

Study on Morphological and Microscopical Characters of *Ocimum basilicum* L.

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Abstract

The present study was carried out morphological and microscopical studies of *Ocimum basilicum* L. These species belong to the family Lamiaceae and are well known for their medicinal values. The morphological characters of the vegetative and reproductive parts of plant have been studied and identified in the Botany Department of Banmaw University. The anatomy of leaves reveals diacytic type of stomata, non-glandular uniseriate multicellular trichomes, peltate types of glandular trichomes and collateral and closed type of vascular bundles. In the anatomy of the stem, collateral and open type of vascular bundles were found due to secondary thickening developed from cambial activity. It can be concluded that the present research may provide a basis for other investigations of these plants.

Keywords: Morphology, Anatomy, *Ocimum basilicum* L.,

Introduction

Genus *Ocimum* is a member of the family Lamiaceae which occur throughout the world, temperate and tropical regions such as India, Pakistan, tropical Africa, Central Asia, Madagascar, America, Arabia, Australia, Malaysia (Kirtikar and Basu 1935). Among the plants known for medicinal value, the plants of genus *Ocimum* are very important for their therapeutic potential. Because of its popularity basil is often referred to as King of herbs, being widely utilized due to its economic, nutritional, industrial and medicinal properties. *Ocimum basilicum* L. is an example of known important species of the genus *Ocimum* which grow in different parts of the world and are known to have medicinal properties (Atal, 1989).

Ocimum basilicum is used in traditional ceremonial rituals and as medicines because it contains biologically active constituents that are antimicrobial, insecticidal, nematocidal and fungistatic and antioxidant. Basil is used in traditional medicine as a tonic and vermifuge, and Basil tea taken hot is good for treating nausea, flatulence, and dysentery. The oil of the plant has been found to be beneficial for the alleviation of mental fatigue, cold, spasm, rhinitis, and as a first aid treatment for wasp stings and snakebites. Preliminary studies have found various constituents of *Ocimum basilicum* to exhibit a variety of therapeutic effects (Ismail, 2006).

In Indian traditional systems of medicine, different parts (leaves, stems, flowers, roots, seeds and even whole plant) of *Ocimum* have been recommended for the treatment of various ailments i.e., bronchitis, bronchial asthma, malaria, diarrhea, dysentery, skin diseases, arthritis, chronic fever and insect bites. The essential oil of *Ocimum* spp. was rich in camphor, citral, eugenol, geraniol, linalool, linalyl acetate and methyl chavicol etc., and was harnessed for successful utilization in industry. There is a variation in the production of these products among different species of *Ocimum*. Therefore, precise characterization such as anatomical and morphological features of species of *Ocimum* is necessary. Standardization of herbal drugs is a pre-requisite as per the global market of herbal medicine. Morphological and anatomical characters play a vital role in crude drug standardization. The morphological and anatomical account of a medicinal plant is the first step towards establishing the correct identity and the degree of purity (Agarwal *et al.*, 2013).

Therefore, the aim and objectives of this research were to study the morphological characteristics of this plant, to examine the microscopical characteristics of its leaves and stem.

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Materials and Methods

Morphological studies

The specimens were collected from Banmaw Township, Kachin State during their flowering time. After collection, all vegetative and reproductive parts of the fresh specimens were studied, measured in detail and recorded with photographs. These plants were classified based on their morphological characteristics. The identification was done by referring to the references of Hooker (1885), Backer (1965), Dassanayake (1981) and Hu-Qi-ming (2009).

Microscopical studies

The lamina, midrib, petiole and stem of studied plants were cut in the free-hand section cutting method to obtain thin slice specimens. These were cleaned with a chloral hydrate solution and then mounted in dilute glycerin. The section cuttings were then applied with acetic acid B.P. for examining the presents of calcium oxalate crystals. The specimens were then observed under a microscope and photographed. Microscopical characteristics were studied as determined by Metcalfe & Chalk (1950) and Esau (1965).

Results

Scientific Name	-	<i>Ocimum basilicum</i> L.
Local Name	-	Pinsein
English Name	-	Sweet basil
Family	-	Lamiaceae

Morphological characteristics of *Ocimum basilicum* L.

Annual aromatic herbs to undershrubs, 0.5-1.0 m high. Stem much branched, quadrangular, woody at the base, glabrous. Leaves simple, opposite and decussate, laminae elliptic-ovate, acute at the apex, entire to distantly crenulate along the margin, cuneate at the base, glabrescent to puberulous above, pubescent with appressed hairs on nerves beneath and copiously dotted with oil glands, petiolate, exstipulate. Inflorescences terminal, verticillasters, six-flowered, densely pubescent. Flowers small, white with faintly pink, the bract broadly ovate, ebracteolate, pedicellate, zygomorphic, bisexual, pentamerous, hypogynous. Sepals (5), fused, bilabiate, green, tube 3.0 mm long, sparsely strigose without and dotted with oil globules within, upper lip broadly orbicular, concave, mucronate, lower lip 4-fid, lower lip teeth lanceolate, apex spinescent, ciliate, and persistent. Petals (5), fused, bilabiate, white, faintly tinged pink, tube infundibular, 4.0-5.0 mm long, upper lip erect, unequally 4-lobed, flat, lower lip declinate, margin entire, slightly concave. Stamen 4, didynamous, exerted, filaments filiform, light purple, the 2-longer filaments 6.0-8.0 mm long, with a transverse process of tufted hair at base, the 2- shorter ones 4.0-6.0 mm long, anthers reniform, ditheous, dorsifixed, longitudinally dehiscence. Ovary bicarpellary, syncarpous, tetralocular, one ovule in each locule, axile placentation, style gynobasic, filiform, glabrous, stigma bifid, superior. Nutlets subgloboid, one seeded. Seeds ovoid (Figure 1).



A. Habit



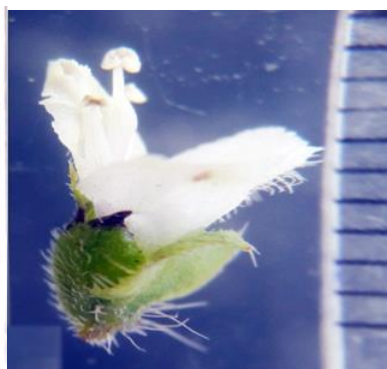
B. Leaf (upper surface)



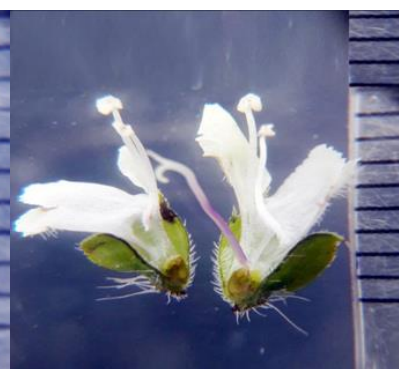
C. Leaf (lower surface)



D. Inflorescence



E. Flower



F. L.S of flower



G. Calyx (opened)



H. Corolla (opened)



I. Stamen



J. Pistil



K. Nutlets

Figure 1. Morphological characteristics of *Ocimum basilicum* L.

Microscopical characteristics of *Ocimum basilium* L. (Figure 2 and 3)

Lamina

The epidermal cells of both surface view are parenchymatous, irregular in shape. The cell walls were highly undulating anticlinal walls. Stomata were present on both surfaces and more abundant on lower surface. They were diacytic in type and oval to oblong in shape. The guard cells were reniform shaped with chloroplasts. Glandular peltate trichomes were present. They consist of a short stalk cell which is buried in circular shallow pits of epidermis and a plate of circular darkly stained secretory cells at the tip of stalk cell.

The transverse section of the lamina is dorsiventral. The upper epidermal cells were slightly thick and elliptical and cylindrical shaped. The lower epidermal cells were thin and squarish small cells. The mesophyll consisted of palisade and spongy parenchyma. The palisade mesophyll was made up of single layer of vertically elongated cylindrical cells, which were compactly arranged. They contained numerous chloroplasts and oil gland. The spongy mesophyll consisted of 4 to 5 layers of small, spherical loosely arranged parenchyma cells. The vascular bundles of lateral vein were rounded to oval in shape. The arrangement was collateral and closed type. Vascular bundle was surrounded by a compact layer of thin-walled parenchyma cells. The phloem cells were very small.

Midrib

The epidermal cells of both surfaces were parenchymatous and elongated along the length of the midrib and they were also rectangular. The lower and upper epidermal cells were similar in shape and size. Trichomes were present on both surfaces.

Transverse section of the midrib was plano-convex in outline with flat upper surface and hemispherical lower surface. The upper and lower epidermal cells were one layered. They were small rectangular shaped with thick walls and covered by cuticle. The cortex composed of angular collenchyma and thin-walled parenchyma cells. The collenchyma cells were 4 to 5 layers in thickness toward the upper surface and 2 to 3 layers in thickness toward the lower surface. The parenchyma cells were 4 to 8 layers above the vascular bundles and 4 to 5 layers of the beneath of the vascular bundles. The vascular bundle was single, wide and bowl shaped and collateral and closed type. The vascular stand consists of several short, angular, narrow xylem elements with wide parenchymatous gaps in between. The phloem elements are located along the lower end of the xylem stand. The vascular bundles are embedded in the parenchymatous cell. The phloem cells were very small.

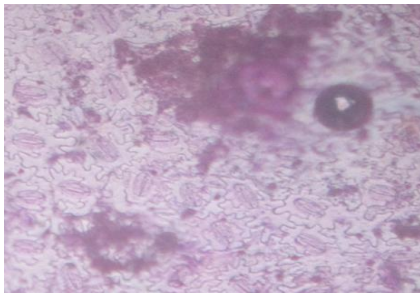
Petiole

The epidermal cells of both surfaces were parenchymatous, elongated or rectangular, similar in shape and size. The cell walls were smooth, anticlinal wall straight. Trichomes were abundant on the lower surfaces the upper ones. Non-glandular uniseriate, multicellular trichomes and glandular peltate trichomes were present.

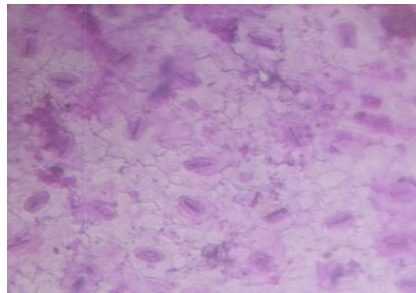
Transverse section of the petiole was more or less rounded oval shape with shallowly concave surface at the upper side. The cuticle layer was thick. Multicellular uniseriate trichomes were present. The cortex was made up of angular collenchyma and thin-walled parenchyma cells. The parenchyma cells were 4-10 layers and collenchyma cells were 2-3 layers above the vascular bundle and 4-6 layers of parenchyma cells and 3-4 layers of collenchyma below the vascular bundle. Intercellular spaces were numerous among the tissue. Vascular bundles system includes a median, large, crescent shaped strand and a smaller, less prominent strand on each wing of petiole and embedded in the parenchymatous tissues. The arrangement was collateral and closed type. Xylem elements of main strand are small, angulars and occur in short vertical strands. Phloem elements are small discrete.

Stem

The epidermal cells of both surfaces were rectangular, elongated cells and compactly arranged. Transverse section of the stem was rectangular or quadrangular shaped in outline. The epidermal cells were slightly tangentially elongated cells and covered by a thin cuticle layer. The cortex is composed of peripheral collenchymatous and parenchymatous tissue. The peripheral collenchymatous tissue consisted of layers in a continuous sheath. The parenchymatous tissues consisted of about 5 to 7 layers. The parenchymatous cells were in shape. Pith composed of polygonal, oval and spherical cells with small intercellular spaces. The vascular bundles consisted of closely arranged 4-large collateral bundles in four lobes. Belts of sclerenchyma fibers can be observed at the ends of large phloem vascular bundles.



A. Upper surface of lamina



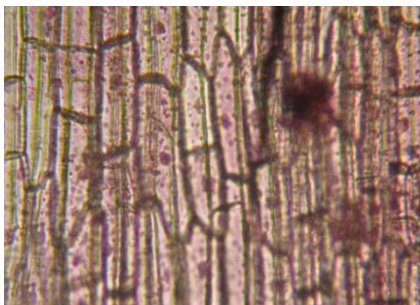
B. Lower surface of lamina



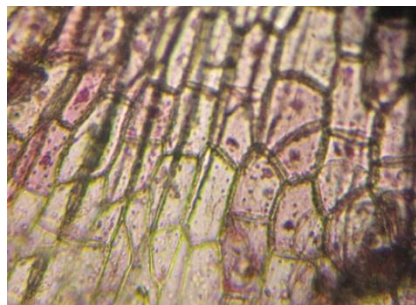
C. T.S of lamina



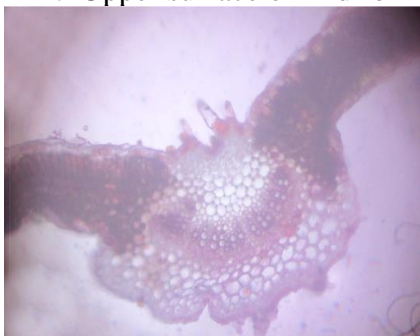
D. Vascular bundle of lamina



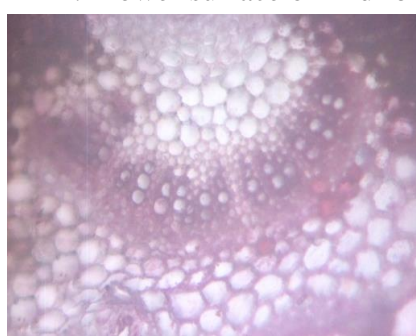
E. Upper surface of midrib



F. Lower surface of midrib

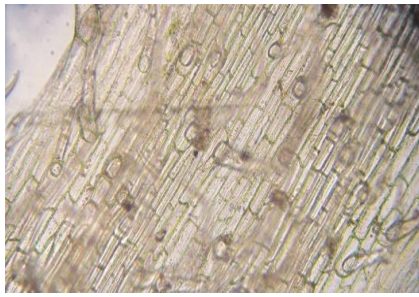


G. T.S of midrib

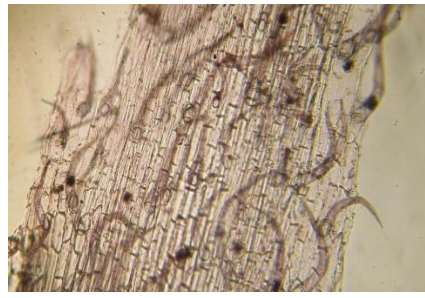


H. Vascular bundle of midrib

Figure 2. Microscopical characteristics of *Ocimum basilicum* L.



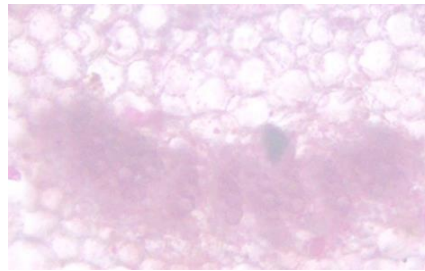
A. Upper surface of petiole



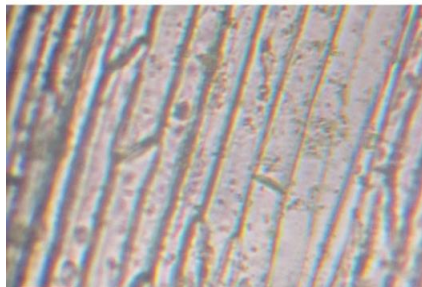
B. Lower surface of petiole



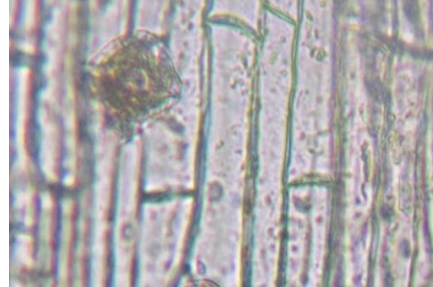
C. T.S of petiole



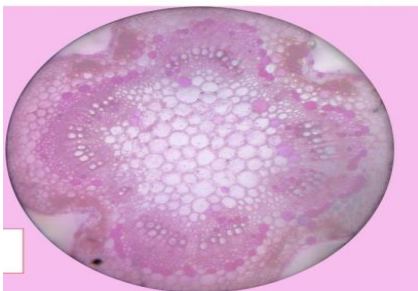
D. Vascular bundle of petiole



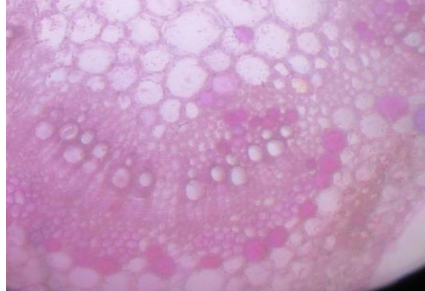
E. Upper surface of stem



F. Lower surface of stem



G. T.S of stem



H. Vascular bundle of stem

Figure 3. Microscopical characteristics of *Ocimum basilicum* L.

Discussion and Conclusion

In this research, morphological and microscopical characters of *Ocimum basilicum* L. were studied. The specimens were collected from Banmaw Township, Kachin State during December, 2017- February, 2018. These plants belong to the family Lamiaceae.

Ocimum basilicum L. is annual aromatic herb to undershrub and the stem is much-branched and quadrangular. The leaves are simple, opposite and decussate, petiolate, exstipulate and dotted with oil glands on both surfaces. Inflorescences are terminal, verticillasters, 6-flowered in a whorl. Flowers are small, bracteate, ebracteolate, pedicellate, zygomorphic, bisexual, pentamerous, hypogynous. The calyx is bilabiate, the upper lip broadly orbicular, the lower lip 4-fid, sparsely strigose and dotted with oil globules within. The corolla

is bilabiate, pubescent. Four stamens, didynamous, filaments free or connate at base, exerted, anther dithecos, were found. *O.basilicum* L. possesses a transverse process and tufted hairs at the base of 2-longer filaments. The carpels are two, syncarpous, tetralocular, disc present, one ovule in each locule, style gynobasic, ovary superior. The fruits are typically four dry nutlet, subtended by the persistent calyx. The seed is oblongoid, non-endospermic. These above characters are found to be in accordance with references reported by Hooker (1885), Backer (1965), Dassanayake (1981) and Hu-Qi-ming (2009).

In leaf anatomy, the lamina consists of small diacytic stomata situated on top of epidermis. The middle nerve is prominent on the adaxial side and has single vascular bundle embedded in the parenchymatous tissue. Uniseriate and multicellular trichomes are found on the middle nerve. There are two types of secretory hairs: one located in a very small depression of the upper epidermis and second located in a very large excavation. In stem anatomy, the quadrangular transverse section is frequently described and the evident collenchyma in the four angles is found. Sclerenchymatous tissue surrounds the phloem groups of vascular bundles. The above-mentioned characters are in agreement with those given by Metcalfe and Chalk (1950), Esau (1965) and Cronquist (1981).

Morphological and anatomical characters play a vital role in crude drug standardization. The above-mentioned information is important as it helps in the identification of these species and contributes to their quality control and evaluation. In the recent years, traditional system of medicines has emerged as a potential source to cope with the growing rate of chronic, degenerative, environmental, lifestyle and stress related diseases. Traditionally, sweet basil and holy basil have been used to treat a large number of diseases. Therefore, this study will partially fulfill the requirement for the pharmacognosy field of these plants.

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References

- Agarwal S, Kumar VR and Kumar A. 2013. Pharmacognostical Characterization of *Ocimum* spp.: Journal of Pharmacognosy and Phytochemistry, 2(1), 219-224.
- Ascensao L, Marques N, Pais MS 1995. Glandular trichomes on vegetative and reproductive organs of Lamiaceae. Annals of Botany 75:619-626.
- Atal CK, Kapur BM. 1989; Cultivation and utilization of Aromatic plants, Reprint edition, 1-2, 90-92, 95, 641.
- Anonymous, 1996. A Dictionary of Indian Raw Material and Industrial Products. Vol. VII. N-Pe Publications and Information Directorate CSIR. New Delhi
- Backer, C.A. and R.C.B. Van Den Brink, 1965. Flora of Java. .Vol:II, The Netherlands N.V.P. Noordhoff-Groningen.
- Craig, Richard and Vassilyev, Andrey. 2010. Plant Anatomy. McGraw-Hill.
- Cronquist, A. 1981. An integrated system of classification of flowering plants. Columbia university press: New York.
- Dassanayake, M.D. and W.D. Clayton, 1981. Flora of Ceylon, Vol.III,.A. Balkema / Rotterdam/Brookfield.
- Esau, K. 1965. Plant Anatomy, John Wiley & Sons Inc, New York.
- Ghosh GR, 1995. Tulasi (N, O Labiate, Genus – *Ocimum*). New Approaches to Medicine and Health (NAMA); 3; 1995; 23-29
- Hooker, J.D. 1885. Flora British India. Vol.I. Reeve & Co.,Ltd. London.
- Hu-Qi-ming, 2009. Flora of Hong Kong Vol.III, Hong Kong Herbarium, Agriculture, Fisheries Conservation Department.

- Hundley and Chit KoKo, 1987, List of Trees, Shrubs, Herbs and Principal Climbers, etc, Government Printing Press, Yangon.
- Kirtikar, K.B and Basu, B.D, 1935. Indian Medicinal Plants, Vol.III. Lalit Mohan Basu, M, B.49, leader Road, Allahabad, India.
- Kirtikar, KR, Basu BD, 1965. In: *Ocimum sanctum* in Indian Medicinal Plants, LB Basu , Affahabad.
- Kress and Yin Yin Kyi, Daw, 2003. A Checklist of the Trees, Shrubs, Herbs and Climbers of Myanmar, Department of Systematic Biology - Botany, National Museum of Natural History Washington, DC.
- Marwat, K.S.; 2011. K.S; Khan, A.M.; Akbari, H.A; Shoaib, M;Shah , A.M., Interpretation and Medicinal Potential of Ar-Rehan (*Ocimum basilicum* L)-A Review, American-Eurasain J. Agri. & Environ . Sci, (2011) 10(4), 478-484
- Metcalf, C.R and L. Chalk, 1950. Anatomy of Dicotyledons. Leaves, Stems and Wood and Relations to Anatomy with Notes on Economic uses Vol.II. He Orford University Press. London.
- Trease, G.E. and W.C. Evans, 2002. Pharmacognosy. 15th Ed., Harcourt Publishers Limited. Landon.