

## MORPHOLOGICAL AND HISTOLOGICAL STUDIES OF *MIRABILIS JALAPA* L. GROWN IN YANGON UNIVERSITY CAMPUS

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### Abstract

*Mirabilis jalapa* L. belongs to the family Nyctaginaceae. In this paper, identification of plant is carried out by using available literatures. Morphological and histological characters of leaves, stems, rhizomes and roots were also carried out by using microscope. In morphological study, the plant is perennial herbs. Leaves opposite. Inflorescences terminal cymes. Flower bracteolate (5-sepaloid) and hypogynous. Perianth fused. Stamen shortly connate around the ovary. Placentation is basal. In microscopical study, the anticlinal wall of lower surface of lamina is wavier than upper. Anomocytic stomata present only in lower surface of lamina. Vascular bundles of lamina, midrib, and petiole are collateral, medullary bundles also present in middle of midrib and petiole. Raphides are present in mesophyll layer of lamina and also in cortical region of midrib and petiole. In stem, vascular bundles are collateral and medullary bundles are scattered in the ground tissue. In rhizome, vascular bundles are collateral. Raphides and starch grains are present. In root, vascular bundle is diarch. Raphides found within the pericycle layer in circular manner. The powdered sample has been investigated and presented as diagnostic characters for the standardization of powdered drugs.

**Keywords:** *Mirabilis jalapa* L., Morphological and Histological Studies

### Introduction

Medicinal plants are rich in Myanmar. Among them, *Mirabilis jalapa* L. belonging to the family Nyctaginaceae is included. This family is mainly distributed in subtropical, particularly America; temperate North America to temperate South America, Africa, South Asia, Australia, New Zealand. The Nyctaginaceae consist of 30 genera and 290 species (Goldberg, 1986).

According to the Hutchinson (1967), this family consists of about 33 genera and 560 species, distributed in tropics and subtropics, but mainly tropical and temperate America. The native of this plant is tropical America (Cooke, 1958). It is generally found cultivated in gardens (Duke, 2002).

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The flowers of *Mirabilis jalapa* L. open in the evening, which give rise to one of the common names “Four O’clock” flowers. Another common name, Marvel of Peru, relates to the polychromic flowers, which are white, yellow, or red (Heywood *et al.*, 2007). Myanmar name of this species is Mye-su, Lay-nar-yi-pan and common name is Marvel of Peru or Four o’clock flower (Hundley and Chit Ko Ko, 1961 and Kress *et al.*, 2003).

The plant is used in the treatment of carminative, diuretic, laxative, fungicide, stomachic, tonic, vermifuge, cancer, diabetes, diarrhoea, dysentery, inflammation, leucorrhoea, syphilis, wound, and whitlow (Duke, 2002). It is used in urinary tract infection (Nagathein, 1972). The leaves are applied to boils, phlegmons and whitlow, as a maturant. The root is used as a purgative in La Reunion and the Philippine Islands (Chopra *et al.*, 1956 and Kartikar and Basu, 1975). Tuber is used as a poultice on carbuncles. Root is a mild purgative (Nadkarni, 1954).

The aims and objectives are to verify the plant *Mirabilis jalapa* L. based on morphological character and to examine the histological characters of leaves, stems, rhizomes and roots and to identify the diagnostic characters of powdered samples for the standardization of traditional medicine.

## **Materials and Methods**

### **Collection and Identification of *Mirabilis jalapa* L.**

The plants *Mirabilis jalapa* L. were collected from Kamaryut Township, Yangon University campus, from July to October (2014). The morphological study of plant was undertaken with the help of available literatures (Hooker, 1885; Cooke, 1958; Wealth of India, 1962; Backer *et al.*, 1963; Lawrence, 1964; Hutchison, 1967; Kirtikar and Basu, 1975; Dassanayake, 1996; Subrahmanyam, 1999 and Qi-ming, 2007).

### **Histological study of *Mirabilis jalapa* L.**

In histological studies, free hand sections of laminae, midribs, petioles, stems, roots and rhizomes from the fresh specimens were prepared by using chloral hydrate solution for clearing reagents, phloroglucinol solution followed by conc: HCl for testing lignin and I<sub>2</sub> B.P solution for starch. These characters were determined according to the literature of Metcalfe and Chalk, (1950), Wallis, (1967), Pandey, (1993) and Pandey and Chadha, (1996).

### Preparation of powdered samples of *Mirabilis jalapa* L.

The collected samples (leaves, stems, rhizomes and roots) were washed with water to remove impurities. After washing the samples were cut into small pieces then air dried at room temperature and weighed. When constant weight was obtained, different plant parts were grounded to get powder and stored in air tight containers to prevent moisture changes and contamination. Powders were examined of different plant parts identify to get standardization for traditional medicine.

## Results

### Morphological characters of *Mirabilis jalapa* L.

|                 |   |                                |
|-----------------|---|--------------------------------|
| Scientific Name | - | <i>Mirabilis jalapa</i> L.     |
| Myanmar Name    | - | Mye-su                         |
| Common Name     | - | Marvel of Peru or Four o'clock |
| Family          | - | Nyctaginaceae                  |

Perennial herbs, about 2ft-4ft high, the stems herbaceous, cylindrical, angular, erect, much branched, often reddish, with tumid nodes, pubescent. Leaves opposite, simple, leaf blade ovate to ovate-triangular, deep green, about 10.9- 6.9 x 5.1- 2.8 cm, the tips acuminate, the margins entire, the margins entire, the base cordate, both the surface glabrous; petioles about 3.5- 1.3 cm long and 0.3- 0.2mm wide, pubescent, exstipulate. Inflorescence terminal, cymose, simple-corymb, about 5.6- 3.5 cm, persistent, ebracteate, bracteolate, pedicellate (very short). Flowers funnel-shaped, yellow, purple, white, or variegated and opening in the evening, about each flower subtended by an involucre, complete, actinomorphic, pentamerous, hypogynous. Perianth tepal (5), syntepalous, funnel shaped, various coloured (yellow, purple, white or variegated), inferior. Stamen 5, usually exserted, shortly connate around the ovary, filament unequal, filiform, anther ditheous, longitudinal dehiscent. Ovary 1-celled, monocarpellary, one ovule, basal placentation, superior, styles filiform, exserted, stigma capitellate with stipitate papillae, a nectariferous disc surround the ovary. Fruit globose, about 0.8- 0.7 cm black, ribbed, persistent perianth. Seed-testa adherent to the pericarp, about 0.5- 0.4 cm, embryo hooked. The results are shown in Figure.1-8.

Flowering and fruiting time – August to December

### Morphological characters of *Mirabilis jalapa* L.



**Figure.1** Habit



**Figure.2** Tuber



**Figure.3** Arrangements of leaves and inflorescence



**Figure.4** L.S of flower



**Figure.5** T.S of ovary



**Figure.6** L.S of ovary



**Figure.7** Mature fruits



**Figure.8** Seeds

### Histological characters of *Mirabilis jalapa* L. leaves

#### Lamina

In surface view, the cuticle is smooth, the epidermal cells both surfaces are parenchymatous and thin wall the anticlinal wall of the lower surfaces are waiver than the upper. Anomocyclic stomata are present only on

the lower surface. The stomata are oval in outline with two-reniform shaped guard cells and contain abundant chloroplasts. Bundles of raphides are present on both surfaces.

In transverse section of lamina, cuticle layer is thin and smooth on both surfaces. Both upper and lower epidermal cells are barrel shaped, thin walled and parenchymatous. Palisade parenchyma found beneath the upper epidermis is only one-layered. These cells are vertically elongated and compact, with abundant chloroplast. The spongy mesophyll cells are 5-6 layers thick, loosely arranged, irregular in shape, with many intercellular spaces. Vascular bundles are embedded in the mesophyll cells. They are collateral type. Each bundle is surrounded by a parenchymatous bundle sheath. The phloem tissue composed of sieve tube elements, companion cells, phloem fibre and phloem parenchyma. The xylem composed of vessels, tracheids, fibres and xylem parenchyma. Bundles of raphides are abundantly present among the mesophyll cells. The results were shown in Figures 9-11.

### **Midrib**

In surface view, the epidermal cells are rectangular in shaped and axillary elongated. Uniseriate, multicellular trichomes with rounded tips are present.

In transverse section, the cuticle layer is thin. Both upper and lower epidermal cells are more or less barrel shaped parenchymatous cells. Below the epidermis, 2-3 layers of lamellar type collenchymatous cells are present towards the upper surface and 1-2 layers embedded in the parenchymatous layers. Inner to the upper and lower collenchymatous layers consists of parenchymatous cells which are rounded to polygonal in shape. Vascular bundles are collateral types, embedded in the parenchymatous layers. The numbers varies from 3-5 and arrange in semicircular shape with 1-2 medullary bundles in the middle. Bundles of raphides are occasionally present between the vascular bundles. Xylem composed of vessels, tracheids, xylem fibres and xylem parenchyma. The phloem tissue composed of sieve tube elements, companion cells, phloem fibre and phloem parenchyma. Uniseriate, multicellular trichomes are present on the upper epidermis. The results were shown in Figure 12.

### **Petioles**

In surface view, the epidermal cells are thin walled, polygonal in shaped and axillary elongated.

In transverse section, the cuticle layer is thin. The epidermal cells of both surfaces are more or less barrel shaped, with thin walled parenchymatous cells. The lamellar type collenchymatous cells present below both epidermises are 2-3 layers and thickened, rounded to polygonal shaped in both surfaces. The parenchymatous cells between two collenchymatous layers are 5-7 layers are thickened and are polygonal to isodiametric in shape. Vascular bundles are collateral types, embedded in the parenchymatous layers. The numbers varies from 3-5 and arrange in semicircular shape with 1-2 medullary bundles in the middle. Bundles of raphides are occasionally present between the vascular bundles. Xylem composed of vessels, tracheids, fibres and xylem parenchyma. The phloem tissue composed of sieve tube elements, companion cells, phloem fibre and phloem parenchyma. Uniseriate, multicellular trichomes are present on the upper epidermis. The results were shown in Figure 13.

### **Histological characters of *Mirabilis jalapa* L. stems**

#### **Stems**

In surface view, the epidermal cells are thin walled parenchymatous cells, polygonal in shaped and axillary elongated.

In transverse section, the stem has two groves lying opposite to each other. The cuticles layer is thin. Epidermal cells are barrel shaped, parenchymatous cells. 2-3 layered of lamellar type collenchymatous cells, 1-3 layered chlorenchymatous cells and 1-3 layered of parenchymatous cells with large intercellular spaces. The endodermal layer is composed of barrel-shaped parenchymatous cells. Pericycle layer lies below this layer and are polygonal shaped. Collateral type vascular bundles and medullary vascular bundles are scattered in the ground tissue. Bundles of raphides are present in cortical region. Uniseriate, multicellular trichomes are present. The results were shown in Figure 14.

### **Histological characters of *Mirabilis jalapa* L. rhizome**

#### **Rhizome**

In surface view, the cork cells are polygonal in shaped; anticlinal walls are straight.

In transverse section, periderm consists of 35-40 layers, thin walled parenchymatous cells, rectangular to irregular in shaped. Periderm composed of phellem or cork, phellogen or cork cambium and phelloderm or secondary cortex. Cortex 11-13 layers, thin walled parenchymatous cells, irregular in

shaped. As secondary growth has taken place vascular elements are all scattered throughout the cortical region. Xylem bundles composed of vessels, tracheids, xylem fibre and xylem parenchyma. Phloem composed of sieve tube, companion cells, phloem fibres and phloem parenchyma. Bundles of raphides and starch grains are present. The results were shown in Figure 15.

### **Histological characters of *Mirabilis jalapa* L. roots**

#### **Roots (Young root)**

In surface view, epidermal cells are thin walled parenchymatous cells.

In transverse section, the young root is circular in outline. The epiblemal layer is made of barrel shaped, one layer, and thin walled parenchymatous cells. The roots hairs are present. Cortex layer composed of 6-7 layers of parenchymatous cells with are polygonal shaped with large intercellular spaces are present. The endodermis is made up of barrel-shaped parenchymatous cells. Pericycle layer lie below this endodermal layers are made up of barrel shaped. Raphides are present within the pericycle layer in a circular manner. Vascular bundle is diarch. Bundles of the xylem are exarch i.e. the metaxylem towards the central and protoxylem towards the periphery. Xylem bundles composed of sieve tube, companion cells, xylem fibre and xylem parenchyma. Phloem composed of sieve tube, companion cells, phloem fibre and phloem parenchyma. The results were shown in Figure 16.

#### **In mature root**

In transverse section, the mature root is circular in outline. Periderm consists of 30-32 layers thin walled parenchymatous cells, rectangular to polygonal in shaped. Endodermis layer is not distinct in mature root. As secondary growth has taken place, all tissues outside the stele become irregular and crushed between secondary phloem and pericycle. The diarch vascular bundles changed into anomalous structure. Patches of raphides are left around the stele. The results were shown in Figure 17.

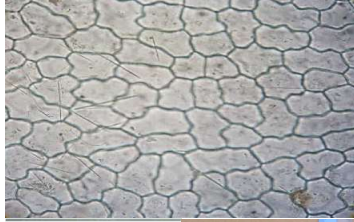
#### **Sensory characters the whole plant powders of *Mirabilis jalapa* L.**

The whole plant powdered of *Mirabilis jalapa* L. was pale green coloured and odourless. It was tasteless and fibrous in texture as shown in Figure 18.

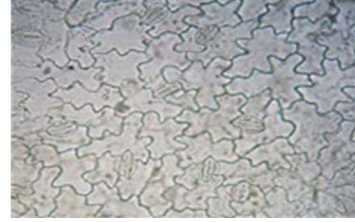
### Microscopical characters the whole plant powders of *Mirabilis jalapa* L.

It consists of multicellular trichome, fragment of upper surface, stomata, spiral vessel, pitted vessel, annular vessels, fibres, tracheids and raphides as shown in Figures 19-29.

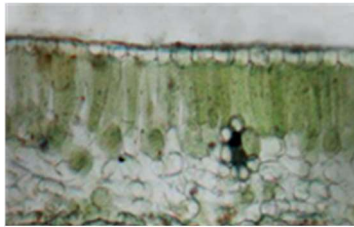
### Histological characters of leaves, stems, rhizomes and roots of *Mirabilis jalapa* L.



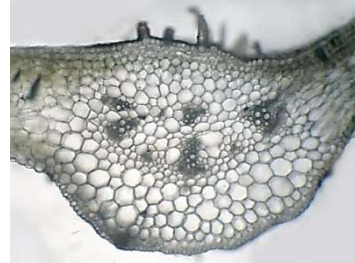
**Figure.9** Surface view of upper epidermis (X400)



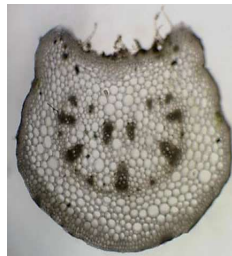
**Figure.10** Surface view of lower epidermis (X 400)



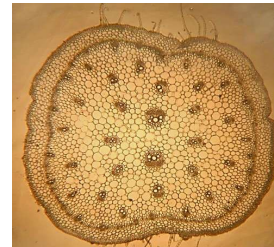
**Figure.11** T.S of lamina showing vascular bundle (X 400)



**Figure.12** T.S of midrib (X 100)



**Figure.13** T.S of petiole (X 100)

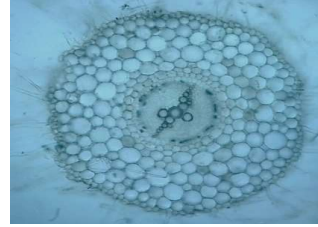


**Figure.14** T.S of stem (X 40)

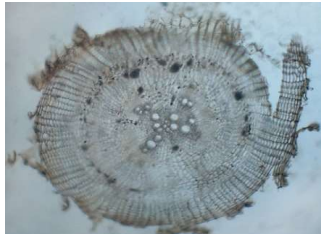




**Figure.15** T.S of rhizome showing vascular bundles and raphides (X 100)



**Figure.16** T.S of root in outline (X 100)



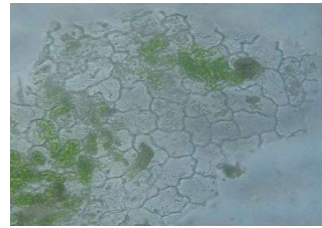
**Figure.17** T.S of mature root (X 100)  
Sensory characters of the whole plant powders of *Mirabilis jalapa* L.



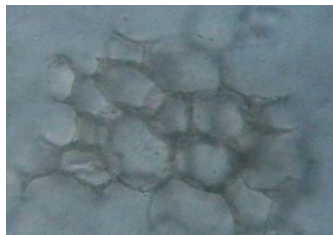
**Figure.18** Powderplant of *Mirabilis jalapa* L. Diagnostic characters the whole plant powders of *Mirabilis jalapa* L.



**Figure.19** Multicellular trichome (X 400) epidermal



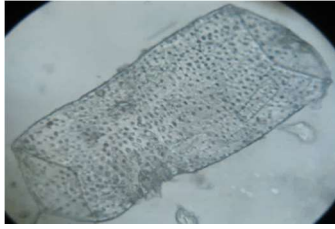
**Figure. 20** Fragment of upper epidermal



**Figure.21** Fragment of parenchymatous



**Figure.22** Spiral vessels (X 400) cells



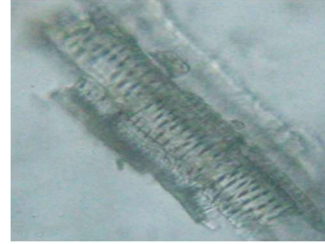
**Figure.23** Pitted vessels (X 400)



**Figure.24** Stomata (X 400)



**Figure.25** Annular vessels (X 400)



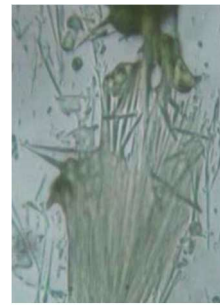
**Figure.26** Scalariform vessels



**Figure.27** Fibres (X 400)



**Figure.28** Tracheids (X 100)



**Figure.29** Raphides  
(X 400)

### Discussion and Conclusion

In this research, the identification and microscopical characters of *Mirabilis jalapa* L. were carried out. The plant is perennial herbs. This characters are agreement in those of The wealth of India, (1962), Hutchinson, (1967), Kirtikar and Basu, (1975), Jain, (1991), Subrahmanyam, (1999) and Qi-ming, (2007). Stems is an erect, much branched, swollen at node. These characters are agreement with those described by The wealth of India, (1962), Jain, (1991), Dassanayake, (1999), Subrahmanyam, (1999), Rawat and Bhatt,

(2002) and Qi-ming, (2007). The leaves are opposite. These characters are agreed with those mentioned by Hutchinson, (1967), Subrahmanyam, (1999) and Qi-ming, (2007).

The inflorescences are terminal cymes and perianth various coloured such as white, yellow, red, purple and variegated colour. These characters are agreed with those mentioned by Backer *et al.*, (1963), Jain, (1991) and Qi-ming, (2007). Flowers are bisexual. These characters are agreed with those mentioned by Saunders, (1939), Subrahmanyam, (1999) and Qi-ming, (2007). Stamen 5, shortly connate around the ovary. These characters are agreement with those mentioned by Hutchinson, (1967) Subrahmanyam, (1999) and Qi-ming, (2007).

Carpel one, monocarpellary, basal placentation and the ovary superior. These characters are agreed with those of Subrahmanyam, (1999). Fruit globose. This character is agreed with those of Hutchinson, (1967) Dassanayake, (1999), Subrahmanyam, (1999) and Qi-ming, (2007). Seed-testa adherent to the pericarp; embryo hooked. This character is agreed with those of Hutchinson, (1967).

In microscopical study, the leaves of this plant is dorsiventral. Anticlinal walls of lower surface of lamina are more waiver than upper. Anomocytic stomata are present only lower epidermis. Vascular bundle of lamina, midrib and petiole are collateral type and medullary bundles are also present in the middle of midrib and petiole. Raphides present in mesophyll layers of lamina and cortex layers of midrib and petiole.

In stem, cortex layers are found below the epidermal cells and composed of collenchymatous, chlorenchymatous and parenchymatous cells. Only one layer of endodermis is present. Vascular bundles are collateral types and medullary vascular bundles are scattered in the ground tissue. Raphide are present in cortical region.

In rhizome, periderm layers present. Vascular bundles are scattered throughout the cortical region. Bundles of raphide and starch grains are present. In root, cortex layer is below epiblema layer. Only one layer of endodermis and pericycle are present. Vascular bundle is diarch in young root and it is changed into anomalous structure in mature root. Raphides are present within the pericycle layer in a circular manner. These characters are agreed with those of Metcalfe and Chalk, (1950), Pandey, (1993) and Pandey and Chadha, (1996).

Multicellular trichome, fragment of upper surface, stomata, spiral vessel, pitted vessel, annular vessels, fibres, tracheids and raphides were found in the powdered sample.

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### References

- Backer, C. A., R. C. Bakhuizen Van Den Brink Jr. (1963). **Flora of Java**, Vol. I. N.V. P. Noordhoff Groningen, The Netherlands.
- Chopra, R. N., S. L. Nayar and I. C. Chopra. (1956). **Glossary of Indian Medicinal Plants**. Council of Scientific and Industrial Research, New Delhi.
- Cooke, T., C. I. E. (1958). **The Flora of the Presidency of Bombay**. Vol. II. Printed by P.C. Ray, Sri Gouranga Press Private Ltd., 5, Chintamain Das Lane, Calcutta-9.
- Dassanayake, M. D. (1996). **A Revised Handbook to the Flora of Ceylon**. Vol. XIII. University of peradeniya, Washigton, DC. Amerind Publishind Co. Pvt. Ltd., New Dehi.
- Duke, J. A. (2002). **Hand Book of Medicinal Herbs**. 2<sup>nd</sup> edition. Printed in the United States of America.
- Goldberg, A. (1986). **Classification, Evolution, and Phlogeny of the families of Dicotyledons**. Smithsonian institution press city of Washington.
- Heywood, V. H., R. K. Brumitt, A. Culhan and O. Seberg. (2007). **Flowering Plants of The World**. London: Oxford University Press.
- Hooker, SIR J. D., C. B., K. C. S. I. (1885). **The Flora of British India**. Vol. IV. L Reeve & Co., 5, Henrietta Street, Covent garden. London.
- Hundley, H. G. and Chit Ko Ko. (1961). **List of Tree, Shrubs, Herbs and Principle Climbers etc**. Govt. Printing and Stationery. Rangoon.
- Hutchinson, J., LL. D., F. R. S. (1967). **The genera of flowering plants**. Oxford at the clarendon press.
- Jain, S. K., B. K. Sinha and R. C. Gupta. (1991). **Notable Plants in Ethnomedicine of India**. Publications A3/27A, DDA Flats, Paschim Vihar New Delhi.
- Kartikar, K. R. and B. D. Basu. (1975). **Indian Medicinal Plants**. Vol. III. Leader Road, Allahabad, Indian.
- Kress, W. J., R. A. Defilipps Ellen Farr and Yin Yin Kyi. (2003). **A Checklist of the Tree, Shrubs, Herbs and Climbers of Myanmar**. Department of Systematic Biology-Botany, National Museum of Natural History, Washington DC, USA.

- Lawrence, G. H. M. (1964). **Taxonomy of Vascular Plant**. The macmillan, Company, New York, London.
- Metcalf, C. R. and L. Chalk. (1950). **Anatomy of the Dicotyledons**. Vol. II. Oxford at the Clarendon Press.
- Nadkarni, A. K. (1954). **Indian Materia Medica**. 3<sup>rd</sup> edition. Published by G.R. Bhatkal for the Popular Book Depot (Regd) Lamington Road, Bombay 7 and Dhootapapeshwar Prakashan Ltd., Panvel.
- Nagathein, A Shin. (1972). **Pon-pya-say A-bidan**. Vol II. Mingala Press. Yangon.
- Pendy, B. P. (1993). **Plant Anatomy**. S. Chand & Company LTD. Ramnagar. New Delhi.
- Pendy, S. N and A. C. Chadha. (1996). **Plant Anatomy and Embryology**. Vikas Publishing House Pvt. Ltd., New Delhi.
- Qi-ming, HU. (2007). **Flora of Hong Kong**. Vol.I. Published by Agriculture, Fisheries and Conservation Department, Government of the Hong Kong Special Administrative Region.
- Rawat, R. S. and V. K. Bhatt. (2002). **Medicinal Plant Diversity in Doon Valley**. Published by: Navdanya,105-Rajpur Road, Dehradun, 248001, Uttaranchal, India.
- Saunders, E. R., F. L. S. (1939). **Floral Morphology**. Vol II. Cambridge W.Heffer and Sons LTD. England.
- Subrahmanyam, DR. N. S. (1999). **Laboratory manual of plant taxonomy**. 2<sup>nd</sup> edition. Vikas Publishing House PVT LTD.
- Wallis, T. E. (1967). **Textbook of Pharmarcognosy**. Fifth edition. J. & A. Churchill LTD. 104 Gloucester place, London.
- The wealth of India. (1962). **A Dictionary of Indian Raw Materials and Industrial Products**. Vol VI. Council of scientific & Industrial Research India.