

QUEEN OF HERBS‘ELIXIR OF LIFE’FROM TRADITIONALTO MODERN MEDICINEA TULSI (OCIMUM)

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ABSTRACT

Plants are most important natural source of medicine. Worldwide demand of essential oils has increased during the past few years. Essential oils are reported in aromatic plants which are distributed in Mediterranean and tropical countries across the world where they are imperative component of the native medicinal systems. Almost all plant organs (flowers, buds, stems, leaves, fruits, seeds and roots) of aromatic plants contain essential oils. Whole plant has been used as traditional medicine for household remedy against various human activities. These are accumulated in secretory cells, cavities, channels, and epidermic cells. Lamiaceae herb family includes one of the richest essential oil bearing plant family, consists of more than 252 genera and 7000 species of plant Kingdom Lamiaceae family is known for the wealth of species with medicinal properties. Many species of Lamiaceae have long history of uses in culinary spices and folk medicine, which have been used since early times and many of these species are common in Mediterranean region. Ocimum is the major essential oil crop which is cultivated commercially in many countries. It is a popular herb and has been used widely as a food ingredient for flavouring confectionary. It is used both as a culinary and an ornamental herb. Ethnomedicinal plants contain complex plant chemicals, also known as phytochemicals. These studies have led to the identification and isolation of diverse phytochemicals from different plant parts of Ocimum species. Ethnopharmacology is a very valuable tool in research and development which leads to the discovery and development of novel bioactive compounds. Plants produce a diverse array of compounds that can broadly be categorized into primary and secondary metabolites. Phytochemical screening in the current study reports the presence of several secondary metabolites, include alkaloids, terpenoids, organic acids, tannins, flavonoids, coumarins, quinones, polyphenols, saponins, and their derivatives. The objective of this paper is to review the literature regarding Ocimum species, specifically for its phytochemical properties, therapeutic benefits from traditional to modern way and scientific studies. This review consists of all publications relevant to Ocimum species that were identified through a systemic search of major medical database. Studies indicate Ocimum possess anti-inflammatory, antimicrobial, antioxidant, anticancer, cardiac stimulant, hepatoprotective activities. The oil of the plant has been found to be beneficial for cold, first aid treatment, and other day today's life in human activities. Preliminary studies have found various constituents of Ocimum to exhibit a variety of therapeutic effects. These results are very encouraging and indicate that this Ocimum herb should be studied more extensively to confirm these results.

Keywords: Ocimum, Phytochemicals, Active Biomolecules, Traditional, Modern, Herb.

Introduction:

The medicinal plants are rich source of essential oils and huge amount of secondary metabolites. Essential oils are reported in aromatic plants which are distributed in Mediterranean and tropical countries across the world where they are esteemed as an imperative component of the native medicine systems. Almost all plant organs (flowers, buds, stems, leaves, fruits, seeds and roots) of aromatic plants contain essential oils. These are accumulated in secretory cells, cavities, channels, and epidermic cells. Lamiaceae (syn. Labiatae) herb family includes one of the richest essential oil bearing plant family, consists of more than 252 genera and 7 000 species in the vicinity of plant Kingdom Lamiaceae family is known for the wealth of species with medicinal properties, which have been used since early times and many of these species are common in Mediterranean region. Many species of Lamiaceae have long history of uses in culinary spices and folk medicine. The genus Ocimum comprising of more than 150 species grows widely and is distributed throughout temperate regions of the world. Ocimum basilicum, Ocimum gratissimum and Ocimum sanctum commonly known as holy basil, clove basil (wild basil) and sweet basil respectively, Basilis frequently cultivated in several countries of East Asia for the production of essential oils.

Habitat and Distribution: Basil (Tulsi) is indigenous in Sindh and lower hills of Punjab in India. The plant is widely grown as an ornamental and field crop throughout the greater part of India. It also grows for worship of gods and temple offering throughout the part of India. It grows around the temple regions for worship of gods.

Botanical Description of The Ocimum Species: The name basil is thought to be derived from the Greek word “Basileus”, meaning “Royal or King”. It is often referred as Queen of the Herbs. An erect branching herb, 0.6 to 0.9 m height, glabrous, more or less hispidly pubescent. Stems and branches are green or sometimes purplish. Leaves of Ocimum are simple, opposite, 2.5-5 cm or more long, ovate, acute, entire or more or less toothed or lobed with a cuneate and entire base. The petiole is 1.3-2.5 cm long. The leaves have numerous dot like oil glands which secrete strongly scented volatile oil. Whorls densely racemose, where the terminal raceme is usually much longer than the lateral ones. The bracts are stalked, shorter than the calyx, ovate and acute. Calyx is 5 mm long, enlarging in fruit and very shortly pedicelled. Its lower lip with the two central teeth is longer than the rounded upper lip. Corolla being 8-13 mm long are white, pink or purplish in colour, glabrous or variously pubescent.

Figures: A. Ocimum tenuiflorum L.,



B. Ocimum gratissimum L.



The upper filaments of slightly exerted stamen are toothed at the base. Nutlets are about 2 mm long, ellipsoid, black and pitted. Sepals of flower are five and remain fused into a 2-lipped calyx. Ovary is superior and there is a 2-carpellary, 4-locular and a 4-partite fruit of four achenes. Traditionally these Ocimum species have been extensively utilized in food and perfumery Industries. The aerial parts of the plants are considered as antispasmodic, stomachic and carminative in native medicine. A high degree of polymorphism in the genus Ocimum determines a large number of subspecies, different varieties and forms producing essential oils with varying chemical composition offering variable level of medicinal potential.

The essential oil extracted from various parts of the plant namely leaves, flowers, stems, seeds, and roots exhibits therapeutic, spicy, cosmetics, aroma. Several volatile components with strong anticancer, antimicrobial, antihelminthic, antioxidant, antistress, antiinflammatory, antiaflatoxic, antifungal, antiviral, antibacterial, insect repellent and antidiabetic. The compounds present in the essential oil of Ocimum sanctum at full bloom stages were observed by Kothari et al. who found that the plant was rich in methyl eugenol. The presence of secondary metabolites like Alkaloids, Steroids, Tannins, Phenol compounds, Flavonoids, Resins, Fatty acids, a gum has shown medicinal importance in giving the first line of defense in the body (Joshi et al., 2009). 19 major compounds were present in all samples from all parts of the plant but at different concentrations. The most common compound detected was camphor, with slightly different concentrations in the essential oil (31.5%), leaves (24.2%), and inflorescence (22.6%). This was followed by eucalyptol with higher concentration in both essential oil and leaves (18.9 and 13.47%, respectively) than in the inflorescence (1.2%). The third most commonly identified compound was eugenol that comprised 23.7% of the total volatile compounds in the leaves, 13.8% in the essential oil and 7.5% in inflorescence. Monoterpenes, especially eugenol, and estragole were present in the highest amounts in the leaves (23.7 and 9.6%, respectively), while sesquiterpenes ocimene (9.30%), caryophyllene-

β (4.9%), bergamotene (2.8%), germacrene (11.3%), beta bisabolene, (10.7%), and alpha bisabolene (16.7%) were more prevalent in the inflorescence.

MEDICINAL PROPERTIES OF OCIMUM (TULSI):

Tulsi has got the great medicinal value. Tulsi is considered to be a ubiquitous plant in India. Tulsi plays a vital role in our everyday life and is said to be the queen of herbal plants. It is the most common household plant in India and it is sacred in Hindu tradition, commonly grown in gardens and in the periphery of temples. Many Hindu epics explain the importance, properties and uses of tulsi. Tulsi plant has a lot of significance for mankind, due to the manifold medicinal benefits it provides. Tulsi leaves are widely used in the preparation of Ayurvedic medicines. It is known to promote the longevity of life, it has got a pungent taste and fragrant smell. It is the only plant that can absorb carbon dioxide throughout its life. It releases the oxygen in the early morning which is beneficial for the people in breathing disorders.

1. Tulsi is also used to prepare herbal tea. It helps in building up stamina.
2. It has been used for gastric disorders, cough, common colds, malaria, and headaches.
3. It is used as mouth wash for reducing tooth ache.
4. It has immuno-modulatory properties.
5. It contains phytochemicals which provide all these beneficial effects.
6. Many herbal cosmetics contain tulsi. It is also used in skin ointments due to its antibacterial properties.
7. Tulsi has antioxidant properties and reduces blood glucose levels. Thus it is useful for diabetics.
8. Tulsi reduces total cholesterol levels. Thus it is useful for heart disease patients.
9. Tulsi reduces blood pressure.
10. Recent research shows that tulsi does have analgesic (pain killer) properties similar to CO₂ inhibitor drugs.
11. Ursolic acid, a chemical in tulsi may have a role as antifertility (contraceptive) agent in future.
12. It has antiviral, antibacterial, antitumor, antifungal, antimalarial properties.

HEALTH BENEFITS OF TULSI IN DAILY LIFE:

Healing Power: The tulsi plant has many medicinal properties. The leaves are a nerve tonic and also sharpen memory. They promote the removal of phlegm from the bronchial tube. The leaves strengthen the stomach and induce copious perspiration. The seed of the plant are mucilaginous.

Children's Ailments: Common pediatric problems like cough cold, fever, diarrhea and vomiting respond favorably to the juice of basil leaves.

Stress: Basil leaves are regarded as an antistress agent. Recent studies have shown that the leaves afford significant protection against stress. Even healthy persons can chew 12 leaves of basil, twice a day, to prevent stress. It purifies blood.

Coughs: Tulsi is an important constituent of many Ayurvedic cough syrups and expectorants. It helps to mobilize mucus in bronchitis and asthma. Chewing tulsi leaves relieves cold and flu.

Sore Throat: Water boiled with basil leaves can be taken as drink in case of sore throat. This water can also be used as a gargle.

Fever and Common Cold: The leaves of basil are specific for many fevers. During the rainy season, when malaria and dengue fever are widely prevalent, tender leaves, boiled with tea, act as preventive against these diseases. The juice of tulsi leaves can be used to bring down fever. Extract of tulsi leaves in fresh water should be given every 2 to 3 hours. In children, it is very effective in bringing down the temperature.

Kidney Stone: Basil has a strengthening effect on the kidney. In case of renal stone the juice of basil leaves and honey, if taken regularly for 6 months it will expel them via the urinary tract.

Heart Disorder: Basil has a beneficial effect in cardiac disease and the weakness resulting from them. It reduces the level of blood cholesterol.

Respiratory Disorder: The herb is useful in the treatment of respiratory system disorder. A decoction of the leaves, with honey and ginger is an effective remedy for bronchitis, asthma, influenza, cough and cold. A decoction of the leaves, cloves and common salt also gives immediate relief in case of influenza.

Headaches: Basil makes a good medicine for headache. A decoction of the leaves can be given for this disorder.

Eye Disorders: Basil juice is an effective remedy for sore eyes and night-blindness, which is generally caused by deficiency of vitamin A.

Skin Disorders: Applied locally, basil juice is beneficial in the treatment of ringworm and other skin diseases. It has also been tried successfully by some naturopaths in the treatment of leucoderma.

Teeth Disorder: The herb is useful in teeth disorders. Its leaves, dried in the sun and powdered, can be used for brushing teeth. This is very good for maintaining dental health, counteracting bad breath and for massaging the gums. It is also useful in pyorrhea and other teeth disorders.

Mouth Infections: The leaves are quite effective for the ulcer and infections in the mouth. A few leaves chewed will cure these conditions.

TRADITIONAL USES OF OCIMUM:

Sidha, Unani and Ayurvedic medicine use tulsi to treat a wide variety of skin conditions, fevers, coughs and internal ailments. Ayurvedic medicine treats bronchitis with a liquid tonic made from tulsi leaves. All three medicinal systems date to ancient times and are based on natural remedies and treatments, primarily based on herbs and plants. According to Plantcultures.org, oil from tulsi is a natural antiseptic and natural anti-inflammatory. According to Botanical.com, tulsi effectively treats snake bites, including those of poisonous snakes, when all parts of the plant are either ingested or mixed with other plants to form a paste that is applied to the bite area. Ocimum has been described as a plant easily available and commonly utilized for the treatment of a plethora of diseases in numerous ethnopharmacological surveys (Ajayi et al., 2017). Tulsi have been used in traditional Indian Ayurvedic system of medicine. It is also used in the Unani system of medicine. Ayurvedic remedies for common colds, headaches, stomach disorders, inflammation, infections, heart disease, poisoning, cataracts and malaria make use of the Tulsi. This perennial and odoriferous plant is now found in all continents and possesses generally acknowledged medicinal properties. Plant are used to treat ear infections, dermatoses, and ophthalmias (Kpoviessi et al., 2014).

In India, it is recommended for diarrhoea therapy (Kpo-viessi et al., 2014). It was also used to treat headaches, fevers, and ophthalmic and skin problems. Recent findings have indicated that the Tulsi may well provide protection from radiation poisoning. It has also been indicated that Tulsi possesses anti-cancerous properties. There has come up a belief that a Tulsi leaf swallowed daily will ensure protection from cancer. Its stem decoction is used to treat hepatitis, cough, asthma, and wound infections (Chah et al., 2006; Kpoviessi et al., 2014). Apart from its religious significance it is of great medicinal significance, and is a prime herb in Ayurvedic treatment. Marked by its strong aroma and a stringent taste, tulsi is a kind of "the elixir of life" as it promotes longevity. Its inflorescences are utilized as aromatizers in a variety of meals. Previous studies have shown that this type of basil has anaesthetic, anti-stress, anti-inflammatory, anthelmintic, anti-diarrhoeal (Offiah and Chikwendu, 1999), antipyretic, anti-mutagenic, anti-ulcerative, gastro-protective, hepatoprotective, sedative, and fungicidal properties, validating its widespread medical use (Priyanka et al., 2018; Martins et al., 2021). Ocimum is antiseptic and has found widespread applications in the preparation of toothpaste and mouthwash and in topical therapies (Pessoa et al., 2002). It is an excellent wash for sore throat and tonsillitis. It is also used as an expectorant and as a cough suppressant. The plant extract is used to treat gastrointestinal helminths in both animals and humans (Chitwood, 2002). Reports on the plant extract may be used as a medicinal resource for people living with the human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) (Priyanka et al., 2018). Crushed leaves of the plant are used to cure conjunctivitis, while the oil extracted from the leaves is considered highly antimicrobial, fresh aerial portions are consumed directly as vegetables in traditional soups, while dried and powdered aerial parts are utilized in a variety of traditional dishes (Kpoviessi et al., 2014).

MODERN MEDICINAL USE OF OCIMUM:

In modern medicine there has been research indicating Tulsi might potentially be an effective treatment for conditions like ulcers, high cholesterol, Type 2 diabetes, obesity and suppressed immune systems (from conditions like cancers and AIDS). It has been used in treatment of diseases such as anxiousness, pyrexia, infections, arthropod stings, stomach aches, coughs, headaches and constipation; it can also control and decrease the blood glucose, with anti-spasmodic and anti-diabetic properties, anti-bacterial, anti-fungal and anti-oxidant activities have been also showed in former studies. The most important medicinal characteristics of eugenol are anti-fungal, nematocidal and anti-bacterial effects against food-borne pathogenic bacteria. Extract ethanol of basil leaves can decrease blood glucose and advanced glycation end products in diabetic rats. Basil leaves used as antispasmodic carminative and stomachic in ethnic medicine. The essential (volatile) oils obtained from the mint herbs are a natural blend of bioactive compounds with fragrance, formed during secondary metabolism.

The content of essential oil compounds in basil leaves are alkaloids, tannins, flavonoids, and saponins. Basil essential oil components have anti-oxidative, anti-inflammatory and anti-microbial activities. Basil seeds have diuretic, antipyretic, antispasmodic and stomachic properties. Basil seed mucilage have many benefits such as hydrophilicity, biocompatibility, low production cost, appropriate film forming, and edibility and viscoelastic properties. Basil polysaccharides has anti-tumor, anti-oxidant, anti-aging activity with anti-bacterial effects, anti-atherosclerotic effects, immunity enhancement effect and useful in treatment of diabetes mellitus. BSG is an anionic polysaccharide with high molecular weight and contains two fractions, PER-BSG and SUPER-BSG. BSG mainly composed of glucomannan (43%), (1-4)-linked

xylan (24.3%), a minor fraction of highly branched arabino-galactan along with glucan (2.31%), with a small fraction of protein (1.32%) The BSG consists of glucose, galacturonic acid, rhamnose, mannose, arabinose, glucuronic acid and galactose. BSG can improve quality of frozen foods. It considers as commercial hydrocolloids in food industry because of its convenience of extraction and particular behavior. BSM can produce edible films and BSM/Polyvinyl alcohol can produce thermostable ultra-thin nanofibers, for different applications in food sector. Cytotoxicity and cell adhesion studies of BSM hydrogel sponge indicated non-cytotoxicity. Addition of BSG may lead to harder heat-induced egg albumin gels for different food applications in functional foods. It can be used as a new source of edible hydrocolloids in food industry. Basil seed gum has a good potential to be used in producing edible film for various food application. Basil seed has practical amounts of gum with good functional properties. The freeze-dried basil seed gum showed the maximum hardness and consistency; the increase in temperature has a negative impact on the color changes of basil gum solution.

Classification And Variation In Ocimum Species:

Basil (*Ocimum basilicum* L.), is an important essential oil crop, medicinal plant and culinary herb, belongs to the Lamiaceae family, which grows in tropical and sub-tropical climates, and its essential oil is a component of oral health, dental products, and has been used in the fragrance and food industry. Its germination rate under laboratory studies is 85-90% and around 60–70% under field conditions. The anatomy of a basil plant consists of Main stem, Node, Internode, Dominant growing tip, Future stem growth and Leaves. All parts of basil can be used for essential oil and as ornamental plant. The most important varieties of basil are sweet basil, purple basil, lemon basil, cinnamon basil, fine leaf basil and bush basil. The most important diseases of basil are Fusarium, Botrytis and leaf spot. Basil is sensitive to drought stress, Kalamartzi et al. found that basil cultivars should have higher water use efficiency in semi-arid regions, which allow them to save more water resources. Its dry products of the stems usually harvest at 1.2–2 (fresh weight 8–10) t/ha. The most important basil diseases are fusarium wilt (*Fusarium oxysporum* f. sp. *basilicum*), leaf spot (*Pseudomonas cichorii*), graymold (*Botrytis cinerea*), damping off or root rot (*Rhizoctonia solani*) and downy mildew (*Peronospora belbahrii*).

List Of The Most Commercial Basil Species.

English Name Scientific Name

Sweet basil	<i>Ocimum basilicum</i>
Genovese	<i>Ocimum basilicum</i> Genovese
Bush or Greek basil	<i>Ocimum basilicum</i> minimum
Purple basil	<i>Ocimum basilicum</i> purpurascens
Lettuce-leaf basil	<i>Ocimum basilicum</i> crispum
Scented basil	<i>Ocimum basilicum</i> odoratum
Holy basil	<i>Ocimum canum</i> or <i>Ocimum sanctum</i>
Camphor basil	<i>Ocimum kilimandscharicum</i>
Thrysiflora basil	<i>Ocimum thrysiflora</i>

Health Benefits Of Phytochemicals:

Phytochemical is derived from the Greek word “Phyto,” which means plant. Phytochemicals are a naturally occurring group of chemicals in plants and plant-derived foods, which may function in reducing the risk of chronic diseases. Although it is estimated at least more than 5000 dietary phytochemicals have been discovered, it is believed that a high percentage of phytochemicals in plants still remain unknown. The phytochemical screening in the current study reports the presence of several secondary metabolites. These include alkaloids, anthraquinones, cardiac glycosides, cyanogenic glycosides, flavonoids, reducing sugars, saponins, tannins, terpenoids, phenolics, and phytosterols. Alkaloids were present in aqueous crude extracts and their fractions and hydroethanolic crude extract but not in the acetone crude extract and its fractions. Alkaloids have biological properties in fauna. Tannins were present in all the crude extracts and fractions of (*Ocimum americanum* L.). They are water-soluble polyphenolic biomolecules which are found in many medicinal plants. Sieniawska and Baj in a review observed that high content of tannins is beneficial due to their antimicrobial and antitumor properties, which is consistent with our findings.

Bioactive saponins were present in hydroethanolic and aqueous crude extracts and their fractions but not in acetone crude extract and its fractions. These saponins are a subclass of terpenoids, typically bitter tasting, plant-derived toxic organic compounds that are frothy when shaken in water. Saponins have varying activities, both beneficial and toxic. Clinical studies have reported that saponins are cytotoxic due to induction of apoptosis and modulation of the immune system against rapidly growing tumor cells. The phytosterols/triterpenes were present in the nonaqueous solvents, i.e., were present in the acetone extract and all the fractions. Phytosterols related to cholesterol are structural components of plant physiological

membranes. Phytosterols are chemopreventive compounds and are reported to have antitumor properties through various mechanisms. Research has also demonstrated that alkaloids possess antimicrobial, antimalarial, and Critical reviews of studies available in the literature support the concept that phytochemicals (polyphenols, tocopherols, tocotrienols, carotenoids, and ascorbic acid) has been associated with the maintenance of good health as well as prevention/treatment of many health conditions including cancer, cardiovascular diseases, diabetes, hypertension, stroke, metabolic syndrome, and other degenerative diseases. It is largely accepted that the additive effects of the combinations of various phytochemicals in whole plant-based foods are shown to have stronger protective actions than single, isolated phytochemical compounds.

Role Of Secondary Metabolites:

The genus *Ocimum* (Basil) comprises more than 150 species of aromatic plants, some of which have excellent therapeutic activity with a potential for isolation of a new bioactive compound. New drug model seeks to meet on bringing compounds active toward target proteins. The main important property of the Lamiaceae is attached to its content of essential oils. Even though newly pharmaceutical companies and support organization stake influence in molecular design, combinatorial chemistry and synthetic chemistry, natural productions, and especially those of plant source, remain as a prerequisite cause of new remedies, current medicine leads and other new synthetic entities. Plants produce a diverse array of compounds that can broadly be categorized into primary and secondary metabolites. Primary metabolites are the ones which are required for the normal growth and biological processes and are produced in the pathways that are crucial for plant survival. The other class of metabolites, though generally termed secondary, is also very crucial for plants from the ecological perspective.

These secondary metabolites are classified on the basis of their biosynthetic pathway and the following types are frequently observed-terpenes, phenylpropanoids, alkaloids, saponins, and glucosinolates. Commonly found as secondary metabolites in various plants, these phytochemicals have a varying array of biophysiological effects on myocardia function and have also been proposed for use in tumor chemotherapy. Cyanogenic glycosides were only present in aqueous and hydroethanolic extract as well as in acetone and ethyl acetate fraction of acetone extract. The flavonoids, reducing sugars, tannins, and phenolics were present in all the samples. Among the secondary metabolites, flavonoids and phenolic compounds are the most active group of phytochemicals. These compounds have broad spectrum of pharmacological properties including antimicrobial activities. The availability of carbon, nitrogen, and sulfur along with energy from the primary metabolism governs the biosynthesis of these compounds. Phytochemical screening in the current study reports the presence of several secondary metabolites, include alkaloids, anthraquinones, cardiac glycosides, cyanogenic glycosides, flavonoids, reducing sugars, saponins, tannins, terpenoids, phenolics, and phytosterols. Polyuronides were not detected in any of the samples alkaloids were present in aqueous crude extracts and their fractions and hydroethanolic crude extract but not in the acetone crude extract and its fractions. Alkaloids have biological properties in fauna's they impede the cyclooxygenase cascade which in turn prevents interleukins and cytokines that initiate pain during inflammatory process.

Research has also demonstrated that alkaloids possess antimicrobial, antimalarial, and antispasmodic activities anthraquinones were only present in the acetone extract and its chloroform fraction. Cardiac glycosides were present in all the samples. Commonly found as secondary metabolites in various plants, these phytochemicals have a varying array of biophysiological effects on myocardia function and have also been proposed for use in tumor chemotherapy. Cyanogenic glycosides were only present in aqueous and hydroethanolic extract as well as in acetone and ethyl acetate fraction of acetone extract. Flavonoids, reducing sugars, tannins, and phenolics were present in all the samples. Among the secondary metabolites, flavonoids and phenolic compounds are the most active group of phytochemicals. These compounds have broad spectrum of pharmacological properties including antimicrobial activities. Phenolics and flavonoids compounds inhibit peptidoglycan and nucleic acid synthesis due to their hydroxyl moiety, thus blocking the synthesis of bacterial cell wall. These findings are consistent with Zengin et al. who reported that the contents of flavonoids and phenols have inhibitory effects against certain bacteria and fungus strains Tannins were present in all the crude extracts and fractions of *Ocimum americanum* L. They are water-soluble polyphenolic biomolecules which are found in many medicinal plants. Sieniawska and Baj in a review observed that high content of tannins is beneficial due to their antimicrobial and antitumor properties, which is consistent with our findings. Bioactive saponins were present in hydroethanolic and aqueous crude extracts and their fractions but not in acetone crude extract and its fractions. saponins are a subclass of terpenoids, typically bitter tasting, plant derived toxic organic compounds that are frothy when shaken in water. Saponins have varying activities, both beneficial and toxic. Clinical studies have reported

that saponins are cytotoxic due to induction of apoptosis and modulation of the immune system against rapid growing tumor cells the phytosterols/triterpenes were present in the nonaqueous solvents, i.e., were present in the acetone extract and all the fractions. Phytosterols related to cholesterol are structural components of plant physiological membranes. Phytosterols are chemopreventive compounds and are reported to have antitumor properties through various mechanisms. McCann et al. observed that dietary phytosterol intake reduces the risk of several types of cancers including ovarian cancer.

Classification Of Secondary Metabolites:

Ethnopharmacology is a very valuable tool in research and development which leads to the discovery and development of novel bioactive compounds. Metabolites are the mediators and amounts of metabolism. The term metabolite is commonly confined to narrow fragments. Metabolites have specific functions, consisting of fuel, structure, signaling, stimulatory and inhibitory effects on enzymes, and the catalytic activity of their holding (mostly as a cofactor to a stimulant), defense and interaction with distinct pathogens. Plant metabolites are categorized based on their biosynthetic pathways. The pathways of biosynthesis are responsible for the occurrence of both primary and secondary metabolites. Plant secondary metabolites can be classified on the basis of chemical structure (for example, having rings, containing a sugar), composition (consisting of nitrogen or not), their solubility in numerous solvents, or the pathway by which they are synthesized e.g., phenylpropanoid.

Essential Oil Of Ocimum (Basil):

Since ancient times, essential oils are known for their medicinal use, and they are very much interesting and impressive natural plant commodities. They continue to be of paramount importance until the present day. Essential oils have been tested as perfumes, flavors for foods and beverages, or to provide both bodies and care for thousands of years. In essential oils, unsaturated terpenes having a cyclohexadiene structure (e.g., terpinene) and secondary cyclic oxygenated terpenes (e.g., thymol) may lead to antioxidant capacity, while acyclic unsaturated oxygenated monoterpenes (e.g., linalool), aromatic oxygenated (e.g. eugenol), methylchavicol (estragole), sesquiterpene hydrocarbons (e.g., α -bergamotene, germacrene D, γ -cadinene, δ -cadinene, β -selinene, sesquiterpenes oxygenated (e.g., spathulenol) may act as pro-oxidants.

Pharmaceutical Activities Of Ocimum (Basil) :

The genus *Ocimum* (family Lamiaceae), collectively known as basil, is composed of a diverse and rich source of essential oil containing plants. The main issues of concern with the use of herbal drugs remain safety, validation of claims and standardization of product. Different species and forms of *Ocimum* species vary in growth, habit, color, and aromatic composition, making the true botanical identity of basil difficult. There exist the problems of significant variation in the content of *Ocimum* plants across and within species, with the implication of varied pharmaceutical activities. During the last two decades, it has been shown that *Ocimum* oil and its constituents possess different pharmaceutical activities including antioxidant, antimicrobial, anticancer, and anti-inflammatory properties.

1. Oxidant Activity:

Anti-oxidants play an important function in protecting the body against free radicals. They achieve this by stopping the formation of new free radical species, converting older ones to free radicals, less toxic molecules that can be easily preventing radical chain reaction. The principal function of antioxidants is in suspending the oxidation of other molecules, by inhibiting the initiation or propagation of oxidizing chain reactions by free radicals and thereby reducing oxidative damage to the human body. Two great mechanisms of procedure have been proposed for antioxidants. The potential role in the food industry and human health, antioxidants are getting acceptance all across the globe.

Antioxidants are defined as a substance that easily in small amounts, can inhibit or prohibit the oxidation of readily oxidizable elements. The antioxidant is also defined as a substance qualified of inhibiting special oxidizing stimulants or a substance that serves with oxidizing agents prior to creating damage to other fragments or a substance that sequesters metal ions or even a substance efficient of the recovering system such as iron transporting protein. Natural antioxidants have been studied intensively during the past years which are mainly phenolic compounds. Various *Ocimum* species and their extracts or essential oils have been determined to achieve antioxidant activity's. Phenolic acids, hydroxycinnamates, and flavonoids are perhaps the major antioxidants. Vitamin antioxidants (e.g., ascorbic acid and carotenoids) are secondary contributors to the overall antioxidant capacity.

2. Immunomodulatory Activity:

Mahapatra et al. (2011) investigated the immunological functions and immunological responses in nicotine-induced macrophages as well as the immunomodulatory activity of *Ocimum gratissimum* extract. Nicotine-induced NO production and iNOS II expression were considerably reduced after the administration of a 10 μ g/mL aqueous extract of the plant. The aqueous extract of the plant had protective effects on murine

peritoneal macrophages by downregulating Th1 cytokines in nicotine-treated macrophages while simultaneously activating Th2 responses.

3. Cytotoxic Activity:

The cytotoxic impact of methanolic extract *Ocimum gratissimum* was studied in murine peritoneal macrophages at doses ranging from 0.1 to 100 g/ml using the 3-(4,5-dimethylthiazol-2-yl)-2,5 diphenyltetrazolium bromide (MTT) technique. The findings indicated that *Ocimum gratissimum* plant extracts have a considerable modulatory influence on nicotine-induced free radical production, lipid-protein damage, and antioxidant status in peritoneal macrophages. It was observed that ME-Og exerted a protective effect against nicotine toxicity. Therefore, the results confirm the modulatory effect of *O. gratissimum* on hazardous chemicals such as nicotine (Mahapatra et al., 2009).

4. Antimicrobial Activity:

For thousands of years, folk medicine has used *Ocimum* leaf for the treatment of infections. Such protective properties have been confirmed by several studies performed in the last decades using *Ocimum* essential oil. The antibacterial and antifungal activities of *Ocimum* species have been studied on various bacteria and fungi. These studies indicate that essential oils are more efficient antifungals and antibacterials compared to the polar extracts. *Ocimum sanctum* essential oils showed remarkable antimicrobial activity against bacteria and other microorganisms, such as periodontopathogens, mainly due to the presence of oxygenated monoterpenes in their chemical compositions. The essential oil and methanol extracts of five *Ocimum* species have an appreciable activity against seven human pathogenic bacteria, essential oils of *Ocimum* species showed strong antimicrobial activity against all seven microorganisms tested. Oils of seven *Ocimum* taxa (*O. americanum* L., *O. basilicum* L., *O. campechianum* Mill., *O. x citriodorum* Vis., *O. kilimandscharicum* Baker ex Gürke and three botanical varieties and cultivars of *Ocimum basilicum* L.: 'Genovese', var. *difforme* and var. *purpurascens*) showed strong antimicrobial activity against all 8 microorganisms tested by Carovic-Stanko et al. Among the antifungal activities, the in vitro antifungal activity of *O. basilicum* L. essential oil against *Aspergillus flavus* fungal growth, essential oils of *O. basilicum* L. showed strong antifungal activity against *A. flavus*.

5. Antidiabetic activity:

Diabetes mellitus is a chronic metabolic disorder caused by an absolute or relative lack of insulin and/or reduced insulin activity which results in hyperglycemia and abnormalities in carbohydrate, fat and protein metabolism. The hypoglycemic effect of *O. tenuiflorum* L., *O. canum* Sims. and *O. gratissimum* L. in animals with alloxan-induced diabetes was applied to potentiation of glucose-induced insulin free and parallel increased peripheral uptake of glucose. Successive studies have reported a greater link of antidiabetic deal with the antioxidant effects of *Ocimum* oil. Studies on the hypoglycaemic activities of *O. gratissimum* have been reported by various researchers using animal models (Egesie et al., 2006; Shittu et al., 2019). The research carried out by Casanova et al. (2014) showed the hypoglycemic activity of *O. gratissimum* against streptozotocin-induced diabetes in rats. In animal experimental designs of alloxan-induced diabetes, both antioxidant and hypoglycemic effects of *O. basilicum* L., *O. tenuiflorum* L., *O. canum* Sims. and *O. gratissimum* L. have been reported. By treating alloxan-diabetic rabbits made a significant decrease in blood glucose levels as corresponded with diabetic control rabbits. Furthermore, the effects of *Ocimum sanctum* leaf polyphenols have been investigated also in insulin-secreting pancreatic β -cells, whose OS-induced alterations contribute to the pathogenesis of diabetes

6. Anticancer activity:

For a long time, the polyphenols of the *Ocimum* oil of the diet have been considered to play a role for the prevention of certain types of cancer in the Asian origin. Even more than in *Ocimum* oil, constituents present in *Ocimum* leaf extract has shown strong antioxidant potency and inhibition of cancer cell proliferation, thus suggesting the protection against the genotoxic action of the ROS as one of the mechanisms explaining the anticancer effects of these compounds. Indeed, either methanol aqueous *Ocimum basilicum* L. leaf extract or the isolated constituent's eugenol epoxide free radical scavenging activity and growth inhibition at low micromolar concentration on human breast cancer cell lines and Human cancerous cell lines (HL60-promyelocytic blood leukemia cells). Anticancer activities from plant bioactive components have been documented (Sun et al., 2002; Surh, 2003; Ohiagu et al., 2021). Lin et al. (2014) investigated the anticancer efficacy of an aqueous extract of *O. gratissimum* due to its antioxidant capabilities after treating human osteosarcoma cells with the extract, adding to the expanding body of research on the plant and its involvement in cancer treatments. This subsequently resulted in the inhibition of tumour growth and breast cancer cells. When human breast cancer cells were treated with both *O. basilicum* and *O. gratissimum*, it was observed that *O. gratissimum* had a lower cytotoxic and apoptotic

impacted the MCF-7 human breast cancer cell line through activation of AMPK signalling pathway (Torres et al., 2018).

Ekunwe and his co-researchers reported that partially purified *O. gratissimum* fractions or aqueous or organic solvent-soluble extracts of *O. gratissimum* (Ekunwe et al., 2013) inhibited the proliferation of several cancer cell lines, especially prostate adenocarcinoma (PC-3) cells. Such findings were further confirmed by other in vitro reports, testing the effects of *Ocimum basilicum* L. against four different human cancer cell lines viz. human cervix adenocarcinoma HeLa cells, human melanoma FemX cells, human chronic myelogenous leukemia K562 cells, and human ovarian SKOV3 cells. Monga et al. studied the antimelanoma and radioprotective activity of essential oils obtained by 50% alcoholic aqueous leaf extract from five species of *Ocimum* viz. *Ocimum sanctum* (SE), *Ocimum gratissimum*, *Ocimum basilicum*, *Ocimum canum*, and *Ocimum kilimandscharicum*, were evaluated using C57BL. Camphor, 1,8-cineole and limonene, the anti-inflammatory compound of *Ocimum kilimandscharicum* oil, showed a strong dose-dependent cytotoxic effect on human ovarian cancer cell. The potential antitumor effects of camphor have been shown previously and the mechanistic action of camphor against cancer included the improvement of immune function.

7. Liver Support:

Generally contributes to healthy liver function, improves breakdown and elimination of dangerous chemicals in the blood, and counteracts various liver diseases. Lung and bronchial support in addition to contributing generally to respiratory health, Tulsi has been shown helpful in treatment of a variety of serious allergic, inflammatory and infectious disorders affecting the lungs and related tissues.

8. Nutrition Property:

Basil (*Ocimum basilicum* L.), is an important essential oil crop, medicinal plant and culinary herb, belongs to the Lamiaceae family. Basil is so rich in nutritional values it contains vitamins C and A, and minerals calcium, zinc and iron, as well as chlorophyll and many other phytonutrients. Also enhances the efficient digestion, absorption and use of nutrients from food and other herbs.

9. Cardiovascular Protection:

For decades, investigation on the health-promoting effects of Asian diet has been revealed that *Ocimum* oil consumption is a key factor in the cardiovascular protection found in Asian origin. It is well established that the healthful properties of *Ocimum basilicum* L. oil depend largely on its Cardiac glycosides and catecholamines content. But, many arguments prove that in *Ocimum* oil there are little bioactive components, much than Cardiac glycosides and catecholamines, effective for its cardiovascular protective properties, among them, the ethanolic fraction of *Ocimum* oil, and in specific omega-3 fatty acids have proved antioxidant, anti-platelet aggregation, vasodilatory, and anti-inflammatory effects, all engaged in this health beneficial action. Oxidation of LDL cholesterol is one of the key steps in the induction of atherosclerotic lesions by increasing damage to the arterial side through several processes, including growth factor and chemotactic protein expression, inflammation, and build up local macrophages have indicated that ethanolic leaf extract of *Ocimum basilicum* L. Although the contraction of plasma cholesterol and LDL is the primary technique regulating the antiatherogenic activity of *Ocimum basilicum* L. extract, other implements are further identified. It is well settled that local leukocyte and monocyte recruitment into the vessel wall is initial walk-in atherogenesis.

10. Wound Healing Properties:

Chang et al. (2021) reported that *O. gratissimum* restored cell activity and protected against ultraviolet C-induced inhibition of cell proliferation and migration of skin cells, and therefore can serve as a potent natural wound care agent. The remarkable antibacterial action of the 2% *ocimum* oil in honey formulation, together with the documented wound healing characteristic of honey, suggests that the 2% *ocimum* oil in honey formulation might be useful as a topical antiseptic agent for wounds (Orafidiya et al., 2006).

11. Anti-aging Activity:

Tulsi contains ursolic acid, a compound that prevents wrinkles and helps retain the elasticity prevalent in young faces. No wonder Tulsi became an instant hit with the beauty industry and a prime ingredient in herbal cosmetics, including face packs, creams and many other products.

12. Beauty and Restoration:

Tulsi enhances beauty; many Indian women make it a part of their daily beauty ritual. Tulsi cleanses and purifies the blood. Healthopedia recommends using Tulsi paste to treat acne.

13. Enzyme-inhibitory Activity:

The leaf extract of *O. gratissimum* inhibited pancreatic lipase and angiotensin 1-converting enzyme significantly. The results of the study revealed that the extract has inhibitory effects on enzyme activities

linked with erectile function, as well as free radical scavenging capacities, and these activities are linked with the plant's phenolic and flavonoid components.

Tulsi Save The Taj Mahal From Pollutants:

Tulsi (*Ocimum sanctum*) chosen for its anti-pollutant antioxidation and air-purifying properties making it an ideal ornamental herb in the vicinity of the Taj Mahal. Now Tulsi is being used to help Taj Mahal to retain its pristine allure. Even as the monument of love yellowing with age awaits its promised beauty pack for well over two years, forest department has come up with another quick-fix project plant a Tulsi drive in Agra. The recommended complexion care regimen, officers claim, has full backing from ancient texts which hold Tulsi to be the panacea for all problems from cosmic to cosmetic. The department is all set to launch the Tulsi plantation drive from January 2009. The public-private joint venture is expected to provide an eco-protection cover to sensitive Taj trapezium zone surrounding the 17th century monument as well as the other two world heritage monuments.

Future Direction And Conclusion:

Despite the many appreciations of science and industry, present practice is filled with stress. Mobile devices and the web have vastly enhanced the pace of life so that many people feel that they are now going down in an endless-increasing ocean of data, while technical culture has overwhelmed us with growing vulnerability to unhealthy prepared and packed food and a profusion of pesticides, food container components, and many toxic modern chemicals. Urban citizens are nevertheless dealt with growing prosperity disparity, social segregation, excessive turbulence, air, water and soil pollution and disconnection from nature. Therefore, while industrialization experiences served to stronger lifespans and impressive expansions in human populations, it is now agreed that the extremist causes of death and disease on the globe are preventable lifestyle-related chronic diseases. The biodiversity of essential oils containing the small molecular terpenoids remains an enchanted field of investigation, and the continuous usage of this reward in a broad field of studies suggested these demands in the consequent. Screening, identifying, and dealing with this vast biodiversity will require a progressing progress of precise, rich-throughput experimental methods including new driving procedures. The beneficial health effects of *Ocimum* oil compounds have also been proven by many randomized, crossover, controlled, human studies on biomarkers of health performed in the last decades. Several preclinical studies suggest that such beneficial effects may be mainly ascribed to the phenolic compounds. Further development of biotechnology with the genomic and metabolic analyses and genetic engineering will advance a variety of fields involving bioactive compounds ranging from food and animal nutrition to plant protection.

Although many biological activities as antimicrobial or antioxidative and other effects have been intensively studied and well documented. However, well studies are needed to further characterize the in vivo effects of individual *Ocimum* derivatives applied as specific agents or in a mixture, consisting of their safety analysis on mortals. Moreover, a better evidence of their molecular procedure of activity may appropriate the system to a better application in human pharmacology. In inference, the tendency of the last moments in the treatment of herbal productions have indicated that nature prospects and trust in pure and healthful products including medicines, cosmetics, household products, since easily as foodstuffs of plant and animal origin have belonged to a vital issue. So, indeed a well-balanced risk-benefit assessment of bioactive essential oils is one of the major challenges and policymakers must be convinced that review on natural products as the volatile terpenoids in essential oils is a huge task to ensure the ultimate human and animal welfare. All these medicinal ingredients makes Tulsi a must have for longer and peaceful life. This small plant is certainly a very good source of medicinal properties. After in depth and rigorous research it has been proved and certified that it is safe to consume Tulsi in any form. All these remedial properties are well accepted and honored by modern science. Tulsi is the herb that cures the mankind from all odds naturally in today's superficial not-so good lifestyle. It is considered as India's Queen of herbs

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