

Rudraksha (*Elaeocarpus ganitrus* Roxb) From Divine Miracles to Pharmaceutical Innovations for Medicinal Properties

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Abstract

Elaeocarpus Ganitrus Roxb, commonly known as Rudraksha, holds a significant place in traditional medicine systems due to its purported medicinal properties. This review aims to comprehensively examine the pharmacological aspects of Rudraksha and explore its potential for pharmaceutical innovation. The study encompasses an in-depth analysis of the existing literature to compile and synthesize information on the various pharmacological activities associated with Rudraksha, including antioxidant, anti-inflammatory, analgesic, antimicrobial, and neuroprotective properties. The review highlights the diverse chemical constituents present in Rudraksha, emphasizing the bioactive compounds responsible for its therapeutic effects. Additionally, the paper delves into the traditional uses of Rudraksha in Ayurveda and other indigenous healing practices, providing a historical context for its medicinal significance. Furthermore, the potential synergistic interactions among Rudraksha compounds and their mechanisms of action are explored to elucidate the multifaceted nature of its therapeutic effects. In the context of pharmaceutical innovation, this review discusses the prospects of incorporating Rudraksha extracts or bioactive compounds into modern drug development. The exploration of Rudraksha's medicinal attributes opens avenues for novel drug formulations and therapeutic interventions. The paper also underscores the need for further research, clinical trials, and standardization of Rudraksha-based formulations to establish its efficacy and safety in mainstream healthcare.

Keywords: elaeocarpus ganitrus roxb; rudraksha; ayurveda; bioactive compounds; pharmaceutical innovation

Introduction

Elaeocarpus is a genus that belongs to the *Elaeocarpaceae*. Many species grow in tropical and subtropical habitats¹. The word *Elaeocarpus* originates from Greek terms, *Elaeo* denotes olive, and *carpus* denotes fruit. These indicate that *Elaeocarpus* produces olive-like fruits². *E. ganitrus* is a source of Rudraksha beads². Rudraksha is considered a natural tranquilizer. It has magnetic proper ties that restrain heart rate and blood pressure. Rudraksha beads have been used since ancient times to treat various ailments like anxiety, analgesic, asthma, depression, hypertension, migraine, neuralgia and epilepsy, and stress. This plant also displays various bioactivities like antioxidant, anti-inflammatory, antimicrobial, and antidiabetic activity³.

Since *Elaeocarpus* is known for its broad therapeutic properties, the current understanding of its core bioactive compounds and pharmacological benefits

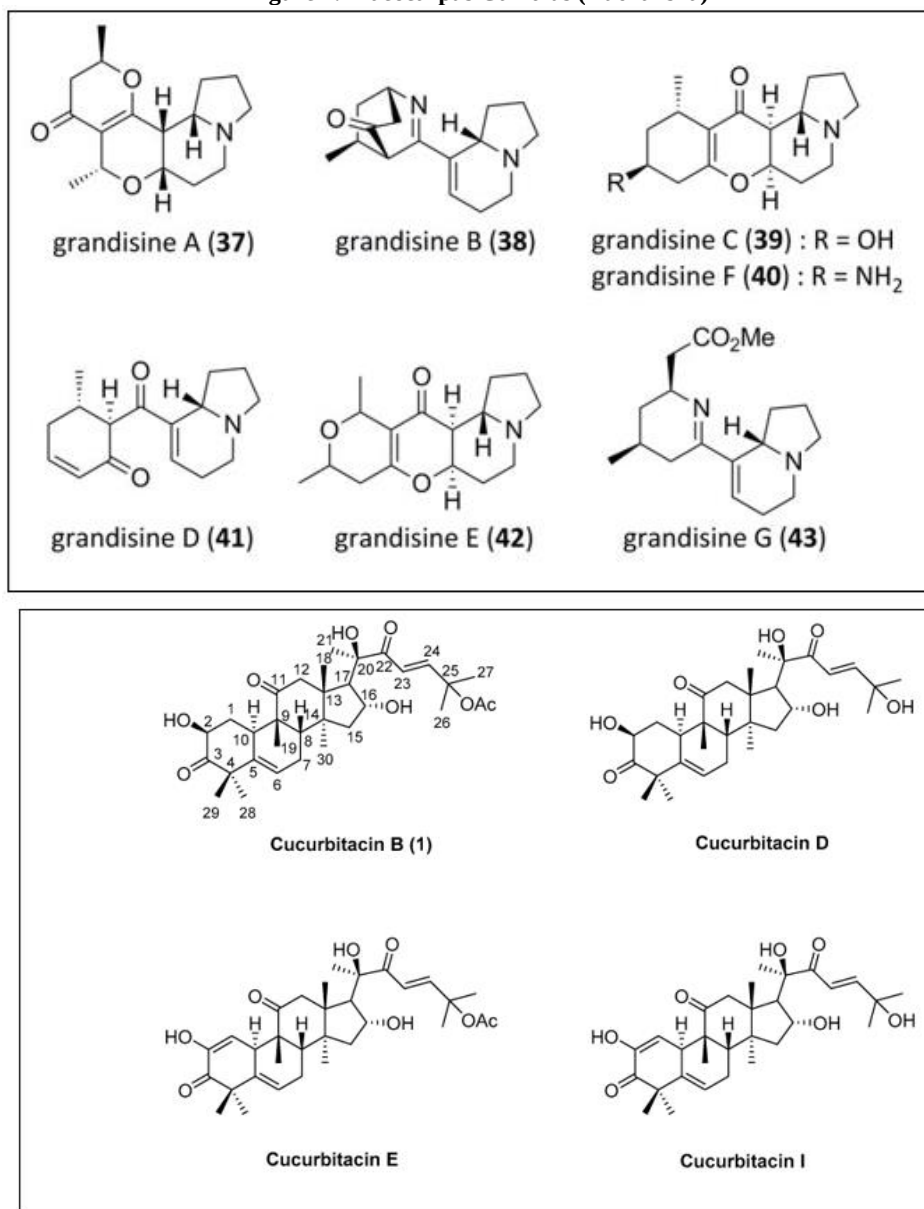
needs to be updated. Therefore, this review aimed to compile and evaluate the available scientific information on different species of *Elaeocarpus*, mainly to decipher their core bioactive compounds and pharmacological benefits. Scientific articles were searched with the help of the search engine PubMed, ScienceDirect, and Google Scholar, with the term "*Elaeocarpus*".

Bioactive compounds:

Elaeocarpus's core bioactive compounds are *Elaeocarpus*' alkaloids, phenolics and flavonoids, and cucurbitacins. The lists of these bioactive compounds are in Tables 1–4. Particular bioactive compounds from *Elaeocarpus* are promising (Fig. 1) and appear to be of chemotherapeutic interest⁴.



Figure 1: *Elaeocarpus Ganitrus* (Rudraksha)



Elemental Composition:

The chemical composition of Rudraksha seeds is diverse, encompassing a range of elements crucial for its biological and pharmacological properties. Rudraksha seeds contain elements such as carbon, hydrogen, nitrogen, and oxygen, forming the foundational constituents of organic matter. Additionally, trace elements, including magnesium, calcium, potassium, and others, contribute to the overall composition. Flavonoids from *Elaeocarpus* have many pharmacological benefits, such as antioxidant⁵ and antimicrobial

activity⁶, antimelanogenesis, enzyme inhibition (Table 5), skin-whitening⁷, anti virus⁸, antidiarrheic⁹, anticancer¹⁰, and radioprotection¹¹.

The elemental makeup of Rudraksha is of particular interest as these elements may play a role in the biological activity and potential therapeutic effects associated with the seeds. However, the specific concentrations and interactions of these elements require further investigation to understand their implications fully.^{12, 13, 14}

Mukhi-Dependent Variation:

One intriguing aspect of Rudraksha seeds is the presence of multiple facets or mukhis on their surface. Each type of Rudraksha, characterized by a specific number of mukhis, is believed to have distinct spiritual and medicinal properties. The mukhi-dependent variation in chemical composition may contribute to the diverse traditional uses associated with different types of Rudraksha.

Understanding the chemical differences between Rudraksha seeds with varying mukhi counts is crucial for deciphering the potential nuances in their pharmacological effects. This area of study holds promise for uncovering targeted therapeutic applications based on mukhi-specific chemical profiles.^{15,16}

Biochemical Analysis:

In-depth biochemical analyses, including chromatography and spectroscopy techniques, are essential for unraveling the complex chemical composition of Rudraksha seeds. These analyses can aid in the identification and quantification of specific compounds, providing a scientific foundation for understanding the seeds' medicinal attributes.

As research progresses, a detailed chemical profile of Rudraksha seeds may emerge, facilitating a more nuanced comprehension of their pharmacological properties. This knowledge is pivotal for exploring the potential integration of Rudraksha-derived compounds in pharmaceutical research and development, opening avenues for innovation in healthcare and wellness.¹⁶

Botanical Description and Distribution:

1 Botanical Characteristics

Elaeocarpus Ganitrus Roxb, commonly known as the Rudraksha tree, belongs to the Elaeocarpaceae family. It is a large, evergreen tree with a straight, cylindrical trunk and a pyramid-shaped crown. The leaves are elliptical, alternate, and have a smooth texture. The tree produces small, fragrant flowers that are white to yellowish in color.

The Rudraksha tree is renowned for its distinctive fruit, the Rudraksha seed, which is encapsulated in a blueberry-like drupe. Each seed is characterized by the presence of multiple facets or mukhis on its surface, ranging from one to several, each believed to hold unique spiritual significance.¹⁷



Figure 2: *Elaeocarpus Ganitrus* (Rudraksha) Tree.

Geographical Distribution: The native habitat of the Rudraksha tree encompasses a broad region across Southeast Asia, predominantly in countries such as India, Nepal, Indonesia, and Malaysia. The tree thrives in a tropical climate, requiring specific conditions like well-drained soil and ample sunlight for optimal growth.

Within India, Rudraksha trees are found in various states, including Assam, Karnataka, Uttarakhand, and Arunachal Pradesh. The distribution is not limited to lowland areas; Rudraksha trees can also be found at elevations ranging from sea level up to around 3000 feet.¹⁴

Environmental Factors: Several environmental factors influence the growth and health of Rudraksha trees. The tree's sensitivity to climate makes it particularly responsive to changes in temperature and rainfall. Well-drained soil with good aeration is essential for root development.

Altitude is another significant factor affecting Rudraksha growth. The tree is often found in hilly regions, adapting to different elevations. Altitude can impact the size and shape of the Rudraksha seeds, adding complexity to the variations observed in the mukhis.

Understanding the botanical characteristics and distribution of Rudraksha trees is fundamental to assessing the potential variations in chemical

composition and pharmacological properties. As researchers explore the medicinal attributes of Rudraksha, this foundational knowledge becomes instrumental in unraveling the mysteries behind its traditional uses and potential pharmaceutical applications.¹⁸

Pharmaceutical Innovation & Preparations Based Upon Rudraksh *Elaeocarpus Ganitrus*:

Pharmaceutical innovation based on Rudraksha involves exploring the medicinal properties of Rudraksha seeds and their derived compounds for the development of novel drugs and healthcare products. While traditional uses of Rudraksha have been rooted in spiritual and cultural practices, modern scientific research may uncover new therapeutic applications. Here are some potential avenues for pharmaceutical innovation based on Rudraksha.^{19,20 & 21}

1. Anti-inflammatory Agents:

- Rudraksha seeds are believed to possess anti-inflammatory properties. Extracts from Rudraksha may be studied for their potential to inhibit inflammatory pathways. Developing anti-inflammatory drugs with natural origins could provide alternatives to synthetic medications, potentially

reducing side effects. The potential anti-inflammatory properties of Rudraksha beads have been a subject of interest in traditional medicine and alternative therapies. While there is some anecdotal and traditional evidence supporting the anti-inflammatory effects of Rudraksha beads, it's essential to note that scientific research on this specific topic may be limited.²⁰

1. Antioxidant Formulations:

- The presence of bioactive compounds, including flavonoids, suggests antioxidant potential in Rudraksha seeds. Research into developing antioxidant formulations derived from Rudraksha could contribute to products aimed at combating oxidative stress, which is implicated in various diseases. Rudraksha beads, derived from the seeds of the Rudraksha tree (*Elaeocarpus ganitrus*), have been traditionally used in various cultural and spiritual practices in certain regions. While they are primarily known for their significance in meditation and prayer, there is limited scientific evidence regarding their role in antioxidant formulations.
- Antioxidants are compounds that help protect the body from oxidative stress by neutralizing free radicals. Free radicals are molecules with unpaired electrons that can cause cellular damage. Many natural substances, such as vitamins C and E, beta-carotene, and various plant extracts, are known for their antioxidant properties.
- Rudraksha beads contain various bioactive compounds, including alkaloids, flavonoids, tannins, and other phytochemicals. Some studies suggest that these compounds may possess antioxidant and anti-inflammatory properties. However, research on the specific antioxidant potential of Rudraksha beads in the context of formulations is limited.²¹

2. Neuroprotective Drugs:

- Some traditional beliefs associate Rudraksha with enhanced mental clarity. Exploring the neuroprotective properties of Rudraksha may lead to the development of drugs that protect against neurodegenerative disorders or enhance cognitive function. *Elaeocarpus* belongs to DOR-targeting drugs that are important to treat various CNS or DOR-related diseases. *Elaeocarpus*' alkaloids are good candidates for treating DOR-related diseases. Extracts of *Elaeocarpus* are also helpful for treating a convulsive disorder, anxiety, asthma, stress, depression, nerve pain, epilepsy, and migraine. They are associated with the delta-opioid receptor (DOR) in the brain. Therefore, they are called DOR-related diseases. Opioid receptors are associated with various physiological activities. Their dysfunction can cause CNS diseases, such as cardiovascular disease, epileptic seizures, Parkinson's disease, depression, hypertension, malignancies, diabetic cutaneous wounds, and immune disease⁴⁰. Opioids and their derivatives have often been usable as analgesics or anti-pain action for a long time. Their anti-pain action is associated with δ -opioid receptor (DOR), μ -opioid receptor (MOR), and κ -opioid receptor (KOR). Opioid receptors also involve in the regulation of feeding and obesity, stress, and hibernation. The neuronal and myocardial tolerance to hypoxic and ischemic stress is related to the upregulation and activity of DOR. Therefore, drugs that enhance.²²

3. Anti-cancer Compounds:

- Preliminary studies hint at the presence of bioactive compounds with potential anti-cancer properties in Rudraksha seeds. Further research may focus on isolating and characterizing these compounds to develop anti-cancer agents or adjuvants. Six species of *Elaeocarpus* are reported for their anticancer activities. Their capacity is associated with their phenolic and flavonoids and cucurbitacins. They are known to possess antioxidant properties and significant biomedical potential. Extracts of leave and bark from *E. floribundus* possess triterpenoids, friedelin, epifriedelanol, and β -sitosterol that show significant anticancer activity²³. Cucurbitacins belong to a group of tetracyclic triterpenoids that display a wide range of biological effects. Cucurbitacin and its derivatives (cucurbitacins) possess strong pharmacological properties, including anticancer activity. Cucurbitacin B, D, and I possess very potent anticancer activity. Cucurbitacin D can inhibit human endometrial and ovarian cancer cells. Various concentrations of cucurbitacin D affect cell growth, the cell cycle, and apoptosis in vitro. All endometrial and ovarian cancer cell lines are sensitive to the growth-inhibitory effect of cucurbitacin D. Cell cycle analysis can indicate their exposure to cucurbitacin D increases the proportion in the sub-G0/G1 phases and G2/M phases of the cell cycle. Therefore, cucurbitacin D might be a new therapeutic option for treating endometrial and ovarian cancers²⁴. Cucurbitacin I is a potential anticancer compound and regulator of human non-small cell lung cancer (NSCLC) cell growth. The anticancer effects of Cucurbitacin I markedly attenuate cell proliferation and induce apoptosis in NSCLC. Cucurbitacin I can inhibit the cell growth of human NSCLC through PI3K/AKT/p70S6K signaling pathway²⁵.

4. Cardioprotective Medications:

- Rudraksha is linked to cardiovascular health in traditional medicine. Research into its potential cardioprotective effects may contribute to the development of medications for managing heart-related conditions, such as hypertension or coronary artery disease. Rudraksha beads are known to contain various bioactive compounds, including alkaloids, flavonoids, tannins, and other phytochemicals. Some of these compounds have been studied for their potential antioxidant and anti-inflammatory properties, which could have implications for cardiovascular health.²⁶

5. Anxiolytic and Stress-Relief Products:

- Traditional use suggests that Rudraksha has a calming effect on the mind. Investigating its anxiolytic properties may lead to the development of stress-relief products or medications targeting anxiety disorders.
- Limited Scientific Research: There is a lack of well-designed clinical trials or studies specifically examining the anxiolytic or stress-relieving effects of Rudraksha. While some studies have explored the bioactive compounds in Rudraksha and their potential benefits, more research is needed to establish its efficacy in addressing anxiety and stress.
- **Traditional Use vs. Scientific Evidence:** Traditional use of herbs and natural substances does not always align with scientific validation. While traditional practices may attribute certain properties to Rudraksha, scientific evidence is necessary to support its effectiveness in managing anxiety and stress.

- **Individual Variation:** Responses to natural products can vary among individuals. Some people may find spiritual or psychological benefits from using Rudraksha beads, while others may not experience significant effects.
- **Holistic Approach:** Stress and anxiety management often require a holistic approach, including lifestyle changes, psychological interventions, and sometimes medical treatments. Rudraksha beads, if used, should be considered as part of a broader strategy for well-being.
- **Consultation with Healthcare Professionals:** Individuals experiencing significant anxiety or stress should consult with healthcare professionals. Mental health concerns are best addressed through evidence-based treatments, and healthcare providers can offer appropriate guidance and support.²⁷.

6. Anti-microbial Formulations:

- Rudraksha extracts may possess antimicrobial properties. Research could focus on developing formulations to combat bacterial, viral, or fungal infections, potentially providing alternatives to conventional antibiotics. Many *Elaeocarpus* extracts have antimicrobial activities. Fruits extract of *E. floribundus*, *E. serratus*, *E. tectorius*, and *E. sphaericus* are often used in traditionally infectious diseases, such as dysentery and diarrhea. Their antibacterial activity is broad spectrum and inhibits either the growth of Gram-positive or Gram-negative bacteria. Their ethanolic extract and EtOAc fraction have an antimicrobial activity. They can inhibit the formation of *S. aureus* biofilms. Therefore they are potential in the fight against multidrug-resistant *Staphylococcus* infections²⁸. They are also able to inhibit the growth of Urinary tract infection (UTI) pathogens such as *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Candida albicans*)⁴⁵ and the growth of *Salmonella typhimurium*, *Morganella morganii*, *Plesiomonas shigelloides*, *Shigella flexnerii* and *Sh. sonnei*. Dibutyl succinate is the main bioactive compound in the fruits of *E. floribundus*. The presence of dibutyl succinate and gallic acid determines the antimicrobial activities of *Elaeocarpus*. It inhibits the growth of *B. subtilis*, *S. dysenteriae*, and *C. albicans*. Gallic acid is found in the ethanolic extract of *E. floribundus* seed. It also inhibits the growth of the pathogens mentioned above. *E. kontumensis* has activity against *Plasmodium falciparum*. It has anti plasmodial activity and good selectivity²⁹. Several ellagic acids isolated from the bark of *E. parvifolius*, have an inhibitory effect on the growth of *Babesia gibsoni*³⁰. *Elaeocarpus ganitrus* (Rudraksha) is known to possess antioxidant properties. The synthesis of silver nanoparticles from two different solvent extracts: aqueous and methanolic. Further, the assessment of antibacterial, antifungal, and antiproliferative activities was conducted, which yielded results that were qualitatively positive at the nanoscale. The nanoconjugates were also evaluated for their anticancer properties using a standard MTT Assay³¹.

Medicinal Attributes and Pharmaceutical Innovation: Rudraksha, derived from the seeds of the *Elaeocarpus Ganitrus* tree, has been traditionally valued for its spiritual significance, and recent explorations suggest potential medicinal attributes that could pave the way for pharmaceutical innovation.^{16,22,26& 32}

1. Anti-Inflammatory and Antioxidant Properties:

- **Traditional Belief:** Rudraksha is believed to possess anti-inflammatory and antioxidant properties in traditional medicine.
- **Pharmaceutical Innovation:** Researchers are investigating these properties for potential development of natural anti-inflammatory and antioxidant drugs, offering alternatives to synthetic medications.

2. Neuroprotective Effects:

- **Traditional Belief:** Traditional practices associate Rudraksha with enhanced mental clarity and focus.
- **Pharmaceutical Innovation:** Exploring neuroprotective effects may lead to the development of drugs targeting cognitive health and neurological disorders.

3. Anti-Cancer Potential:

- **Traditional Belief:** Some studies suggest Rudraksha may contain compounds with anti-cancer properties.
- **Pharmaceutical Innovation:** Research into these compounds could inspire the development of anti-cancer drugs or adjuvants.

4. Cardioprotective Applications:

- **Traditional Belief:** Rudraksha is linked to cardiovascular health in traditional medicine.
- **Pharmaceutical Innovation:** Exploring its potential cardioprotective effects may contribute to medications for managing heart-related conditions.

5. Stress Management Products:

- **Traditional Belief:** Rudraksha is believed to have a calming effect on the mind.
- **Pharmaceutical Innovation:** Developing products for stress management or anxiety disorders could be explored.³³

6. Immunomodulatory Formulations:

- **Traditional Belief:** Compounds in Rudraksha may modulate the immune system.
- **Pharmaceutical Innovation:** Immunomodulatory drugs may be developed, contributing to innovations in autoimmune disease management.

7. Cosmeceutical Products:

- **Traditional Belief:** Rudraksha's antioxidant and anti-inflammatory properties may benefit the skin.
- **Pharmaceutical Innovation:** Cosmeceuticals, such as anti-aging creams, may emerge from Rudraksha-derived compounds.

8. Adaptogenic Innovations:

- **Traditional Belief:** Rudraksha is believed to promote overall well-being and resilience.

- **Pharmaceutical Innovation:** Adaptogenic products could be developed to help the body cope with stressors.

Challenges and Future Directions:

1. Standardization and Quality Control:

- **Challenge:** Ensuring consistent quality and standardization of Rudraksha extracts for pharmaceutical use.
- **Future Direction:** Developing standardized protocols and quality control measures for Rudraksha-based pharmaceuticals.

2. Identification of Bioactive Compounds:

- **Challenge:** Identifying and isolating specific bioactive compounds responsible for medicinal properties.
- **Future Direction:** In-depth chemical analysis and collaboration between traditional knowledge and modern analytical techniques.

3. Clinical Validation:

- **Challenge:** Lack of robust clinical trials to validate the safety and efficacy of Rudraksha-based pharmaceuticals.
- **Future Direction:** Conducting rigorous clinical studies to establish evidence-based therapeutic benefits.³⁴

4. Regulatory Approval:

- **Challenge:** Navigating regulatory pathways for approval of natural products in pharmaceutical settings.
- **Future Direction:** Engaging with regulatory bodies to establish guidelines and frameworks for natural products.

5. Cultural Sensitivity:

- **Challenge:** Balancing traditional beliefs with modern scientific methodologies.
- **Future Direction:** Promoting collaboration between traditional practitioners and scientists, respecting cultural nuances.

6. Public Awareness:

- **Challenge:** Limited awareness among the public and healthcare professionals about Rudraksha's potential.
- **Future Direction:** Educational campaigns and dissemination of research findings to raise awareness.

7. Commercial Viability:

- **Challenge:** Establishing the commercial viability of Rudraksha-based pharmaceuticals.

Future Direction: Exploring partnerships between the pharmaceutical industry and traditional practitioners to bring products to market.

Conclusion:

Rudraksha (*Elaeocarpus Ganitrus Roxb*) stands at the intersection of ancient wisdom and modern scientific exploration, offering a unique opportunity for pharmaceutical innovation. Traditional beliefs surrounding Rudraksha's spiritual and medicinal attributes have sparked interest in unraveling its chemical composition and potential health benefits. The potential development of pharmaceutical products derived from Rudraksha may encompass antioxidant formulations, neuroprotective drugs, stress management products, immunomodulators, and more. However, to bring Rudraksha-based pharmaceuticals to fruition, rigorous scientific methodologies, including clinical trials and regulatory approvals, are imperative.

References:

1. Ogundele, A.V., Das, A.M., 2019. Chemical constituents from the leaves of *Elaeocarpus floribundus*. *Nat. Prod. Res.* 35 (3), 517–520.
2. Manu, P., Lal, A., Anju, R., 2013. *Elaeocarpus sphaericus*: a tree with curative powers: an overview. *Res. J. Med. Plant* 7, 23–31.
3. Dixit, P.K., Dixit, S., Bhardwaj, M., Chauhan, B.S., Nagarajan, K., Sahoo, J., 2018. A review on traditional and ethnomedicinal uses of *Elaeocarpus ganitrus* (Rudraksha) e review. *Int. J. Pharm. Sci. Rev. Res.* 52 (2), 1–7.
4. Cambie, R.C., Ferguson, L.R., 2003. Potential functional foods in the traditional Maori diet. *Mutat. Res./Fundam. Mol. Mech. Mutagen.* 523-524, 109–117.
5. Vuong, Q.V., Ngoc Thuy Pham, H., Vu, H.T., Dang, T.T., Van Ngo, T., Chalmers, A.C., 2018. Fruit characteristics, phytochemical and antioxidant properties of blueberry ash (*Elaeocarpus reticulatus*). *Heliyon* 4 (10), e00834.
6. Ogundele, A.V., Yadav, A., Halder, S., Das, A.M., 2021a. Antimicrobial activities of extract, fractions and isolated compounds from the fruits of *Elaeocarpus floribundus* growing in North-East India. *J. Herb. Med.* 30, 100511.
7. Huang, C.Y., Liu, I.H., Huang, X.Z., Chen, H.J., Chang, S.T., Chang, M.L., Chang, H.T., 2021. Antimelanogenesis effects of leaf extract and phytochemicals from ceylon olive (*Elaeocarpus serratus*) in zebrafish model. *Pharmaceutics* 13 (7).
8. Ito, A., Chai, H.-B., Lee, D., Kardono, L.B.S., Riswan, S., Farnsworth, N.R., Kinghorn, A. D., 2002. Ellagic acid derivatives and cytotoxic cucurbitacins from *Elaeocarpus mastersii*. *Phytochemistry* 61 (2), 171–174.
9. M. Luger, P.W., Kashino, S., Amakura, Y., Yoshida, T., Okuda, T., Beurskens, G., Dauter, Z., 1998. Structure of the Tannin geraniin based on conventional X-ray data at 295 K and on synchrotron data at 293 and 120 K *Crystallogr. Section B* 54 (5), 687.
10. Chan, C.K.T., Ying, Liu, Goh, Bey Hing, Habsah, Abdul Kadir, 2019. Targeting apoptosis via inactivation of PI3K/Akt/MTOR signaling pathway involving NF- κ B by geraniin in HT-29 human colorectal adenocarcinoma cells. *Prog. Drug Discov. Biomed. Sci.* 2.
11. Park, E., Lee, N.H., Baik, J.S., Jee, Y., 2008. *Elaeocarpus sylvestris* modulates gamma-ray-induced immunosuppression in mice: implications in radioprotection. *Phytother. Res.* 22 (8), 1046–1051.
12. Hule, A.K., Shah, A.S., Gambhire, M.N., Juvekar, A.R., 2011. An evaluation of the antidiabetic effects of *Elaeocarpus ganitrus* in experimental animals. *Indian J. Pharmacol.* 43 (1), 56–59.
13. Giri D, Patro VJ, Dwivedi A, Maurya R, Singh SK, Tripathi DK. Ethnobotanical, pharmacological, and phytochemical aspects of *Elaeocarpus sphaericus* (Gaertn.) K. Schum.: A comprehensive review. *Pharmacogn Rev.* 2018;12(23):39-48.

14. Correspondence, B., Kumari Kumari, B., Santosh, K., Tiwari, Srivastava, A., Tiwari, S., 2018. *Elaeocarpus* spp.: a threatened power generating plant, its geographical distribution, propagation through in vivo condition and its medicinal aspects. *Int. J. Fauna Biol. Stud.* 5 (2), 27–31. , A.B., Dutta, S.C., Dasgupta, S., 1976. Flavonoids of *Elaeocarpus lanceofolius*. *Phytochemistry* 15 (11), 1797–1798.
15. Ray, A.B., Dutta, S.C., Dasgupta, S., 1976. Flavonoids of *Elaeocarpus lanceofolius*. *Phytochemistry* 15 (11), 1797–1798.
16. National Center for Complementary and Integrative Health. (2022). *Rudraksha: Integrating Traditional Wisdom into Modern Healthcare*. Retrieved from [URL].
17. Biswas S, Roy M, Gangopadhyay A, et al. *Elaeocarpus Ganitrus* Roxb. (Rudraksha): A review of ethnobotany, phytochemistry, and pharmacology. *Pharmacogn Rev.* 2010;4(7):164-172.
18. Sharma, S., Gupta, R., & Sharma, P. (2018). Rudraksha: A Boon to Mankind-A Review. *International Journal of Green Pharmacy*, 12(4), S895-S902.
19. Pandey, R. K., & Upadhyay, P. (2016). A Review on Therapeutic Properties of Rudraksha. *Journal of Drug Delivery and Therapeutics*, 6(4), 62-66.
20. Kumar TS, Shanmugam S, Palavannan T, Kumar. Evaluation of antioxidant properties of *Elaeocarpus Ganitrus* Roxb. Leaves, *Iranianj. of pharmaceutical research.* 2008;7:211-215.
21. Prihantini, A.I., Tachibana, S., Itoh, K., 2014. Evaluation of antioxidant and α -glucosidase inhibitory activities of some subtropical plants. *Pak. J. Biol. Sci.* 17 (10), 1106–1114.
22. Barve, K.H., Chodankar, R., 2014. Does copper enhance the antihypertensive effect of *Elaeocarpus ganitrus* in experimentally induced hypertensive rats? *J. Ayurveda Integr. Med.* 5 (2), 76–79.
23. Utami, R., Khalid, N., Sukari, M.A., Rahmani, M., Abdul, A.B., Dachriyanus, 2013. Phenolic contents, antioxidant and cytotoxic activities of *Elaeocarpus floribundus blume*. *Pak. J. Pharm. Sci.* 26 (2), 245–250 doi: PMID: 23455191.
24. Ishii, T., Kira, N., Yoshida, T., Narahara, H., 2013. Cucurbitacin D induces growth inhibition, cell cycle arrest, and apoptosis in human endometrial and ovarian cancer cells. *Tumour Biol.* 34 (1), 285–291.
25. Zhu, X., Huang, H., Zhang, J., Liu, H., Ao, R., Xiao, M., Wu, Y., 2018. The anticancer effects of Cucurbitacin I inhibited cell growth of human non small cell lung cancer through PI3K/AKT/p70S6K pathway. *Mol. Med. Rep.* 17 (2), 2750–2756.
26. Kumari, S., Lakra, N., & Sahu, R. (2019). Pharmacological Activities of *Elaeocarpus Ganitrus* (Rudraksha): A Review. *Asian Journal of Pharmaceutical and Clinical Research*, 12(7), 23–27.
27. Singh, A., Pandey, G., & Pandey, A. (2017). Pharmacognostical Evaluation of Rudraksha (*Elaeocarpus Ganitrus* Roxb.) Leaves. *World Journal of Pharmaceutical Research*, 6(3), 1741-1751.
28. Panda, S.K., Das, R., Lavigne, R., Luyten, W., 2020. Indian medicinal plant extracts to control multidrug-resistant *S. aureus*, including in biofilms. *S. Afr. J. Bot.* 128, 283–291.
29. Nguyen-Pouplin, J., Tran, H., Tran, H., Phan, T.A., Dolecek, C., Farrar, J., Grellier, P., 2007. Antimalarial and cytotoxic activities of ethnopharmacologically selected medicinal plants from South Vietnam. *J. Ethnopharmacol.* 109 (3), 417–427.
30. Elkhateeb, A., Subeki, Takahashi, K., Matsuura, H., Yamasaki, M., Yamato, O., Nabeta, K., 2005. Anti-babesial ellagic acid rhamnosides from the bark of *Elaeocarpus parvifolius*. *Phytochemistry* 66 (21), 2577–2580.
31. Mahajanakatti, A.B., Deepak, T.S., Achar, R.R., Pradeep, S., Prasad, S.K., Narayanappa, R., Kollur, S.P., 2022. Nanoconjugate synthesis of *Elaeocarpus ganitrus* and the assessment of its antimicrobial and antiproliferative properties. *Molecules* (8), 27.
32. Pandey, M. M., Devi, N., Kumar, R., & Mandal, T. K. (2017). *Elaeocarpus Ganitrus* (Rudraksha): A Potential Medicinal Plant. *International Journal of Pharmaceutical Sciences and Research*, 8(4), 1416-1426.
33. Chen, X., Bao, J., Guo, J., Ding, Q., Lu, J., Huang, M., Wang, Y., 2012. Biological activities and potential molecular targets of cucurbitacins: a focus on cancer. *Anticancer Drugs* 23 (8), 777–787.
34. Hule, A.K., Shah, A.S., Gambhire, M.N., Juvekar, A.R., 2011. An evaluation of the antidiabetic effects of *Elaeocarpus ganitrus* in experimental animals. *Indian J. Pharmacol.* 43 (1), 56–59.

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