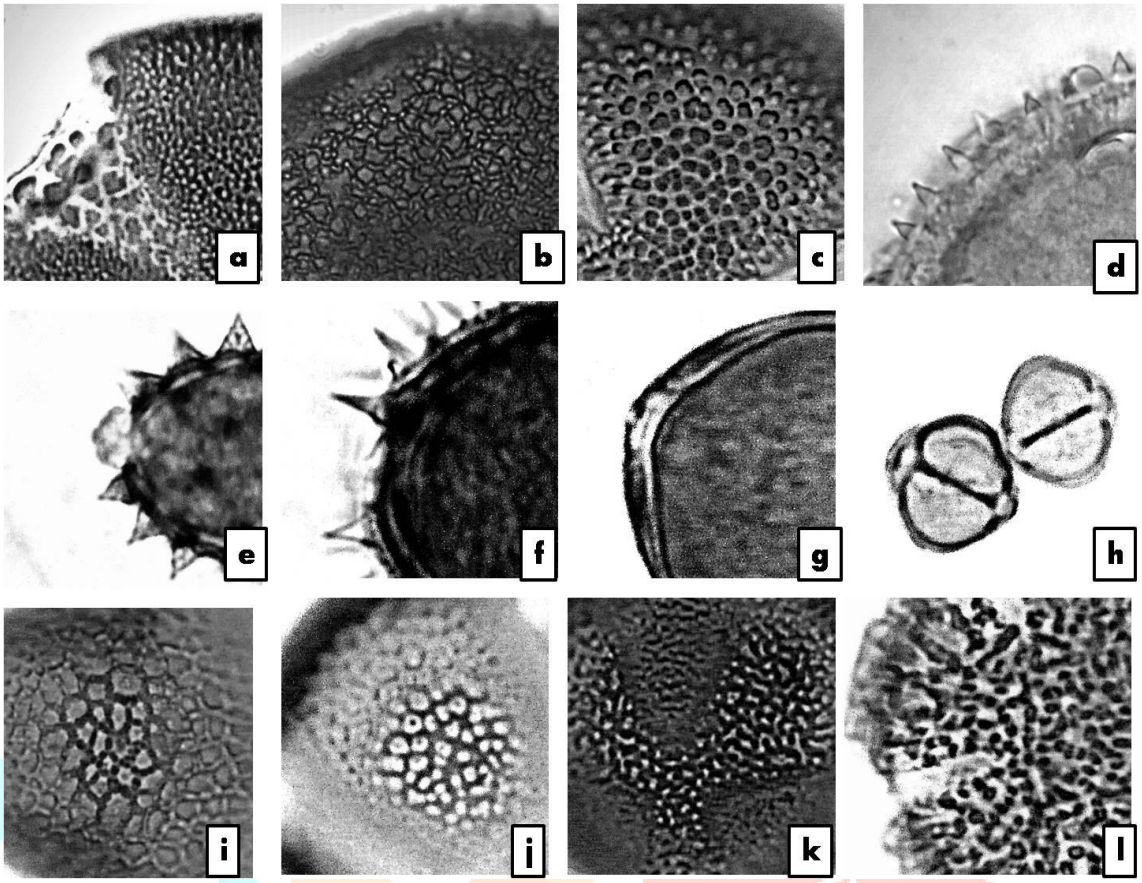
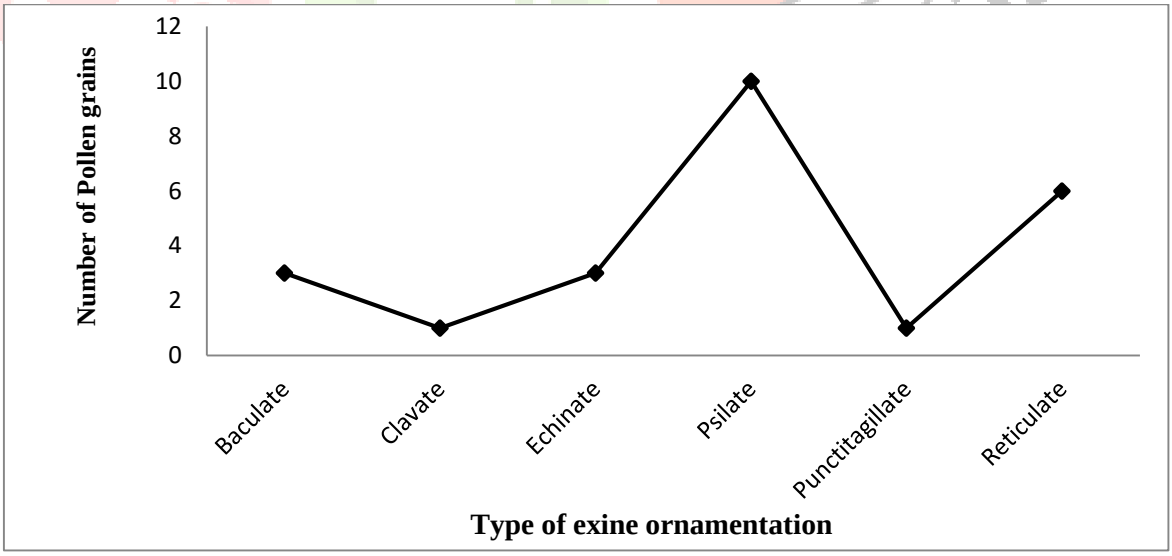


Figure 3. Magnified view of diversity of exine ornamentation found in pollen grains



(a) *Bauhinia vahlii* (Baculate) (b) *Martynia annua* (Clavate) (c) *Plumbago zeylanica* (Baculate)
(d) *Boerhaavia diffusa* (Echinate) (e) *Sphaeranthus indicus* (Echinate) (f) *Tridex procumbens* (Echinate)
(g) *Cleome viscosa* (Psilate) (h) *Mimosa pudica* (Psilate) (i) *Bombex ceiba* (Reticulate)
(j) *Butea monosperma* (Reticulate) (k) *Ceasalpinia bonducella* (Reticula (l) *Cuscuta reflexa* (Reticulate).

Graph 3. Diversity in Exine ornamentation.



The present study signify that the various parts .,*viz.*, leaves, roots, latex, bark, seed and fruit of these plants of Bilaspur region are not only useful as ethnomedicinal plants to tribes to cure various diseases .,*viz.*, diabetes, fever, toothache, asthma, malaria, fungal infection, dysentery, headache, filariasis and wounds. For the identification of particular plant gross morphology or external features are commonly used. Morphological features of pollen grains play important role for correct identification, characterization of taxa. Palynological data will be well recognized as a potential reference tool for reconstruction of past vegetation and environment. The outcome of the present studies will be applied in the detection of purity of honey through melissopalynology as well as for mapping of the diversity of medicinal plants used by tribes of Chhattisgarh.

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