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A Comprehensive Review on *Ocimum basilicum*

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Abstract

The genus *Ocimum* has a number of species that are used to treat different types of disorders and diseases from ancient times. In this genus, *O. basilicum* plays a vital role due to its various medicinal properties. It is universally cultivated as herbaceous, perennial plant but originated from Asian continent. *O. basilicum* is used as a culinary herb and also has a number of pharmacological activities to prevent or treat cardiovascular disorders, diabetes, menstrual cramps, digestive disorders, neuro-degenerated disorders and cancer. In addition to that, it has been reported for antioxidant, antimicrobial, and larvicidal activities. Chemical constituents such as linalool; eugenol; 1, 8-cineone; methyl eugenol and anthocyanins are mostly responsible for the above mentioned activities. Some traditional uses of this plant coincidences with experimental results. However, the studies conducted based on its traditional use are negligible. This review is an attempt to provide a pharmaceutical perspective of *Ocimum basilicum*.

Keywords: Cancer, Chemical Constituents, Immunomodulatory, Pharmacological Activity, GC-MS

1. Introduction

The genus *Ocimum* belongs to the family Lamiaceae. There are about 150 species of *Ocimum*[1]. The genus *Ocimum* has a number of species that are used to treat different types of ailments from ancient time, especially the species *Ocimum basilicum*[2]. It is otherwise known as sweet basil. It is a universally cultivated herbaceous, perennial plant[3]. It is a popular herb used in Italian and Southeast cuisines of Thailand and Vietnam[4]. It has numerous potent activities due to the metabolites present in it. As a consequence of its virulent metabolites, it is used in traditional medicine[5-6] and also as an ornamental plant[7]. The extracts of essential oils of *Ocimum basilicum* are used as the flavors for the food products. It is used as a kitchen herb, culinary herb and ornamental herb[8]. It has also been used as commercial fragrances, flavors and to improve the food products shelf life[9-11].

O. basilicum has been reported numerously in areas related to agriculture, food, and pharmacology. Hence, this review would shed more lights on different dimension of *O. basilicum* to the researchers. At the same time, the disappearance of *O. basilicum* in certain regions is increasing day by day so, it is vital to create awareness on the medicinal importance of this plant to prevent its extinction. All these things made us to pen down this review which is mainly focused on the pharmaceutical prospective of *Ocimum basilicum*.

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2. Historical Perspectives

Ayurveda and Unani physicians used this plant in various forms to cure ringworm, rashes, and other skin troubles. Since 1930, *Ocimum* is targeted to study the chemical combination of basil oil and also as a kitchen herb and decorative plant[12]. The genus *Ocimum* covers over 150 species of herbs in addition shrubs[13-14]. It is broadly used in food, pharmaceutical, cosmetic, aromatherapy and perfumery industries[15-16] and used all over the world because of its sense of taste especially, in Mediterranean food court[17]. The infusions of *Ocimum basilicum* are extensively used as old style medicine to shrink plasma lipid content in Mediterranean areas[18]. Above 100 herbs and shrubs of genus *Ocimum* originated from tropical and sub-tropical region and cultivated around the world[19]. The taxonomical hierarchy of *O. basilicum* is shown in Table 1.

Table 1. Taxonomical Hierarchy of O. *basilicum*

Kingdom	Plantae
Phylum	Magnoliophyta
Class	Magnoliopsida
Order	Lamiales
Family	Lamiaceae
Genus	*Ocimum*
Species	*basilicum*

3. Traditional Claims

In Turkey, *Ocimum basilicum* is used as a folk medicine and traditional Uyghur medicine to prevent and treat diabetics[20] and cardiovascular disorders[21, 22]. In Indian Siddha medicine, it is used for treating pimples on face[23]. Traditionally basil has been used to treat headaches, coughs, diarrhea and kidney malfunctions[1]. It also used in the treatment of insect stings, snake bites and skin infections externally. In Bulgaria, it is used as a folk medicine for the treatment of aches and pains[24]. In Spain, it is used as a sedative[25].

4. Perfumery

The ethanolic steam distillation extract of flowers is used as pleasant smelling compound in perfumes[26]. The presence of essential oils determines the aroma of the *O. basilicum*.

5. Biogeography and Ecology

Basil is a vital oil bearing herb which can be grown in various environmental conditions on a wide range of terrain. Among varied aromatic and medicinal crops, basil is one of the crops for utilization of sodic wasteland owing towards its tolerance to higher salt, pH and exchangeable sodium percentage[28]. Hence, *O. basilicum* habitation varies from tropical areas of Asia, Africa, Central and south America[1] but it is highly cultivated in Iran, Japan, China and Turkey[29].

6. Phytochemical Studies

O. basilicum majorly contains about 20 compounds such as linalool, estragole, methyl eugenol, 1, 8-cineole, etc., which has been identified by GC-MS[30]. Camphor, limonene, thymol, citral, α-linalool, β-linalool, estragole, are the monoterpene's of *O. basilicum*. Methyl eugenol is the active compound of *Ocimum basilicum*. Chichoric acid was found in the fresh basil leaves[31]. Crude extract of various morphological parts of *Ocimum* are rich in phenolics. The intensely purple pigment of flower is due to the presence of anthocyanins[32]. Linalool (52.42%), methyl eugenol (18.74%), 1,8-cineol (5.61%) are the major compounds in *O. basilicum* which are isolated by the HPLC method[30]. Myrcene, borneol and neral are the minor compounds present at 5%, 9%, 8% w/w respectively. Fourteen different anthocyanins have been isolated by HPLC within that 11 has cyanidin based pigments and 3 has peonidin based pigments[32]. It is also used in the preparation of cosmetics and perfumes. Extracts of *Ocimum* show strong inhibitory effects on HIV-1 reverse transcriptase and platelet aggregation[33]. Chemical constituents of *O. basilicum* and their biological activity are shown in Table 2. The chemical structures of *O. basilicum* constituents are shown in Figure 1.

7. Effluent Treatment

Over 50,000 tons of diverse artificial colorants are yearly produced as of many industrialized processes and around 1-10 % of them are settled into the surroundings[84]. Due to synthetic source and compound molecular structure, dyes are challenging to biodegrade when at large to the environment and their half-finished degradation frequently produces toxic compounds[85]. There are

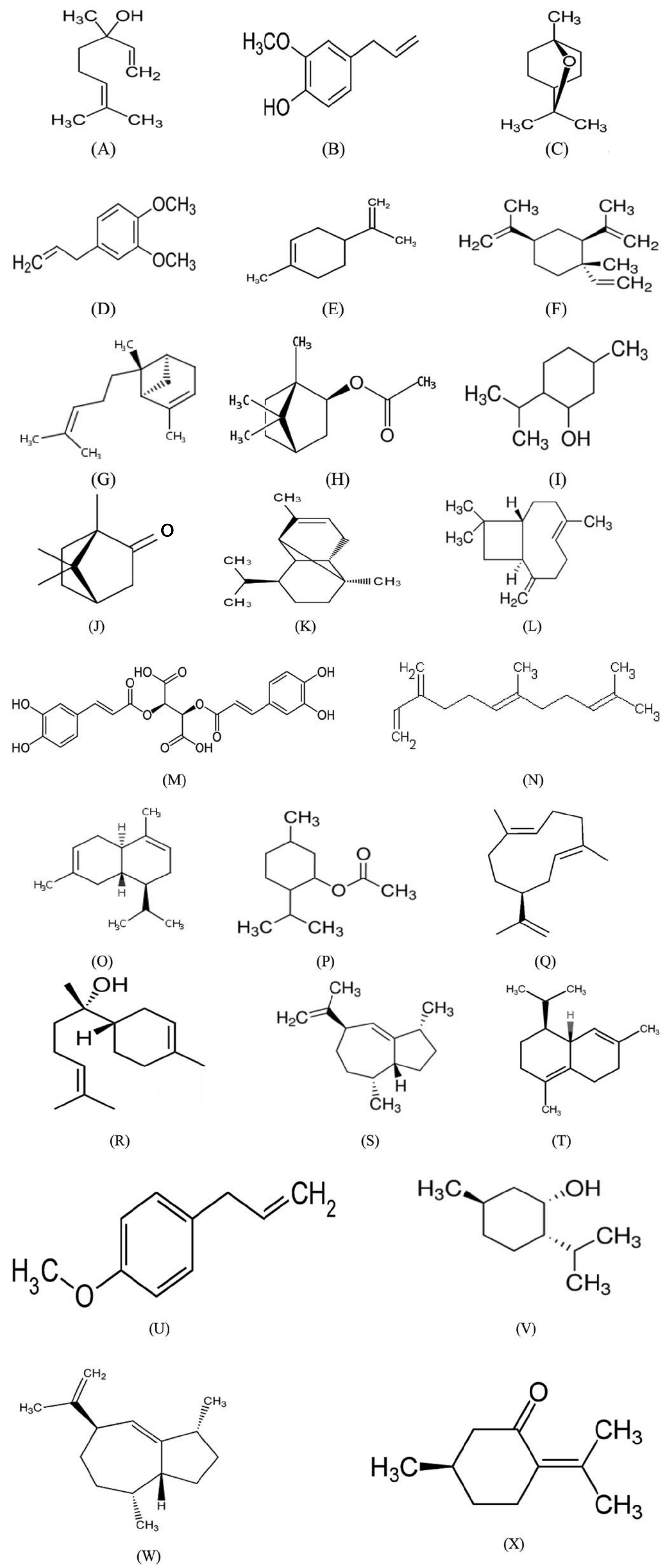

Figure 1. Chemical structures of (A) Linalool, (B) Eugenol, (C) 1,8-cineole, (D) Methyl eugenol, (E) Limonene, (F) β-elemene, (G) α-bergamotene, (H) Bornyl acetate, (I) Menthol, (J) Camphor, (K) α-copaene, (L) β-caryophyllene, (M) Chicoric acid, (N) Farnesene, (O) β-cadinene, (P) Menthyl acetate, (Q) Germacrene, (R) α-bisabolol, (S) δ-gurjunene, (T) δ-cadinene, (U) Estragole, (V) Neo isomenthol, (W) Guaiene, (X) Pulegone.

Table 2. Extraction methods, chemical constituents and biological activities of O. basilicum

S.No	Chemical constituents	Chemical class	Extraction method	Biological activity
1	Linalool	Monoterpene alcohol	Solvent free microwave extraction and conventional hydrodistillation[34]	Antihyperalgesic, Antinociceptive[35]
2	Eugenol	Phenylpropanoid	Steam distillation[36]	Neuro-protective, Anti-cancer, local anesthetic[37]
3	1,8-cineole	Monoterpenoid	Hydrodistillation[38]	Antiulcer, Wound healing activity[39]
4	Methyl eugenol	Phenylpropene	Hydrodistillation[40]	Anticonvulsant and Anesthetic[41]
5	Limonene	Monoterpene	Solvent at high pressure high temperature extraction[42]	Motor relaxant, Anti-inflammatory[43]
6	β-elemene	Sesquiterpenoid	Hydro and glycol distillation[44]	Antineoplastic, Anticancer[45]
7	α-bergamotene	Sesquiterpene	Cold maceration[46]	Abiotic stresses release[47]
8	Bornyl acetate	Acetate ester	Microwave assisted extraction[48]	Analgesic, Anti-inflammatory[49]
9	Menthol	Alcohol	Soxhlets solvent extraction[50]	Local anesthetic[51]
10	Camphor	Terphenoid	Liquid liquid extraction[52]	Decongesting, Antipruritic, counterirritant[53]
11	α-copaene	Sesquiterpene	Supercritical fluid extraction[54]	Cytotoxic, Anti-genotoxic, Antioxidant[55]
12	β-caryophyllene	Sesquiterpene	Supercritical fluid extraction[56]	Antibiotic, Antioxidant, anti-Carcinogenic[57]
13	Chicoric acid	Phenylpropanoid	Solvent microwave extraction[58]	Antioxidant, Immunostimulatory[59]
14	Farnesene	Sesquiterpene	Steam distillation[60]	Anti-oxidant, Anti-Insecticidal[61]
15	β-cadinene	Bicyclic sesquiterpene	Supercritical fractioned extraction[62]	Antinociceptive, Antiproliferative[63]
16	Menthyl acetate	Monoterpene	Solid-phase microextraction[64]	Antioxidant, Antibacterial[65]
17	Germacrene	Sesquiterpene	Solvent extraction[66]	Analgesic[67], Anti-inflammatory[68]
18	α-bisabolol	Sesquiterpene alcohol	Supercritical carbon dioxide extraction and in situ extraction[69]	Analgesic[70], Antibiotic[70], Anticancer[71]
19	δ-gurjunene	Cyclo aromadendrane sesquiterpenoid	Supercritical fluid extraction method[72]	Antitumor, Anti-inflammatory, Anti-oedematous[73]
20	δ-cadinene	Bicyclic sesquiterpene	Headspace solid-phase Microextraction[74]	Antioxidant, Antimicrobial[75]
21	Estragole	Phenylpropene	Hydrodistillation[76]	Neuronal excitability[77]
22	Neo isomenthol	Menthane monoterpenoid	Steam distillation[78]	Nasal sensation[79]
23	Guaiene	Sesquiterpene	Steam distillation[80]	Antiplatelet, Antithrombotic, Aphrodisiac, Antidepressant[81]
24	Pulegone	Monoterpenoid	Salting-out assisted liquid-liquid extraction[82]	Antinociceptive[83]

several methods which are active to reduce the dyes[86]. Coagulation-flocculation is one of the furthermost effective and inexpensive processes for treatment of wastewater containing dye[87]. The plant-based coagulants are harmless to human health, cost effective and biodegradable[88]. They produce a lesser amount of sludge and do not modify pH of the treated water[89]. The *Ocimum basilicum* was used as a natural coagulant for the treatment of textile waste water[84]. The seeds obtained from this plant are also used for biosorption of copper[90]. The plant is also used as a potential bio-sorbent for chromium uptake with its high biosorption capacity of the seeds[91]. The plant is adaptable for all soil conditions, this plant also adaptable to grow in sodic soil which was proved by the bacterial isolates from the soil where it is isolated[91].

8. Analytical Analysis

8.1 GC-MS

In GC-MS, helium gas Agilent-Gas chromatography was equipped with HP-innowax fused silica capillary column (30 mm × 0.25 mm, film thickness 025 μm)[29]. The GC-MS analysis were performed with a carloErba HRGC 5160 mega gas chromatography equipped with FID and a Hitachi 2000 integrator[15]. For the different types of basil Automated HS-SPME of basil, volatiles was performed using a CombiPal multipurpose sampler connected to a GC-ITMS system[92-94].

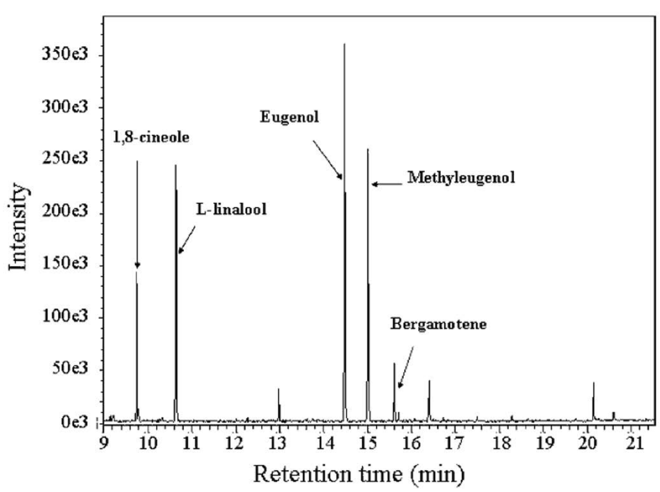

Figure 2. GC-MS image of Methyl *tert*-butyl ether extract of *O. basilicum* (50).

"Reprinted (adapted) with permission from Effect of Chitosan on the Biological Properties of Sweet Basil (*Ocimum basilicum L.*)[95]".

The GC-MS study (Figure 2) confirms the presence of terpenoids such as eugenol, methyl eugenol, 1, 8-cineole, L-linalool, bergamotene in the methyl *tert*-butyl ether extracts of *O. basilicum* at different retention time. It also reveals that the eugenol has the higher percentage (33%) in the composition when compared with others. Identification of these compounds was done by GC-MS equipment from Shimadzu, model no: GC-17A with a DB-5 capillary column (60mm-0.25 mm, thickness 0.25 *μ*m) and the detector used was GCMS-QP 5050 mass spectrometer[50].

8.2 SEM

A SEM study has examined the leaves at various stages of development which is dehydrated in the ethanolic series and the solvent-substituted liquid carbon-dioxide and sputter coated with gold. The material was examined using a Jeol JSM 35 SEM[96].

8.3 HPLC

The aqueous extract of basil has been separated to specific compounds with the help of HPLC[21]. The injector and detector parts of the HPLC are maintained at 523 K and 573 K respectively[97]. Rosmarinic acid and caffeic acid were quantified in all basil samples using a dual pump waters HPLC system[98]. The Identification of the essential oil compounds was based on the retention time[99]. It has been proved by the presence of peaks in various retention time at 280 nm. For the above analysis, Shimadzu LC-10 AS with diode array detector (Shimadzu, SPD-10A) and the reverse phase Spherisorb ODS II (RP18), analytical column (250 mm× 4.6 mm, particle size 5 μm) was used.

9. Pharmacological Activities

It is mostly used to treat anxiety, cold, fevers, migraines, diabetes, menstrual cramps, sinusitis, cardiovascular diseases, nerve pain, insect bites, and headache[99-101]. Moreover, it also acts as an anticonvulsant[96,25], anti-hyperlipidemic[102], anti-inflammatory[103], anti-oxidant[104-105], antiplatelet property[102], anti-thrombotic[17], anti-microbial[9-11], insecticidal[25], immunomodulatory[106] and cytotoxicity effect[107]. It also acts against neuro-degenerated disorders and digestive disorders. It is also used as cardiotonic and abdominal pain reliever[111]. Moreover, it also has an effect on the coccidial activity in the broiler chicks[112]. It also has spasmolytic, carminative, hepatoprotective, diuretic and stimulating properties that lead to the production of various drugs from *Ocimum* in pharma industries.

9.1 Antimicrobial

Numerous therapeutic plants have its own antimicrobial agents have gained popularity in recent years[26]. Due to the accidental and extensive practice of antibiotics for the action of infectious and communicable diseases, the pathogenic microorganisms remain developed into multiple disease resistance at recent years[108]. One of the finest methods toward to resolve this problem is to look for new therapeutic agents from plants which contain antimicrobial activities against the pathogenic microorganisms[109]. Extracts obtained from *Ocimum basilicum* has a rich source of flavor compounds and volatile oils which contain variety of compounds and these compounds possess antimicrobial activity[106,33]. The essential oil from *O. basilicum* is shown to have an inhibitory effect on *Aspergillus ochraceus*[110]. The hairy root cultures of *Ocimum basilicum* is used to achieve antimicrobial activity against bacteria and fungi by inhibiting z^{++} ion assays in contradiction of the organisms such as *P. aeruginosa strains* (PAO1) (PA14), *A, rhizogenes, P. fluroscens, X. campestris, E. carotovora, P. drechsleri, Phytopthora megasperma, Phytophthora parasitica, A. niger, Rhizoctoniasolani, F. oxysporum, P. aphanidermatum, P. ultimum, Versicillium dahailia, Alternaria solani* and *Alternaria brassicae*[111]. The leaf extract is prepared into a powder and soaked with 95% ethanol and kept free of oil obtained from this plant also shows antimicrobial activity by ethanoic extracts from its leaves which were observed against *E. coli* and *Staphylococcus aureus* with its inhibition level[26]. Anti-fungal activity of the *O. basilicum* is performed in 2045 fungal species which showed more effect on the *Aspergillus flavus* which is toxigenic in nature[112]. Basil oil also has been reported for its significant effect in *in vitro* studies[113].

9.2 Antioxidant

Ocimum basilicum contains several active antioxidant compounds[114]. The oil obtained from this plant also shows antioxidant properties to assist sperm parameters and enhance sperm quality in rats to increase spermatogenesis[26]. The antioxidant property is due to the polyphenoid rosmarinic acid which is a derivative of cinnamic acid[32].

9.3 Anti-Hyperlipidemic

The aqueous *O. basilicum* extract significantly lowered both plasma triglycerides (TG) and cholesterol in acute hyperlipidemia induced by Triton WR-1339 in rats[102].

9.4 Anticonvulsant

Hydro distillation of aqueous leaf extract of *Ocimum basilicum* has strong anticonvulsant activity majorly due to the eugenol present in it[25].

9.5 Anti-Inflammatory

Solvent extraction of methanolic extract of *Ocimum basilicum* aerial parts have potent anti-inflammatory activity against macrophage (RAW264.7), human chondrosarcoma (SW1353) cell lines and human primary chondrocytes[103].

9.6 Antiplatelet

The aqueous extract of *Ocimum basilicum* aerial parts was concentrated in a rotatory evaporator under vacuum at 65°C and studied against its antiplatelet activity using thrombint (0.5 U/ml) and ADP (5μM) as agonists. It inhibits ADP-induced platelet aggregation by 13%, 28.2%, 30.5%, 44.7% and 53% at a dose of 1, 2, 3, 4 and 5 g/l, respectively[102].

9.7 Anti-Thrombotic

Platelet aggregation induced by ADP (5 AM) and thrombin (4 UI), and thrombus weight in an arteriovenous thrombosis (AVT) model were tested after 2 weeks treatment with 15, 75 and 375 mg/kg OBL orally in rats, compared to 8.8 mg/ kg/day aspirin Thrombin-induced aggregation reached 33%, 22%, 21% for the aqueous extract of *O. basilicum*[17].

9.8 Insecticidal Activity

Usage of synthetic insecticides causes some significant consequences such as environmental pollution, pests or vector resistance and toxicity to other non-target creatures including human beings[107]. The vector mosquitoes are accomplished of communicating potential pathogens to human beings and them in charge for several infectious diseases like malaria, filariasis, Japanese encephalitis, yellow fever, dengue and chikungunya[115]. Moreover, the essential oil extract from the leaf *O. basilicum* was evaluated against *Culex tritaeniorhynchus, Aedesal bopictus* and *Anopheles subpictus* to predict the larvicidal activity[116]. It has its own significant effect against third stage larvae of *Culex tritaeniorhynchus, Aedes albopictus* and *Anopheles subpictus* with an LC_{50} and 9.75 ppm and LC_{90} values of 23.44, 21.17 and 18.56 ppm respectively[97].

9.9 Immunomodulatory

The extracts from the plant *Ocimum basilicum* indicates its immunomodulatory action taking place in the cellular level, including platelet anti-aggregant property and inhibitory activity to counter HIV-1 reverse transcriptase[106,33]. The mechanisms underlying the hypolipidemic properties of *Ocimum basilicum* and anti-atherogenic potential of this plant at the cellular level is mysterious[18].

9.10 Cytotoxicity Effect

The cytotoxicity effect of the active compounds (methyl cinnamate, linalool) of leaves extract of *O. basilicum* was performed by methyl thiazol tetrazolium (MTT) assay. In Table 3, the different concentration of extracts were affected the viability of human cancer cell line such as HeLa, HEp-2 and NIH 3T3 has been tabulated along with their IC_{50} value.

The HeLa and HEp-2 cells were grown in Eagles Minimum Essential Medium containing 10% foetal bovine serum (FBS) and NIH 3T3 fibroblasts were grown in Dulbecco's Modified Eagles Medium containing 10% FBS. For the screening experiment, the cells were seeded into 96-well plates in 100 mL of the respective medium containing 10% FBS, at plating density of 10,000 cells per well, and incubated at 37°C, 5% CO2, 95% air and 100% relative humidity for 24 h. The essential oil was solubilized in dimethylsulphoxide (DMSO) and diluted in respective medium containing 1% FBS. After 24 h, the medium was replaced with respective medium with 1% FBS containing the oil at various concentrations (12.5, 25, 50, 100, 200, and 300 mg/mL) and incubated at the previously set parameters[63-64]. Triplicate was maintained and the medium without the oil served as control. After 48 h, 10 mL of MTT (5 mg/ 1mL) in phosphate-buffered saline was added to each well and incubated at 37C for 4 h. The medium with MTT was then flicked off and the formed formazan crystals were solubilized in 100 mL of DMSO and absorbance was measured at 570 nm using microplate reader[107].

Table 3. IC_{50} value of different cancer cell lines

S. No	Cancer cell line type	Parts of the plant	IC_{50} (µg/mL)
1	HeLa[107]	Leaves	90.0
2	MCF-7[107,115]	Leaves	260.3–270.3
3	NIH 3T3 mouse embryonic fibroblasts[107]	Leaves	120.7
4	Ln-CaP[107,115]	Leaves	70.1–172
5	P388 KB[107,115]	Leaves	36.2
6	HEp-2[107]	Leaves	96.5
7	EAC[109,115]	Leaves	30.33

10. Diseases Affecting the *O. basilicum sp*

Although various medicinal properties has been exhibited by *O. basilicum*, it also been affected by some diseases like wilt, mold, spot and rot. Most diseases occurs in leaves and stem of basil plants due to the infection of fungi. However it can be eradicated by using proper natural fungicide to maintain its original medical nature. Some of the diseases affecting basil are shown in Table 4.

11. Companies Manufacturing *O. basilicum Products*

Basil products were commercially used all over the world for its nutritive purposes and medicinal values. Because of its multi dimensional use, many manufacturers produce basil products. Most of the basil products producing companies are located in Asian countries as shown in Table 5.

12. Adverse Effects and Caution

Quercetin (a flavonoid) may be a co-carcinogen in bracken fern (*Pteridium aquilinum*). It has been suggested that it may interact with bovine papilloma virus type 4, leading to malignant epithelial papillomas[122]. Caffeic acid and P-coumaric acid (phenolic acids) may inhibit digestion of plant cell walls in ruminants, because of their antimicrobial activity. When these phenolic acids are metabolized by rumen microbes, benzoic acid, 3-phenylpropionic acid and cinnamic acid may be formed. On further detoxification, hippuric acid is formed. 3-phenylpropionic acid and hippuric acid can decrease metabolic efficiency and also decreases productivity. Safrole, which was used to flavor sodas, was banned as a food additive in the US because it has the potential to cause cancer in rats[122]. Moreover, it should not be used during pregnancies.

Table 4. Diseases affecting *O. basilicum*

Sl. No	Disease Name	Parts of the Plant	Symptoms	Causing agents
1.	Fusarium wilt[118]	Leaves and stem	Yellow and wilting leaves, death of the plant	*Fusarium oxysporum f.*
2.	Gray mold[119]	Leaves and stem	leaves dying and dropping from plant	*Botrytis cinerea*
3.	black spot[120]	Leaves and stem	Black spots on leaves	*Colletotrichum gloeosporioides*
4.	Basal rot[121]	Leaves	Wilting of leaves	*Rhizoctonia solani*
5.	Cercospora leaf spot[118]	Leaves	Circular to irregular dark spots on leaves	*Cercospora ocimicola*
6.	Downy mildew[119]	Leaves	Yellowing leaves	*Peronospora belbahrii*
7.	Leaf spot[119]	Leaves	streaks on stems	*Pseudomonas spp*
8.	Root rot[119]	Stem	Failure of seeds to germinate	*Rhizoctonia solani*

13. Conclusion and Future Perspectives

This review majorly focused on the distinctive pharmacological activities of *O. basilicum* and the specific extraction procedures for the chemical constituents present in it. Basil possesses anticonvulsant, anti-hyperlipidemic, anti-inflammatory, anti-oxidant, antiplatelet property, anti-thrombotic, anti-microbial, insecticidal, immunomodulatory and cytotoxicity activities. Moreover, it also delivers those chemical constituents which is very helpful for the sustainable development of drugs for human consume. Furthermore, it also speaks about some of the manufacturers of basil products. On the converse, basil also has some adverse

Table 5. Companies manufacturing basil products

S.No	Company Name	Country	Products	Source
1.	Global Merchants	India	Basil oil.	www.global-merchants.in/
2.	Right Future International	India	Leaves for flavoring purpose.	www.rightfutureinternational.co.in/
3.	Frontier Natural Products Co-op.	US	Basil leaf for flavors.	www.frontiercoop.com/
4.	Haridass Aggarwal & sons	India	Leaves for flavoring.	www.indiamart.com/haridas-agarwal-sons/
5.	Natural Healthy concepts	India	Basil oils.	www.naturalhealthyconcepts.com/
6.	Zhongbei Northland Bio-chem industry Co.Ltd.	China	Basil oils for tonic purpose.	http://daxinganlinglily.en.china.cn/
7	Jkh exports	India	Leaves for aroma products.	www.jkhexports.com/
8.	Dujardin Foods Nv	Belgium	Basil oils.	www.dujardin-foods.com/
9.	Jdg seeds company	India	Basil seeds.	www.jdgseeds.com/
10.	Silver line Chemicals	India	Basil essential oils.	www.silverlinechemicals.com/

effects, so it should be consumed with proper prescribed medications. In the future, research may make a transgenic basil plant to eradicate the environmental stress of the plant and to address a specific chemical constituent to act against various human diseases. Here we imaged the rough and trough of basil, so it will be very helpful for the future researcher to work in different dimensions of basil to make new products. *O. basilicum* is the important product of nature so "we would use and should protect it".

14. Acknowledgement

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15. Conflict of Interest

There is no any conflict of interest among the authors.

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