

Review Article

Ethnobotanical and Pharmacological review of genus *Oenothera*

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ABSTRACT

Medicinal plants are the gift of nature to the human society. The present review is an effort to give a detail literature survey of genus *Oenothera*. They are known for their herbal medicinal uses in various disorders. Its leaves, flowers, and stems are used for the treatment of inflammation, kidney and liver problems, microbial infections, tumors, ulcers, and diabetes. These plants are source of different pharmaceutically active ingredients including triterpenoids, biflavonols, sterols, phenolic acid, alkaloids, saponins, tocopherols. This article is a collection of biological activities and traditional uses of several species of the *Oenothera* genus.

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INTRODUCTION

Herbal plants have been used from ancient times for their therapeutic value. They play a crucial part in human life as they are used widely in many fields like nutraceuticals, beverages, perfumery, cosmetics, pharmacology and in dyeing industries. Prior to the creation of synthetic medications, these herbal plants were used in order to treat various kinds of diseases. *Oenothera* is a genus belonging to the *Onagraceae* family, it is being one of the largest genera which includes 145 species of flowering plants. (Wagner, Hoch and Raven, 1985) This genus is commonly referred to as evening primrose and it occurs mainly in temperate America and in the tropics in the form of herbs that are annual, biennial or perennial with mostly narrow and alternate leaves. The whole plant is

used for medicinal purposes. *Oenothera* species are recognized for their fragrance and saucer-shaped red, pink, yellow and white flowers. (Dahiya, Kaur and Sharma, 2012) Traditionally the oil of this plant is used to provide hormonal balance, menopause symptoms, premenstrual syndrome (PMS), breast pain, rheumatoid arthritis, atopic dermatitis and systemic diseases. It can also help to clear up acne, ease bone pain, combat neuropathy and can help to induce labour during natural birth.

In Ayurveda literature *Oenothera* is mentioned for its pharmacological properties such as anti-oxidant, anti-diabetic, anti-inflammatory, nematocidal, anti-bacterial, anti-fungal, anti-viral, anti-diarrheic, anti-ulcerogenic,

anthelmintic etc. It is also used as famine food and animal feed.



Figure - *Oenothera biennis*

Scientific classification

Kingdom : Plantae
Order : Myrtales
Family : *Onagraceae*
Subfamily : *Onagroideae*
Tribe : *Onagreae*
Genus : *Oenothera*

Origin

The origin of *Oenothera* genus is in Mexico and in central America. Further it spreads to farther north in North America and into the South America. Now the species in this genus are found in most of the temperate regions throughout the world. There are about 70 species found in Europe alone.(Greiner and Köhl, 2014)

Cultivation and Collection

An estimated 3000 tonnes of evening primrose seed can be produced annually from wild sources, but since 1986, it has also been grown for both its seed and oil using a variety of methods. It grows on lower mountains, plains, and hilly areas at the height of 50-300 meters. It grows best on the fertile, damp soil and sunny field. It can also grow on slightly saline or alkaline soil. From 145 species of *Oenothera* about 8 species grow in China from which *O. biennis* is the dominant species, it is highly variable in terms of subspecies and races.(Hua, 2017)

Cultural Technique

The soil is prepared carefully and fertilized. The rows are prepared with the spacing of about 33 – 60 cm, the irrigation is done before sowing of the seeds. The seeds are soaked in water at 40⁰ to 50⁰C for 24-48 hours and then are covered with the soil about 0.4 – 0.5 cm deep, slightly pressed and irrigated again if required. The rate of sowing is about 3.0 and 9.5 kg ha¹. The average weight of thousand seeds is 0.373g and percentage of germination is 80 – 98%. During the growing season the

crops are weeded 2 to 4 times. The fields are irrigated if required. The plants are collected when 2/3rd of the capsules get ripe and thrashed. After thrashing the seeds are sun dried and stored.(Hua, 2017)

Life cycle

Evening primrose is sown between March to April. In some areas polyethylene sheeting is used to warm the soil and the seedlings are emerged after 6 to 15 days. Whereas in the areas with lower temperature conditions, the seeds are sown in the greenhouse, and then they are transplanted. The flowering period is from June to October, the capsules start ripping from the middle of the august till the first 10 days of the October and the plants mostly become rosettes if it is sown after May and it does not flower throughout the year. Its height varies from 1.0 to 1.5 meters but it reaches upto 1.75 meters. The reproductive cycle is about 180 to 200 days in Shandong, 150 days in Hebei and 125 days in Jilin.(Greiner and Köhl, 2014)

Persistence

The evening primrose has strong resistance to insects, pests, diseases and drought. It forms a shape of lotus throne by autumn which helps it to survive in the winter even if the temperature falls to -22⁰C. Sometimes the insect pests emerges, such as *Acheronits lachesis* etc.(Hua, 2017)

Phytochemicals

There are highly vast and diversified group of phytoconstituents present in genus *Oenothera*. It includes some esters, fatty acids, tannins, quinones, triterpenoids, flavonoids, biflavonols, alcohols, fatty alcohols, alkaloids, tocopherol, carboxylic acid, phenolic acid, lactones, sterols, chalcone, anthocyanins and saponins.(Lorenz and Stermitz, 2000)

Traditional uses

Sr. no.	Botanical name	Traditional uses
1	<i>O. biennis.</i>	In treatment of Eczema, Asthma, Rheumatoid arthritis.(Srivastava, Kumar and Plants, 1999)
2	<i>O. albicaulis.</i>	In treatment of Impotence, Fatigue, Menopausal problems.(Wagner, Hoch and Raven, 1985)
3	<i>O. lamarckiana.</i>	In treatment of Premenstrual syndrome, Endometriosis, Multi-sclerosis.(Yoon <i>et al.</i> , 2009)
4	<i>O. paradoxa</i>	In treatment of

		Inflammations, renal, liver and tumour issues.(Amburger, 2004)
5	<i>O.speciosa</i>	In treatment of Wounds, Bruises, skin eruptions.(Yoon <i>et al.</i> , 2009)
6	<i>O. laciniata</i>	Used as skin protective agent, antioxidant, anti-melanogenic.(Tannin and From, 1995)
7	<i>O. hoelscheri</i>	Used to reduce pain severity and improve mobility. It also helps with symptoms like morning stiffness.(Iura <i>et al.</i> , 2007)
8	<i>O. cheiranthifolia</i>	In treatment of microbial infections, ulcers and Blood pressure.(Neumann and Schwemmler, 1993)
9	<i>O. odorata</i>	In treatment of inflammation, as anti-tumor.
10	<i>O. rosea</i>	In treatment of microbial infection, ulcers, liver and renal issues.(Don <i>et al.</i> , 2015)
11	<i>O. tetraptera</i>	In treatment of tumors, diabetes. Used as antibiotic. (Zinsmeister and Bartl, 1971)
12	<i>O. gigas</i>	Anti-aging, dietary-supplement. In treatment of digestive problems.('No Title', 2000)
13	<i>O. berteriana</i>	In treatment of Asthma, diarrhea. To lower blood pressure and lower cholesterol.(Neumann and Schwemmler, 1993)
14	<i>O. hookeri</i>	In treatment of colds, neurogenerative disorders and muscle pain.(Zinsmeister and Bartl, 1971)
15	<i>O. brachycarpa</i>	In the management of Wounds, Bruises, skin eruptions.(Averett, Wagnert and Huang, 1991)

Pharmacological activities.

1. Antioxidant activity.

Human diseases can be prevented in large part by antioxidants. Natural radical scavengers are abundant in medicinal plants, and it is thought that these properties are what primarily contribute to many medicinal plants' therapeutic benefits.

Oenothera's ability to act as an antioxidant has been known since the mid-1990s. The most significant medicinal plant is *Oenothera biennis* L., one of its members. As the substrate, lard was used. its antioxidant activity was initially described in 1995. On the basis of calculating the sample's peroxide number, antioxidant strength was evaluated. *O. biennis* L. ethanolic extract was found to possess potent antioxidant properties.(Budinčević *et al.*, 1995)(Shahidi *et al.*, 1997)

2. Anti-diabetic activity.

Diabetes mellitus is spreading quickly and is now posing a severe threat to human health on a global scale. There are several medications that can control diabetes, but none are ideal. No reported cure has yet been found. The natural remedies are believed to enhance existing methods in order to better treat diabetes the physical body's resistance.

An investigation into the ability of an ethanolic extract from the defatted *Oenothera biennis* L. seeds to prevent the rise in blood sugar levels was done on rats in 2003.

It was discovered that the extract was crucial to the suppression of hyperglycemia postprandial. (Li *et al.*, 2004)

An examination of the *Oenothera erythrosepala* Borb's antidiabetic ability was also carried out the next year. According to reports, the dosage of Oil from *Oenothera erythrosepala* Borb, 15 g/100 mL, can reduce experimental mice' fasting blood sugar levels.(Meckes *et al.*, 2004)

3. Anti-inflammatory activity.

Patients with inflammatory disorders typically employ complementary and alternative therapies, notably herbal therapy. In 2004, methanolic acid's anti-inflammatory *Oenothera rosea* (*O. rosea*) extract was found to be initially discovered to be effective using rat paw edoema model caused by carrageenan. It was discovered that 70 percent of the *O. rosea* plant extract generated a significant edoema reduction.(Márquez *et al.*, 2009) The aerial components (leaves and other *O. speciosa* Nutt stems) were also reported to have powerful anti-inflammatory properties in a dose-dependent way.(Andrade-Cetto, 2009)

Additionally, *O. laciniata* was said to have significant pharmacological properties.

The anti-inflammatory activity of the *O. laciniata* extract was assessed using the dichloromethane fraction. The extract Efficaciously reduced lipopolysaccharide-induced PGE(2), NO, and the production of proinflammatory cytokines in cells RAW264.7. (Yoon *et al.*, 2009)

4. **Anti-tumor and Anti-cancer activity.**

In recent years, interest in employing herbal medicines for cancer prevention and therapy has grown. Oil of evening primrose was originally mentioned in a report in 1999. Reports stated that this oil may be useful in mammary gland tumor therapy. (Muñoz *et al.*, 1999) Several years later, a test was conducted on female mice that received a S.C injection of 5×10^6 syngeneic Sp6 cells that cause solid tumour growth Within 7–10 days in them. Tumor volume was kept in track everyday. After that, they were given an evening primrose oil diet. Then it was discovered that the *O. biennis* defatted seeds possess anti-tumor potential, and their behaviour seems to be selective for bone marrow-depression. (Dalla Pellegrina *et al.*, 2005)

In order to determine how the preparation of flavanol of *O. paradoxa* affected the growth and human prostate cancer cell (DU 145) are also invasive and immortalised prostate, tissue-lining cells. For the first time, it was revealed that the flavanol *O. paradoxa* preparation decreases DU 145 cell proliferation both invasiveness (by $IC_{50} = 97$ mM GAE during incubation for 72 h) and 24% in comparison to control at 75 mM GAE). It severely restrained invasiveness of immortalised prostate epithelial cells in a a way dependent on concentration (Lewandowska *et al.*, 2013)

5. **Treatment of kidney disorders.**

To investigate the biological properties of the therapeutic plants utilised in Zamora-Chinchi and Loja, Ecuador, an ethnobotanical survey was done in 2009. After receiving views from various sources, it was reported that *Oenothera* sp. and *O. rosea* fresh leaf aqueous extracts was said to cure renal disorders. (Cronin and Draelos, 2010)

6. **Nematicidal activity.**

Among the most well-known plant pathogens worldwide is plant-parasitic nematodes. Aqueously extracted *Oenothera affinis* was evaluated in opposition to *Xiphinema americanum* for nematicidal in 2001. The research revealed that after 24 hours, the plant extract renders nematodes immobile. (Insunza, Aballay and Macaya, 2001)

7. **Immune response activity.**

In the advanced world, herbal medications are highly sought after because they provide treatments for age-related problems including memory loss, immunological disorders, etc. without having any side effects. It was reported in 2014 that *O. paradoxa* ethanolic extract demonstrates dual influence of stimulus-dependent effect on a human's respiratory burst leukocytes. (Burzynska-Pedziwiatr *et al.*, 2014)

8. **Anti-bacterial activity.**

Each year, bacterial infections cause a wide number of fatalities. Therefore, we must immediately update our stock of anti-infective drugs. The substances obtained from plants having antibacterial qualities are drawing more and more attention.

In 2009, *O. biennis* L. seed extract in methanol was used, it demonstrated strong antibacterial action against four pathogens i.e., *Pseudomonas aeruginosa*, *Candida albicans*, and *Staphylococcus aureus* and *Staphylo-Escherichia coli*.

A short while later, it was discovered that methanolic and aqueously extracted *O. rosea* have antimicrobial effects and was also useful in adjuvant therapy of various illnesses brought on by enterobacteria. (Gomez-Flores, 2012)

9. **Anti-neuropathic activity.**

It is well known that breast survivors of breast cancer who take adjuvant chemotherapy may experience late side effects from the treatment, such as neuropathy, osteoporosis, early menopausal and congestive heart failure.

One study conducted in 2003 revealed that there is a very crucial role of *O. biennis* for chemotherapy induced neuropathy.

The patients ingesting *O. biennis*, which is high in γ -linolenic acid and linoleic acids shows nerve function improvements measurement and symptoms. (E. and A., 2003)

10. **Hypocholesterolemic activity.**

Six dietary oils have hypocholesterolemic effects on rats fed cholesterol, it was conducted in the late 1990s. This study showed that oil of *O. biennis* Linn prevents the serum total cholesterol from rising, and very low density lipoproteins, low density lipoproteins cholesterol concentrations in the presence of cholesterol excess in the diet with prolonged feeding. (Fukushima *et al.*, 1997) (Bałasińska, 1998)

11. **Thrombolytic activity.**

Many therapeutic compounds found in medicinal plants have antithrombotic, antimicrobial, and other properties. According to a report from the year 1998, taking *O. biennis* increases the endothelium's antithrombotic capacity, decreases in sub-endothelial thrombogenicity and lesions on the vascular wall brought on by a hyperlipemic diet. (Hamburger *et al.*, 2002)

12. **Cariostatic activity.**

Dental cavity is still among the most prevalent issues with oral health. Oral illnesses have

traditionally been treated using herbal products. In a test, the inhibitory effects of *Oenothera biennis* seed extract on dental caries developed by *Streptococcus mutans* in rats were identified. Then it was announced that *Oenothera biennis* seed extract has powerful dental decay-preventing effects. (Matsumoto-Nakano *et al.*, 2011)

13. Anti-ulcerogenic effect.

In order to cure stomach ulcers, there are numerous products in the market. among the most amazing sources of novel medications are plant extracts, which have been demonstrated to offer promising outcomes to treat gastric ulcers. There was research done on where rats were used to test evening primrose oil's anti-ulcerative properties. It was demonstrated that *O. biennis* shows significant anti-ulcer effect and effects of cytoprotection on a variety of experimentally induced gastric lesions. (Arabia, 1997)

14. Anthelmintic activity.

Many parasitic illnesses are treated extensively with medicinal plants, which constitute a plentiful supply of herbal anthelmintics. The *Oenothera* genus anthelmintic activity with *O. rosea* was first reported in 2012. Research revealed that the ethanolic and aqueous extract of stem and roots shows anthelmintic action that is dosage dependent. It was also discovered that the stems alcoholic extract demonstrated the substantial increase in anthelmintic activity compared to ethanolic root extract as well as ethanolic extract of stem and root is more effective than aqueous extracts. (Dahiya, Kaur and Sharma, 2012)

15. Curing hepatic disorders.

Both the aqueous extract of the fresh leaves of *Oenothera rosea* and the full fresh plant of *Oenothera pubescens* Willd were discovered to have the ability to reduce hepatic discomfort. (Kim, Lee and Kim, 2017)

16. Anti-fungal activity.

Due to an increasing level of resistance to currently available antifungal medications, New antifungal drugs are highly desired. During a 1999 study, it was discovered that *O. biennis*'s roots are helpful in antifungal activity against *Fusarium semitectum*, *Alternaria* and *Fusarium fusiformis* alternately presenting most effective against *Fusarium semitectum*. (Srivastava, Kumar and Plants, 1999)

17. Anti-diarrheic activity.

A primary investigation was done into the antidiarrheal properties of various Mexican species,

including *O. rosea*. It was found that *O. rosea* has far more pronounced diarrheal inhibition than other plants species employed in the research. (Vargas S. *et al.*, 1998)

18. Anti-viral activity.

The need for novel substances with antiviral capabilities has grown significantly in the modern period because the antiviral medications currently in the market have shown to be ineffective for treating viral infections. This is because of the persistent resistance of viral infections in immunosuppressed patients. Now therapeutic herbs with major pharmaceutical actions are employed in this purpose.

A United States copyright was granted in the year 1995. To a mixture of antiviral drugs that includes an aqueous extract of *O. caespitose*. This extract's chemical make-up is particularly effective in treating modern herpes simplex lesions and encourages the healing of herpes-related lesions caused by three viruses i.e., the herpes simplex virus, Epstein-Barr virus, and varicella viruses. Additionally, composition may lessen the recurrence of herpes simplex lesions. (Insunza, Aballay and Macaya, 2001)

19. Treatment of cardiac disorders.

In 2012 research examined the effects of an aqueous extract of *O. paradoxa* on neutrophils from healthy people and those who had recently experienced acute myocardial infarction on the formation of reactive oxygen species in vitro and the inhibition of neutral endopeptidase activity. The results showed that a dosage of *O. paradoxa* extract at 20, 50, and 100 mg/mL concentrations caused a significant decrease in neutral endopeptidase activity in both groups. It was the proposed that this extract is an appealing candidate for supplements and in preventing cardiovascular illnesses. (Kiss *et al.*, 2012)

20. Vasorelaxation activity.

Vascular flexibility and responsiveness are negatively impacted by ageing. Several research indicate that bioactive substances can enhance vascular functioning. An experiment was done on rats to investigate the impact of *Oenothera odorata* ethanol extract on vascular relaxant activity. Rats were cervical dislocated to death. The carotid artery from rats was dissected from surrounding connective tissues and fat, and was instantly put in a ice-cold Krebs-Ringer solution and (118 mM NaCl, 1.1 mM MgCl₂, 1.2 mM KH₂PO₄, 1.5 mM, 4.7 mM KCl 1.2 pH 7.4 mixture of CaCl₂, 25 mM NaHCO₃, and 10 mM glucose) and aerated with 95% O₂ and 5% CO₂. The effect of the K⁺ channel

inhibitors of *O. odorata* induced vasorelaxation was tested. It was discovered that ESOO causes vasorelaxation via activating K⁺ channels, namely K⁺ ATP channels. (Kim *et al.*, 2011)

21. Conclusion.

Oenothera plants are now recognised as a reliable source of medications for the treatment of immunological disorders, kidney issues, neurodegenerative illnesses, and diarrhoea. The basic extracts of these plants have shown a variety of Pharmacological actions in vivo and in vitro, including anti-microbial, anti-oxidant, and anti-inflammatory.

There have been many different phytoconstituents isolated. and identified from various Oenothera species. Triterpenoids, flavonoids, and phenolic acids are found in these species the most frequently. Additional components include alcohols, sterols, saponins, alkaloids, esters, and more. A special substance is methyl ester of valoneic acid dilactone is unique constituents of this genus.

In terms of pharmacological research and phytoconstituents *O. biennis* the species under study the most. There are additional species with significant medicinal importance. The review article offers research scholars information for further discovery of this genus to cure numerous diseases.

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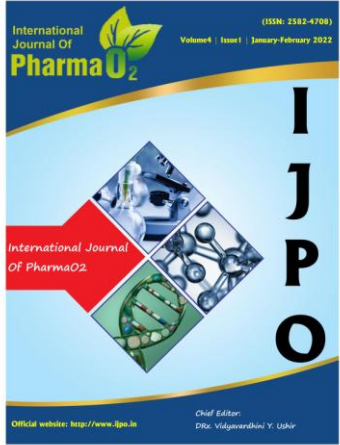
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