

A Nano Analytical attempt on Hibiscus Rosa-Sinensis Pollens Using Scanning Electron Microscopy (SEM) and the UV-Vis Spectroscopy

Rajesh Katru, I. Johnson, and S. Anbarasu

PG and Research Department of Physics, St. Joseph's college, Tiruchirappalli, Tamil Nadu, India

ABSTRACT

Mother Nature has the best of the solutions for today's rising pathological problems that often make the world hazardous, putting the life forms at stake. This study includes the characterisation of the pollen grains of Hibiscus Rosa-Sinensis using **Scanning Electron Microscope (SEM)** and the **UV- Visible Diffuse Reflectance Spectroscopy**. The attempt made is to characterise and study the Nano-Particle analysis of the Pollen grains. HRS (Hibiscus Rosa Sinensis) has a lot of medical applications and it has received a great attention all over the world in its taxonomical studies. Especially, the pollen studies are important for assessing the biodiversity of life, and the sexual reproduction of plants and plant-pollinator interactions. Pollen morphology on the other hand is one of the significant tools in solving some taxonomic problems on the family, and has become a part of the multidisciplinary and a collaborative approach in plant systems and their evolution. The pollen study would have a great scope in the field of medicine. The result suggests that the pollens have a strong symmetry regarding the distribution of its spines over the spherical grain. The work on the pollen morphology of Hibiscus Rosa-Sinensis is an inter-departmental venture combining both life and physical sciences.

Keywords : Hibiscus Rosa-Sinensis (HRS), pollen grains, SEM analysis, UV analysis

*Corresponding Author- katrurajeshsj@gmail.com

I. INTRODUCTION

Nature always provides everything what man needs not what he wants. For the sustenance of the biodiversity of life, plant families play an important role. Moreover, flowers for man have always been a matter of great interest due to their fragrance, colour, beauty and feel. In fact, the biological function of a flower in plants is to initiate the reproduction process, usually by providing a mechanism for the union of sperm with eggs. They are the organs of sexual reproduction. They form as a bud, grow into flower and then convert into

fruit after pollination. They are the most beautiful structures on the surface of plants. The flowers regulate breeding and support the food cycle. They provide food in the form of nectar^[1]. Interestingly, the pollen grains carry the responsibility of taking forward the flower and its plants progeny. This process of reproduction through pollens occurs by the transfer of male gametes.

Therefore, the morphological study and the absorptive behaviour of the biochemical composition of the pollens give us a deeper understanding of their taxonomical nature. The main object of the present

study is to investigate and describe the behaviour of the pollen grains of Hibiscus Rosa Sinensis of the family Malvaceae, through the instrumentation methods of SEM and UV Vis Spectroscopy, by studying which we realize that there is a lot more to explore and discover in attaining some efficacious results in medicinal and the advanced sciences.

II. HIBISCUS ROSA SINENSIS

China rose is a popular name for the beautiful flowering plant Hibiscus Rosa Sinensis. It is mainly found in south-east China and some islands in the Pacific and Indian Ocean. The name to this species was believed to have been given the name “rosa sinensis” which means “Rose of China” in Latin, by the famous Swedish biologist, Carolus Linnaeus in the early 1750s [2].



Fig 1. Flower of Hibiscus Rosa Sinensis (Clive’s house)

The reports say that Hibiscus flowers possess antitumor properties, as well as their uses have been as analgesic, antipyretic, anti-asthmatic, and anti-inflammatory agents. The studies also have proved the presence of anti-oxidant, anti-fungal, and antimicrobial properties in flowers of Hibiscus rosa-sinensis. More importantly, the investigations on extracts of stems, roots, leaves, and flowers from Hibiscus reveal that its photochemical components contributed to very

striking findings that are useful to human’s health such as antioxidant activity, which is the removal of free radicals that can lead to DNA damage [3].

III. METHODOLOGY

HRS Flower Collection: The flower for the experiment is collected from Clive’s house of St. Joseph’s College, Tiruchirapalli, Tamil Nadu, and India. It was collected in the month of January. The approximate temperature at the time of the collection was found to be around 25° to 27°C.

Dissection method is one of the easiest methods in the taxonomy of the flowers used to segregate them by parts. It is also one of the easiest methods in extracting the pollen grains from any flower. **There are various steps that are involved in the dissection:** careful removal of the flower from the plant, extraction of the sepals and petals from the flower: sepals are the small, green leaf-like structures in between the petals and the stem. Careful removal of the anthers and their stems: where anthers create pollen inside the stamen of the flower, finally, slicing the stamens and anther in half with a scalpel where the pollen is produced. Caution should be taken in slicing the anther as it is very small and fragile.

Sample Preparation:

The pollen grains are directly mounted on the specimen holder of the SEM. The dimension of the holder is 1 cubic centimetre. For the UV Vis analysis the pollen grains are dissolved in ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) as it is a good solvent and it is also unabsorptive in the UV region.

IV. RESULTS AND DISCUSSION

SCANNING ELECTRON MICROSCOPE (SEM)

Scanning electron microscope (SEM) is one of the most popular instrumentation techniques in the characterization of the nanomaterials and

nanostructures. Besides the surface morphology (texture), the signals that derive from electron-sample interactions also reveal information about the chemical composition present in the sample. As for my study, the prima-facie attempt was to characterise material in the Nano-particulate form. However, the material magnification is stable and intact at the micro level itself.

However, when we analyse them under the Particle Size Analyser, the size of the pollen particle is 252 nm taking the study towards the Nano analysis. Here, the SEM analysis is precisely to study the morphology of the pollen grains. The Fig.2a depicts microphotography of a pollen grain. The spines are sharp and long, and also symmetrically distributed over the pollen grain surface. The positions of pollen spines are similar to those of carbons in the buckminster C₆₀ fullerene molecule.

The carbons on the buckminster C₆₀ fullerene surface form polygons such as hexagon and pentagon. Similarly the spines form hexagons on the pollen grain surface. But polygon pattern in pollen grain is different from that of the fullerene. Spherical hexagons are regularly patterned and each polygon is centred in a pollen grain. In a fullerene molecule 20 hexagons and 12 pentagons are patterned by connecting 60 carbon point centres. Similarly in pollen grain also. 32 additional spine point centres are observed in each polygon centre. It is estimated that 92 spines could be distributed over a pollen grain sphere and also the measured mathematical parameters associated with the symmetrical distribution of spines on the surface of the pollen grain are analogized with buckminster C₆₀ fullerene [4].

In C₆₀ fullerene molecule, carbons are separated in a symmetrical manner and their chemical bonds are same length due to the electrical polarity. Here spines also play a vital role in structuring the pollen [5]. Mechanical and electrical properties of pollen of *H.*

Rosa were also studied. The super stability of this spherical pollen structure was analysed on the basis of mechanical and chemical properties [6,7]. It is found that the electrical charges are existing in the spines and those charges are separated in equidistance by electrostatic repulsion. In pollination process, the negative charged surface of pollen grains are attracted by positively charged surface in the legs of Honey bee.

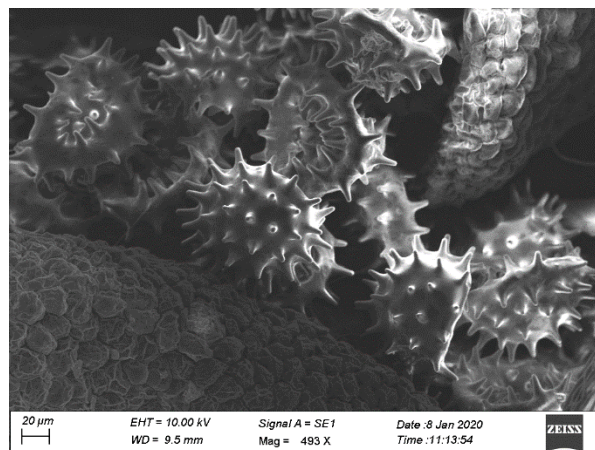


Fig. 2. SEM image of the pollen grain

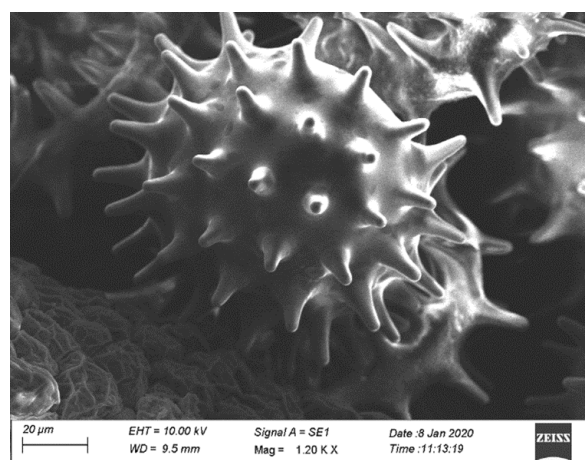


Fig. 2a. SEM Micro-image of the pollen grain

UV-vis-NIR

Varian Carry 5E model UV-vis-NIR spectrometer recorded the optical transmittance against the wavelengths of UV-vis-NIR region from 200 nm to 1400 nm. Fig. 3.depicts the optical absorption spectrum of latex of CG. The UV-Vis spectra profile of HRS Pollen grains reveals the absorptive behaviour of the

biochemical composition in the pollen. This is applied to identify the number and the characteristics (position, intensity, shape) of absorption peaks, in order to determine the specific bioactive classes of compounds. Mostly, the Carboxylic acids absorb the UV light of wavelength region from 200 to 240 nm [8]. In HRS pollen, the Carboxylic acids make absorptive peaks at 204 nm and 219 nm. The peaks in the UV region ranging from 250-400 nm reveal the presence of phenolic acids and their derivatives, e.g., flavones, flavonols, flavanones, flavonoids. The peak at 271 nm is pertained to flavonoids present in the HRS pollens.

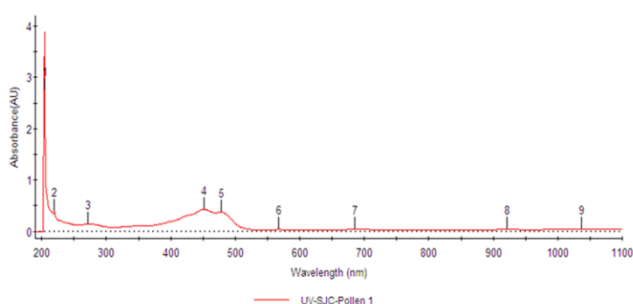


Fig. 3. UV-vis-NIR spectrum of HRS pollens

SUMMARY and CONCLUSION:

It is becoming clear that Hibiscus Rosa Sinensis plays a very important role, physiologically, ecologically, and evolutionarily, in anti-herbivore plant defences and in plant-insect interactions in a very unique way. **The Future studies will unveil:** The enhancement of carrier multiplication in pollen grains attracts a great deal of attention owing to their potential application in the field of research and the medicine. The advantages of HRS are at the medicinal level and the pollen morphology in specific makes us understand the inner nature of the plant. This surely paves way for a deeper research on pollen grains. Access to HRS pollens is based on review and scientific merits and it provides a cutting edge scientific idea to carry out research on characterizing HRS pollens for further applications. Optical absorption and transmission behaviour of HRS pollens witnessed the biochemicals present in the HRS

pollen grains. Eco-friendly and pollutant free material selection is always a matter of the greatest priority as it enhances the knowledge about the secrets that remain hidden in the nature and as a matter of fact the Nature never stops revealing itself to us.

V. CONCLUSION

PTh-PEO polymer composites were prepared successfully by in situ chemical oxidative polymerization of thiophene doped with Li₂SO₄. FTIR study confirms the successful polymerization of polymer composite. The value of transference number of all polymer composite samples was investigated by dc polarization techniques and found to be in the range of 0.80 to 0.89. This suggests that the charge transport in the PTh-PEO composite doped is predominantly due to ions only.

VI. REFERENCES

- [1]. <https://www.flowersworld.com/uses-of-flowers/>
- [2]. Komal Arora, POLLEN IDENTIFICATION OF HIBISCUS ROSA-SINENSIS AND SIDA ACUTA THROUGH FTIR SPECTROSCOPY, October 2014, Department of Botany, DAV College, Jalandhar, Punjab, India 144008
- [3]. Kawase, hl. And Takahashi. M. 1995. Chemical composition of sporopollenin in Magnolia grandij7ora (hlagnoliaceae) and Hibiscus syriacirs (hialvaceae). - Gana 31: 242-245. ISSN 0017-3134.
- [4]. Andrade K, Guerra S, Debut A (2014), Fullerene-Based Symmetry in Hibiscus rosa-sinensis Pollen. PLoS ONE 9(7): e102123. doi:10.1371/journal.pone.0102123
- [5]. Bowker GE, Crenshaw HC (2007) Electrostatic forces in wind-pollination-Part 1: Measurement of the electrostatic charge on pollen. Atmospheric Environment Vol. 41 (8), 1587-1595.

- [6]. Karton A, Chan B, Raghavachari K, Radom L (2013) Evaluation of the heats of formation of corannulene and C60 by means of high-level theoretical procedures. *The Journal of Physical Chemistry* Vol. 117, 1834–1842.
- [7]. Zhang JY, Ohsaki (2012) Self-equilibrium and stability of regular truncated tetrahedral tensegrity structures. *Journal of the Mechanics and Physics of Solids* Vol.60, 1757–1770
- [8]. Andrade K, Guerra S, Debut A (2014), Fullerene-Based Symmetry in *Hibiscus rosa-sinensis* Pollen. *PLoS ONE* 9(7): e102123. doi:10.1371/journal.pone.0102123