

A PHARMACOGNOSTICAL REVIEW ON *ELAEOCARPUS SPHAERICUS*KALPANA GARG^{1*}, KOMAL GOSWAMI¹, GAURAV KHURANA²¹Department of Pharmaceutical sciences, Ch. Devi Lal college of pharmacy, Yamuna nagar, India 517102, ²Department of Pharmaceutical sciences, Shri Baba Mast Nath Institute of Pharmaceutical Sciences & Research, Asthal Bohr, Rohtak. Haryana-125001.
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ABSTRACT

In recent times, the use of herbal products has increased tremendously in the Western world as well as in developing countries. *Elaeocarpus sphaericus* (rudraksha) is a broad leaved tree, belonging to the family Elaeocarpaceae found in tropical and subtropical areas. It is popular in an indigenous system of medicine like Ayurveda, Siddha and Unani. Traditionally rudraksha is used for the treatment of various ailments like stress, anxiety, depression, palpitation, nerve pain, and epilepsy, and migraine, lack of concentration, asthma, hypertension, arthritis and liver diseases. According to the ayurvedic medicinal system, wearing of rudraksha can have a positive effect on heart and nerves. Rudraksha contains indolizidine type of Alkaloids. Indolizidines are widely distributed in nature – in plants as well as in many animals. It also contains minerals, vitamins, steroids, flavanoids. Aqueous extract of leaves contains glycosides also. Ethanolic extract of leaves contains gallic acid, ellagic acid & quercetin. The present review summarizes our current knowledge of major phytoconstituents, clinical studies with major emphasis on traditional and pharmacological activities. This plant reported to display various biological activities like antihypertensive, antidepressant, anti-inflammatory, antimicrobial, analgesic, antidiabetic and antioxidant activity. In view of its wide pharmacological and biological activities, it seems to be having a great therapeutic potential.

Keywords: *Elaeocarpus sphaericus*, *Elaeocarpus*

INTRODUCTION

Elaeocarpus sphaericus (syn. *Elaeocarpus ganitrus*) commonly known as rudraksha in sanskrit and rudraki in hindi is grown in Assam and Himalayan region of India for its attractive fruit stones and medicinal properties [1]. It is used in folk medicine in treatment of stress, anxiety, depression, palpitation, nerve pain, epilepsy, migraine, lack of concentration, asthma, hypertension, arthritis and liver diseases. According to the ayurvedic medicinal system, wearing of rudraksha can have a positive effect on heart and nerves [2,3,4].

BOTANICAL CLASSIFICATION⁵

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Oxilidales
Family	Elaeocarpaceae
Genus	Elaeocarpus
Species	Sphaericus/ Ganitrus

DESCRIPTION

Elaeocarpus sphaericus commonly known as rudraksha is a large evergreen broad leaved tree found in tropical and subtropical areas at the altitude ranging from seacoast to 2,000 meters above the sea level⁶. The *Elaeocarpus* consists of about 12 genera and 350 species of trees and shrubs and are distributed in the tropical and subtropical regions but mainly it has about 36 sister species including rudraksha [7,9]. Rudraksha has two words bonded together; Rudra+ Aksha means "Rudra-eye" is the Sanskrit name of dark berries of *Elaeocarpus ganitrus*, used to make prayer beads. The tree is considered as a threatened plant in north eastern region of India⁸. The leaves of rudraksha tree are shining green on the upper side with a dull leathery on the dorsal side. The main trunk of rudraksha tree is cylindrical with a grayish white & rough textured bark. The fruits of Rudraksha appear in June and ripen by August & October. They are globular in shape. The bead present inside is hard and tubercle. Fruits are 1cm. in diameter, deep blue or mealy when ripe. The bark is grayish white & rough in texture. The flowers of Rudraksha are white with fringed petals & they appear in April-May. Flowers in racemes mostly from axils of fallen leaves, nodding, white, about 1cm across, anther bristled at the apex [9,10]. Color- white (flowers); Taste- sour (fruit, pulp); Shape- ovate with tithed edges (leaves); Round and ovate (fruits); Size - length: 5-6 inch,

Width: 2 inch (leaves); Diameter: ½ Inch (flowers) Diameter: 1½ inch (fruits). *Elaeocarpus sphaericus* is used to make prayer beads the stones of this plant are cleaned, polished, sometimes stained and used for making bracelets and other ornamental objects [8]. The term rudraksha itself symbolizes Lord Shiva. Rudraksha comes from 1 to 38 mukhis but rudraksha of 1-14 mukhis are commonly found. The five faced rudraksha are found easily & abundantly. One much rudraksha is rare. Rudraksha depending upon the availability & production of rudraksha different prices have been allocated for different mukhis rudraksha. Most of power of rudraksha seems to be associated with no. of mukhis that the bead has [12].

Rudraksha	Major Benefits
1 mukhi	Enlightens the super consciousness, provides improved concentration and mental structure changes.
2 mukhi	Blesses the wearer with 'UNITY'. It could be related to Guru- Shishya, parent- children or friends.
3 mukhi	The wearer gets free from sins or wrongs from his life and returns to purity. Ideal for those who suffers from guilt and depression.
4 mukhi	The wearer gains power of creativity when blessed increases memory power and intelligence.
5 mukhi	Wearer gains health and peace, increases memory also.
6 mukhi	Saves from emotional trauma of wordy sorrows and gives learning, wisdom and knowledge.
7 mukhi	It should be worn by peoples who are suffering from finance and mental set-up.
8 mukhi	Removes all obstacles and brings success in all undertakings.
9 mukhi	Wearer is blessed with lot of energy, powers, dynamisms and fearlessness which are useful to live a life of success.
10 mukhi	It works like a shield on one's body and drives evils away.
11 mukhi	Blesses wearer with wisdom, right judgment, fearlessness and success.
12 mukhi	Wearer gets the quality of sun- to rule and to move continuously with brilliant radiance and strength. Removes worry, fear. Increases self image and motivation.
13 mukhi	It gives honor and fulfills all the earthly desires. It is helpful for meditation.
14 mukhi	It awakens the sixth sense organ by which the wearer foresees the future happenings.

CULTIVATION

Rudraksha farming is a difficult process due to the slow sprouting from the beads. Depending on the humidity of the soil, it usually takes 1-2 years for a tree to sprout. Rudraksha is grown in subtropical climate region with temperature ranges from 23-25 degree centigrade. The tree starts giving fruit after 7 years and period. A single rudraksha tree bears beads in all different faces or mukhis at the same time. The higher mukhis or faces are very rare. Most common rudraksha bead is five faceted or Panchmukhi. The environment and location of rudraksha tree plays a major role in the bead formation and the type of bead formed, e.g. The Himalayan beads seems larger, heavier and more powerful due to the environment they grow in [6,11]. In the single tree Rudraksha tree comes in different faces at the same time but higher mukhis faces are very rare. The Himalayan beads simply seems to be larger, heavier and more powerful due to the environment they grown in. So it is a certainty that environment and specifically the location of rudraksha trees play a key role in their growth [6].

RUDRAKSHA AND HINDU MYTHOLOGY

All legends pertaining to the origin of Rudraksha describe them as tears shed by Lord Shiva. According to one story, Lord Shiva once entered a profound state of meditation for the benefit of mankind. When he emerged from this state and opened his eyes, the deep joy and peace that he felt were expressed as tears, which ran down his cheeks and fell on the earth. From his tears emerged the rudraksha tree. The word Rudraksha, in fact, comes from two Sanskrit words – 'rudra', a synonym for Lord Shiva and 'aksha' meaning eyes [13].

CONSERVATION STATUS IN INDIA

As per recent studies, the population of the rudraksha tree in India is dwindling at an alarming rate. The decrease in the population is mainly attributed to the over-exploitation of the species and also, to the large-scale disturbances in their habitats. The tree reproduces by means of seeds. The increased seed collection by local people has resulted in the shrinkage of the natural seed bank in the soil. This in turn has adversely affected the regeneration of the species. Thus, the tree is being pushed to the threatened category (currently not listed in the Red data book) and may even become extinct in the future if immediate conservation measures are not taken up [10].

DENSITY, POPULATION STRUCTURE AND REGENERATION STATUS OF RUDARKSHA

The density of adult trees is 21 individuals per hectare in the undisturbed stand, 19 in the mildly disturbed stand, 14 in the moderately-disturbed stand and 12 in the highly-disturbed stand. The regeneration was recorded in the undisturbed (two saplings and 200 seedlings/ha), mildly-disturbed (four saplings and 200 seedlings/ha) and moderately-disturbed (100 seedling/ha) stands, while no regeneration (saplings and seedlings were absent) was recorded in the highly disturbed stand. The highest basal area was recorded in the undisturbed stand (4.2 m²/ha), intermediate (2.8 and 2.6 m²/ha) in the mildly- and moderately-disturbed stands and least (1.9 m²/ha) in the highly disturbed stand. Seedling survival and growth were more in the undisturbed stand. No cut stump was recorded in the undisturbed- and highly-disturbed stands. The population of rudraksha was rather low in all the studied forest stands. The adult individuals were recorded in all the stands, but populations of seedlings and especially of saplings were very poor in most of the stands. Population structure of rudraksha was studied during 1998-99 using the quadrat method (30 m × 30 m for trees and saplings, 10 m × 10 m for seedlings). For this purpose, ten quadrats were placed randomly at each stand for trees, saplings and seedlings. The individuals of rudraksha occurring in each of the quadrates were listed and their circumference was measured. The study reveals that a threatened species such as rudraksha, which has a low population density and exacting habitat preference, may not be able to perpetuate itself for long, if effective conservation measures are not taken in time [14].

COMPOSITION OF RUDRAKSHA

Rudraksha beads are a plant product, containing carbon, hydrogen, nitrogen, oxygen and trace elements in combined form. Percentage composition of gaseous elements in rudraksha beads:

Carbon - 50.031%
 Nitrogen - 0.95%
 Hydrogen - 17.897%
 Oxygen - 30.53% [9,1]²

MICROSCOPY

Seed coat of rudraksha consists of multilayered, oval to polygonal stone cells and internally followed by 8 to 10 layers of tangentially elongated, oval shaped, thin walled, parenchymatous cells, filled with reddish- brown contents, excepting the middle 2 or 3 layers, endosperm consists of oval to polygonal, thin walled, parenchymatous cells, rosette crystals of calcium oxalate and oil globules present in this region, embryo slightly curved and consists of oval to polygonal, thin walled, parenchymatous cells, a few having oil globules. Powder of seed shows Reddish brown, polygonal lignified with narrow lumened stone cells, thin walled, parenchymatous cells with reddish brown contents, and rosette crystals of calcium oxalate and oil globules.

IDENTITY, PURITY, AND STRENGTH (SEED)

Total ash : NMT 1.2% Foreign matter : NIL Acid insoluble ash : NMT 0.4
 Alcohol soluble extractive : NLT 2% Water soluble extractive : NLT 1%

TRADITIONAL USES OF RUDRAKSHA [15]

Unripened and ripened fruits of *Elaeocarpus sphaericus* shows different traditional uses:

- *Elaeocarpus sphaericus* imposes positive effect on stress, anxiety, depression, palpitation and lack of concentration.
- It cools down the body temperature and brings calm to mind. Those who suffer from anxiety should keep big size five mukhi *Elaeocarpus sphaericus* with themselves and whenever they feel nervous; they should hold them tight in their right palm for ten minutes. It will help them to regain their confidence and their body becomes stable.
- *Elaeocarpus sphaericus* also possess antiageing property [16].
- *Elaeocarpus sphaericus* is also useful in mental diseases. Milk boiled with four faced rudraksha seed is good medicine for mental diseases. This also helps in increasing memory.
- *Elaeocarpus sphaericus* is also good for women's who suffering from hysteria and coma.
- *Elaeocarpus sphaericus* is also good for children's who suffers from frequent fever.
- *Elaeocarpus sphaericus* also helps to cure prolonged cough, the paste of ten- faced rudraksha with milk relieves prolonged cough. This medicine should take thrice a day. It can be used as a cure for skin diseases, sores, ringworms, pimples, boils and burns also.
- To cure small pox equal quantity of black pepper and *Elaeocarpus sphaericus* should powdered and taken with water.

METHODS FOR IDENTIFICATION OF REAL ELAEOCARPUS SPHAERICUS [15,17-19]

It is very simple to identify a real *Elaeocarpus sphaericus*. The version of it increases the importance and price. It is made synthetically and the artificial *Elaeocarpus sphaericus* are also being sold in market. There are many methods of testing a genuine (or fake) *Elaeocarpus sphaericus*:

Cut Test

It is most reliable methods and for this cut the *Elaeocarpus sphaericus* bead horizontally. When it will be cut one can find the same number of section as the number of lines. If it is not then drawback of this method is that bead gets damaged.

Properties Test

This test gives information that whether the beads show properties like inductance, capacitance, conduction of electric current etc.

Copper Coin Test

Generally it is believed that when an *Elaeocarpus sphaericus* bead is placed between two copper coins it will slightly rotate either clockwise or the anticlockwise direction. This phenomenon occurs due to physical and magnetic properties of the *Elaeocarpus sphaericus* beads. Only expert people are good for it.

Eye test

Sometimes the fake or the artificial *Elaeocarpus sphaericus* may seem same as real one but these fake *Elaeocarpus sphaericus* facets cannot be made as real as those present on the real *Elaeocarpus sphaericus*. This is a natural partition on *Elaeocarpus sphaericus* which just like the closed lips with deep natural. See these deep linings (facets) with the help of a magnifying glass (Lenses) and thus can be easily distinguish a real *Elaeocarpus sphaericus*.

Water test

Some of the rare *Elaeocarpus sphaericus* beads like Gauri Shankar *Elaeocarpus sphaericus* or a Trijuti can be made by synthetically joining two or three *Elaeocarpus sphaericus* with help of paste etc. If there is any hesitation this *Elaeocarpus* bead, kept in boiling water bath for some minutes. A sharp streak will take place at the joint in case of synthetic *Elaeocarpus sphaericus*.

RUDRAKSHA OIL

It is cold compressed 100% pure oil extracted from rudraksha seeds. It is used as a dietary supplement. Drink two drops of oil once a day for internal healing. It is also used as externally as hair oil daily, removes dandruff and acts as hair conditioner, reduces acne & pimples. It also pacify skin condition such as eczema, ringworm removes itching and helps to heal faster. It is also used as bodies massage oil.

AYURVEDIC PROPERTIES OF RUDRAKSHA [11,20]

Ayurveda refers to this wonderful bead and gives details of rudraksha for strengthening body constitutions. The beads of rudraksha, its bark and leaves all are used to cure various ailments like mental disorders, headache, fever, skin diseases etc. Rudraksha may be worn either on wrist, arm or other parts of the body.

As a blood purifier: Rudraksha shall be used for treating the blood impurities and strengthens the body substance.

As antibacterial: Rudraksha can be used for treating the burns and marks. It can also be used for curing cough and breathing problems.

For blood pressure: Rudraksha can be used to treat high blood pressure, heart diseases etc. As cosmetic product: Rudraksha can be used in cosmetics to bring skin glow, also brings in a charming face.

For improving memory power: Rudraksha can be used for improving memory power when taken with milk.

For all brain diseases: Rudraksha can be used for treating all brain diseases like brain fever etc.

For controlling epilepsy: By using pulp of Rudraksha fruit or bark, can be used for controlling epilepsy.

For curing liver related problems, jaundice, and stomachache: Rudraksha can be used for treating stomach pain and liver problems.

MEDICINAL VALUE OF RUDRAKSHA [11,20]

Modern science has shown that the electromagnetic nature of rudraksha beads affect our neurophysiology in a specific manner that allows control of heart beat, blood pressure, stress levels, hypertension and at the same time relieves anxiety, depression and neurotic condition. Rudraksha can be used even for the treatment of chronic diseases like cancer either used externally by wearing it or an oral administered by drinking milk of rudraksha beads boiled in it and taking the finest dust of rudraksha mixed with water and different mukhi dust are used for different diseases.

- Heart, spine, diaphragm, thymus, blood, veins, eye sight = 1& 12 mukhi.
- Stomach including gastric processes, non blood fluid system= 2 mukhi.
- Hands, arms, lungs, sensory organs, thyroid glands, brain disorders = 4 mukhi.
- Adrenal glands, red blood cells, blood pressure disorders = 3 mukhi.
- Posterior lobe of pituitary related to growth and thighs = 5 mukhi.
- Mental/ emotional tension, depression, spleen, skeletal system and anterior lobe of pituitary gland = 7&14 mukhi
- Skin problem, body pain = 9 mukhi.
- Sleep disorders = 9 mukhi.
- Nervous system disorders = 11 mukhi

EFFECT OF ALKALOIDAL FRACTION OF *ELAEOCARPUS GANITRUS* ROXB

The alkaloidal fraction of *Elaeocarpus ganitrus* seeds (EGAF) was prepared and evaluated for in vitro effects on murine cells for release of immune mediators and cell proliferation. The EGAF was tested at concentrations ranging between 6.5-832µg/ml. The release of mediators assayed from peritoneal exudates cells (PEC) include nitric oxide (NO), superoxide (NBT reduction), lysosomal and myeloperoxidase. The fraction was also evaluated for cell proliferation in sulforhodamine B (SRB) assay on murine PEC, splenocytes and bone marrow cells. Swiss albino mice were acclimatized for 10 days before being used for the experiments. They were housed in a room with controlled temperature (23±20C) and a 12h light/ 12h dark cycle. The animals were fed with standard pellet diet [21]. Thioglycollate medium elicited isolated murine peritoneal exudates cell (PEC) preparations composed of ~30% macrophages, ~ 60% neutrophils, and 7-10 % lymphocytes [22]. These cells are important immune effectors cells required in maintaining disease free-state or elevating disturbed immune state. Macrophages actively participate as cellular effectors of non-specific host defense. Antigen stimulation transforms the precursor monocytes into macrophages, which subsequently eliminate pathogens via phagocytosis [23]. Macrophages are the main proinflammatory cells that respond to invading pathogens by releasing many pro-inflammatory molecules, including short-living free radical nitric oxide (NO). NO is synthesized from L-arginine by NO synthase (NOS) in numerous types of cells. In mammals, 3 distinct isoforms of NOS have been cloned: endothelial, neuronal, and inducible NOS (iNOS). Among these isoforms, iNOS plays an important role in the regulation of cytotoxic responses [24]. Agents that modulate the activity of NO may be of considerable therapeutic value. NO mediates diverse functions, including vasodilatation, neurotransmission and inflammation [25]. The alkaloidal fraction has shown stimulation of nitric oxide release from PEC indicating protective property against pathogens. The formation of insoluble blue formazan by reduction of NBT was used as a probe for superoxide generation, although it is not entirely specific for O₂-radical [26]. The NBT reduction assay estimates the ability of neutrophils, and macrophages to produce various oxygen radicals viz. O₂⁻, OH⁻, O₃, H₂O₂. The ability of macrophages to kill the pathogenic microbes is probably one of the most important mechanisms of protection against disease [27]. In lysosomal enzyme activity, the transformation of p-NPP to coloured compound by the acid phosphatase of the stimulated macrophages correlates to the extent of degranulation in phagocytosis [28]. The alkaloidal fraction of *Elaeocarpus ganitrus* has shown significant stimulation of NBT reduction and non-significant increase of lysosomal enzyme activity of PEC indicating enhanced phagocytic capability of these cells. Myeloperoxidase, a heme protein secreted by neutrophils and macrophages, which uses the oxidizing potential of H₂O₂ to convert chloride ion into hypochlorous acid (HOCl). A potent bactericidal agent, HOCl is a critical component of host defenses against invading

bacteria, fungi, and viruses [29]. The increase in the stimulation index of myeloperoxidase by the exposure of alkaloidal fraction indicates enhanced defense capability of these cells to pathogenic organisms. The release of immune mediators from peritoneal exudates cells i.e. mainly from macrophages and neutrophils were significantly stimulated by the exposure of alkaloidal fraction of *Elaeocarpus ganitrus* to these cells.

PHYTOCHEMISTRY

Rudraksha contains indolizidine type of Alkaloids. Indolizidines are widely distributed in nature – in plants as well as in many animals. Their structures can be described either as derivatives of the aromatic bicyclic indolizine or as azabicyclo [4.3.0]-nonanes [30]. The indolizidine alkaloids display a wide range of biological activities and have been the subject of numerous synthetic studies [31]. It also contains minerals, vitamins, steroids, flavanoids. Aqueous extract of leaves contains glycosides also. Ethanolic extract of leaves contains gallic acid, ellagic acid & quercetin. Seven isomeric alkaloids of molecular formula, $C_{16}H_{21}NO_2$, have been isolated from the leaves of *Elaeocarpus sphaericus* (Gaertn.) K. Schum. Two of the alkaloids are identical (-)-isoelaecarpiline and (+)-elaecarpiline previously isolated from *E. dolichostylis*. The other alkaloids are Elaecarpidine, (+)-Elaecarpine, (+)-Isoelaecarpine, Isoelaecarpidine, Rudrakine [32]. Study has been made of the alkaloids obtained by sodium borohydride reduction of some isomeric alkaloids [33]. The structures and absolute configuration of seven alkaloids isoelaecarpiline and elaecarpiline and five new alkaloids have been determined [34]. A cyanogenic glycoside – 6'-O-galloylsambunigrin – has been isolated from the foliage of the Australian tropical rainforest tree species *Elaeocarpus sericopetalus* F. Muell. (Elaeocarpaceae). This is the first formal characterisation of a cyanogenic constituent in the Elaeocarpaceae family, and only the second in the order Malvales. 6'-O-galloylsambunigrin was identified as the principal glycoside, accounting for 91% of total cyanogen in a leaf methanol extract. Preliminary analyses indicated that the remaining cyanogen content may comprise small quantities of sambunigrin, as well as di- and tri-gallates of sambunigrin. *E. sericopetalus* was found to have foliar concentrations of cyanogenic glycosides among the highest reported for tree leaves, up to 5.2 mg CN g⁻¹ dry wt. A cyanogenic glycoside – 6'-O-galloylsambunigrin – has been isolated from foliage of the highly cyanogenic Australian tropical rainforest endemic *Elaeocarpus sericopetalus* (Elaeocarpaceae). This is the first published characterisation of a cyanogenic glycoside in the family Elaeocarpaceae [35]. Five new indolizidine alkaloids, grandisines C, D, E, F, and G (4–8), and one known indolizidine alkaloid, (-)-isoelaecarpiline (3), were isolated from the leaves of *Elaeocarpus grandis* and their structures determined by 1D and 2D NMR spectroscopy. Grandisine C (4) is isomeric with the known compound rudrakine (1). The absolute configuration of grandisine D (5) was deduced by its conversion to (-)-isoelaecarpiline. Grandisine E (6) contains a novel tetracyclic ring system. Grandisine F (7) is the 14-amino analogue of grandisine C. Grandisine G (8) contains the novel combination of a piperidine attached to an indolizidine. Grandisines C, D, F, and G and (-)-isoelaecarpiline showed receptor binding affinity for the human δ -opioid receptor with IC₅₀ values of 14.6, 1.65, 1.55, 75.4, and 9.9 μ M, respectively [36].

BIOLOGICAL ACTIVITIES OF GENUS ELAEOCARPUS

1. Antihypertensive Activity [37]

Hypertension is one of the leading causes of disability, mortality and mobility along the population. It is the most common chronic illness among the world faces [38,39]. Hypertension is the most common cardiovascular diseases and constitutes a major factor for several cardiovascular pathologies including atherosclerosis, coronary artery diseases, myocardium infarct, heart failure, renal insufficiency, stroke and dissecting aneurysm of aorta [40]. Aqueous extract of *Elaeocarpus ganitrus* Roxb. Seeds powder (Family- Elaeocarpaceae) was evaluated for its antihypertensive activity in renal artery occluded hypertensive rats. Male wistar rats were pretreated with aqueous extract of *Elaeocarpus ganitrus* for 6 weeks. Hypertension was induced in animals by clamping the renal artery

with renal bulldog clamp for 4 hrs. Ischemia of the kidneys causes elevation of blood pressure by activation of the rennin- angiotensin system. Elevated blood pressure of the animals was significantly decreased by the aqueous extract of *Elaeocarpus ganitrus* at the dose levels of 25, 50 and 100 mg/kg i/v. Captopril angiotensin converting enzyme inhibitor at the dose of 1mg/kg i/v showed significantly reduced in elevated blood pressure. The antihypertensive activity of aqueous extract of *E. ganitrus* may be due to the action of rennin-angiotensin system. Because of high incidence and morbidity, various drugs and regimes have been advocated for the control of hypertension. Many new drugs have been introduced which may demonstrate better efficacy but possess side effects. Recently attention has been focused towards herbal and mineral preparations which are traditionally used as potential therapeutic agents in the prevention and management of cardiovascular diseases [41].

2. Antidepressant Effect [42]

Pharmacological investigations with the water soluble portion of 90 % ethanol extract of the fruits of *Elaeocarpus ganitrus* showed the presence of a prominent central nervous system depressant effect, characterized by typical behavioral actions, potentiating of hexobarbitone hypnosis and morphine analgesia, anticonvulsant and anti-amphetamine effects. In addition the extract showed a cardio stimulant, depressor, smooth muscle relaxant and hydrocholeretic activities, part of these being mediated through beta adrenoreceptor stimulation and in part through a direct musculotropic effect. The pharmacological profile of activity of the extract substantiates the use of the plant fruits in the treatment of mental diseases, epilepsy, hypertension, asthma and liver diseases in the ancient Indian systems of medicines.

3. Anti-inflammatory Effect [43]

Elaeocarpus sphaericus fruits are used in ayurveda for mental diseases, epilepsy, asthma, hypertension, and arthritis and liver diseases. 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 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.

4. Central analgesic activity [44]

Elaeocarpus ganitrus fruits in a dose of 100mg/kg i/p show analgesic activity.

5. Antioxidant activity [45]

Oxygen is essential for the survival of all living creatures on this earth. During the process of oxygen utilization in normal physiological and metabolic processes approx. 5% of oxygen gets univalent reduced to oxygen derived free radicals [46,47] like superoxide, hydrogen peroxide, hydroxyl and nitric oxide radicals. All these radicals known as reactive oxygen species exert oxidative stress towards the cells of human body rendering each cell to face about 10000 oxidative hits per second [48]. Ethanolic extract of leaves of *Elaeocarpus ganitrus* was analyzed for their total antioxidant capacity, reducing power, metal chelating, ABTS⁺ radical scavenging and hydroxyl radical scavenging activities. The extract at 500 μ g/ml showed maximum iron chelating activity (76.70%) followed by the scavenging of the ABTS⁺ radical (55.77%) at the same concentration. However, the extract showed only moderate hydroxyl radical scavenging activity (13.43%). Total antioxidant capacity was found to be 24.18 mg ascorbic acid equivalent at 500 μ g/ml extract concentration. There was a positive correlation between the total phenolic content and antioxidant capacity. The results show that phenolic and flavonoids in the leaves provide substantial antioxidant activity.

6. Antimicrobial Activity [49]

Antibacterial activity of petroleum ether, benzene, chloroform, acetone and ethanol extracts of dried *Elaeocarpus sphaericus* fruit was investigated against 28 gram +ve and gram -ve bacteria using the disc diffusion and plate dilution methods. The acetone fraction showed marked antimicrobial activity against ten organisms. Benzene was active against *Salmonella typhimurium* and *Morganella morganii*, and ethanol extract against *Plesiomonas shigelloides*, *Shigella flexneri* and *Sh. sonnei*. The alkaloids and flavanoids present in the plant appear to be of chemotherapeutic interest. Leaves of *Elaeocarpus serratus* also showed significant antibacterial activity against some pathogenic bacteria. It is a medium to big sized tree with simple leaves and small flowers. Fruit juice of this plant has been used in treatment of diarrhea and dysentery [50].

7. Antimalarial and Cytotoxic Activity [51]

Malaria is a global public health problem and alarming spread of drug resistance and limited number of effective drugs now available underline how important it is to discover antimalarial compounds. By ethno pharmacological investigations 49 plants were identified, 228 extracts were prepared and tested for their in-vitro activity against *Plasmodium falciparum*, and assessed for any cytotoxicity against the human cancer cell line HeLa and the embryonic lung MRC5 cell line. In a first screening at a concentration of 10 µg/ml, 92 extracts from 46 plants showed antiparasmodial activity (parasite growth inhibition >30%). The IC₅₀ values of the most active extracts were determined as well as their selectivity towards *Plasmodium falciparum* in comparison to their cytotoxic effects against the human cell lines. *Elaeocarpus kontumensis* Gagn. (elaecarpaceae) with IC₅₀ value ranging from 0.4-8.6 µg/ml showed antiparasmodial activity with a good selectivity.

8. Antidiabetic Activity [52]

Water extract of *Elaeocarpus grandiflorus* was investigated for alloxan induced diabetes. Leaves, fruits and twigs of the plant were weighed and boiled with distilled water. Then water extract was filtered and freeze dried. A freshly prepared solution of alloxan (120mg/kg of body weight) in 0.9% NaCl was S/C injected to 24 hrs. fasted rats. After 24 hrs. Blood glucose was measured using glucostrip read on a glucometer. The animals were divided in to seven groups of 5 rats each. The first three groups were, normal control rats orally receiving distilled water, normal control rats orally receiving the extract 0.01g/kg of body weight and diabetic rats orally receiving distilled water. The other four groups were diabetic rats I/P injected with insulin (6u/kg) and diabetic rats orally receiving the extract at the doses of 0.0001, 0.001 or 0.1 g/kg of body weight. The treatment was performed daily for 30 days. After this it is concluded that *E. grandiflorus* water extract possess a hypoglycemic effect.

9. Anxiolytic Activity [53]

The incidence of pathologic anxiety in the community is very high and is associated with lot of morbidity. Lifetime prevalence in women is 30.5% and in males is 19.2% [54]. Hence, it is very important to address the problem of anxiety and find effective remedies. Anxiolytic effect of Tensarin tablet in mice was determined. Tensarin tablet contains Jatamansi root (100mg), Rauwolfia serpentina (100mg), Acorus calamus rhizome (75mg), *Elaeocarpus ganitrus* seed (75mg), *Withania somnifera* rhizome (75mg) and *Tinospora cordifolia* stem (75mg). The powder was mixed with 0.5% carboxy methyl cellulose solution. The solution was administered orally with the help of orogastric tube. There were eight groups of ten animals each. The mice were tested only once after the completion of drug treatment. Overnight fasted animals were selected randomly on the day of experiment for administration of vehicle, standard drug and study drug. The animals were acclimatized one hour before for behavioral tests. One hour time interval between drug administration and behavioral tests was maintained. Tensarin (50-200 mg/kg) given for 7days were observed to produce anxiolytic effects as indicated by an increase in rearing, number of crossing and time spent by animal in central square and it was also seen that there was significant decrease in

step down latency, increase in step down error and time spent by animal in shock zone. It shows that Tensarin has some psychotropic effect in a dose dependent manner.

10. Bronchial Asthma [55]

The study on rat mesenteric mast cell was undertaken to investigate the effect of *E. sphaericus* fruits on autacoid release. The petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE) and ethanol (EE) extracts of *E. sphaericus* fruits were found to have mast-cell stabilizing activity, substantiating the efficacy of *E. sphaericus* against bronchial asthma.

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