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A Comprehensive Review of The Therapeutic Potential of *Elaeocarpus Ganitrus*

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Abstract

Elaeocarpus ganitrus, also known as Rudraksha, is a member of the Elaeocarpaceae family and has a long history of antidepressant and antibacterial benefits against various illnesses. Elaeocarpus ganitrus has been used in Unani and Ayurveda medicine as an antidepressant, an antibiotic, and as an external treatment for mental disease, epilepsy, liver discomfort, and stomach pain. In addition, it is used to treat a variety of other conditions, including hepatic diseases, dyspepsia, skin infections, blood purification, asthma, tumors, and wounds. Their biological effects include their antioxidant, anti-inflammatory, neuroprotective, anticancer, hepatoprotective, immunomodulatory, antifertility, antibacterial, and antidepressant properties. To further explore the trends and perspectives for future research, a thorough discussion of Elaeocarpus ganitrus' taxonomic classification, traditional uses, botanical description, phytochemical components, pharmacology, and safety aspects is required.

Keywords: *Anticancer, Cucurbitacins, Elaeocarpus ganitrus, Antioxidant, Immunomodulatory, Quercetin, Molecular docking.*

1. Introduction

In addition to being mentioned in the systems of medicine like Ayurveda, Siddha, Unani, and homeopathy, about 6000–7000 of these species play a significant part in folk medicine. The scientific name for Rudraksha is *Elaeocarpus ganitrus*, a tall evergreen tree with enormous leaves that grows in tropical and subtropical countries at elevations between the seashore and 2,000 meters above sea level. Elaeocarpus is a genus of tropical and subtropical evergreen trees and shrubs that belongs to the Elaeocarpaceae family. It is beneficial for epileptic fits, manic states, and mental illnesses, and is utilized in Ayurveda as a febrifuge, liver tonic, cerebral sedative, and expectorant. Elaeocarpaceae is often known as the Rudraksha family. Its maturing seeded fruits have a hard, stony endocarp known as a bead or nut. It was discovered that the epicarp, endocarp, and bark extracts were extremely rich in alkaloids, quinone, coumarins, and tannins. The endocarp sample had the highest concentration of proteins. *E. ganitrus* beads contain quercetin as a glycoside. Using antianxiety activity-guided fractionation, an anxiolytic component called quercetin was extracted from an ethanol extract of *E. ganitrus* beads. Rudraksha beads are dielectric because they retain electrical energy. Blood pressure, stress, anxiety, depression, palpitations, and lack of concentration can all be improved by wearing rudrakshas, which also regulate heartbeat. This review primarily focuses on *Elaeocarpus ganitrus'* distribution, cultivation, phytochemistry, traditional and medicinal characteristics, and safety considerations, including its pharmacological activities. The review will go on to examine the most recent developments in *Elaeocarpus ganitrus*, including the use of nanocarriers to improve *Elaeocarpus ganitrus* bioavailability and eliminate all drug delivery issues. **[1]**

Botanical classification:

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Oxalidales
Family: Elaeocarpaceae
Genus: Elaeocarpus

Species: E. ganitrus/ Sphaericus
Binomial name: *Elaeocarpus ganitrus (Roxb.)*
Common name: Rudraksha

Biological distribution: India, Indonesia, and Nepal are the three countries from which commercial Rudraksha is sourced. The origins of 75% of the Rudraksha sold on the international market are Indonesian, 20% are Indian, and 5% are from Nepal. Since they grow in a more powerful environment, Nepalese Rudraksha are hard, compact, weighty, and shiny. As a result, they are more expensive. To raise their market pricing, these beads are given an oil and dye treatment. *Elaeocarpus sphaericus*, sometimes known as the Rudraksha Tree, leaves, and dried fruit (bead) are just a few examples. The woody texture of the dirty white, yellow, brownish-black, or reddish-brown *E. sphaericus* seeds is rough. The Endocarp is globular, stony, hard, and heavily tubercule. **[2]**

Cultivation: Elaeocarpus has 51 species, seven species of Macrocera, two species of Ganitrus, and one species of Craspendum. Due to the beads' slow movement, Rudraksha cultivation is a challenging procedure. For a genuine to sprout, it typically takes 1-2 years, depending on the soil's humidity. With temperature ranges of 25-300°C, it may be cultivated well in tropical and subtropical environments. After planting, it takes plants roughly five years to produce flowers. It blooms in the summer, perhaps in May and June, in its natural habitat. The fruits ripen between November and December.

The main product of constituents appears:

According to reports, the fruit contains a variety of phytoconstituents, including alkaloids, steroids, terpenoids, tannins, flavonoids, carbohydrates, and cardiac glycosides have been used for various purposes, including as antioxidants, antibacterial, antifungal, analgesic, and anti-inflammatory, CNS activities, typical behavioral action, sedative, tranquilizing, hypnosis potentiation, hydrocholeretic, antidiabetic, cardiostimulation, antihypertensive, and anticonvulsant. Gallic acid and ellagic acid, two substances that may be used as anti-cancer medicines, are produced by E. ganitrus. In the *E. ganitrus* fruit, elaeocarpidine, elaeocarpine, rudrakine, quercetin, palmitic acid, isopalmitic acid, and linoleic acid have all been detected through phytochemical analysis. **[3]**

Traditional and Medicinal Properties of *Elaeocarpus ganitrus*:

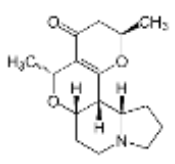
Traditional Properties:

- Different traditional applications are displayed by an *Elaeocarpus sphaericus* fruit that is unripe and ripped.
- *Elaeocarpus sphaericus* and black pepper should be ground into a powder and administered with water to treat smallpox.
- Additionally effective in treating mental illnesses is *Elaeocarpus sphaericus*.
- *Elaeocarpus sphaericus* also has anti-aging properties.

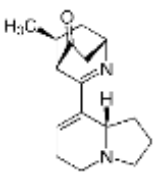
Ayurvedic Properties of Rudraksha:

- Rudraksha's beads, bark, and leaves are all used to treat a variety of illnesses, including skin conditions, headaches, fevers, and mental disorders.
- Rudraksha should be used to heal blood impurities and increase body substance strength.
- Rudraksha fruit or bark pulp can be used to manage epilepsy.
- High blood pressure, cardiac problems, and other conditions can be treated with Rudraksha.

Phytochemicals' chemical structures are shown: [4]



Grandisine A



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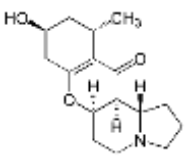

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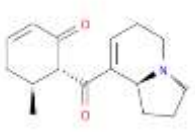
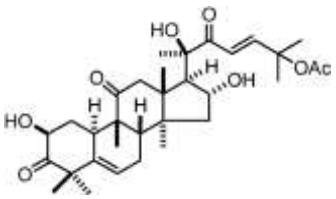
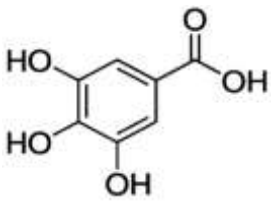


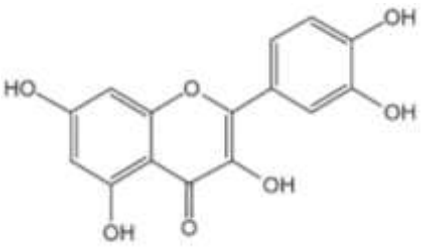
Grandisine D



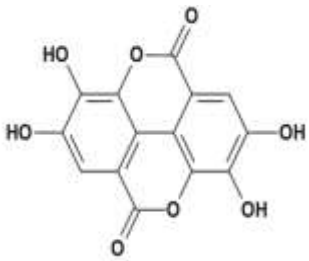
Cucurbitacin B



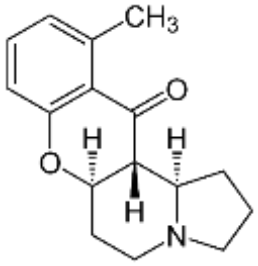
Gallic acid



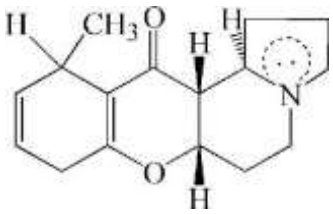
Quercetin



Ellagic acid



Elaeocarpine



Isoelaeocarpine

Pharmacological Properties of *Elaeocarpus ganitrus*:

Antioxidant activity: Traditional methods are employed to study the antioxidant activity of herbs about on their total phenolic content. *Elaeocarpus ganitrus* leaf extracts were examined for their level of total antioxidant activity, reducing power, metal chelating, ABTS+ (2, 2-azinobis-(3-ethylbenzothiazoline-6-sulphonate) radical scavenging, and hydroxyl radical scavenging activities. The Highest ion chelating activity was demonstrated by the extract at 500 g/ml (76.70%), which was followed by the highest ABTS+ radical scavenging activity (55.77%) at the same concentration. At a concentration of 500 g/ml of extract, a total antioxidant capacity of 24.18 mg ascorbic acid equivalents was discovered. According to the findings, the leaves' phenolics and flavonoids exhibit significant antioxidant activity. **[5]**

Wound healing activity: When rats with excision wounds were topically administered an ointment base containing an ethanolic extract of *Elaeocarpus ganitrus*, the rate of wound healing was statistically significantly accelerated ($P< 0.001$) and the time it took for epithelization to occur was shortened. Applying leaf extract from *Elaeocarpus ganitrus* topically reduced the epithelization period from 28 days in the control group to 16 days. According to tests on animals, leaf ethanolic extract can heal wounds and drastically reduce their width. As a result, we conclude developing an ointment from *Elaeocarpus ganitrus* leaf extract will be effective for commercializing wound-healing drugs. **[6]**

Tuberculosis activity: The following Rudraksha mixture was prescribed by ancient physicians even though we now have superior tuberculosis treatments. Patients with tuberculosis were administered this remedy. Now, in cases of multi-drug-resistant tuberculosis, it can be administered as supportive therapy in combination with Swarna Bhasma and Vasant Malti Rasa. The maximum dosage of vamshalochan needs to be added for strength and protection of the lungs.

Anti-bacterial activity: It is well known that medicinal plants contain specific bioactive chemicals that interact with environmental organisms to prevent bacterial or fungal growth and defend the body against diseases. *Elaeocarpus ganitrus* dried fruit extracts were tested for antifungal activity on various fungal strains using petroleum ether, chloroform, ethanol, and water. *Bacillus subtilis, Staphylococcus aureus* (Gramme-positive), *Klebsiella pneumonia, Escherichia coli, Salmonella typhi, Proteus vulgaris*, and *Pseudomonas aeruginosa* (Gram-negative) were all significantly inhibited by the extract of *E. ganitrus* seed, but it had little of an inhibitory effect on the fungi *Aspergillus niger*. The *Staphylococcus epidermidis* bacteria were effectively inhibited by the methanol extract of ganitri leaves at a concentration of 100% with an inhibition zone diameter of 11 mm. *Elaeocarpus ganitrus Roxb.'s* leaf methanol extract did not significantly differ from the positive control or the negative control with $p <0.05$. The concentration series of the ethanol and methanol extracts did not, however, significantly differ with a $p< 0.05$. **[8]**

Anti-diabetic activity: The diabetic rats responded significantly to the doses of 40 mg/kg and 75 mg/kg. Positive outcome while methanolic extract exhibited a significant effect 5 hours after dose, glibenclamide had a substantial effect 3 hours after administration. In diabetic rats, twice daily injections of the extract for three days reduced blood and urine glucose levels. When compared to insulin's 27% blood glucose-lowering effect, the extract's blood glucose-lowering effects at 40 mg/kg

and 75 mg/kg were considerably (P<0.05) decreased by 60% (P<0.001) and 42.8%, respectively. Streptozotocin selectively kills pancreatic insulin-secreting beta cells, leaving behind less active cells and causing a diabetic condition. **[9]**

Anti-fungal activity: Some endophytic fungus species have been shown to contain substances that are immunosuppressive, anticancer, diabetic, and insecticidal. Two of the most significant fungi that cause disease, *Candida albicans* and *Candida glabrata*, were examined using a methanol extract of *Elaeocarpus sphaericus* leaves. The Minimum Inhibitory Concentrations (MIC) for various strains of fungi, such as *Candida albicans*, *Candida tropicalis*, and *Aspergillus niger*, varied when dried Rudraksha beads were extracted using petroleum ether, chloroform, ethanol, and water. The MIC for *C. albicans* was determined to be 1.5 mg/ml for CE and 4.0 mg/ml for EE. When CE was tested for *C. tropicalis*, the MIC was 5.0 mg/ml. The sensitivity of C. tropicalis to WE and EE was nonexistent. For *A. niger*, the MIC of CE and EE was 3.0 mg/ml, followed by WE (MIC: 5.0 mg/ml), whereas *C. glabrata* and *G. candidum* did not exhibit any inhibition even at higher concentrations. **[10]**

Anti-hypersensitivity activity: Given intravenously to hypertensive rats at doses of 25, 50, and 100 mg/kg was an aqueous extract of *E. ganitrus* seeds. It demonstrates a dose-dependent reduction in the increased blood pressure that is significant (p<0.05). The rennin-angiotensin system may have a role in the antihypertensive properties of the aqueous extract of *E. ganitrus*. Significant antihypertensive efficacy was observed in an animal model of renal adrenaline- and nicotine-induced hypertension using an aqueous extract of Rudraksha Churna (RC). Parkinson's disease and depression are also successfully treated with RC. As a result of its impact on the renin-angiotensin system, an aqueous extract of *E. ganitru* also demonstrated antihypertensive efficacy. According to a different study, administering an ethanol extract of *E. ganitrus* to anesthetized cats reduced their normal blood pressure significantly and entirely resolved adrenaline-induced hypertension. **[11]**

Anti-cancer activity: Rudraksha bark phytochemical investigation revealed the presence of ellagic acid and cucurbitacin, both of which have demonstrated cytotoxicity against cancer cells. On human malignant cell lines and animal models, various extracts of *Elaeocarpus ganitrus* leaves, bark, and fruits have been studied. According to the Insilico investigations, cucurbitacins and ellagic acid have the potential to be effective anticancer medication candidates. Cucurbitacins and ellagic acid inhibited nitric oxide synthase (NOS2), Kirsten rat sarcoma viral oncogene homolog (KRAS), tumor protein p53 (TP53), and mut L homolog 1 more effectively in this study than did NOS2, mut S homolog 2 (MSH2), and RAC serine/threonine-protein kinase (AKT2). *Elaeocarpus ganitrus* seed extract serves as the reaction's capping and reducing agent by converting chloroauric acid (HAuCl4) to gold nanoparticles (Au NPs). The synthesized substance was then tested for antibacterial, antioxidant, and anticancer properties against the Human Prostate Cancer (PC-3) cell line after being characterized using XRD and TEM analyses. Against the PC-3 cell line, the anticancer activity was measured in terms of cell viability. The MTT assay was used to calculate how much of an impact the concentration of Au NPs (20–100 mg/mL) had on the PC-3 cell line's viability. In PC-3 cells, the proportion of cell death gradually increased as the quantity of Au NPs increased, as seen in PC-3 cells subjected to Au NP exposures at various doses of 20, 40, 60, 80, and 100 mg/mL. The results gained demonstrate definitely that the cancer cells are significantly under the control of the Au NPs at a moderate concentration. The percentage of viable cells decreased as the concentration of Au NPs used to treat the PC-3 cell line increased**. [12]**

Analgesic and Anti-inflammatory activity: The test animals were separated into 5 treatment groups, including a negative control group that received CMC-Na, a positive control group that received mefenamic acid, and an extract group that received extract at doses of 100 mg/Kg BW, 200 mg/Kg BW, and 400 mg/Kg BW. The pain inducer given is 1% acetic acid. Observations were made by examining the stretching of the mice, which is a pain response that is characterized by stretching in the form of mice drawing their legs back and clamping their abdomens to the bottom of the cage. The outcomes demonstrated that the ganitri (*Elaeocarpus ganitrus*) leaf aquadest extract exhibited analgesic effects on mice and had a significant effect (p<0.05) on animals produced by acetic acid. The best analgesic effect on mice was provided by a dose of 400 mg/Kg BW of ganitri (*Elaeocarpus ganitrus*) leaf extract, which was significant with a p<0.05. The dosage of the methanolic and aqueous extract of *E. sphaericus* leaves used for its inhibitory impact on carrageenan-induced inflammation is 200 mg/kg. It took place as a result of cyclooxygenase inhibition, which prevented prostaglandin formation. At three hours, prostaglandin causes the second phase of the inflammatory reaction to emerge. As a positive control, sodium diclofenac (5 mg/kg) was used. **[13]**

Anti-asthmatic: To learn more about how *E. sphaericus* fruits affect autacoid release, the current investigation was conducted on rat mesenteric mast cells. The effectiveness of *E. sphaericus* against

bronchial asthma was confirmed by the discovery that the petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE), and ethanol (EE) extracts of the fruit of *E. sphaericus* have mast-cell stabilizing activity. Additionally, *E.sphaericus* prevents guinea pig bronchospasms caused by histamine and cholinergic aerosols. **[14]**

Anti-depressant activity: The study's objective is to assess how the alcohol extract of Elaeocarpus fruits affects the levels of dopamine and serotonin, two chemicals that are often used as antidepressants. Dopamine was given that name since it was a monoamine, and 3, 4-dihydroxyphenylalanine (L-DOPA) was its synthetic precursor. Brahmi was employed as a test medicine along with imipramine (10 mg/kg), fluoxetine (30 mg/kg), and other common medications. [67] Mice were given various extract doses (20, 40, 60, and 80 mg/kg). Low doses (20, 40, and 60mg/kg) were able to simultaneously decrease immobility and increase active behaviors, such as climbing. However, immobility and climbing were less affected by the high dose (80mg/kg). **[15]**

Immuno-modulatory activity: According to the pathological experiment mentioned above, Group-2 Rudraksha bead wearers are healthier than Group-1 Rudraksha bead non-users. The blood CBC and urine pathological reports from Group 2 people confirm that rudraksha beads have unquestionably some beneficial effects on human body metabolism, whether through favorable electromagnetic properties, piezoelectric effects, or acupressure, which still require additional scientific study. This pathological experiment shows that the electromagnetic Rudraksha bead has certain anti-aging and immune-modulating effects on the human body. **[16]**

4. Conclusion

More clinical studies need to be done to support the medicinal use of Elaeocarpus species, although they have been used successfully in Ayurvedic medicine for centuries. It's also critical to understand that Elaeocarpus species may work not just when taken alone but also when combined with other medicines or medications, potentially potentiating their effects. The Rudraksha plant has historically been used to treat conditions such as anxiety, stress, depression, palpitations, asthma, hypertension, epilepsy, nerve pain, arthritis, migraines, and liver problems. The Rudraksha plant is used in Ayurveda to treat a variety of conditions, including high blood pressure, mental illness, neurological issues, asthma, diabetes, reproduction disorders, burning disorders, fever, and hypertension. Anti-aging qualities are also present in it. From the published studies, it is evident that the Rudraksha plant contains a variety of extracts or phytochemical components that have significant pharmacological significance and possess anticancer, antidiabetic, antidepressant, anti-asthmatic, anti-inflammatory, analgesic, hypertensive, antifungal, antioxidant, and antibacterial properties.

Future Direction: It has been passed down from generation to generation to practice plant collection and use plants as medicines. There is a significant medicinal value gap between plants gathered from various sources. In India, the domestic narcotics industry has grown more recently. In turn, this has greatly raised the demand for therapeutic plants. Since there are over 500,000 plants in the globe and the majority have not yet been studied for their potential medical benefits, the future of medicinal plants looks bright. This means that treatments for current and future research may be influenced by these plants' hidden potential for medical benefits. The Rudraksha plant is currently regarded as the most precious and significant herbal plant. Along with the growing population, the demand for the Rudraksha plant and its derivatives is also rising. Rudraksha plant items are now being artificially manufactured to meet consumer demand, which is good for business. Today, to meet consumer demand and increase profits, rare faceted Rudraksha beads like Ekk mukhi (one-faced) beads are intentionally produced.

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