

**A REVIEW ON ETHNOMEDICINAL AND TRADITIONAL USES OF
ELAEOCARPUS GANITRUS ROXB. (RUDRAKSHA)****SURESH C. JOSHI* AND PRATIBHA K. JAIN***Center for advanced studies, Department of Zoology
University of Rajasthan, Jaipur – 302 055 (India).***ABSTRACT**

In the present review, an attempt has been made to congregate the botanical, phytochemical, ethno medicinal, pharmacological information on *Elaeocarpus ganitrus* Roxb. belongs to family Elaeocarpaceae. It is prevalent for its fascinating fruit stones and medicinal properties. It procures a remarkable position in Hinduism and Ayurveda, the indigenous system of medicine. In Hindi it is recognized as Rudraksha, is a large evergreen broad-leaved tree whose seed is conventionally used for prayer beads in Hindu religion. In traditional system of medicine, different parts (beads, bark, leaves and outer shell of beads) of Rudraksha are taken for the alleviation of various health problems such as mental disorders, headache, fever, skin diseases, and for healing the wounds. Ayurvedic texts categorise Rudraksha fruits as thermogenic, sedative, cough alleviator and are useful for the treatment of bronchitis, neuralgia, cephalagia, anorexia, migraine, manic conditions and other brain disorders. It is employed in folk medicine as a counter agent of stress, anxiety, depression, palpitation, nerve pain, epilepsy, lack of concentration, asthma, hypertension, arthritis and liver diseases. Furthermore it is retrieve to exhibit multifarious pharmacological activities like anti-inflammatory, analgesic, hypoglycemic, antiulcerogenic and very high antimicrobial activity. Phytosterols, fats, alkaloids, flavonoids, carbohydrates, proteins and tannins have been found to be largely responsible for the therapeutic potential of *E. ganitrus*. Aqueous extract of leaves contains glycosides also. Ethanolic extract of leaves contains gallic acid, ellagic acid & quercetin. This review provides a scientific basis for pharmacological /medicinal properties and therapeutic uses of *Elaeocarpus ganitrus* Roxb.

KEY WORDS: Phytochemicals, Pharmacological, Antioxidant, Therapeutic**SURESH C. JOSHI***Center for advanced studies, Department of Zoology
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INTRODUCTION

Elaeocarpus ganitrus Roxb. (Syn. *E. sphaericus* Gaertn; family Elaeocarpaceae) is commonly known as Rudraksha¹. The word Rudraksha, literally derived from two Sanskrit words –‘rudra’, a synonym for Lord Shiva and ‘aksha’ meaning eyes². It is also called blueberry beads as, beads are covered by an outer shell of blue color on fully ripening³. The seed is borne by several species of *Elaeocarpus*, with *E. ganitrus* being

the principal species. The specific appellation *ganitrus* is plausibly taken from ganitri, the name for this species in Sundanese and Malay. It has been adored in almost all ancient ayurvedic texts for its extraordinary medicinal properties. It is ethnomedicinally important plant and possesses ameliorating pharmacological properties which have been used for the treatment of various ailments.



Figure 1
Elaeocarpus ganitrus roxb.

Botanical classification

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Oxalidales
Family	Elaeocarpaceae
Genus	<i>Elaeocarpus</i>
Species	<i>E. ganitrus</i>
Binomial name	<i>Elaeocarpus ganitrus</i> (Roxb.)
Common name	Rudraksha

Origin and distribution

Rudraksha botanically called *Elaeocarpus ganitrus* raise in tropical and subtropical regions at the eminence ranging from seacoast to 2,000 meters above the sea level⁴. Rudraksha cultivate in the area from the Gangetic Plain in foothills of the Himalayas to South-East Asia, Indonesia, New Guinea to Australia, Guam, and Hawaii⁵.

Rudraksha tree flourish on mountains and hilly region of Nepal, Indonesia, Java, Sumatra and Burma.

Morphology

Elaeocarpus ganitrus is a large evergreen broad leaved tree. The tree of Rudraksha is about 50-200 feet long and possess cylindrical trunk with a

grayish white & rough textured bark. The diameter of trunk is up to 1.22 meter. The morphological & organoleptic examination^{6,7} demonstrates that rudraksha leaves are shining green on the upper side with a dull leathery on

the dorsal side. The flowers of Rudraksha are white with bristling petals. The macroscopical study of the leaf and seed shows following observations as tabulated in table 1.

Table 1
Macroscopical Examination of leaf and seed of *Elaeocarpus ganitrus*^{6,7}

Leaf	Observations	Seed	Observations
Shape	Ovate	Shape	Bulbous
Color	Shining green	Color	Blue(on fully ripening)
Margin	Undulate	Texture	Hard
Size	5-6 inch in length, 2 inch broad	Size	½-1 inch
Apex/Base	Acute/Symmetric	Taste	Sour

Microscopical examination⁸ of transverse section of leaf shows the presence of cuticle, epidermis, collenchymas, palisade and vascular bundles as shown in fig 2a. Vascular bundle shows collateral type closed vascular bundle. Transverse section of seed⁹ reveals the presence of a hard endocarp encompassed by lignified isodiametric sclereids, seeds with membranous seed coat, which enfolded a dense cellular endosperm incorporating of calcium oxalate druses as depicted in fig 2b.

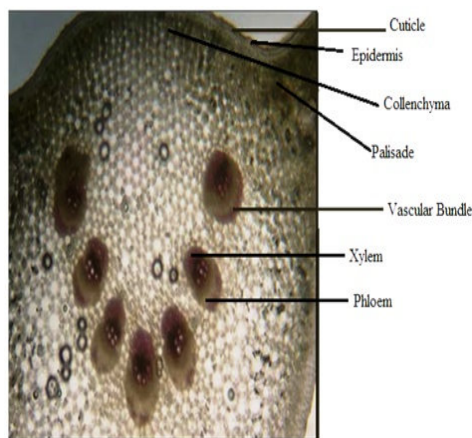


Figure 2a: Transverse section of leaf of *Elaeocarpus ganitrus*⁸

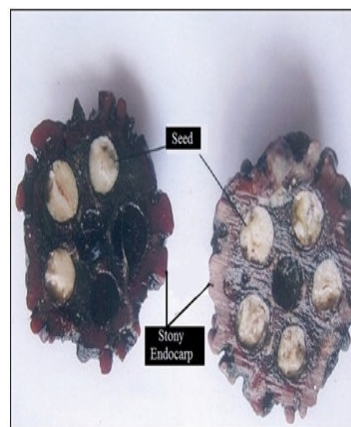


Figure 2b: Transverse section of seed of *Elaeocarpus ganitrus*⁹

Cultivation

The Rudraksha trees are very tall and endure small white colored sweet smelling flowers on blooming in the rainy season. These flowers turn into black berry like fruits, which on ripening yield brownish red colored seeds. The tree is annual i.e. grows throughout the year. Rudraksha is germinating in subtropical climate area with temperature ranges of 25-30 degree centigrade. These trees start giving fruit after 7 years. Fruits appear in June and grow up by August-October. The bead formation and the type of bead formed












depends on the environment and location of rudraksha tree, e.g. The Himalayan beads looks larger, heavier and more powerful due to the environment they grow in.


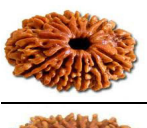


Types of Rudraksha

Rudraksha beads are catalogued depending on the number of "mukhis" – the clefts and furrows – they have on the surface. The scriptures state of 1 to 38 mukhis, but Rudrakshas of 1 to 14 mukhis are usually bring to light. One mukhi rudraksha is not widely distributed. Five faceted

or Punchmukhi rudraksha bead is most influence associated with the number of mukhis commonly found. The higher mukhis or faces it has as listed in table 2. very rare. Each bead imposes a different

Table 2
Benefits of Rudraksha associated with no. of mukhis

Rudraksha		Therapeutic potentials and other Benefits
	1 mukhi	Medicament for diseases like mental anxiety, heart problems, eye problems, TB, paralysis, bone pain, etc. Enlightens the super-consciousness and provides improved concentration.
	2 mukhi	Implausible treatment of ailments like chronic asthma, renal failure, impotency, stress, anxiety, depression, eye problems, negative thinking, mental chaos, lack of concentration, hysteria, intestinal disorder etc. Blesses the wearer with 'UNITY'.
	3 mukhi	Sure shot remedy for the diseases like depression, schizophrenia, blood pressure, jaundice, mental disability, fever or weakness, directive of the menstrual cycle/ menstrual stress, mood swings, etc.
	4 mukhi	Provides medication for diseases like blood circulation, asthma, memory lapse, cough respiratory strip problems, and brain linked illness, etc. The wearer bestows power of creativity, enhances memory power and intelligence.
	5 mukhi	For treating medical conditions like blood pressure, diabetes, piles, stress, displeasure, mental disability, as well as neurotic, heart and maladjustment problems etc.
	6 mukhi	Counter measure for the ailments like gynecological problems, epilepsy etc. Defends from emotional trauma of wordy sorrows and imparts wisdom, learning and knowledge.
	7 mukhi	Extraordinarily works for treating diseases like asthma, impotency, pharyngitis, respiratory confusion, foot related diseases, pains and aches etc. Beneficial for peoples who are suffering from finance and mental set-up.
	8 mukhi	Provides cures for medical conditions like stomach ache, skin diseases, stress, anxiety etc. Get rid of all obstacles and affords success in all undertakings.
	9 mukhi	Works as a mystical therapeutic agent for treating strange diseases. Wearer is harbored with lot of energy, powers, dynamism and fearlessness.
	10 mukhi	Alleviates discomforts like mental insecurity, hormonal inequality in the body, whooping cough etc. It does a job like a shield on one's body and kicks evils away.
	11 mukhi	Provides relief from body pain, backache and recovers from chronic alcoholism and liver diseases. Blesses wearer with wisdom, right judgement, fearlessness and success.

	12 mukhi	Medically it is more valuable for ameliorating discomforts of bone diseases, osteoporosis, rickets, mental disability, anxiety etc. Wearer gains the strength of sun to rule and to move continuously with brilliant radiance. Boosts self image and motivation.
	13 mukhi	Used for treating muscle dystrophies. It gives honor and fulfills all the earthly desires.
	14 mukhi	It provokes the sixth sense organ by which the wearer foresees the forthcoming happenings.
	15 mukhi	Skin diseases, recurring miscarriage, still birth etc can be cured.
	16 mukhi	Taken as a curative agent for the diseases like leprosy, cor-pulmonale, tuberculosis, lung diseases etc.
	17 mukhi	Excellent for handling conditions like memory lapse, body functional disorders etc.
	18 mukhi	Prevent ailments like loss of power, mental inharmonization etc.
	19 mukhi	Exterminate the disorders of blood, spinal cord etc.
	20 mukhi	Taken as nullifier for problem of eyesight and snake bites.
	21 mukhi	Possesses built-in medical healing and it eradicates every form of diseases.
	Trijuti	Trijuti Rudraksha is supreme for keeping internal as well as external body disorders at bark.
	Gauri Shankar	Works for the medication of problems related to sex and behaviour.

Rudraksha and hindu mythology

Rudraksha is a valuable and magical bead of Hindu Tradition & Meditation. Rudraksha beads signify the “eyes” of lord Shiva, so they are speculated to be very felicitous and sacred. All legends pertaining to the origin of Rudraksha describe them as tears shed by Lord Shiva. According to "Shiva Purana", Lord Shiva once went into deep meditation for the health and prosperity of all living being. When he awoken, he opened his eyes and tear drops fell on the Earth. These tear drops carved out the form of

seeds that later on emerges as the Rudraksha tree. “Rudraksha Daan (Donation) Is The Best Donation Among All”¹⁰.

Physicochemical parameters

The physicochemical analysis of coarsely powdered dried fruits of rudraksha exposed the moisture content (loss on drying), total ash, acid insoluble ash, water-soluble extractives, pet ether soluble extractives, chloroform soluble extractives, ethanol soluble extractives are as shown in fig.3

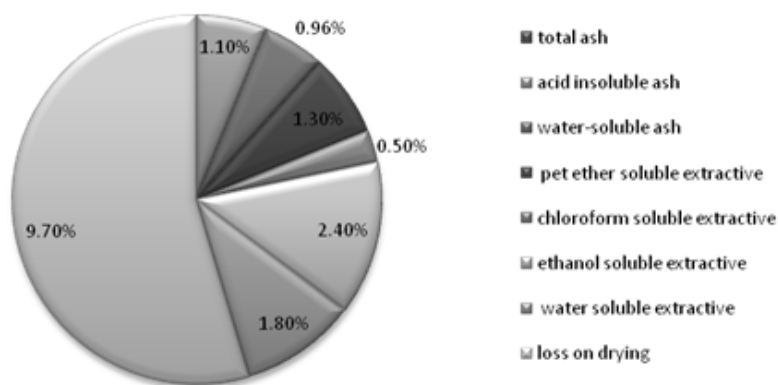


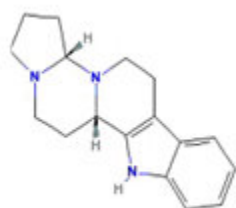
Figure 3
Physiochemical parameters of *Eleoecarpus ganitrus*

Total ash is approximately 1.36 times greater than the acid insoluble ash illustrates the existence of adequate acid soluble inorganic matter in *E. ganitrus*. Out of all the solvents analysed, ethanol comprises a maximum extractable value of 2.4%, whereas chloroform comprises a minimum value of 0.5%.

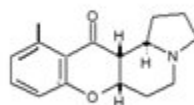
Biochemical / phytochemical constituents of *Eleoecarpus ganitrus roxb.*

Rudraksha beads are constructed of carbon, hydrogen, nitrogen, oxygen and some trace elements in collective form. C-H-N analyzer and gas chromatography designates the percentage composition of these gaseous elements as 50.031% carbon, 0.95% nitrogen, 17.897% hydrogen and 30.53% oxygen. Phytochemical screening¹¹⁻¹⁵ manifested positive test for

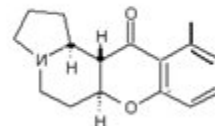
phytosterols, fats, alkaloids, flavonoids, carbohydrates, proteins and tannins. Aqueous extract of leaves contains glycosides also. Ethanolic extract of leaves contains gallic acid, ellagic acid & quercetin¹⁶. *E. ganitrus* Roxb. (Syn. *E. sphaericus* Gaertn) leaves comprises of several isomeric alkaloids of molecular formula, C₁₆H₂₁NO₂¹⁷. Rudraksha contains indolizidine type of Alkaloids. Two of the alkaloids are alike (-)-isoelaecarpiline and (+)-elaecarpiline earlier isolated from *E. dolichostylis*. The other alkaloids are Elaecarpidine, (+)-Elaecarpine, (+)-Isoelaecarpin, (+)-Epiisoelaecarpiline, (+) – Epiialloelaecarpiline, (-) – Alloelaecarpiline, (+) – Pseudoepiisoelaecarpiline, Rudrakine¹⁸ and fatty acids includes palmitic acid and linolenic acid¹⁹. The chemical structures of phytochemicals are depicted in fig.4 (a-m).



(a)



(b)



(c)

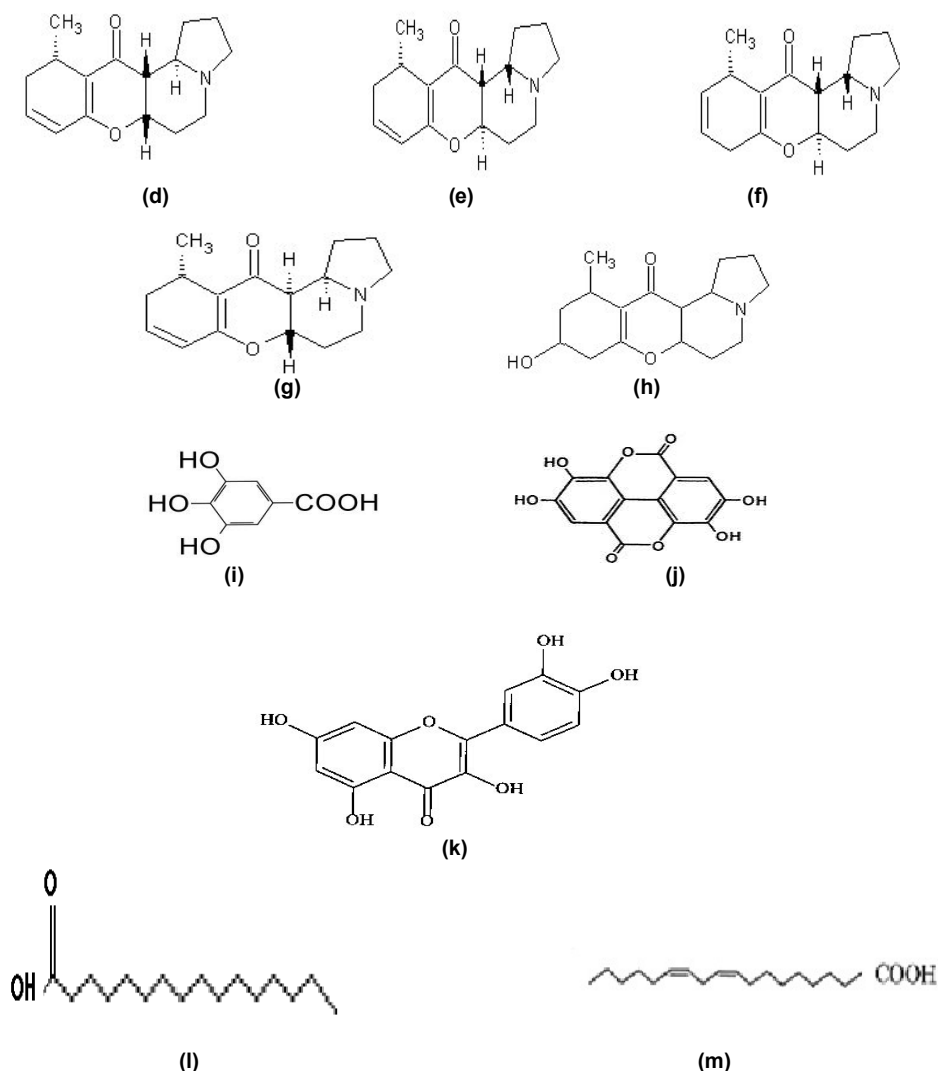


Figure 4
(a-h): Alkaloids

(a) Elaeocarpidine, (b) (+)-Elaecarpine, (c) (+)-Isoelaecarpine, (d) (+)-Epielaecarpiline, (e) (-)-Alloelaecarpiline, (f) (+)-Pseudoepiisoeleocarpiline, (g) (+)-Epialloelaecarpiline and (h) Rudrakin^{17,18}; (i,j) Tannins(Leaf)- (i) Gallic acid (j) Ellagic acid¹⁹; (k) Flavanoids-Quercetin¹⁹; (l,m) Fatty acids(Seeds)- (l) Palmitic acid (m) Linoleic acid²⁰.

The different types of phytochemicals that have been extracted and investigated from coarsely powdered dried fruits of *E. ganitrus* with various solvents are tabulated in Table 3.

Table 3
Phytochemicals from fruits of *E. ganitrus*⁹

Extract	Phytochemicals
Petroleum ether extract (PE)	Phytosterol, fats and fixed oil
Chloroform extract (CE)	Phytosterol
Ethanol extract (EE)	Alkaloids, flavanoids, carbohydrates, proteins and tannins
Water extract (WE)	Protein, tannins and carbohydrates

Traditional uses /ayurvedic properties of rudraksha

Different parts (beads, bark and leaves) of rudraksha are used for the treatment of diverse ailments as well as may be worn either on arm, wrist or other parts of the body.

As blood purifier and general tonic: Rudraksha can be taken as a medicament for blood purification and powers the body substance. Regular consumption as a quath in conjunction with honey purifies blood and works as general tonic.

Curing breathing problems or cough: A quath made by mixing beads of rudraksha, bark of adusa and harad, in equal amount can be consumed with honey. The concoction of ten-faced rudraksha with milk mitigates recurrent cough.

For getting good sleep: Rudraksha shall be kept under pillow and preparation of its bead in the milk shall be applied on the eye lid for getting better sleep.

Rectifier of chicken pox or small pox: Equal proportion of black pepper and *Elaeocarpus ganitrus* should be crushed together and taken with stale water to alleviate the problem of small pox.

Burn Pox or Marks alleviator: The five-faced rudraksha is the foremost remedy for burn or pox marks on face. It can be used as a panacea for skin diseases, ringworms, sores, pimples and boils also.

Epilepsy management: Pulverized bark of rudraksha tree and pulp of fruit or the bead can be used.

For curing Piles: Rudraksha bead in combination with triphala churna and guggul or with root of kaneer is beneficial for treating piles.

Counter measure for jaundice, liver related problems or stomach ache: Rudraksha, chitrak, harad, devdaru, giloy, daruhaldi, dharangi and punarnava shall be taken in equal proportion and regular consumption of it as a quath is an important medicine.

Nullifying poisonous effects caused by bites of insects: Panchamukhi rudraksha can be ground with lemon juice on a stone and the application of this paste on the affected spot will subside pain.

For improving memory power: Milk boiled with four or six faced rudraksha seed is an excellent remedy for mental disorders. This also assists in enhancing memory.

Sexual power improvement: A recipe of rudraksha applied over the forehead improves sexual power.

For Blood Pressure: Five mukhi rudraksha keeps blood pressure normal.

For High Blood Pressure: Rudraksha is a best medication for curing H. B. P. (high blood pressure).

Sure shot remedy for conceiving baby: One rudraksha and one karsa (10 gm) of Sarpa'kshi (*Ophiorrhizamungos*) can be cooked together and pestled in the milk of one colored cow. Consumption of it during the menstrual period will bestow even a sterile woman conceive - Damara Tantra.

Alleviator of heaviness, tongue cracks and tastelessness: Gargling with rudraksha decoction is beneficial in heaviness, tongue cracks and tastelessness.

Curing all brain disease: All brain disorders can be recovered with four faced rudraksha remedy.

Neutrilizer of brain fever: Consumption of overnight kept water of rudraksha in an earthen pot on an empty stomach can get rid of brain fever.

For Hysteria and Coma: *Elaeocarpus ganitrus* is also a good assistance for panic conditions of hysteria and coma in woman.

For Frequent fever: Rudraksha is also good for children's who suffer from frequent fever.

Imparts calmness to mind: It cools down the body temperature and brings calm to mind.

Controlling anxiety: A person grieves from anxiety should keep big size panchmukhi rudraksha with themselves and during nervousness; they should hold them tightly in their right palm for ten minutes. It will assist them to get back their confidence²¹.

To Ward off evil spirits and omens: The rudraksha fruits were employed to defend from evil spirits in traditional Indian medicinal system²². These diversified traditional uses are presented in figure 5.



Figure 5
Traditional uses of *Elaeocarpus ganitrus* (Rudraksha)

Medicinal and scientific value of *Elaeocarpus ganitrus roxb.* (Rudrakasha)

Rudraksha beads have been used for thousands of years as an amazing aid to gain power and for living healthy life. It has been observed that Rudraksha beads possess electromagnetic properties and by virtue of these properties they empowers and controls proper functioning of all body parts. Inductance, resistance, dielectrical as well as permanent magnetic properties and dynamic polarity are extensively catalogued in to electrical properties of rudraksha. Due to electromagnetic and inductive properties of rudraksha beads, they send out equivalent signals, differing for different mukhis to brain, activates certain brain chemicals and neurotransmitters thereby imposes positive impact on blood circulation, nervous system and various other organ systems. Scientifically the Rudraksha beads are dielectrical as they store electrical energy and owing to this property they play an important role in regulating palpitations

of heart, hyperactivity, streamlining heart beat, lack of concentration etc. Rudraksha seeds are dynamically polar and also possess both paramagnetic and diamagnetic properties which facilitate beneficial healing capacity to them. Rudraksha beads confer anti ageing properties depend on their electromagnetism²². Rudraksha pulp is used in managing head related diseases, epilepsy, and mental sickness²³. Furthermore it is noted to have myriad pharmacological activities that involve anti-inflammatory²⁴, analgesic²⁵, hypoglycemic²³, antidepressant²⁶, antiasthmatic²⁶, sedative²⁵, antihypertensive^{27,28,29}, smooth muscle relaxant³⁰, hydrocholeretic³⁰, antiulcerogenic³¹ and anticonvulsant³². Besides, Rudraksha extracts possess potential antimicrobial activity^{33,34} and can be used even for the alleviation of chronic diseases like cancer. Different mukhi dusts of rudraksha are given for different disorders as listed in table 4.

Table 4
Treatment of different diseases by different mukhi (face) dust of rudraksha

Disorders	Rudraksha
Eye sight, heart, diaphragm, spine, blood, veins, thymus	1&12 mukhi
Stomach involving gastric processes, non blood fluid system	2 mukhi
Brain, thyroid glands, sensory organs, hands, arms, lungs disorders	4 mukhi
Red blood cells, adrenal glands, blood pressure disorders	3 mukhi
Neurohypophysis related to growth and thighs	5 mukhi
Depression, mental/ emotional tension, spleen, skeletal system and adenohipophysis	7 & 14 mukhi
Body pain, skin problem	9 mukhi
Nervous system disorders	11 mukhi
Sleeping problems	9 mukhi

Experimental and clinical studies

All over the world scientific research is getting momentum to evaluate the pharmacological activities, side effects and medicinal uses of *E. ganitrus* against different diseases. On the basis of various *in vitro*, experimental and clinical researches, the following pharmacological activities or medicinal properties of *E. ganitrus* have been reported.

Antimicrobial

In vitro antimicrobial activity of aqueous extract of *E. ganitrus* leaves was tested against clinical isolates of bacteria and fungi. The extract exhibited extensive antimicrobial action as it showed growth inhibition for *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Aspergillus flavus*, *Penicillium* sp, *Candida albicans* and *C. tropicalis*. Agar well diffusion method³⁴ is used for determining antibacterial activity of the crude extracts. Aqueous extract of *E. ganitrus* leaves was screened for antibacterial activity against three gram positive (*B. cereus*, *S. aureus*, and *M. luteus*) and three gram negative bacteria (*P. aeruginosa*, *E. coli*, and *K. pneumoniae*), isolated from the clinical samples. The extract exhibited excellent antibacterial activity against all the bacterial cultures, except *M. luteus*. Antifungal activity of the crude extracts was examined through the agar well diffusion method³⁵. Antifungal activity of the extract was evaluated against three molds (*Penicillium* sp, *A. niger* and *A. flavus*) and two yeast (*C. albicans* and *C. tropicalis*), isolated from clinical samples.

Extract exhibited antifungal activity against all the fungal cultures except *A. niger*. Antimicrobial activity of *E. ganitrus* leaves extract was compared with the antimicrobial activity of standard drugs for evaluating relative percentage inhibition. The aqueous extract of *E. ganitrus* leaves exhibited maximum relative percentage inhibition against *B. cereus* (124.16 %) and *Penicillium* sp. (88.26%) for bacteria and fungi respectively. Minimum inhibitory concentration values of the extract varied from 125-2000 µg/ml; however minimum value was reported against *B. cereus* and *A. flavus* (125 µg/ml). The results indicate the potential use of *E. ganitrus* leaves for the development of antimicrobial compounds³⁶.

Earlier, experiments were performed with various extracts (Petroleum ether, benzene, chloroform, acetone and ethanol) of dried *E. sphaericus* fruit. The extracts have been recited to exhibit a broad spectrum of antimicrobial action against a variety of gram positive and gram negative bacteria³³. *E. ganitrus* is a less explored source of immensely useful antimicrobial constituents and it is worth for prospective experimental investigation. Further, the active principle can be isolated and the mechanism of antimicrobial activity can be studied using advance scientific techniques.

Antifungal activity

Petroleum ether (PE), Chloroform (CE), Ethanol (EE) and Water (WE) extracts of *E. ganitrus* dried fruits were examined for *in vitro* antifungal activity by using the disk-diffusion assay³⁷ and broth dilution test^{38,39}. Turbidimetry method was

used for determining inhibitory concentration in terms of MIC (mg/ml) for different fungal strains of *Aspergillus niger*, *Candidum geotrichum*, *Candida albicans*, *C. glabrata* and *C. tropicalis*. Ketoconazole was taken as the positive control. The CE showed maximum inhibitory potential (MIC 1.5 mg/ml) on *C. albicans*. The maximum inhibition (MIC 3.0 mg/ml) was observed for CE and EE against *A. niger*. No sign of inhibition was illustrated on *C. glabrata* and *G. candidum* by various extracts even at higher concentration. CE and EE were identified to be potential antifungals. Phytochemical investigations of extracts which confirms the presence of alkaloids, flavonoids, phytosterols, carbohydrates, proteins, tannins, fats and fixed oils may be responsible for activity⁹.

Antidiabetic activity

The chitosan based extract as well as aqueous extract of *E. ganitrus* have been studied for antidiabetic activity in rats. It was observed that chitosan based *E. ganitrus* leaf extract stimulated hypoglycaemic action on normal rats. By virtue of antioxidant potential of taken extract they can relieve the stress induced through hyperglycaemia⁴⁰. Due to chitosan, insulin secretion of pancreatic cells could be stimulated, overgrowth of cells and isolated pancreatic islet cells improved, disorders of glucose tolerance decreased and disposed⁴¹. The % decrease in blood glucose in case of the chitosan based aqueous extract at a dose of 200 mg/kg was as good as with that of standard antidiabetic drug glimeperide 20 mg/kg. More reduction in blood glucose was observed with in diabetic rats when compared to normal rats administered with the same dose. The study illustrates marked antidiabetic activity of *E. ganitrus* in diabetic rats. The chitosan based extract enhanced the antidiabetic potential of *E. ganitrus* evidently manifests synergy⁴².

One more study indicates the hypoglycemic activity of *Elaeocarpus ganitrus* (EGA) aqueous seed extract. The activity was investigated by administering single dose at three ordered dose levels viz. 250, 500 and 1000 mg/kg of body weight in normoglycemic rats.

Streptozotocin (STZ) (60 mg/kg, i.p.) induced diabetic rats were also administered with the same dose levels for investigating antihyperglycemic activity of the extract. Metformin (500 mg/kg) was administered as the reference drug. EGA demonstrated a marked hypoglycemic effect at 2 h in normoglycemic rats. The EGA administration markedly reduced the blood glucose level and modulated lipid profile in a dose-dependent fashion in STZ-induced diabetic rats during the 30 days of treatment period. Therefore it designates that EGA seeds possess significant antidiabetic activity⁴³. STZ stimulates diabetes by a rapid depletion of pancreatic beta-cells and thereby, depletes insulin secretion and stimulates hyperglycemia⁴⁴. Metformin develops hypoglycemia by an extra pancreatic mechanism⁴⁵. Elevated levels of serum triglycerides and cholesterol in STZ-diabetic rats reinforce findings by⁴⁶. EGA treatment recommends its presumptive role in attenuation of impacts on lipid profile in diabetes. Alkaloids, viz. rudrakine, (-) elaeocarpine and (-) iso-elaeocarpine, flavonoids and glycosides may be attributed for hypoglycemic effect of *E. ganitrus*³¹.

Antihypertensive activity

The effects of Rudraksha (*Elaeocarpus ganitrus* Roxb.) in experimentally induced acute hypertension by adrenaline and nicotine have been investigated. Study was done in 6 anaesthetised cats having similar body weight and age. 90 % Ethanol extracts (E.g-90) of *E. ganitrus* is extracted and water soluble portion was given intravenously to cats to study its effect on normal blood pressure as well as hypertension induced by hypertensive agents. Blood pressure was measured by using Pressure transducer and Polyrite (INCO). Adrenaline and nicotine, when administered through I/V route induces significant increase of BP in normal control animals. Adrenaline failed to induce any hypertension in animals pretreated with E.g-90. But nicotine induces statistically significant hypertension in E.g-90 pretreated animals. *Elaeocarpus ganitrus* Roxb. reduces

adrenaline induced hypertension and also normal blood pressure; but it is not effective in nicotine induced hypertension. Experimental results showed hypotensive effect of *Elaeocarpus ganitrus* on experimental hypertension as well as in normal blood pressure⁴⁷.

Aqueous extract of *Elaeocarpus ganitrus* Roxb. seeds has been assessed for its antihypertensive activity in renal artery occluded hypertensive rats. Male Wistar rats (180-200 g) were pretreated with aqueous extract of *E. ganitrus* for 6 weeks. Hypertension was persuaded in rats by clamping the renal artery with renal bulldog clamp for 4 h. Ischemia of the kidneys accounts elevation of blood pressure by activation of the renin-angiotensin system. Considerable decrease was observed in elevated blood pressure of the rats when treated by the aqueous extract of *E. ganitrus* at the dose levels of 25, 50 and 100 mg/kg, *i.v.* Captopril, angiotensin converting enzyme inhibitor (ACE-I) at the dose of 1 mg/kg, *i.v.* demonstrated significant reduction in the elevated blood pressure. The action on rennin-angiotensin system may be attributed for antihypertensive activity of aqueous extract of *E.ganitrus*. The phytochemical evaluation of aqueous extract of *E. ganitrus* showed the presence of glycosides, alkaloids, steroids and flavonoids⁴⁸.

Antioxidant activity

In vitro antioxidant activity of ethanolic extract of *Elaeocarpus ganitrus* leaves was evaluated for their total antioxidant capacity, metal chelating, reducing power, hydroxyl radical scavenging and ABTS+ (2, 2-azinobis-(3-ethylbenzothiazoline-6-sulphonate) radical scavenging activities. Maximum iron chelating activity (76.70%) was observed at 500 µg/ml extract concentration followed by the scavenging of the ABTS+ radical (55.77%) at the same concentration. However, the extract demonstrated only moderate hydroxyl radical scavenging activity (13.43%). Total antioxidant capacity was detected to be 24.18 mg ascorbic acid equivalents at 500 µg/ml extract concentration. Recent studies have shown that various flavonoids and related

polyphenols confer substantially to the total antioxidant activity of many plants⁴⁹. Total phenolic content in *E. ganitrus* was detected to be 56.79±1.6 mg gallic acid equivalents/g of dry material. Total flavonoids in *E. ganitrus* were detected to be 18.58± 0.3 mg rutin equivalents/g of dry material. These findings recommend 85% of the antioxidant capacity of *E. ganitrus* is by virtue of phenolics and flavonoid components. Moreover, enzymatic and other non-enzymatic antioxidants may be contributed to antioxidant potential⁴⁰.

Anxiolytic activity

Anxiolytic effect of *Elaeocarpus ganitrus* was evaluated in mice. The experimental study was conducted with the extract of *Elaeocarpus ganitrus* in comparison with Diazepam using open field test and passive avoidance apparatus. Different dose of EG produce anxiolytic effect as elucidated by marked increase in number of square crossing and rearing as well as time spent in central square by animals and it was also seen that there was significant decrease in step down latency as well as significant increase in step down error and time spent in shock zone by animals⁵⁰. It shows *Elaeocarpus ganitrus* has central nervous system effect and indicative of anxiolytic effect³⁰.

Elaeocarpus sphaericus fruits methanolic extract at the dose of 200 mg/kg increased the percentage of time-spent and the percentage of arm entries in the open arms of the elevated plus-maze (EPM) and decreased the percentage of time-spent in the closed arms of EPM. Furthermore, it extended the ketamine-induced latency to sleep but had, no detectable effects on total sleeping time induced by ketamine. Also, the locomotor activity was deliberately affected in contrast to diazepam. The actions of methanolic extract of *Elaeocarpus sphaericus* fruits on spontaneous locomotor activity were determined automatically by breaking of infrared beams⁵¹. The effect of the studied extract on ketamine-induced sleeping time was determined as interpreted by Mimura *et al.*⁵². The behavior observed in the elevated plus-maze confirmed the anxiolytic activity of diazepam⁵³. The

decrease repugnance to the open arms is a consequence of an anxiolytic effect depicted by an increased number of open arm entries and time spent in the EPM. The decreased time spent on the central platform is one more indication of a reduced 'decision making' behavior. Both parameters are acknowledged as sound indicators of anxiety and fearfulness⁵⁴. Likewise, phytochemical screening of methanolic extract showed the presence of flavonoids, triterpenoids and saponins and the same could explain its anxiolytic activity. This study authenticates the conventional use of the plant in management of anxiety⁵⁵.

Different extractives, petroleum ether (PE), ethanol (EE), chloroform (CE), and water (WE) of *Elaeocarpus ganitrus* and *Centaurea behen* were prepared and evaluated for antianxiety effect by using elevated plus maize model in mice. The observations were compared with standard drug, diazepam. The chloroform and ethanol extractives of *E. ganitrus* at 200 and 400 mg/kg concentration and ethanol extractive of *C. behen* at 200 mg/kg concentration appreciably increased the time spent and percentage of the open arm entries in the elevated plus maize model and hence exhibited antianxiety activity, which was comparable to diazepam. Chemically the extracts of both the plants exposed phytosterols, alkaloids, flavonoids, fats, carbohydrates, proteins and tannins. The anxiolytic effects of the ethanol extractive of *C. behen* and chloroform and ethanol extractives of *E. ganitrus* may be related to their alkaloidal and flavonoid content⁵⁶.

Antidepressant Effect

Pharmacological examinations with the water soluble portion of 90% ethanol extract of the *Elaeocarpus ganitrus* fruits showed the existence of an important central nervous system depressant effect, characterized by typical behavioral actions, potentiating of hexobarbitone hypnosis and morphine analgesia, anticonvulsant and anti-amphetamine effects. The pharmacological outline of action of the extract substantiates the use of the plant fruits in the management of mental diseases, epilepsy,

hypertension, asthma and liver diseases in the traditional Indian systems of medicines. Benzene, Chloroform and Acetone extracts decreased swim stress immobility in mice representative of some degree of antidepressant activity²⁶.

Analgesic and Anti-inflammatory activity

Ethanol extract of the fruits of *Elaeocarpus ganitrus* shows analgesic activity³⁰ at a dose of 100mg/kg *i/p*⁵⁷. Analgesic and Anti-inflammatory potentials of different extracts (petroleum ether, chloroform, methanol and aqueous) of *Elaeocarpus sphaericus* leaves have been evaluated by using tail flick tests in mice and carrageenan-induced paw oedema (inflammation) in rats respectively. The methanol and aqueous extract of *Elaeocarpus sphaericus* leaves at all doses (50, 100, 200 mg/kg) showed significant percentage inhibition of oedema at 3rd hr of treatment when compared with control group but maximum percentage inhibition of oedema at dose 200 mg/kg (i.e. 46.21% and 41.66%) for both extracts. Analgesic activity was also confers by significant increase in tail flick response with the methanol and aqueous extract of *E. sphaericus* leaves at 100 mg/kg concentration. Methanolic and aqueous extract of *E. sphaericus* leaves at dose 200 mg/kg showed inhibitory effect on carrageenan induced inflammation. It may be due to inhibition of the enzyme cyclooxygenase leading to inhibition of prostaglandin synthesis⁵⁸. Prostaglandins (PGs) participate in the development of the second phase of inflammatory reaction which is measured at 3rd hr⁵⁹.

Petroleum ether, benzene, chloroform, acetone, and ethanol extracts of *Elaeocarpus sphaericus* fruits at a dose of 200 mg/kg was studied in rat paw oedema using different inflammogens. The petroleum ether, ethanol extracts are effective against carrageenan, bradykinin and PGE. The chloroform extract showed effect against histamine. Ethanol (EE) extract also inhibit histamine. Chloroform extract, was mainly effective in 5-HT induced inflammation²⁴. Sequential petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE)

and ethanol (EE) extracts (50-200 or 200 mg/kg, ip, or 200 mg/kg, po) of dried *Elaeocarpus sphaericus* fruits, pretreatment time 30-45 min, showed considerable anti-inflammatory action against both acute and sub-acute models, analgesic, barbiturate-hypnosis potentiation and antiulcerogenic activities in rats. Phytochemically screening of the extracts showed the positive test for glycosides, steroids, alkaloids and flavonoids and same may confers these medicinal potentials to plant³¹.

Stimulation of Immune Mediators

In vitro effects of *Elaeocarpus ganitrus* seeds with alkaloidal fraction (EGAF) have been investigated on murine cells for discharge of immune mediators and cell proliferation. The EGAF was experienced at concentrations ranging between 6.5-832 µg/ml. The discharge of mediators, nitric oxide, superoxide (NBT reduction), lysosomal and myeloperoxidase analysed from peritoneal exudates cells (PEC). The fraction was also investigated for cell proliferation in sulforhodamine B (SRB) assay on murine PEC, splenocytes and bone marrow cells. The fraction showed significant stimulation of NBT reduction, NO release and myeloperoxidase activity of PEC cells. Significant proliferation was noted in SRB assay with PEC and bone marrow cells. Phytohaemagglutinin, positive control, showed stimulation of discharge of all the experienced mediators and proliferation of immune cells. Hence the EGAF showed *in vitro* stimulation of immune mediators from PEC and proliferation of immune cells⁶⁰.

Antiasthmatic

The petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE) and ethanol (EE) extracts of *Elaeocarpus sphaericus* fruits were found to encompass mast-cell stabilizing activity, substantiating the worth of *Elaeocarpus sphaericus* in bronchial asthma³¹. In another

study the petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE) and ethanol (EE) extracts protected guinea-pigs in opposition to bronchospasm induced by histamine and acetylcholine aerosols³¹.

Antiulcerogenic

Different extracts (petroleum ether, benzene, chloroform, acetone, and ethanol) of dried *Elaeocarpus sphaericus* fruit also shows antiulcerogenic activities in rats³¹.

Other activities

Ethanol extract of fruits show signs of sedative, hypnotic, tranquillizing, antiepileptic, anticonvulsive and antihypertensive properties³⁰.

CONCLUSION

The widespread investigation of literature exposed that *Elaeocarpus ganitrus Roxb.* is an imperative basis of various pharmacologically and medicinally significant chemicals, such as indispensable triterpenes, tannins like geraniin and 3, 4, 5-trimethoxy geraniin, indolizidine alkaloids grandisines, rudrakine and flavonoids quercetin. Different bioactive extracts prepared from *Elaeocarpus ganitrus roxb.* have shown numerous healthpromoting effects *in vitro* and *in vivo*, such as antioxidant, anti-inflammatory, analgesic, antifungal, antimicrobial, antidiabetic, antioxidative, antihypertensive, antianxiety, antiasthmatic and antidepressant activities. *Elaeocarpus ganitrus* has been used lucratively in Ayurvedic medicine for centuries; investigations are called for to be attempted towards more clinical trials to support its therapeutic use. Eventually, it is also important to distinguish that *Elaeocarpus ganitrus* may be effective not only in isolation, but may in fact have a potentiating effect when given in combination with other herbs or drugs.

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