INTERNATIONAL JOURNAL OF INSTITUTIONAL PHARMACY AND LIFE SCIENCES

Pharmaceutical Sciences

Review Article……!!!

Received; accepted

SCIENTIFIC BASIS FOR THE CHEMICAL CONSTITUENT AND THERAPEUTIC USE OF ELAEOCARPUS SPECIES: A REVIEW

Gagan Shah[1*],Prabh Simran Singh[2],A.S.Mann[1], R.Shri[3]

1. Department of Pharmacognosy, B.I.S College of Pharmacy, (Gagra), Moga, Punjab, India.
2. Department of Pharmaceutical Chemistry, S.B.S College of Pharmacy, Patti, Punjab, India.
3. Department of Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala, Punjab India.

Keywords:
Elaeocarpus, Indolizilidine alkaloids, Flavonoids, Antidepressent

For Correspondence:

Gagan Shah

Department of Pharmacognosy, B.I.S College of Pharmacy,(Gagra), Moga, Punjab, India.

E-mail:

gaganshah83@gmail.com

ABSTRACT

Elaeocarpus is a genus of tropical and subtropical evergreen trees and shrubs belonging to family Elaeocarpaceae. This review is in a narrative format and consists of all publications relevant to Elaeocarpus genus that were identified by the authors through a systematic search of major computerized medical databases; no statistical pooling of results or evaluation of the quality of the studies was performed due to the widely different methods employed by each study. Studies Indicate that various Elaeocarpus species contain chemical constituent such as Triterpenes, Tannins such as geraniin and 3, 4, 5-trimethoxy geraniin, indolizilidine alkaloids Grandisines, Rudrakine and Flavonoids; Quercitin. Various Elaeocarpus species possesses Anti-inflammatory, Antimicrobial, Antianxiety Analgesic, Antidepressant and Antihypertensive activities. These results are very encouraging and indicate various Elaeocarpus species should be studied more extensively to confirm these results and reveal other potential therapeutic effects.

INTRODUCTION

Elaeocarpus is a genus of tropical and subtropical evergreen trees and shrubs belonging to family Elaeocarpaceae. Approximately 350 species are distributed from Madagascar in the west through India, Southeast Asia, Malaysia, Southern China, and Japan, through Australia to New Zealand, Fiji, and Hawaii in the east. The islands of Borneo and New Guinea have the greatest concentration of species (Coode, 2001).

Some common species are: -

- *Elaeocarpus aberrans*
- *Elaeocarpus acrantherus*
- *Elaeocarpus acuminatus: India. Endangered.*
- *Elaeocarpus acutifidus*
- *Elaeocarpus aemulus*
- *Elaeocarpus affinis*
- *Elaeocarpus alaternoides*
- *Elaeocarpus alatus*
- *Elaeocarpus alnifolius*
- *Elaeocarpus amboinensis*
- *Elaeocarpus amoenus: Sri Lanka*
- *Elaeocarpus amplifolius*
- *Elaeocarpus angustifolius: (syn. E. grandis) Blue fig, blue marble tree, blue quandong. Queensland, Australia.*
- *Elaeocarpus apiculatus: China, Indonesia, Malaysia, Philippines*
- *Elaeocarpus bifidus*
- *Elaeocarpus biflorus*
- *Elaeocarpus blascoi: India. Endangered.*
- *Elaeocarpus castanaefolius*
- *Elaeocarpus chelonimorphus*
- *Elaeocarpus coorangooloo: Queensland (Australia)*
- *Elaeocarpus coriaceus: Sri Lanka*
- *Elaeocarpus crassus: New Guinea*
- *Elaeocarpus dentatus: New Guinea*

- *Elaeocarpus eumundii*
- *Elaeocarpus floribundus*
- *Elaeocarpus ganitrus (rudraksh tree)*
- *Elaeocarpus gaussenii: Southern India. Endangered.*
- *Elaeocarpus graeffii*
- *Elaeocarpus grandiflorus: India, Indo-China, Malesia*
- *Elaeocarpus grandis*
- *Elaeocarpus hartleyi: New Guinea*
- *Elaeocarpus hedyosmus: Sri Lanka*
- *Elaeocarpus hookerianus: Pokaka. New Zealand.*

PHYTOCHEMICAL INVESTIGATION OF ELAEOCARPUS SPECIES.

1. *Elaeocarpus Chelonimorphus*

Triterpenes are mainly obtained from the fruits of *Elaeocarpus chelonimorphus* (Cambie et al., 1992).

2. *Elaeocarpus densiflorus*

Elaeocarpidine alkaloid has been isolated from *Elaeocarpus densiflorus* (Johns et al., 1969).

3. *Elaeocarpus dolichostylis*

A series of non aromatic indolizidine alkaloid have been isolated from *Elaeocarpus dolichostylis*. These include (+) 15, 16 dihydroelaeocarpine and (-)-15, 16 dihydroelaeocarpine were isolated from *Elaeocarpus dolichostylis* (Johns et al., 1968).

4. *Elaeocarpus dentatus*

The fruit-coat fats of *Elaeocarpus dentatus* and the seed fats of *Elaeocarpus dentatus* contain as their major fatty acids palmitic 11–35%, oleic 13–68%, and linoleic 16–31%. The seed fat of *Elaeocarpus dentatus* contains 10% hexadecenoic acid and the fruit-coat fat 13% linolenic acid (Morice, 1974).

5 *Elaeocarpus grandiflorus*

Tannin, geraniin and 3, 4, 5-trimethoxy geraniin have been isolated from *Elaeocarpus grandiflorus* leaves (Rahman et al., 1998).

6 *Elaeocarpus grandis*

Chemical constituent - 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 contain 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 (Katavic et al., 2006).

7. *Elaeocarpus kaniensis*

It contains different series of indolizidine alkaloids which include elaeokanine A, B, C, D, E, and elaeokanidine A (Hart et al., 1972).

8. *Elaeocarpus lanceofolius*

4′-Methylmyricetin has been isolated from the leaves of *Elaeocarpus lanceofolius* together with myricetin and its 3-*O*-rhamnoside. This is the second report of the natural occurrence of 4′-methyl ether of myricetin and the first in the family Elaeocarpaceae (Ray et al., 1976).

9. *Elaeocarpus mastersii*

The bark of *Elaeocarpus mastersii* using KB (human oral epidermoid carcinoma) cells as a monitorled to the isolation of two cucurbitacins, cucurbitacin D and cucurbitacin F as cytotoxic principles, together with two ellagic acid derivatives two ellagic acid derivatives, 4'-O-methylellagic acid 3-(2", 3"-di-O-acetyl)-a-L-rhamnoside and 4,4'-O-dimethylellagic acid 3-(2",3"-di-O-acetyl)-α-L-rhamnoside (Ito et al., 2002).

10. *Elaeocarpus parvifolius*

The bark of *Elaeocarpus parvifolius* led to the isolation of three new ellagic acid derivatives 4-*O*-methylellagic acid 3′-α-rhamnoside, 4-*O*-methylellagic acid 3′-(3″-*O*-acetyl)-α-rhamnoside, and 4-*O*-methylellagic acid 3′-(4″-*O*-acetyl)-α-rhamnoside in addition to the known ellagic acid derivative, 4-*O*-methylellagic acid 3′-(2″,3″-di-*O*-acetyl)-α-rhamnoside (Elkhateeb *et al.,* 2005).

11. *Elaeocarpus polydactylus*

Chemical constituent –A aromatic indolizidine alkaloid elaeocarpine, isoelaeocarpine and elaeocarpidine have been isolated from *Elaeocarpus polydactylus* (Johns et al 1968; 1969).

12. *Elaeocarpus sericopetalus*

Chemical constituent - A cyanogenetic 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 cyanogenetic 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 (Miller et al., 2006).

13. *Elaeocarpus sphaericus*

Alkaloids

Phytochemical investigations have shown the presence of the following: -

From the leaves of *Elaeocarpus sphaericus* (Gaertn.) K. Schum., several isomeric alkaloids of molecular formula, $C_{16}H_{21}NO_2$, have been isolated (Johns *et al*., 1970; 1971). which include the following -

1. Elaeocarpidine

2. (+)- Elaeocarpine

3. Isoelaeocarpine

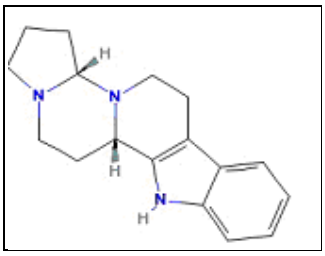
4. (+)- Epiiisoelaeocarpiline (Johns et al., 1970; 1971).

5. (+) - Epiialloelaeocarpiline (Johns et al., 1970; 1971).

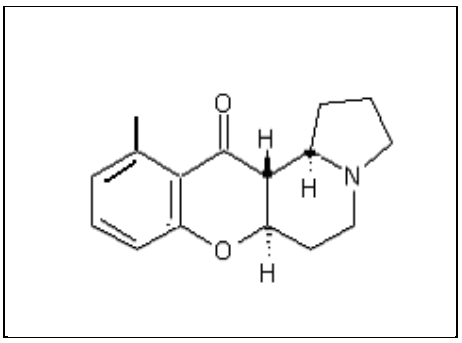
6. (-) - Alloelaeocarpiline (Johns et al., 1970; 1971).

7. (+) - Pseudoepiisoelaeocarpiline (Johns et al., 1970; 1971).

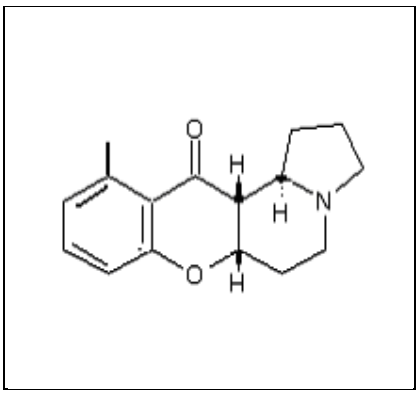
8. Rudrakine- It is also example of non aromatic indozolidine alkaloid isolated from *Elaeocarpus sphaericus* (Ray et al., 1979).



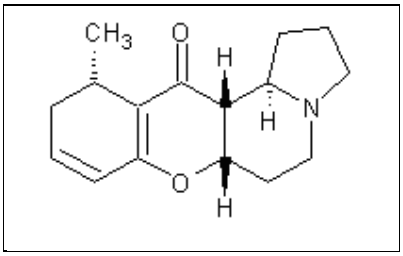
Elaeocarpidine



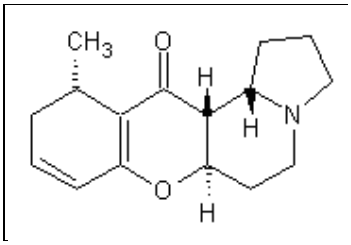
(+) - Elaeocarpine



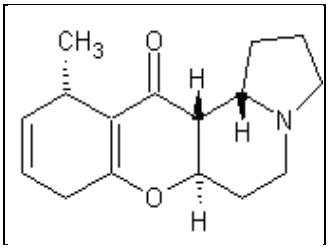
(+) -Isoelaeocarpine



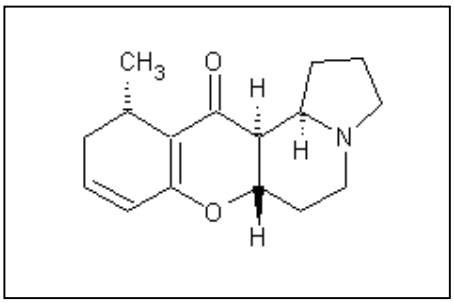
(+)-epielaeocarpiline



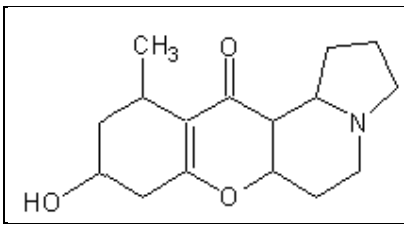
(-)-alloelaeocarpiline



(+)-pseudoepiisoelaeocarpiline



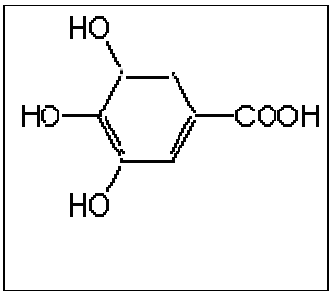
(+)- epialloelaeocarpiline



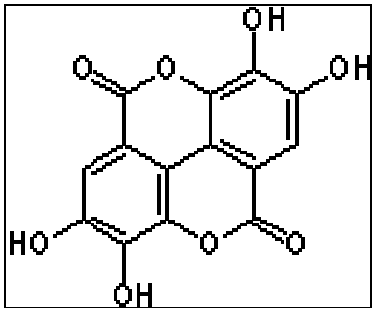
Rudrakine

B. TANNINS (Leaf) (Chand et al., 1977).

1. Gallic acid and Ellagic acid



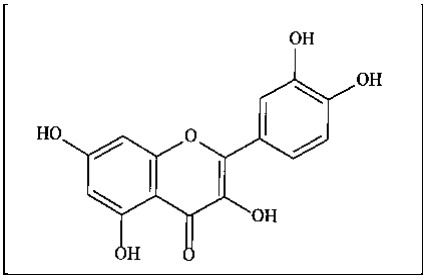
Gallic acid



Ellagic acid

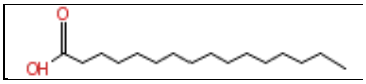
C. FLAVNOIDS (Chand et al., 1977).

Quercetin

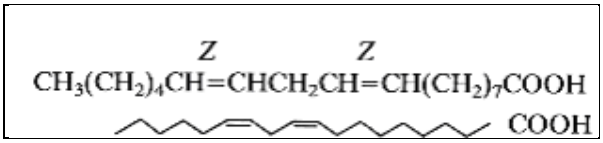


D. FATTY ACIDS (Seed) (Rastogi and Mehotra, 1991).

Palmitic acid, isopalmitic acid and linoleic acid. (Seeds)



Palmitic acid



Linoleic acid

PHARMACOLOGICAL INVESTIGATION OF *ELAEOCARPUS* SPECIES:

1. *Elaeocarpus floribundus*

An infusion of bark stem and leaf has been used as mouth wash and fruits have been used as antiseptic (Pullaiah, 2006).

2. *Elaeocarpus grandiflorus*

Elaeocarpus grandiflorus possesses antibacterial (Rahman et al., 1998), anti-diuretic (Van Der Woerd, 1950) and antiviral (Kurokawa et al., 1993; Nawawi et al., 1999; Xu et al., 1996) activities. Water extract of leaves, fruit and twigs of *Elaeocarpus grandiflorus* has been traditionally used to treat diabetic patients. *Elaeocarpus grandiflorus* water extract possesses a hypoglycemic effect (Bualee et al., 2007).

3. *Elaeocarpus grandis*

Elaeocarpus grandis indolizidine alkaloids grandisine A and isoelaeocarpiline compounds bind to opoid receptor and have analgesic effect (Carroll et al., 2005).

4. *Elaeocarpus mastersii*

Chloroform-soluble extract of the bark of *Elaeocarpus mastersii* was found to exhibit significant cytotoxic activity when evaluated against a panel of human cancer cell line (Kinghorn et al., 1999).

5. *Elaeocarpus oblongus*

The fruit is used as antiseptic. It is useful in rheumatism, pneumonia, ulcers, piles and leprosy (Pullaiah, 2006).

6. *Elaeocarpus parvifolius*

The bark of the plant *Elaeocarpus parvifolius* (Elaeocarpaceae), which is found in Indochina, Thailand, Peninsular Malaysia, Singapore and Borneo especially in the treatment of malarial infection (Sosef et al., 1998).

7. *Elaeocarpus petiolatus*

Bark is bitter and sour juice of leaves is used to prevent sunstroke and given in fevers (Pullaiah, 2006).

8. *Elaeocarpus polydactylus, Elaeocarpus dolichostylis, Elaeocarpus densiflorus.*

These species have antitumour, analgesic activities and exhibited cardiovascular effect (Collins *et al*., 1990).

9. *Elaeocarpus serratus*

It is used in rheumatism and as antidote for poison. Bark is used in hemorrhages, biliousness and ulcers (Pullaiah, 2006).

10. *Elaeocarpus tuberculatus*

It is used in rheumatism, typhoid and epilepsy (Pullaiah, 2006).

11. *Elaeocarpus sphaericus*

Ethanol extract of the fruits of *Elaeocarpus ganitrus* shows analgesic activity (Bhattacharya *et al*., 1975).

Antiasthmatic

The petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE) and ethanol (EE) extracts of *Elaeocarpus sphaericus* fruits were found to have mast-cell stabilizing activity, substantiating the efficacy of *Elaeocarpus sphaericus* in bronchial asthma. (Singh et al., 2000). In another study the petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE) and ethanol (EE) extracts protected guinea-pigs against bronchospasm induced by histamine and acetylcholine aerosols (Singh et al., 2000).

Antidepressent

Petroleum ether (PE), ethanol (EE) extracts decreased swim stress immobility in mice indicating some degree of antidepressant activity (Singh et al., 2000).

Anti-inflammatory

The petroleum ether, benzene, chloroform, acetone, and ethanol, extracts of *Elaeocarpus sphaericus* fruits at a dose of 200 mg/kg was studied in rat paw edema 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 inflammation (Singh and Pandey, 1999). In another study petroleum ether, benzene, chloroform, acetone and ethanol extracts showed significant anti-inflammatory action against both acute and sub-acute models (Singh et al., 2000).

Antimicrobial

The petroleum ether, benzene, chloroform, acetone, and ethanol extracts of dried *Elaeocarpus sphaericus* fruits was investigated against 28 gram-positive and gram-negative bacteria using the disc diffusion and plate dilution methods. The acetone fraction showed marked antimicrobial activity against ten organisms. Benzene extracts was active against *Salmonella typhimurium and Morganella morganii,* and ethanol extracts against *Plesiomonas shigelloides, Shigella flexnerii and Sh. Sonneii* (Singh and Nath, 1999).

Antiulcerogenic

The petroleum ether, benzene, chloroform, acetone, and ethanol, extracts of dried *Elaeocarpus sphaericus* fruits, show antiulcerogenic activities in rats (Singh et al., 2000).

Other activities

Ethanolic extract of fruits exhibit sedative, hypnotic, tranquillizing, anticonvulsive, antiepileptic and antihypertensive properties (Bhattacharya et al., 1975; Pandey and Bhattacharya, 1985).

CONCLUSION

The extensive survey of literature revealed that Elaeocarpus species is an important source of many pharmacologically and medicinally important chemicals, such as Essential Triterpenes, Tannins such as geraniin and 3, 4, 5-trimethoxy geraniin, indolizilidine alkaloids Grandisines, Rudrakine and Flavnoids Quercitin. Various Elaeocarpus species have also been widely studied for their various pharmacological activities like analgesic, antifungal, anti-inflammatory, antimicrobial, antidiabetic, antioxidative, Antiviral, Antitumor, antihypertensive, antianxiety and antidepressant activities. Although the results from this review are quite promising for the use of Elaeocarpus species as a multi-purpose medicinal

agent, several limitations currently exist in the current literature. While Elaeocarpus species has been used successfully in Ayurvedic medicine for centuries, more clinical trials should be conducted to support its therapeutic use. It is also important to recognize that Elaeocarpus species may be effective not only in isolation, but may actually have a potentiating effect when given in combination with other herbs or drugs.

REFERENCES:

1. Coode M.J.E. Elaeocarpus in Australia and New Zealand. Kew Bull.1984; 39: 509–586.
2. Cambie R.C, Lal A.R, Pausler M.G. Triterpenes from the fruit of *Elaeocarpus chelonimorphus*. Biochem. Syst. Ecol. 1992; 20: 708-709.
3. Johns S.R, Lamberton J.A, Sioumis A.A. Elaeocarpus alkaloids. III. The structures of elaeocarpidine, a new indole alkaloid. Australian Journal of Chemistry.1969; 22: 801–806.
4. Johns S.R, Lamberton J.A., Sioumis A.A, Wunderlich J.A. Chem comm.1968; 290-291.
5. Johns S.R, Lamberton J.A., Sioumis A.A, Wunderlich J.A. Chem comm.1968; 1324-1325.
6. Morice I.M. Fruit-coat and seed fats of Rhopalostylis, Elaeocarpus and Nestegis species. Phytochemistry. 2001; 14(3):765-767.
7. Rahman A, Wahyuono S, Bates R. Anti-infective compounds isolated from leaves of *Elaeocarpus grandiflorus* J.E. Smith. Indonesian Journal of Pharmacy.1998; 9(3):139-145.
8. Katavic P.L, Venables D.A, Forster P.I, Guymer G, Carroll A.R. Grandisines C-G, Indolizidine Alkaloids from the Australian Rainforest Tree *Elaeocarpus grandis*. J. Nat. Prod.2006; 69: 1295-1299.
9. Hart N.K, Johns S.R, Lamberton J.A. Australian Journal of Chemistry. 1972; 25: 817-835.
10. Ray A.B, Dutta S.C, Dasgupta S. Flavonoids of *Elaeocarpus lanceofolius*. Phytochemistry.1976; 15(11): 1797-1798.
11. Ito A, Chai H.B, Lee D, Kardono L.B, Riswan S, Farnsworth N.R, Cordella G.A, Pezzuto M, Kinghorn D.A. Ellagic acid derivatives and cytotoxic cucurbitacins from *Elaeocarpus mastersii*. Phytochemistry. 2002; 61(2): 171-174.
12. Elkhateeb A, Subeki Takahashi K, Matsuura H, Yamasaki M, Yamato O, Maede Y, Katakura K, Yoshihara T, Nabeta K. Anti-babesial ellagic acid rhamnosides from the bark of *Elaeocarpus parvifolius*. Phytochemistry.2005; 66(21): 2577-80.
13. Johns S.R, Lamberton J.A, Sioumis A.A. Elaeocarpus alkaloids. III. The structures of elaeocarpidine, a new indole alkaloid. Australian Journal of Chemistry.1968; 22: 801–806.
14. Johns S.R, Lamberton J.A, Sioumis A.A. 1969; 295-299.

15. Miller R.E, Stewart M, Capon R.J, Woodrow I.E. A galloylated cyanogenic glycoside from the Australian endemic rainforest tree *Elaeocarpus sericopetalus* (Elaeocarpaceae). Phytochemistry.2006; 67(13): 1365-71.
16. Johns S.R, Lamberton J.A, Sioumis A.A, Willing R.I. 1970; 295-299.
17. Johns S.R, Lamberton J.A, Sioumis A.A. Willing R.I. The alkaloids of *Elaeocarpus sphaericus*. Australian journal of chemistry.1970; 24(8): 1679-1694.
18. Ray A.B, Dutta S.C, Dasgupta S. Rudrakine, a new alkaloid from *Elaeocarpus ganitrus*. Phytochemistry.1979; 18: 700–701.
19. Chand L, Dasgupta S, Chattopadhyay S.K, Ray A.B. Chemical investigation of some Elaeocarpus species. Planta Medica.1977; 32(2): 197-9.
20. Rastogi, R.P. and Mehrotra, B.N. (eds). Compendium of Indian Medicinal Plants Volume–1. CDRI, Lucknow, Publication and Information Directorate, New Delhi.1980-1984. pp. 261-262.
21. Pullaiah T. Encyclopedia of world medicinal plants Volume-2, Regency Publication, New delhi.2006. pp 852-853.
22. Bualee C, Ounaroon A, Jeenapongsa R. Antidiabetic and Long-term Effects of *Elaeocarpus grandiflorus*. Naresuan University Journal. 2007. 15(1): 17-28.
23. Carroll A.R, Arumugan G, Quinn R.J, Redburn J, Guymer G, Grimshaw P. J Org Chem. 2005; 70,1889-1892.
24. Kinghorn A.D, Farnsworth N.R, Soejarto D.D, Cordell G.A, Pezzuto J.M., Udeani G.O.et al. Novel strategies for the discovery of plant-derived anticancer agents. Pure and Applied Chemistry.1999; 71: 1611–1618.
25. Sosef M.S.M, Hong L.T, Prawirohatmodjo S. Plant Resources of Southeast Asia 5(3)**.** Timber Trees: Lesser-Known Timbers. Prosea, Bogor, Indonesia.1998. pp-538
26. Collins D.J, Culvenor C.C, Lamberton J.A. Loder J.W, Price J.R. Plant for Medicines: A Chemical and Pharmacoligical Survey of Plants in the Australian Region. 1st ed.; CSIRO:Melbourne, 1990.
27. Bhattacharya S.K, Debnath P.K, Pandey V.B, Sanyal A.K. Pharmacological investigations on *Elaeocarpus ganitrus*. Planta Medica.1975; 28(2):174-177.
28. Singh R.K, Bhattacharya S.K, Acharya S.B. Studies on extracts of *Elaeocarpus sphaericus* fruits on in vitro rat mast cells. Phytomedicine. 2000; 7(3): 205-7.
29. Singh R.K and Pandey B.L. Anti-inflammatory activity of *Elaeocarpus sphaericus* fruits extracts in rats. Journal of Aromatic and plant sciences.1999; 21: 1030-1032.
30. Singh R.K and Nath G. Antimicrobial activity of *Elaeocarpus sphaericus*. Phytother Res.1999. 13(5): 448-50.
31. Panday V.B and Bhattacharya, S.K. Scientific appraisal of rudraksha (*Elaeocarpus ganitrus*) : chemical and pharmacological studies. J Res Edu Ind Med.1985; 4: 47-50.