

ORIGINAL RESEARCH PAPER

A Comparative Pharmacognostic Evaluation of the Leaves of Tulsi (*Ocimum basilicum* L.) and (*Ocimum sanctum* L.)

Sonal Singh Kushwaha^{1*}, Priya Gupta¹, Suman Panwar²

¹PG Scholar, Department of *Dravyaguna Vigyana*, Shri Dhanwantry Ayurvedic College and Hospital, Chandigarh, India.

²Professor and HOD, Department of *Dravyaguna Vigyana*, Shri Dhanwantry Ayurvedic College and Hospital, Chandigarh, India.

ARTICLE INFO

Article history:

Received on: 09-03-2024

Accepted on: 17-04-2024

Published on: 30-04-2024

Key words:

Ayurveda,
Ocimum basilicum L.,
Ocimum sanctum L.,
Pharmacognosy,
Transverse section

ABSTRACT

Background: Pharmacognostic evaluation plays a key role in standardizing herbal medicines, ensuring their efficacy and safety. This study aimed to conduct a detailed macroscopic and microscopic analysis of the leaves of *Ocimum basilicum* L. (Sweet Basil) and *Ocimum sanctum* L. (Holy Basil).

Methods: Leaves of *O. basilicum* L. and *O. sanctum* L. were subjected to macroscopic and microscopic examinations. Macroscopic analysis measured leaf length and described their shapes. Microscopic examination involved observing the leaf epidermis and mesophyll structure.

Results: *O. basilicum* Linn. leaves typically measured 4–8 cm in length, displaying an elliptic ovate shape, while *O. sanctum* L. leaves were smaller, measuring about 2–2.5 cm and exhibiting an ovate shape. Microscopic examination revealed distinct differences between the two species: *O. sanctum* L. displayed a square-shaped epidermis with parenchymatous cells and sclerenchyma patches, whereas *O. basilicum* L. showcased a dorsiventral mesophyll structure with stomata and glandular trichomes.

Conclusion: The macroscopic and microscopic characteristics identified in this study provide valuable insights for the standardization, authentication, and quality control of herbal medicines containing *O. basilicum* L. and *O. sanctum* L. These findings contribute to ensuring the efficacy and safety of herbal formulations derived from these plants.

1. INTRODUCTION

The *Ocimum* genus, a prominent member of the Lamiaceae family, holds significant importance in various fields, especially in *Ayurveda*, the traditional Indian system of medicine. While the exact number of species within this genus remains uncertain, *Ocimum basilicum* L. (Sweet Basil) and *Ocimum sanctum* L. (Holy Basil) stand out for their therapeutic potential and historical significance in *Ayurvedic* practices. *Bhavaprakash Nighantu*^[1] has described the properties of *Tulsi* in *Pushpa varga*.^[2] *Raj Nighantu* has described 18 synonyms of *Tulsi*.^[3]

Tulsi (*Ocimum* sp.) is renowned for its effectiveness in treating a range of ailments, including skin disorders, pain in the flank region, cough, respiratory disorders, and fever.

Corresponding Author:

Dr. Sonal Singh Kushwaha,
1698/8, Vishnu Colony, Kurukshetra, Haryana, India.
Ph: +91-8887937320.
Email: sonal27091999@gmail.com

Surpala acknowledges the remarkable attributes of *Tulsi* plants, renowned for their medicinal benefits and spiritual significance. In his writings, he offers guidance on cultivating, caring for, and harnessing the therapeutic properties of *Tulsi* for physical well-being and spiritual practices.^[4]

O. basilicum L., native to the warm regions of the Indo-Malayan territories, is valued not only for its aromatic fragrance but also for its diverse uses in *Ayurveda*. Its essential oils and *swaras* (juice) extracted from leaves are integral in treating *shwas* (respiratory) and digestive issues, *shirashula* (headaches), *Kasa* (cough), gastrointestinal disturbances, and even *Jwara* (fever). In addition, its seeds, known for their mucilaginous properties, effectively relieve chronic dysentery and alleviate constipation, demonstrating its multifaceted therapeutic benefits.

Tulsi (Holy Basil) revered in *Ayurveda* for its sacred and medicinal qualities, holds a special place in Indian culture. Considered to

have divine blessings, it symbolizes health and well-being. Its pharmacological benefits, including antioxidant, antidiabetic, cardioprotective, and immunostimulant properties, align with *Ayurvedic* principles.

Although *O. basilicum* L. and *O. sanctum* L. share heritage within *Ayurvedic* medicine, their histological and pharmacognostic differences remain relatively unexplored. This article aims to illuminate these distinctions through a comprehensive comparative analysis (Tables 1 and 2), exploring their intricate anatomical structures and pharmacological constituents. By elucidating their unique characteristics and therapeutic potentials within the framework of *Ayurveda*, we seek to provide valuable insights for future research and enhance the utilization of these botanical treasures in traditional and modern healing practices.

2. MATERIALS AND METHODS

2.1. Collection of the Sample

Fresh leaves of *O. basilicum* L. and *O. sanctum* L. were collected from the campus of Shri Dhanwantry Ayurvedic College and Hospital, Chandigarh (Herbal Garden) in February 2024. The leaves were washed under running tap water and blotted dry.

2.2. Panchendriya pareeksha (Organoleptic Examination) of the Fresh Drug

Organoleptic characters of the leaves of Tulsi by Shraavanendriya (Auditory), Sparshanendriya (Tactile), Chakshurendriya (Visual), Rasanendriya (Taste) and Ghranendriya (Odour) has been evaluated (Table 3).

2.3. Macroscopic and Microscopic Evaluation

Macroscopic characters such as shape, size, and margins were recorded as per visual observation. For the micrometric evaluation, the fresh leaves were used. Sections were visualized under Compound microscope after slide preparation by transverse sectioning using dissecting kit.

3. RESULTS AND DISCUSSION

3.1. Transverse Section of Leaves of *O. sanctum* L.

3.1.1. Macroscopic features

Tulsi is a highly branched, small herb, typically reaching heights of 30–75 cm. All parts of the plant are utilized in medicine, particularly the fresh and dried leaves. The leaves are oblong and pointed, with a smooth or slightly toothed edge, and they are covered in fine hairs and tiny glandular dots. They are green and possess an aromatic fragrance with a mildly spicy taste. The flowers of *tulsi* are purplish and arranged in clusters called racemes. The nutlets of the plant are slightly flattened and round, ranging from pale brown to red in color. The seeds are reddish-black and also round in shape.^[5]

3.2. Microscopic Features

The *tulsi* leaf exhibits dorsiventral structure. Stomata, predominantly found on the lower surface, are of the diacytic type [Figure 1a]. The epidermal cells have undulating walls and a thin cuticle. Beneath the upper epidermis, there is a single layer of elongated palisade cells [Figure 2b]. The mesophyll comprises four to six layers of spongy parenchymatous cells with intercellular spaces and oil glands [Figure 1c]. The leaf features

both covering and glandular trichomes. The covering trichomes are uniseriate, multicellular, and often elongated (100–400 µm). Glandular trichomes are sessile, with a radiate head composed of eight cells and a common cuticle, forming a bladder-like structure characteristic of the Labiateae family. In addition, a few glandular trichomes with a unicellular stalk and a spherical unicellular head can be observed. In the midrib region, collenchymatous cells are present below both the upper and lower epidermises. Xylem bundles are arranged in an arc, with the phloem located on the dorsal side of the xylem [Figure 1d].^[6]

3.3. Transverse Section of Leaves of *O. basilicum*

3.3.1. Macroscopic features

The leaves are arranged simply, in opposite pairs that cross at right angles (decussate), and are shaped like ellipses or lanceheads, with pointed tips and wedge-shaped bases. They measure 4–8 cm in length and 2–3 cm in width, with margins that are typically smooth but may be slightly serrated. The upper surface is nearly hairless (glabrous) and a bright green color, while the petioles are 6–12 mm long. The leaves emit a pleasantly aromatic odor and have a spicy, slightly salty taste.^[7]

3.3.2. Microscopic features

The transverse section (TS) of the leaf, passing through the midrib, resembles a pot shape, with a convex lower surface and an almost flat upper surface. Beneath the upper surface, there are 4–5 rows of collenchymatous tissue [Figure 2a]. The lower side appears obscure, with a centrally located meristeles consisting of 8–12 uniseriate rows of vessels, parenchyma, and an arc of phloem [Figure 2b]. The epidermis of the leaf blade is grooved in places, housing numerous sessile glandular trichomes with 8-celled heads, as well as others with unicellular or multicellular stalks and one, two, or many-celled heads [Figure 2c]. In addition, a few simple, multicellular, uniseriate trichomes are mostly located over the costae on both surfaces. The mesophyll tissue is made up of 7–10 rows of spongy parenchyma and 1–2 rows of radially arranged cells of poorly developed palisade tissue [Figure 2d]. Traces of meristeles protected by a parenchymatous sheath, traverse throughout the mesophyll tissue. In surface view, the cells of both epidermises are wavy, with the lower epidermis having more sinuous walls and containing diacytic stomata.^[7]

The number of glandular and tectorial trichomes per surface unit is decreased from the base to the top of the stem. The tectorial trichomes are uniseriate, consisting of three cells, with an acute apex and a bi-or multicellular basis.^[8]

4. CONCLUSION

The pharmacognostic evaluation of the leaves of *O. basilicum* L. (Sweet Basil) and *O. sanctum* L. (Holy Basil) provides valuable insights into their macroscopic and microscopic characteristics. In conclusion, the microscopic transverse sections of *O. sanctum* L. and *O. basilicum* L. leaves exhibit notable differences in various features.^[9] While both species display wavy epidermal cells with diacytic stomata,^[10] *O. sanctum* L. typically has 2–4 rows of collenchyma, a centrally located meristeles composed of 8–12 uniseriate vessels, and a mesophyll tissue with 7–10 rows of spongy parenchyma.^[11] In contrast, *O. basilicum* L. presents 4–5 rows of collenchyma, a similar central meristeles composition, and a wider zone of spongy parenchyma extending up to the area of meristeles.^[12] In addition,^[13] the trichome characteristics differ, with *O. sanctum* L.

having glandular trichomes with 4-celled heads, while *O. basilicum* L. exhibits multicellular curved trichomes and various other types. These variations in microscopic features provide valuable insights into the distinct anatomical structures of these two *Ocimum* species.^[14] These findings contribute to the standardization and authentication of *O. basilicum* L. and *O. sanctum* L. for quality control in herbal medicine formulations. This study enhances our understanding of these medicinal plants and their potential therapeutic applications in traditional and modern healing practices. Further research into the pharmacological properties and therapeutic benefits of these species can provide additional insights into their medicinal value and expand their use in healthcare.

5. ACKNOWLEDGMENT

Nil.

6. AUTHORS' CONTRIBUTIONS

All the authors contributed equally to the design and execution of the article.

7. FUNDING

Central Council for Research in Ayurvedic Sciences.

8. ETHICAL APPROVALS

This study does not require ethical clearance as it is an experimental study.

9. CONFLICTS OF INTEREST

Nil.

10. DATA AVAILABILITY

This is an original manuscript, and all data are available for only review purposes from the principal investigators.

11. PUBLISHERS NOTE

This journal remains neutral with regard to jurisdictional claims in published institutional affiliations.

REFERENCES

1. Kushwaha SS, Gupta P. Critical analysis of Bhavaprakash Nighantu-a review. *World J Pharm Res* 2023;12:1250-6.
2. Chunekar KC. Pushpa varga. In: Bhavaprakash Nighantu. Varanasi: Chaukhambha Bharti Academy; 2020. p. 496.
3. Gupta P, Kushwaha SS. A crystal compendium on Raja Nighantu. *World J Pharm Res* 2023;12:1112-5.
4. Kushwaha SS. Surpala's Vrikshayurveda: A rare gem in the field of horticulture. *Int Ayurvedic Med J* 2023;7:454-9.
5. Kirtikar KR, Basu BD. Indian Medicinal Plants. Vol. 2. Dehra Dun: Bishen Singh Mahendra Pal Singh; 1994. p. 1884-8.
6. Lee SJ, Umano K, Shibamoto T, Lee KG. Identification of volatile components in basil (*Ocimum basilicum* L.) and thyme leaves (*Thymus vulgaris* L.) and their antioxidant properties. *Food Chem* 2005;91:131-7.
7. Pharmacy180. Pharmacognosy and Phytochemistry: Drugs Containing Volatile Oils. Available from: <http://www.pharmacy180.com/tulsi-pharmacognosy> [Last accessed on 2024 Mar 05].
8. Gupta AK. Quality Standards of Indian Medicinal Plants. Vol. 2. New Delhi: Indian Council of Medical Research; 2013. p. 169.
9. Gupta AK. Quality Standards of Indian Medicinal Plants. Vol. 2. New Delhi: Indian Council of Medical Research; 2013. p. 170.
10. Rawat R, Tiwari V, Negi KS. A comparative study of morphological and anatomical structures of four *Ocimum* species in Uttarakhand, India. *J Drug Deliv Ther* 2016;6:1-6.
11. Parida S, Mohapatra BK, Mahalik G. Anatomical study of six *Ocimum* species: The valuable method used in Indian Systems of Medicines (ISM). *Int J Ayurvedic Med* 2020;11:278-83.
12. Deore SL, Ingole SR, Baviskar BA. Comparative pharmacognostical, phytochemical and biological evaluation of five *Ocimum* species. *Pharmacogn J* 2021;13:463-74.
13. Joshi A, Pathak AK, Tailang M. Comparative pharmacognostical characterization of selected species of *Ocimum*. *J Drug Deliv Ther* 2014;4:72-80.
14. Tewari D, Pandey HK, Sah AN, Meena HS, Manchanda A, Patni P. Pharmacognostical, biochemical and elemental investigation of *Ocimum basilicum* plants available in western Himalayas. *Int J Res Pharm Biomed Sci* 2012;3:840-5.

How to cite this article: Kushwaha SS, Gupta P, Panwar S. A Comparative Pharmacognostic Evaluation of the Leaves of Tulsi (*Ocimum basilicum* L.) and (*Ocimum sanctum* L.). *IRJAY*. [online] 2024;7(4):9-13.

Available from: <https://irjay.com>

DOI link- <https://doi.org/10.48165/IRJAY.2024.70402>

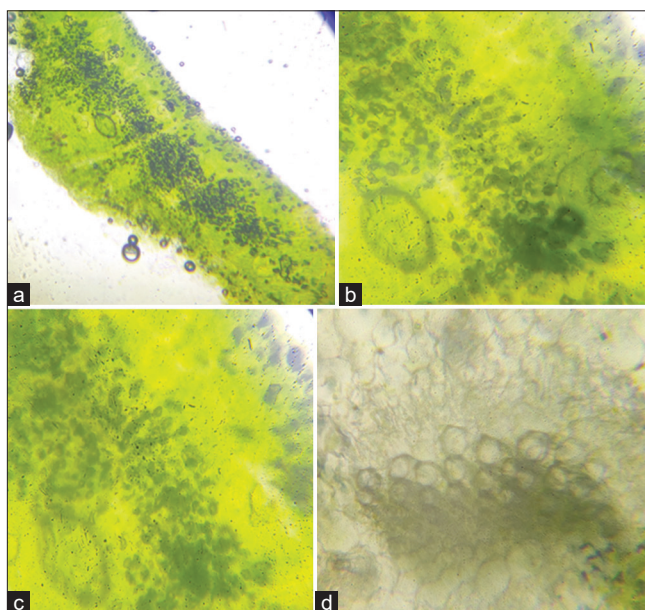


Figure 1: (a-d) Microscopic features of *Ocimum sanctum*

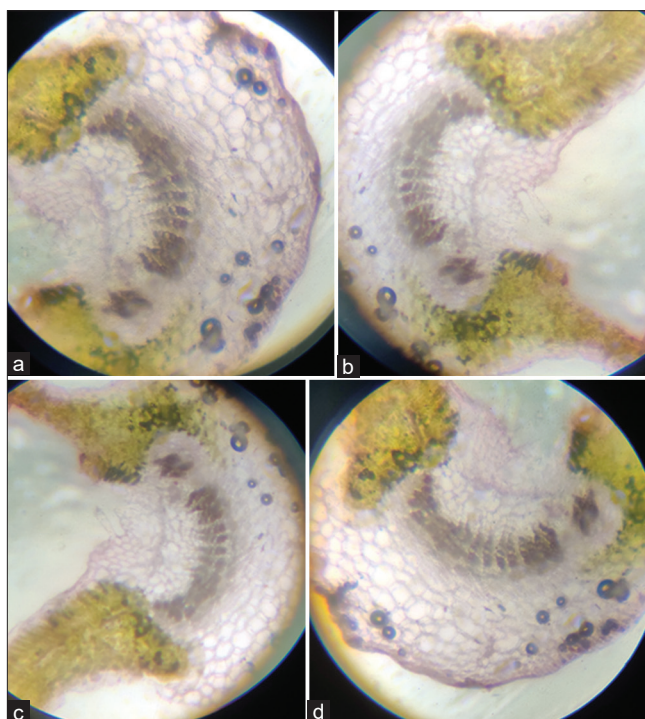


Figure 2: (a-d) Microscopic features of *Ocimum basilicum*

Table 1: Morphological difference between the leaves of *Ocimum basilicum* L. and *Ocimum sanctum* L.

Characteristics	<i>Ocimum basilicum</i> L.	<i>Ocimum sanctum</i> L.
Size	4–8 cm in length	2–2.5 cm in length
Shape	Elliptic ovate shape with a pointed apex and a slightly rounded base	Ovate or elliptic shape, with a pointed apex and a slightly tapered base
Color and texture	Bright green to Purplish-green	Dark green with purple-tinged veins
Leaf arrangement	Opposite	Opposite
Leaf type	Simple	Simple
Venation	Reticulate	Reticulate
Margin	Smooth or slightly serrated	Serrated or toothed

Table 2: Microscopic differences between the leaves of *Ocimum basilicum* L. and *Ocimum sanctum* L.

Features	<i>Ocimum basilicum</i> L.	<i>Ocimum sanctum</i> L.
Collenchyma layers	2–4 rows	4–5 rows
Vascular bundle composition	Central meristele composed of 8–12 uniseriate vessels, parenchyma, and phloem	Central meristele composed of 8–12 uniseriate vessels, parenchyma, and phloem
Mesophyll tissue composition	7–10 rows of spongy parenchyma and 1–2 rows of radially arranged cells of ill-developed palisade tissue	Wide zone of spongy parenchyma extending up to the area of meristele
Epidermis features	Wavy cells with diacytic stomata	Wavy cells with diacytic stomata
Trichome characteristics	Glandular trichomes with 4-celled heads, some with single-cell stalks	Multicellular curved trichomes, simple multicellular uniseriate trichomes, sessile glandular trichomes with 8-celled heads, and others with multicellular stalks and one, two, or many-celled heads

Table 3: The Organoleptic evaluation of the leaves of the fresh drug *O. basilicum* L. and *Ocimum sanctum* L.

Pareeksha (Examination)	<i>Ocimum basilicum</i> L.	<i>Ocimum sanctum</i> L.
<i>Shravanendriya</i> (Auditory)	No characteristic sound	No characteristic sound
<i>Sparshanendriya</i> (Tactile)	Smooth or slightly wrinkled texture	Smooth
<i>Chakshurendriya</i> (Visual)	Bright Green- Purplish green	Dark Green with Purple-tinged veins
<i>Rasanendriya</i> (Taste)	Bitter, Pungent	Bitter, Pungent
<i>Ghranendriya</i> (Odour)	Sweet, Aromatic	Spicy, Aromatic