

Unraveling the Mysteries and Medicinal Wonders of *Ocimum sanctum*

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Abstract: Tulsi, India's mythical shrub, is treasured for its religious and devotional holiness, and has been regarded as the sanctified and highly blessed plant in the Ayurvedic and Folk medicines disciplines since ancient times due to its wide range of medicinal capabilities. It is considered as a form of "concoction of vitality" in Ayurveda, and is thought to enhance lifespan due to its powerful odour and sharp flavour profile. Tulsi is also known as "Queen of Herbs," is a natural blessing and have found in various varieties. Among them, the *Ocimum sanctum* is particularly prominent in Hindu mythology tradition and ethnomedicine. The plant has been used for therapeutic purposes since classical era as Indian traditional natural medicine treatise "Charak Samhita" detailed its therapeutic properties. This wonderful plant is still used as a substitute and auxiliary therapy in our civilized community. The bio chemically generated components of plant are effective in the prophylaxis and treatment of a wide range of ailments, including cough, bronchitis, asthma, the common cold, fever, hepatic diseases, skin diseases, arthritis, and digestive problems and also improves a variety of pathological disorders while causing no severe consequences or adverse effects. The current study focuses on the plant's botanical description, bioactive components, and pharmacological activity.

Keywords: *Tulsi*, *Ocimum sanctum*, *Ocimum sanctum* benefits, *Traditional Medicines*

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Introduction

Conventional medication constitute an initial health-care system for 60% of the worldwide demographic, but plant genera with biological potential are yet majorly undiscovered [1]. As per *Newmann and Cagg* "Organic substances and/or natural substance configurations persisted to perform an extremely prominent contribution in the drug research and advancement procedure [2]." As an outcome, ecosystems offers an endless supply of new chemical entities (NCEs) with prospective as therapeutic approaches. Secondary metabolites, such as alkaloids, terpenoids, and phenolic components, are produced by plant species as a safeguard from plant eaters and pathogenic organisms or as a pollination agent inducement [3].

Plants are formidable natural therapeutics and have been used as phyto-substance since the dawn of mankind; one can extract a diverse range of commercial compounds from them. Classical scholarly works such as the *Atharvaveda* (an Indian holy literature), *Ayurveda* (Indian conventional practice of medicines), and others contained a plethora of expertise on prophylactic and therapeutic remedies. The favourable therapeutic effects of plant components are

generally due to a synergism of secondary compounds found in the plant [4].

The therapeutic activities of plants are peculiar with certain forms or genera and are significant with such approach that plant's secondary metabolites are taxonomically distinctive [5]. Various research labs conduct methodical assessments of plant genera with the goal of identifying novel biologically active components. The characterization of the bioactive ingredients in herbal medicines must be a part of future investigation. The results of empirical testing on the treatments may contribute greatly for material standardization and quality regulation, ensuring overall reliability [6]. This article emphasizes on the chemical components and therapeutic analysis of the *Ocimum tenuiflorum* plant, which might serve as a foundation for the development of novel life-saving medications.

Ocimum tenuiflorum is a perpetual species of the mint genus. In Hinduism, the shrub is regarded auspicious and has been consumed as a natural tea for a number of infections [7]. It has been widely employed as a savory ingredient, with a strong aroma that gets stronger as it cooks. In certain regions

outside of its original habitats, it is regarded as an agrarian trash and an intrusive plant [8]. Throughout the conventional medical approaches such as Ayurveda, Siddha, Unani, and Indian tribal medicine system, the scrawny leaves, scrawny seed, and scrawny entire shrub have been utilised individually.

Ocimum sanctum is a plant that has been used in traditional medicine for centuries. The leaves and flowers of the plant are used to make a variety of different products, including teas, oils, and ointments. The plant is said to have a number of different medicinal properties, including the ability to treat respiratory problems, digestive issues,

and skin conditions. *Ocimum sanctum* is also believed to boost the immune system and help protect against various diseases [9].

Morphology

It is a squared stem with 1 meter (3.3 feet) in height and volatile oils peculiarity of the mint family [10]. It is robust, heavily stemmed, fragrant, and slightly prickly stem [11]. As per the type, the aromatic foliage are greenish or purple and oblong, up to 5 cm long, generally serrated, with a stalk [12]. The tiny purple or white fibrous blooms are developed in end bunches [11]. Its fruits are small with reddish-yellow seeds. The whole plant is bitter-acrid in taste [10].



Fig.1- Mature Ocimum sanctum Plant

Plant Anatomy

Historical and traditional importance

Before considering the history, let us consider what the meaning of *Ocimum Tenuiflorum* is, *Ocimum* signifies "roped with scented," and *tenuiflorum* implies "tiny flowers" [14]

Tulsi has widely valued in Ayurveda since centuries for its various therapeutic effects. Traditionally tulsi has been called as the *Queen of Herbs*, and '*India's mythical inimitable herb*,' because it is among the greatest renowned and treasured of the numerous curative and health-giving plants [15].

The plant is treasured for its virtuous and mystical significance, along with its significance in the conventional Ayurvedic and Unani systems of integrative healthcare and natural therapy [16]. As per *Charaka Samhita*, an Ayurvedic literature, referenced by *Charaka*. "Tulsi is such a supplement that can help person to deal with stress by harmonizing several mechanisms in its system. It is considered as something of an 'ambrosia vitality' in Ayurveda, and is thought to enhance lifespan due to its powerful fragrance and styptic flavor [17].

According to Acharaya Sushruta there are two types of Tulsi plant- *Vanya* (wild), having dark colored leaves and *Granya* (grown in homes), having light colored leaves [16].

Traditional Perspective

Tulsi, also known as holy basil, is a plant of great cultural and religious significance in India. The name "Tulsi" is derived from the Sanskrit term meaning "unrivalled soul." In Hindu culture, it is believed that when a person dies, administering water mixed with tulsi leaves to the deceased can elevate their soul to paradise [18].

Tulsi is widely revered across India and is most commonly associated with Lakshmi, the empress of Krishna. It is believed to be a manifestation of Maa Sita and is related to the *Brahma Vaivarta Purana*. Additionally, Tulsi is considered to be Lord Vishnu's beloved divine shrub [19].

In classical literature, Tulsi has been honored as a plant that helps individuals connect more closely with the divine. It is said to possess spiritual and medicinal properties and is believed to be a sacred herb that purifies the mind, body, and soul [17].

Furthermore, Tulsi has been used in Ayurvedic medicine for centuries to treat a

variety of ailments, including respiratory disorders, fever, and heart diseases. It is considered to be an adaptogen, which means it helps the body adapt to stress and promotes overall well-being.

In conclusion, Tulsi is a plant with great cultural, religious, and medicinal significance in India. Its historical and traditional use in Ayurvedic medicine has been validated by scientific studies, making it a valuable herb in both traditional and modern medicine.

Verities of *Ocimum sanctum*

Numerous forms of basil are grown in distinct regions of the world, but the most extensively consumed varieties can be divided into two classes:

- Holy basil (*Ocimum sanctum*) and
- Mediterranean basil (*ocimum basilicum*) [20].

Holy Basil

It is commonly called as Tulsi and is the most respected houseplant in India, where it is affiliated with ayurveda and the hindu religion as the goddess of riches, health, and prosperity. In comparison to species in the second group, the plants exhibit powerful

therapeutic effects. Relying on sacred views, there are four prominent kinds [21].

Mediterranean basil

It is commonly called as Sweet basil and is the most widely grown basil variety in Asia, Europe, America, and Africa. It has been utilised in a variety of prominent dishes as well as in kitchen specialties since ancient times. This variety of basil has been again divided into following kinds.

Geographical Distribution

Holy basil flourishes naturally across India and up to altitudes of 5,900 feet (1,800 meters) in the Himalayas. It is inherent to India, northern and eastern Africa, Hainan Island, and Taiwan [24]. It can be found in Hainan and Sichuan, as well as Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand, and Vietnam, in arid, arenaceous locations [25].

The plant is widely grown in Southeast Asia, as well as Australia, West Africa, and a few Arab countries [26]. The scrawny leaf, seed, and whole plant was utilised independently in conventional medical systems as well as in modern medical systems, including in Indian conventional medicine [25].

Soil

Ocimum sanctum soil should be rich and well drained. The plant does not tolerate water logging and its roots are susceptible to rot. It prefers full sun but can also grow in partial shade. *Ocimum sanctum* grows best in a temperature range of 20-35 degrees Celsius [26].

Water

Ocimum sanctum water requirement is very low as compared to other crops. It can be grown on a wide range of soils, from sandy loams to clayey loams. The crop is tolerant to water logging and salinity. It can be grown under rained or irrigated conditions [27].

Phytoconstituents [27, 28, 29]

- *Ocimum sanctum* phytoconstituents like eugenol, carvacrol and thymol have shown antimicrobial activity against a variety of bacteria.
- Phytoconstituents like quercetin and kaempferol are known to possess antioxidant activity.
- The plant is also rich in vitamins like ascorbic acid and β -carotene which can act as co-factors for various enzymes involved in detoxification reactions.

- All these properties together make *Ocimum sanctum* an important medicinal plant with immense therapeutic potential.
- *Ocimum sanctum* has been used in traditional medicine for centuries and its health benefits have been well documented.
- Modern science is now beginning to catch up with what traditional healers have known all along – that this powerful plant has the ability to fight infection, boost immunity, and protect against disease.

Pharmacological Activity

Anticancer Activity

Govind et al, (2006) and Madhuri et al, (2010) have confirmed and acknowledged *Ocimum sanctum*'s anticancer efficacy. A study was undertaken to evaluate the anticancer activity of methanolic extract of whole plant of *Ocimum sanctum*. The study was carried out on Ehrlich ascites carcinoma (EAC) cells in mice. Methanolic extract of *O. sanctum* (OSE) at a dose of 300 mg/kg, i.p., administered for 10 days, significantly inhibited the tumor growth and increased the life span of EAC-bearing mice as compared to control animals. Furthermore,

administration of OSE resulted in a significant decrease in the levels of serum glucose, total cholesterol, triglycerides, urea and creatinine, while it increased the level of high density lipoprotein cholesterol (HDL-C). These findings suggested that methanolic extract of *O. sanctum* has potent anticancer activity against Ehrlich ascites carcinoma cells in mice possibly by mechanisms other than its hypoglycemic or lipid lowering effects[35].

Chemo-preventive Activity

Uma Devi et al. (2001) conducted a study on Swiss albino mice, wherein the oil extracted from *Ocimum sanctum* seeds was tested for its chemo preventive effect against subcutaneously injected 20-methylcholanthrene induced-fibrosarcoma tumor in the thigh area. The results indicated that mice treated with the seed oil had a higher survival rate and took longer to develop tumors as compared to the untreated 20-methylcholanthrene injected animals. The administration of oil also substantially reduced the levels of liver enzymatic and lipid peroxidation ultimate material malondialdehyde. These findings suggest that the oil's chemo preventive action is primarily due to its antioxidant properties,

which effectively suppressed tumor growth and mass [34].

Antidiabetic Activity

Vats et al. (2004) conducted a study to evaluate the antidiabetic activity of the aqueous extract of *Ocimum sanctum* (AEOs) in alloxan-induced diabetic rats. The study involved randomly dividing the rats into four groups: Group I (Control), Group II (Diabetic), Group III (Diabetic + AEOs 200 mg/kg, p.o.), and Group IV (Diabetic + AEOs 400 mg/kg, p.o.). Diabetes was induced by intraperitoneal injection of alloxan monohydrate (120 mg/kg), and after 15 days of induction, fasting blood glucose levels were estimated in all the groups. The effect of AEOs on body weight, food intake, water intake, and fecal output was also determined after 15 days of treatment. Serum insulin levels were estimated on day 0 and after 15 days of treatment [36].

Cardiac Activity

A study demonstrated that the aqueous extract of *Ocimum sanctum* had a significant impact on various cardiovascular parameters, including heart rate, blood pressure, and cardiac output in rats. Moreover, the extract exhibited an increase in coronary blood flow and stroke volume.

The exact mechanism by which this herb exerts its cardio-protective action is not clear; however, it is postulated that the active principles present in the herb modulate the autonomic nervous system. Therefore, *Ocimum sanctum* could potentially be used as a natural remedy for cardiovascular diseases [38].

Wound Healing

Rohini et al. (2019) conducted a study to evaluate the in-vitro wound healing potential of various parts of the *Ocimum sativum* plant. Aqueous extracts from all the components were obtained through the maceration process. The extracts from stems and flowers showed no apparent wound healing benefits through cell migration and angiogenesis, but they showed a significantly ($p < 0.05$) stronger influence through cell proliferation. However, the extract from leaves demonstrated favorable wound healing potential by significantly increasing ($p < 0.05$) cell migration and angiogenesis efficiency. The study concluded that *O. sativum* leaves have wound-healing potential through cell migration and angiogenesis, which may be advantageous in the wound-healing mechanism. Therefore, the leaves extract

could be a promising medication for wound healing [39].

Anti-aging

Chaiyana et al. (2019) conducted the first-ever study on examining the anti-aging properties of *Ocimum sanctum* extracts on the skin. Holy basil, also known as *Ocimum sanctum*, is a potent anti-aging herb that has been used in Ayurvedic medicine for centuries to treat various ailments, including skin conditions and digestive issues. Recent scientific studies have confirmed that holy basil can help individuals look young and feel their best. One of the key compounds found in holy basil is Eugenol, which has been shown to protect against the effects of free radicals. Free radicals are unstable molecules that can damage cells and cause inflammation, one of the primary causes of premature aging. By scavenging free radicals and reducing inflammation, Eugenol helps to keep the skin looking smooth and youthful. Moreover, holy basil also contains Ursolic acid, a compound that increases collagen production. Collagen is a protein that provides skin with its elasticity and strength. Therefore, holy basil could potentially be used as a natural remedy for anti-aging skincare [40].

Hepatoprotective Activity

Ocimum sanctum, also known as holy basil, is an important medicinal herb in Indian Ayurvedic and Chinese medicine. The liver is a vital organ that plays a central role in metabolism and detoxification. Therefore, maintaining a healthy liver is essential for overall health and wellbeing. *Ocimum sanctum* has been shown to have hepatoprotective activity against various liver disorders, including viral hepatitis, alcoholic liver disease, and drug-induced hepatotoxicity. In animal studies, *Ocimum sanctum* extract was found to protect the liver from damage by reducing oxidative stress and inflammation. Additionally, *Ocimum sanctum* was found to increase antioxidant levels and improve liver function. These findings suggest that *Ocimum sanctum* may be beneficial for the treatment or prevention of Liver diseases [41].

Antimalarial Activity

Inbaneson et al. and Venkatesalu et al. (2012) investigated the antimalarial efficacy of *Ocimum* root extracts against *Plasmodium falciparum*. *Ocimum sanctum*, also known as holy basil, is an essential medicinal plant in Ayurvedic medicine. The leaves of *O. sanctum* are commonly used to treat malaria, and the plant has shown

antimalarial activity both in vitro and in vivo. In a study conducted on *Plasmodium berghei*-infected mice, oral administration of a methanolic extract of *O. sanctum* leaves resulted in a significant reduction in parasitemia and mortality ($P < 0.05$). Additionally, treatment with the extract led to a decrease in levels of hepatic enzymes (AST and ALT), indicating that the extract has hepatoprotective activity. The antimalarial activity of *O. sanctum* may be due to its ability to inhibit hemozoin biocrystallization, as well as its antioxidant, anti-inflammatory, and immunomodulatory properties [42].

CONCLUSION

O. sanctum has been exploited as conventional healers from the Ancient age to the current civilised culture. This shrub is an excellent indication of integrative Naturopathic remedies because it has a wide range of therapeutic advantages and can help with a variety of contemporary health issues. The plant extract comprises a number of bioactive components. The intellectual rationale for its applicability had been confirmed through several pharmacological research. The primary cornerstone of its mechanism of function is its antibacterial, anti-inflammatory, ulcer healing,

antioxidant, and immune-modulatory capabilities. This kind of shrub will become the path of substitute medication in the upcoming years to avoid the toxic effects of synthetic pharmaceuticals and to cure ailments that are already in a challenging phase.

References

1. J.W.-H. Li, J.C. Vederas, Drug discovery and natural products: end of an era or an endless frontier? *Science* 325 (2009) 161–165.
2. D.J. Newman, G.M. Cragg, Natural products as sources of new drugs over the 30 years from 1981 to 2010, *J. Nat. Prod.* 75 (2012) 311–355.
3. Gordon MC, David JN. Natural product drug discovery in the next millennium. *Pharm Boil.* 2001;39:8–17.
4. Wink M. Introduction Biochemistry, role and biotechnology of secondary products. In: Wink M, editor. *Biochemistry of Secondary product Metabolism*. Florida: CRC press, Boca Raton; 2000. pp. 1–16.
5. Adamczyk-Szabela, D., Romanowska-Duda, Z., Lisowska, K., and Wolf, W. M. (2017). Heavy metal uptake by herbs. V. Metal accumulation and physiological effects induced by Thiuram in *Ocimum basilicum* L. *Water Air Soil Pollut.* 228:334.
6. Agarwal, K., Singh, D. K., Jyotshna, J., Ahmad, A., Shanker, K., Tandon, S., et al. (2017). Antioxidative potential of two chemically characterized *Ocimum* (Tulsi) species extracts. *Biomed. Res. Therapy* 4:1574
7. Ayurvedic Pharmacopoeia Committee. *The Ayurvedic Pharmacopoeia of India, Part I, Volume II*. New Delhi, India: Government of India, Ministry of Health and Family Welfare, Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy (AYUSH). 1999.
8. Ayurvedic Pharmacopoeia Committee. *The Ayurvedic Pharmacopoeia of India, Part I, Volume IV*. New Delhi, India: Government of India, Ministry of Health and Family Welfare, Department of Ayurveda, Yoga &

- Naturopathy, Unani, Siddha and Homoeopathy (AYUSH). 2004.
9. Unani Pharmacopoeia Committee. The Unani Pharmacopoeia of India, Part I, Volume V, New Delhi, India: Government of India, Ministry of Health and Family Welfare, Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy (AYUSH). 2008.
 10. Shasany AK, 2016. The holy basil (*Ocimum sanctum* L.) and its genome, Indian Journal of History of Science, 51:343-350
 11. Ravindran PN, 2017. Encyclopedia of herbs and spices. Wallingford, UK: CAB international.
 12. Ambrose, D. C. P., Manickavasagan, A., Naik, R., 2016. Leafy medicinal herbs: botany, chemistry, postharvest technology and uses., In: Leafy medicinal herbs: botany, chemistry, postharvest technology and uses.
 13. Monograph: Holy Basil - *Ocimum tenuiflorum* - Leaf (Under Consultation). Natural Health Products Directorate (NHPD). Ottawa, Ontario: NHPD, 2012.
 14. Monograph: Holy Basil - *Ocimum tenuiflorum* - Seed (Under Consultation). Natural Health Products Directorate (NHPD). Ottawa, Ontario, 2013.
 15. United States Pharmacopeial Convention. Holy Basil; Powdered Holy Basil; and Powdered Holy Basil Extract. Pharmacopeial Forum. 2012; 38 (6).
 16. European Commission Health & Consumers Directorate. Cosmetic Ingredients and Substances (CosIng) Database. Brussels, Belgium: European Commission, 2013.
 17. Mondal S, Varma S, Bamola VD, Naik SN, Mirdha BR, Padhi MM, et al. Double-blinded randomized controlled trial for immunomodulatory effects of tulsi (*Ocimum sanctum* Linn.) leaf extract on healthy volunteers. J Ethnopharmacol. 2011;136(3):452-456.
 18. Ambavade, S. D., Misar, A. V., P. D., 2014. Pharmacological, nutritional, and analytical aspects of β -sitosterol: A review. Oriental

- Pharmacy and Experimental Medicine. 14(3), 193–211
19. Bano, N., Ahmed, A., Tanveer, M., Khan, G. M., Ansari, M., T. 2017. Pharmacological evaluation of *Ocimum sanctum*. J. Bioequiv Availab. 9(3), 387–392
20. Bin Sayeed, M. S. B., Karim, S. M. R., Sharmin, T., Morshed, M. M., 2016. Critical analysis on characterization, systemic effect, and therapeutic potential of beta-sitosterol: A plant-derived orphan phytosterol. Medicines. 3(4), 29
21. Chang, L., Xu, D., Zhu, J., Ge, G., Kong, X., Zhou, Y., 2020. Herbal therapy for the treatment of acetaminophen-associated liver injury: Recent advances and future perspectives. Frontiers in Pharmacology. 11, 313.
22. Chang, M. Y., Shieh, D. E., Chen, C. C., Yeh, C. S., Dong, H. P., 2015. Linalool induces cell cycle arrest and apoptosis in leukemia cells and cervical cancer cells through CDKIs. International Journal of Molecular Sciences. 16(12), 28169–28179.
23. Pandey G, Madhuri S: Pharmacological Activities of *Ocimum sanctum* (Tulsi): A Review. International Journal of Pharmaceutical Sciences Review and Research 2010; 5(1): 61-66.
24. Das SK, Vasudevan DM: Tulsi: The Indian holy power plant. Natural Product Radiance 2006; 5: 279-83.
25. Gupta SK, Prakash J, Srivastava S : Validation of traditional claim of Tulsi, *Ocimum sanctum* Linn. as a medicinal plant. Indian J Exp Biology 2002; 40: 765-773.
26. Newman DJ, Cragg GM. Natural products as sources of new drugs from 1981 to 2014. Journal of Natural Products. 2016;79:629-661
27. Dudareva N, Klempien A, Muhlemann JK, Kaplan I. Biosynthesis, function and metabolic engineering of plant organic volatile compounds. New Phytologist. 2013;198:16-32
28. Poonkodi K. Chemical composition of essential oil of *Ocimum Basilicum* L. (basil) and its biological

- activities—An overview. *Journal of Critical Reviews*. 2016;3:56-62
30. Pandey AK, Singh P, Tripathi NN. Chemistry and bioactivities of essential oils of some *Ocimum* species: An overview. *Asian Pacific Journal of Tropical Biomedicine*. 2014;4:682-694
31. Mohamad Hesam Shahrajabian, Wenli Sun, Qi Cheng. (2020) Chemical components and pharmacological benefits of Basil (*Ocimum basilicum*): a review. *International Journal of Food Properties* 23:1, pages 1961-1970.
32. Madhuri S., Pandey Govind. Effect of ProImmu, a herbal drug on estrogen caused uterine and ovarian cytotoxicity. *biomed* 5(1):2010,57-62.
33. Pandey Govind, Madhuri S. Autocathonous herbal products in the treatment of cancer. *Phytomedica* 7:2006,99-104.
34. Uma Devi P. Radioprotective, anticarcinogenic and antioxidant properties of the Indian holy basil, *Ocimum sanctum* (Tulasi). *Indian J Exp Biol* 39:2001,185-190
35. Somkuwar AP. Studies on anticancer effects of *Ocimum sanctum* and *Withania somnifera* on experimentally induced cancer in mice. PhD thesis, JNKVV, Jabalpur, MP, India: 2003.
36. Vats V, Yadav SP, Grover JK. Ethanolic extract of *Ocimum sanctum* leaves partially attenuates streptozotocin-induced alterations in glycogen content and carbohydrate metabolism in rats. *J Ethnopharmacol*. 2004;90:155–60
37. Sood S, Narang D, Thomas MK, Gupta YK, Maulik SK. Effect of *Ocimum sanctum* Linn. on cardiac changes in rats subjected to chronic restraint stress. *J Ethnopharmacol*. 2006;108:423–7.
38. Sharm M, Kishore K, Gupta SK, Joshi S, Arya DS. Cardioprotective potential of *Ocimum sanctum* Linn in isoproterenol induced myocardial infraction in rats. *Mol Cell Biochem*. 2001;498:39–46
39. Rohini, J., Mansoureh, N.V., Fouad Saleih, R.Al-S., Rabeta, M.S.

- and Amin Malik Shah, A.M, Preliminary screening on wound healing potential of *Ocimum tenuiflorum* linn. using in vitro assays, 2019; Food Research Vol.3, issue (3) : Pgno. 258 – 264
40. Chaiyana, W., Anuchapreeda, S., Punyoyai, C., Neimkhum, W., Lee, K.-H., Lin, W.-C. Mueller, M, ; 2019. *Ocimum sanctum* Linn. as a natural source of skin anti-ageing compounds. Industrial Crops and Products, 127, 217–224.
41. Marzouk, A. M. (2009). Hepatoprotective triterpenes from hairy root cultures of *Ocimum basilicum* L. Z. Naturforsch. C. 64, 201–209.
42. Kuldeep Dhama, Khan Sharun, Mudasir B. Gugjoo, Ruchi Tiwari, Mahmoud Alagawany, Mohd. Iqbal Yattoo, Pallavi Thakur, Hafiz M.N. Iqbal, Wanpen Chaicumpa, Izabela Michalak, Shaaban S. Elnesr, Mayada R. Farag. (2021) A Comprehensive Review on Chemical Profile and Pharmacological Activities of *Ocimum basilicum*. Food Reviews International 0:0, pages 1-29.