Review Article

A Review on Traditional and Ethnomedicinal Uses of *Elaeocarpus ganitrus* (Rudraksha)

Praveen Kumar Dixit[1*], Suchita Dixit [2], Monika Bhardwaj[1], Bhupendra Chauhan[3], K.Nagarajan[1], Jagannath Sahoo[1]
[1]Department of Pharmaceutical Sciences, KIET School of Pharmacy, Muradnagar, Ghaziabad, India.
[2]Sunderdeep Pharmacy College, Dasna, Ghaziabad, India.
[3]Adarsh Vijendra Institute of Pharmaceutical Sciences, Shobhit University, Gangoh, India.
***Corresponding author's E-mail:** pharmindia.praveen87@gmail.com

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ABSTRACT

The use of herbal products has increased attention in both in recent years for treatment as medical therapy in developed & developing countries. *Elaeocarpus ganitrus* roxb. (rudraksha) is a broad leaved tree, belonging to the family Elaeocarpeaceae has found in tropical and subtropical areas. It has great a place in indigenous system of medicine like Ayurveda, Siddha and Unani. Ancient time rudraksha is used for the treatment of various ailments like stress, anxiety, depression, neuralgia and epilepsy, migraine, asthma, hypertension, arthritis and liver diseases. According to the ayurvedic medicinal system, putting on rudraksha can have positive effects on heart and nerves. Research revealed that aqueous extract of leaves contains glycosides and ethanolic extract of leaves contains gallic acid, ellagic acid & quercetin. This plant reported to display various biological activities like antihypertensive, anti-depressant, anti-inflammatory, anti-microbial, analgesic, anti-diabetic and anti-oxidant activity. In view of its wide pharmacological and biological activities, it seems to be having a great therapeutic potential. The present review summarizes our current knowledge of major phytoconstituents, medical studies with major emphasis on traditional and pharmacological activities.

Keywords: *Elaeocarpus ganitrus*, Rudraksh, Elaeocarpaceae, Anti-hypertensive activity, Ant-diabetic activity.

INTRODUCTION

Elaeocarpus ganitrus universally known as rudraksha in sanskrit and rudraki in hindi is grown in Assam and Himalayan region of India [1]. Ayurvedic system of medicine, wearing *Rudraksha* beads relieves strain, insomnia, anxiety, lack of concentration, depression, palpitation, hypertension, rheumatism, infertility and asthma. It has anti-aging effect also [2]. It is useful in treating of epileptic fits, melancholia, manic conditions, mental disorders, convulsions, insomnia, hepatopathy, hypertension, bronchitis, fever [3]. The fruits of Elaeocarpus group are artistic with a very unbreakable and highly patterned stony endocarp. Out of about 120 species of Elaeocarpus reported from Asia, 25 species occur in India. Rudraksh, is a common tree alongside the foothills in Arunachal Pradesh except in Tawang, Upper Subansiri and some high elevation areas [4]. The word Rudraksha, literally imitative from two Sanskrit words –'rudra', a synonym for Lord Shiva and 'aksha' meaning eyes. It is also called blueberry beads because beads are sheltered by an outer shell of blue color on fully ripening [5]. The folklore states about the plant that the three demons, Tripurasuras were having inestimable powers. They lived in Purams which was built in the sky and revolved in the region of the space. The Purams were cosseted by a fortunate thing from Lord Ganesha that nonentity can harm them, unless they come into a single axis .That moment comes only once in every thousand years. Prayed by all gods, Lord Shiva resolute to kill those demons. Lord Shiva did tapasya (meditation) with half-closed eye (Ardha nimeelita neetra). He opened his eyes, strenuous on the axis and burnt Tripurams. Due to the stress caused by tapasya, tears came out his eyes while opening them and they turned into rudraksha [6]. The fruits of this plant are commonly known as Rudraksha and have been used in Ayurvedic traditional medicine for the treatment of mental diseases, epilepsy, asthma, hypertension, arthritis and liver diseases [7]. *E. ganitrus* fruits be full of glycosides, steroids, alkaloids and flavonoids. Apart from this, it has been found that the exocarp of the fruit provisions a nutritious incentive to consumers, predominantly rich in carbohydrates (21.0% dry mass, or 0.58 g per fruit) and proteins (4.3% dry mass, or 0.12g per fruit), but lacking in lipids [8]. These trees start giving fruit after 7-years. The percentage symphony of gaseous elements C-H-N present in the *Elaeocarpus sphaericus* analyze by Gas chromatography. These percentages are 50.031 % C, 0.95% N, 17.897% H [9]. The Rudraksha as a mediator is superior and privileged over other plant materials as it stands non degradable, the same bead is capable of giving extracts innumerable times, can withstand repeated boiling; while most of the plant materials humiliate after extract being once taken out [10].

Chemical Constituents

Elaeocarpus species are known to contain several chemicals such as triterpenes, tannins (e.g., geranin and 3, 4, 5-trimethoxy geranin), indolizine alkaloids (e.g. grandisines), flavonoids [11]

Five new indolizilidine alkaloids grandisines C, D, E, F, and G and one known indolizidine alkaloid isoelaeocarpiline were isolated from the leaves of *Elaeocarpus grandis*.

Grandisine is isomeric compound rudrakine. The absolute configuaration of grandisine D was deduced by its conversion isoelaeocarpiline. Grandisine E contains a novel tetracyclic ring system. Grandisine F is the 14-amino analogue of grandisine C. Grandisine G contains the novel combination of piperidine attached to an indizolidine [12].

Plant Profile [13,14]:

Kingdom: Plantae	**Common Names:**
Division: Magnoliophyta	**Sanskrit, Hindi & Marathi:** Rudraksha
Class: Magnoliopsida	**Bengali:** Rudrakaya
Order: Oxilidales	**Kannada:** Rudrakshi
Family: Elaeocarpaceae	**Tamil:** Akkamrudrakai
Genus: Elaeocarpus	**Telugu:** Rudraksha Halu
Species: Sphaericus/ Ganitru	**English:** Woodenbegar

Medicinal Perspectives

Anti-Hypertensive Activity

Hypertensive vascular disease is a common entity readily detectable, asymptomatic at times, easily treatable usually and often known to lead to lethal complications if left untreated [13]

Blood pressure is summarised by two measurements, systolic and diastolic, which depend on whether the heart muscle is contracting (systole) or relaxed between beats (diastole). This equals the maximum and minimum pressure, respectively. Normal blood pressure at rest is within the range of 100–140 mmHg systolic and 60–90 mmHg diastolic. High blood pressure is said to be present if it is often at or above 140/90 mmHg. [14].

The powdered seeds of *Elaeocarpus ganitrus* Linn. were extracted by maceration, overnight, using water, in copper (E1) and glass vessel (E2) and investigated for antihypertensive activity in cadmium chloride induced hypertension in male Wistar rats at three dose levels. E1 was administered at the different dose and E2 at different dose and both (E1 and E2) did not show any toxicity at the dose of 5 g/kg in rats. It was found that 15 mg/kg of E1 and 30 mg/kg of E2 decreases the blood pressure by 30.20 mmHg and 28.96 mmHg, respectively, in hypertensive rats [15] & also the water extract of *Elaeocarpus ganitrus* seeds (EGW) was studied for its antihypertensive activity in renal artery-occluded hypertensive rats and the extract was prepared by macerating the seeds powder in distilled water for 24 hours than dried in hot plate evaporator at 50–55^{0}C than the dried EGW was administered orally to male Albino Wistar rats at three different doses for six weeks. At the day of experiment, hypertension in anaesthetized rats was induced by the occlusion of renal artery for 4h and carotid artery was connected to blood pressure transducer of Power Lab eight channel recorder to measure the blood pressure and jugular vein was also cannulated for administration of the test compound. After obtaining stable blood pressure values, the renal arterial clip was removed and the Mean arterial blood pressure (MABP) was measured. MABP of animals in control group was measured without renal artery ligation. Then 1/10th of dose of test substance was administered by intravenous injection to experimental rats and MABP was measured. Captopril, an angiotensin converting enzyme inhibitor (ACE-I) was used as a positive control and the results showed that the EGW significantly decreased the elevated blood pressure in dose dependent manner comparable to positive control, captopril [16] & also the effect of *Elaeocarpus ganitrus* in experimentally induced acute hypertension by adrenaline and nicotine was study & done in 6 anaesthetised cats having similar body weight and age. Ethanol extracts of *E. ganitrus* Roxb was given intravenously to cats and blood pressure was measured by using Pressure transducer and Polyrite (INCO) & it show that *E. ganitrus* reduces adrenaline induced hypertension and also normal blood pressure but it is not effective in nicotine induced hypertension. The effect of the drug was found when the water soluble portion of the extract was given to cats [17] & also the aqueous extract of *Elaeocarpus ganitrus* seeds powder was evaluated for its antihypertensive activity in renal artery occluded hypertensive rats & for this male wistar rats were pre-treated with aqueous extract of *E. ganitrus* for 6 weeks and hypertension was induced in animals by clamping the renal artery with renal bulldog clamp for 4 h. Ischemia of the kidneys causes elevation of blood pressure by activation of the renin-angiotensin system. Elevated blood pressure of the animals was significantly decreased by the aqueous extract of *E. ganitrus* at the different dose. Captopril, angiotensin converting enzyme inhibitor (ACE-I) showed significantly reduced in the elevated blood pressure & indicated that antihypertensive activity of aqueous extract of *E. ganitrus* may be due to the action on rennin-angiotensin system. [18]

Anxiolytic Effects

Anxiety is a normal response to stress, a feeling of apprehension or fear, combined with the symptoms of increased sympathetic activity. A clinical problem may arise if anxiety becomes persistent that interferes with everyday performance. Clinical symptoms of anxiety include panic disorder, agoraphobia and other phobias and generalized anxiety [19]. Anxiolytics have been shown to be useful in the treatment of anxiety disorders.

The water methanolic extract of *E. ganitrus* was prepared and evaluated for antianxiety activity in mice in comparison with Diazepam in 60 mice using open field

test and passive avoidance apparatus in six experimental groups & show that there was a significant increase in number of square crossed, time spent in central square and rearing behavior of animal. There was also decreased significantly time prolongation in Step down latency and increase of attempts in step down errors as well as time spent in the shock zone & the result indicated that *E. ganitrus* showed anxiolytic effect but there is need to find out safety, efficacy and the exact mechanism of action of this herbal remedies. [20]. & the methanolic extract of *E. sphaericus* fruits 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 and in addition it long-lasting the ketamine-induced latency to sleep but had no significant effects on total sleeping time induced by ketamine. Also, the locomotor activity was affected but not to the same extent as observed for diazepam & result showed that the anxiolytic effects of methanol extract *E. sphaericus* fruits may be related to their content of flavonoids.[21].The petroleum ether (PE), chloroform (CE), ethanol (EE) and water extractives (WE) of *Centaurea behen* and *Elaeocarpus ganitrus* were prepared and evaluated for antianxiety activity in mice using elevated plus maize model and the results were compared with standard drug, diazepam. The ethanol extractive of *C. behen* and chloroform and ethanol extractives of *E. ganitrus* significantly increased the time spent and percentage of the open arm entries in the elevated plus maize model and hence exhibited anti-anxiety activity, which was comparable to diazepam. Chemically the extracts of both the plants showed the presence of phytosterols, fats, alkaloids, flavonoids, 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 content and results indicate that both the plants can be considered as potential aspirant for bioactivity guided isolation of natural antianxiety agents [22].

Analgesic and anti-inflammatory activity

Inflammation is the response to injury of cells and body tissues through different factors such as infections, chemicals, and thermal and mechanical injuries [23]. Sometimes, it may also evoke systemic signs and symptoms such as fever, malaise, loss of appetite, and so on[24]. Analgesic and Anti-inflammatory drugs are those reliefs in this condition.

The petroleum ether, chloroform, methanol and aqueous extract of *E. sphaericus* leaves was studied for analgesic and anti-inflammatory potentials using carrageenan-induced paw oedema in rats and tail flick tests in mice & shows that the methanol and aqueous extract of *E. sphaericus* leaves at all doses showed significant percentage inhibition of oedema at 3rd hr of treatment when compared with control group but maximum percentage inhibition of oedema at dose 200mg/kg for both extracts. While the standard drug Diclofenac sodium showed significant inhibition of oedema at 3rd hr. It is also concluded that for analgesic activity the methanol and aqueous extract of *E. sphaericus* leaves showed significant increase in tail flick response. The result concluded that inhibitory effect of methanolic and aqueous extract of *E. sphaericus* leaves on carrageenan induced inflammation may be due to inhibition of the enzyme cyclooxygenase leading to inhibition of prostaglandin synthesis [25].

Antidiabetic effects

Diabetes mellitus is a progressive metabolic disease [26]. Diabetes mellitus is a complex, chronic disorder that results from partial, complete or relative lack of insulin secretion by pancreatic b-cells and/or impairment of insulin action [27]. There are two main types of diabetes mellitus.

Anti-hyperglycemic activity of the extract of *Elaeocarpus ganitrus* (EAG) was also evaluated at the same dose levels in streptozotocin (STZ) -induced diabetic rats during a 30-day treatment period. Metformin was used as the reference drug. Parameter measured like fasting blood glucose and lipid parameters, viz. triglycerides, total cholesterol, high-density lipoprotein and low-density lipoprotein levels. Acute oral toxicity of the EGA extract was carried out in Swiss albino mice. In normoglycemic rats, EGA showed a significant hypoglycemic effect. In STZ-induced diabetic rats, the EGA treatment significantly decreased the blood glucose level in a dose-dependent manner during the 30 days of treatment period. EGA modulated lipid profile changes in STZ-diabetic rats in a dose-dependent manner. The investigation shows that EAG seeds has potential antidiabetic effects [28]. The constituents of essential oil of leaves and evaluation of phytochemical and antihyperglycemic effect of methanolic seed extracts of *E. ganitrus* Roxb. in streptozotocin induced diabetes. Essential oil was extracted from *E. ganitrus* leaves by hydrodistillation and purified oil was subjected to GC-FID analysis Preliminary phytochemical screening of various extracts of *E. ganitrus* seeds was carried out and antidiabetic activity of methanolic extract was evaluated in streptozotocin induced diabetic rats and the methanolic seed extract of *E. ganitrus* exhibit potent antidiabetic activity comparable to the standard drug glybenclamide. The methanolic extract of *E. ganitrus* seeds possess potent hypoglycemic activity [29]. The antidiabetic potential of chitosan based extract of *E. ganitrus* and antidiabetic activity of aqueous extract of *E. ganitrus* was evaluated and rats were used as experimental animals. It was found that chitosan based leaf extract of *E. ganitrus* produced hypoglycaemic effect in normal rats and study indicates clinically significant antidiabetic activity of *E. ganitrus* in diabetic rats. The chitosan based extract improved the antidiabetic activity of *E. ganitrus* clearly indicating synergism[30].

Anti-Microbial Activity

Contagious diseases are the world's foremost cause of impulsive deaths, killing almost 50000 people every day. Morbidity and mortality due to diarrhoea continues to be a major problem in many developing countries, specially amongst children [31]. The enlargement of microbial resistance towards antibiotics makes it necessary to search for new potential effective compounds against pathogenic bacteria [32]. Those agents which combat these bacteria's are called antibacterial agents.

Antibacterial activity of petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE) and ethanol (EE) extracts of dried *Elaeocarpus sphaericus* fruit was investigated against 28 gram-positive and gram-negative bacteria using the disc diffusion and plate dilution methods and result showed that AE fraction showed marked antimicrobial activity against ten organisms, BE was active against *Salmonella typhimurium* and *Morganella morganii*, and EE against *Plesiomonas shigelloides, Shigella flexnerii* and *Sh. Sonneii* & this may be due to alkaloids and flavonoids present in the plant [33] & the aqueous extract of leaves of *E. ganitrus* was tested against clinical isolates of bacteria and fungi. *In vitro* antimicrobial activity was performed by agar well diffusion method on Mueller Hinton agar and Sabouraud Dextrose agar for bacterial and fungal cultures respectively & the extract exhibited a broad spectrum of antimicrobial activity as it inhibited the growth of *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae, Penicillium* sp, *Aspergillus flavus*, *Candida albicans* and *C. tropicalis* and showed maximum relative percentage inhibition against *B. cereus.* [34]

Anti-Fungal Activity

Fungi are significant destroyers of foodstuffs and grains during storage, rendering them unfit for human consumption by retarding their nutritive value and often by producing mycotoxin. [35]

Antibiotics are one of our most important weapons in fighting bacterial infections and have greatly benefited the health-related quality of human life since their introduction. [36]

The different extracts of *E. ganitrus*, petroleum ether, chloroform, ethanol and water were prepared. Chemically the extracts showed the presence of phytosterols, fats, alkaloids, flavonoids, carbohydrates, proteins and tannins but chlorofom and ethanol extracts have high antifungal activity against *Candida albicans*. Whereas, chloroform, ethanol and water extracts showed moderate inhibition against *Aspergillus* niger [37].

Antioxidant Activity

The human body has a complex system of natural enzymatic and non-enzymatic antioxidant defenses which counteract the harmful effects of free radicals and other oxidants.[38].Antioxidants are compounds that inhibit or delay the oxidation of other molecules by inhibiting the initiation or propagation of oxidizing chain reactions [39].

Ethanolic extract of leaves of *Elaeocarpus ganitrus* was analyzed for their total antioxidant capacity, reducing power, metal chelating, ABTS+ (2, 2-azinobis-(3-ethylbenzothiazoline-6-sulphonate) radical scavenging and hydroxyl radical scavenging activities. The extract showed maximum Iron chelating activity followed by the scavenging of the ABTS+ radical at the same concentration. However, the extract showed only moderate hydroxyl radical scavenging activity and total antioxidant capacity was found to be 24.18 mg ascorbic acid equivalents at 500 µg/ml extract concentration. There was a positive correlation between the total phenolic content and antioxidant capacity, R2 = 0.8547, whereas the correlation between the total flavonoids and antioxidant capacity was determined to be R2=0.8413. Thus the phenolics and flavonoids in the leaves provide substantial antioxidant activity. [40]

Hepatoprotective Activity

The liver performs the normal metabolic homeostasis of the body as well as biotransformation, detoxification and excretion of many endogenous and exogenous compounds, including pharmaceutical and environmental chemicals[41]. Hepatotoxic agents can react with the basic cellular components and consequently induce almost all types of liver lesions [42]. So those chemical agents which prevent the damage of liver are called hepatoprotective agents.

The extract of *E. ganitrus* was screened for its hepatoprotective activity in carbon tetrachloride induced liver damage in Wistar albino rats and the extracts at different dose were administered orally once daily. The substantially elevated serum enzymatic levels of serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), serum alkaline phosphatase (ALP), total bilirubin, SOD and catalase were restored towards normalization significantly by the extracts. Silymarin was used as standard reference and exhibited significant hepatoprotective activity against carbon tetrachloride induced hepatotoxicity in rats and results of this study strongly indicate that *E. ganitrus* have potent hepatoprotective action against carbon tetrachloride induced hepatic damage in rats [43].

Immunomodulatory Activity

Immunomodulation is a process, which alters the immune system of an organism by interfering with its functions [44]. Immunomodulation is a procedure which can alter the immune system of an organism by interfering with its functions; if it results in an enhancement of immune reaction it is named as an immunostimulative drug which primarily implies stimulation of non-specific system [45]. The agents which are used to do so are called immunomodulatory agents.

The methanolic extract of *Elaeocarpus ganitrus* (EGM) seeds were evaluated for immunomodulatory activity using invitro and in vivo methodologies and effect of the extract at various concentrations on secretion of mediators like nitric oxide, superoxide and lysosomal enzyme from isolated murine peritoneal macrophages were evaluated after this extract showed significant stimulation of release of nitric oxide, superoxide and lysosomal enzyme and also evaluated for invivo phagocytic activity by carbon clearance assay in mice and it showed significant increase in the phagocytic index. The effect of the extract in delayed type hypersensitivity (DTH) and antibody titre assay were evaluated in ovalbumin immunized mice. & result of extract showed significant stimulation of DTH response and antibody titer but the effect of EGM extract in cyclophosphamide induced myelosuppressed mice was not significant [46].

Anti-Parkinsonian Activity

Parkinson's disease (PD) is the second most common neurodegenerative disorder worldwide and is characterized by the progressive loss of dopaminergic neurons in substantia nigra[47].Pathological features of PD include loss of dopamine neurons in substantia nigra and the presence of Lewy bodies in surviving dopamine neurons [48].

The anti-parkinson effect of *E. ganitrus* was evaluated & for evaluation rota rod and catalepsy bar tests were used. Assessment of oxidative stress was done by measuring the malondialdehyde (MDA) and reduced glutathione (GSH) levels in the striatal region of the brain. *E. ganitrus* pre-treated groups significantly increased the retention time in rota rod test and significantly decreased the latency period in catalepsy bar test when compared with haloperidol treated group alone & also *E. ganitrus* pre-treated groups showed significant anti-oxidative effect by causing a decrease in brain MDA levels and a significant increase in GSH levels & shows that oxidative stress plays a vital role in the pathophysiology of parkinson disease [49].

Anti-Depressant Activity

Depression is considered as an affective disorder characterized by change in mood, lack of interest in the surroundings, psychomotor retardation and melancholia [50]. Those agents which are used to elevate mood are called antidepressant agents.

Antidepressant effects of fruit extract of *Elaeocarpus ganitrus* (75% ethanol) on albino mice was evaluated and albino mice of either sex, weighing 25-30g were divided into seven groups and each group contains six animals. Group I, II and III were administered orally with distilled water, fluoxetine and imipramine respectively. Group IV, V, VI and VII were administered orally with different doses of *Elaeocarpus ganitrus* fruit extract (EGFE). Antidepressant effect was assessed by forced swim test & result showed that (EGFE) significantly decreased the immobility time and it also increased climbing and swimming time significantly. Duration of immobility of mice increased at high dose as compared to vehicle form this it is concluded that the EGFE exhibit antidepressant effect in tested animal model at low dose but at high dose it is sedative [51].

Miscellaneous Activity

Elaeocarpus sphaericus fruits are used in Ayurveda for mental diseases, epilepsy, asthma, hypertension, arthritis and liver diseases. Sequential petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE) and ethanol (EE) extracts of dried *E. sphaericus* fruits, pretreatment time 30–45 min, showed significant anti-inflammatory action against both acute and sub-acute models, analgesic, barbiturate-hypnosis potentiation and antiulcerogenic activities in rats. All the extracts, except PE and EE decreased swim stress immobility in mice indicating some degree of antidepressant activity. All the extracts protected guinea-pigs against bronchospasm induced by histamine and acetylcholine aerosols. Chemically, the extracts showed the presence of glycosides, steroids, alkaloids and flavonoids [52].

CONCLUSION

The legendary and religious importance of anything has line in faith and conviction the human beings have, which need not any explanation. But, the myths about amazing effects of Rudraksha on human body have been proved right by modern science. The remedial uses of *Rudraksha* beads in human body have been recognized through clinical trials under controlled and standard conditions. The extraordinary electro- magnetic properties, especially diamagnetism contained in these beads are accountable for the beneficial effects on the different systems of human body through simple contact with these beads or putting on. Till date, proportional evaluation of all the properties of different types of *(mukhi) Rudraksha* has also not been explored yet scientifically. Scientific research from this summit of outlook will further unfurl the mysteries related to *Rudraksha*.

REFERENCES

1. Garg Kalpana, Goswami Komal, Khurana Gaurav. A pharmacognostical review on *Elaeocarpus sphaericus*. International Journal of Pharmacy and Pharmaceutical Sciences, 5(1), 2013, 3-8.
2. Kumar Naresh, Dubey Mukesh, Agarwal Vivek. *Rudrakha*: a review on mythological, spritual and medicinal importance. Global Journal of Research on Medicinal Plants & Indigenous Medicine. 2(1), 2013, 65-72.
3. Kedia Akash, Ivanov Dmitry S and Dubey Nawal Kishore. Fungal contamination of stony endocarp (Rudraksh) of the *Elaeocarpus spp.* From three different countries. Indian Journal of Natural Products & Resources. 5(1), 2014, 97-100.
4. Khan M. L, Putul Bhuyan and Tripathi RS. Regeneration of Rudraksh (*Elaeocarpus ganitrus* Roxb.) - A Threatened Tree Species: Germination Strategies. International Journal of Ecology and Environmental Sciences. 29, 2003, 255-260.

5. Joshi Suresh C. and Jain Pratibha K. A review on ethnomedicinal and traditional uses of *Elaeocarpus ganitrus* roxb. (Rudraksha). International Journal of Pharma and Bio Sciences. 5(1), 2014, 495 – 511.
6. Prabha Rashmi, Kaur Amrinder. Mythological and Spiritual Review on *Eloeocarpus ganitrus* and Assessment of Scientific Facts for its Medicinal Uses. International Journal of Research. 1(5), 2014, 334-353.
7. Awan Bharti. Determination of Quercetin in extract of *Elaeocarpus ganitrus* Roxb seeds by using HPTLC method. International Research Journal of Pharmacy. 4(3), 2013, 186-188.
8. Singh Balbir, Ishar Mohan Pal S. and Sharma Anupam. Estimation of Quercetin, an Anxiolytic Constituent, in *Elaeocarpus ganitrus*. Journal of Pharmacognosy and Phytochemistry. 1(6), 2013, 117-121.
9. Swami Gaurav, Nagpal Navneet, Rahar Sandeep, Singh Preeti, Singla Shwali, Porwal Amit and Kapoor Reni. *Elaeocarpus sphaericus*: Medical and Scientific facts. Der Pharmacia Lettre. 2(1), 2010, 297-306.
10. Dwivedi Poushpi, Narvi Shahid S. and Tewari Ravi P. Novel Scientific Appraisal of *Elaeocarpus ganitrus* the Rudraksha: Nano Silver Synthesis with Aspects of Variation in Concentration Antimicrobial Activity and *In vitro* Biocompatibility. Annual Research & Review in Biology, 4(7), 2014, 1059-1069.
11. Pant Manu, Lal Ankita, Bisht Prabha and Rani Anju. *Elaeocarpus sphaericus*: A Tree with Curative Powers: an Overview. Research Journal of Medicinal Plant, 7, 2013, 23-31.
12. Shah Gagan, Singh Prabh Simran,Mann AS, Shri R. Scientific basis for the chemical constituent and therapeutic use of *Elaeocarpus* species: A review. International Journal of Institutional Pharmacy and Life Sciences. 1(1), 2011, 267-278.
13. Kale Anand, Maniyar Yasmeen A. Prescribing Patterns of Antihypertensive Drugs in A Tertiary Care Hospital. Scholars Academic Journal of Pharmacy. 2(5), 2013, 416-418.
14. Lewington S, Clarke R, Qizilbash N, Peto R, Collins R. Prospective Studies Collaboration. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. Lancet, 14, 360(9349), 2002, 1903-13.
15. Barve Kalyani H, Chodankar Rahul. Does copper enhance the antihypertensive effect of *Elaeocarpus ganitrus* in experimentally induced hypertensive rats. Journal of Ayurveda & Integrative Medicine. 5(2), 2014, 76-79.
16. Juvekar MR, Bodhankar SL, Sakat SS, Wankhede SS, Mali VR, Juvekar AR. Study of antihypertensive activity of *Elaeocarpus ganitrus* water extract in renal artery-occluded hypertensive rats. Planta Med. 2008, 74, 28.
17. Sarma Jayantha Kumar, Bhuyan GC, Koley Jyotika, Maity LN, and Drm Naikwadi VB. An experimental evaluation of the effect of rudraksha (*Elaeocarpus ganitrus* roxb) in adrenaline and nicotine induced hypertension. Anc Sci Life. 23(4), 2004 1–10.
18. Sakat SS, Wankhede SS, Juvekar AR, Mali VR, Bodhankar SL. Antihypertensive effect of aqueous extract of *Elaeocarpus ganitrus* Roxb. seeds in renal artery occluded hypertensive rats. International Journal of PharmTech Research. 1(3), 2009, 779-78.
19. Nagaraju B, Sahar SH, Ali Bolouri, Neha Kushnoor Z, Zahra A, Zothanmawia C, Surendranatha A. Anxiolytic effect of *Myristica fragrans*. International Journal of Phytothearpy Research. 3(1), 2013, 1-7.
20. Rauniar GP, Sharma M. Evaluation of anxiolytic effect of *Elaeocarpus ganitrus* in mice. Health Renaissance. 10(2), 2012, 108-112.
21. Shah Gagan, Shri Richa, Mann Avninder, Rahar Sandeep, Panchal Vivek. Anxiolytic effects of *Elaeocarpus sphaericus* fruits on the elevated plus-maze model of anxiety in mice. International Journal of Pharm Tech Research. 2010, 2(3), 1781-1786.
22. Singh Balbir, Sharma Anupam and Ishar MPS. Antianxiety Investigations of *Centaurea behen* Linn. and *Elaeocarpus ganitrus* Roxb. Journal of Pharmacy Research, 5(3), 2012, 1483-1486.
23. Kaushik Dhirender, Kumar Ajay, Kaushik Pawan, and Rana AC. Analgesic and Anti-Inflammatory Activity of *Pinus roxburghii* Sarg. Advances in Pharmacological Sciences. 2012, 1-6.
24. Ruknuddin G, Biswajyoti P, Kumar PP, Krishnaiah AB, Basavaiah R. Anti- inflammatory and analgesic activities of *Dashanga Ghana*: An Ayurvedic compound formulation. Int J Nutr Pharmacol Neurol Dis. 3(3), 2013, 303-8.
25. Nain Jaspreet, Garg Kalpna and Dhahiya Sumitra. Analgesic and anti-inflammatory activity of *Elaeocarpus sphaericus* leaf extract. International Journal of Pharmacy and Pharmaceutical Sciences. 4(1), 2012, 379-381.
26. Sabitha V, Ramachandran S, Naveen KR, and Panneerselvam K. Antidiabetic and antihyperlipidemic potential of *Abelmoschus esculentus* (L.) Moench. in streptozotocin-induced diabetic rats. J Pharm Bioallied Sci. 3(3), 2011, 397–402.
27. Nasry MR, Abo-Youssef AM, Abd El-Latif HA. Anti-diabetic activity of the petroleum ether extract of Guar gum in streptozotocin-induced diabetic rats: A comparative study. Journal of Basic and applied Sciences. 2(1), 2013, 51-59.
28. Hule AK, Shah AS, Gambhire MN, Juvekar AR. An evaluation of the antidiabetic effects of *Elaeocarpus ganitrus* in experimental animals. Indian Journal of Pharmacology. 43(1), 2011, 56-59.
29. Tripathi YC, Shukla Pratibha, Tewari Devesh. Phytochemical evaluation and antihyperglycemic effects of *Elaeocarpus ganitrus* roxb (*rudraksha*) in streptozotocin induced diabetes. International Journal of Pharmacy and Pharmaceutical Sciences, 7(1), 2015, 280-283.
30. Rao KS, Rao OU, Aminabee SK. Hypoglycemic and antidiabetic potential of chitosan aqueous extract of *Elaeocarpus ganitrus*. International Journal of Research in Pharmacy and Chemistry. 2(2), 2012, 428-441.

31. Alavijeh PK, Alavijeh PK and Sharma Devindra. A study of antimicrobial activity of few medicinal herbs. Asian Journal of Plant Science and Research. 2(4), 2012, 496-502.

32. Zaouia Kendour, Segni Ladjel, Noureddine Gherraf, and Redha Ouahrani Mohamed. Antimicrobial activity of nine medicinal plants growing in the south of Algeria. Annals of Biological Research. 1(4), 2010, 145-147.

33. Singh RK and Nath Gopal. Antimicrobial activity of *Elaeocarpus sphaericus*. Phytotherapy Research. 13(5), 1999, 448-450.

34. Kumar Gaurav, Karthik Loganathan and Rao KVB. Antimicrobial activity of *Elaeocarpus ganitrus* Roxb (Elaeocarpaceae): An *invitro* study. Elixir Bio. Tech. 40, *2011*, 5384-5387.

35. Satish S, Mohana DC, Raghavendra MP and Raveesha KA. Antifungal activity of some plant extracts against important seed borne pathogens of Aspergillus sp. Journal of Agricultural Technology. (1), 2007, 109-119.

36. Bhalodia NR and Shukla VJ. Antibacterial and antifungal activities from leaf extracts of *Cassia fistula* l.: An ethnomedicinal plant. J Adv Pharm Technol Res. 2(2), 2011, 104–109.

37. Singh B, Chopra A, Ishar MPS, Sharma A, Raj T. Pharmacognostic and antifungal investigations of *Elaeocarpus ganitrus* (Rudrakasha)", Indian J Pharm Sci, 72(2), 2010, 261-5.

38. Md. Alam Nur, Bristi Nusrat Jahan, Md. Rafiquzzaman. (2013). Review on in vivo and in vitro methods evaluation of antioxidant activity. Saudi Pharmaceutical Journal. 21, 2013, 143–152.

39. Velioglu YS, Mazza G, Gao L, and Oomah BD. Antioxidant Activity and Total Phenolics in Selected Fruits, Vegetables, and Grain Products. J. Agric. Food Chem. 46, 1998, 4113-4117.

40. Kumar TS, Shanmugam S, Palvannan T and Kumar VMB. Evaluation of Antioxidant Properties of *Elaeocarpus ganitrus* Roxb. Leaves. Iranian Journal of Pharmaceutical Research. 7(3), 2008, 211-215.

41. Lahon Kingshuk and Das Swarnamoni. Hepatoprotective activity of *Ocimum sanctum* alcoholic leaf extract against paracetamol-induced liver damage in Albino rats. Pharmacognosy Res. 3(1), 2011, 13–18.

42. Eidi Akram, Mortazavi Pejman, Bazargan Maryam Jalal, Zaringhalam. Hepatoprotective activity of cinnamon ethanolic extract against ccl-induced liver injury in rats. EXCLI Journal. 11, 2012, 495-507.

43. Anusha, Janarthan M. Evaluation of hepatoprotective activity of *Elaeocarpus ganitrus* leaf extract against CCl4 induced liver damage. Journal of Chemical and Pharmaceutical Sciences. 7(4), 2014, 336-344.

44. Agrawal SS, Khadase SC and Talele GS. Studies on Immunomodulatory Activity of *Capparis zeylanica* Leaf Extracts. International Journal of Pharmaceutical Sciences and Nanotechnology. 3(1), 2010, 887-892.

45. Sahu MS, Sahu RA, Verma Amita. Immunomodulatory activity of alcoholic extract of *Habenaria intermedia* in mice. International Journal of Pharmacy and Pharmaceutical Sciences. 5(3), 2013, 406-409.

46. Hule AK, Juvekar AR. Evaluation of immunomodulatory effects of methanol extract of *Elaeocarpus ganitrus* seeds. Journal of Natural Remedies. 10(1), 2010, 1-10.

47. Kabra MP, Bhandari SS, Sharma A, Gupta RB. Evaluation of anti-parkinson's activity of gentisic acid in different animal models. Journal of Acute Disease, 2014, 141-144.

48. Sandhu KS, Rana AC. Evaluation of anti-parkinson's activity of *Nigella sativa* (kalonji) seed in chlorpromazine induced experimental animal model. International Journal of Pharmacy and Pharmaceutical Sciences. 5(3), 2013, 884-888.

49. Bagewadi HG, Khan AKA. Evaluation of anti-parkinsonian activity of *Elaeocarpus ganitrus* on haloperidol induced Parkinson's disease in mice. International Journal of Basic & Clinical Pharmacology, 4(1), 2015, 102-106.

50. Pemminati Sudhakar, Gopalakrishna HN, Shenoy AK, Sahu SS, Mishra Shishir, Meti Vinayak, Nair Vinod. Antidepressant activity of aqueous extract of fruits of *Emblica officinalis* in mice. International Journal of Applied Biology and Pharmaceutical Technology. 1(2), 2010, 449-454.

51. Dadhich Amit, Jasuja Nakuleshwar Dut, Chandra Subhash and Sharma Gargi. Antidepressant effects of fruit extract of *Elaeocarpus ganitrus* in force swim test. International Journal of Pharmaceutical Sciences and Research. 5(7), 2014, 2807-12.

52. Singh RK, Acharya SB and Bhattacharya SK. Pharmacological activity of *Elaeocarpus sphaericus*. Phytotherapy Research. 14(1), 2000, 36-39.

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