



## **A complete profile on *Xylocarpus moluccensis*: traditional uses, pharmacological activities and phytoconstituents**

Raja S and Ravindranadh K

GITAM Institute of Pharmacy, GITAM University, Visakhapatnam- Andhra Pradesh, India-Pincode-530 045

Received: 31-10-2014 / Revised: 14-11-2014 / Accepted: 17-11-2014

### **ABSTRACT**

The present work offers a review addressing the ethnomedical, active constituents and pharmacological activity of *Xylocarpus moluccensis* (belonging to Meliaceae family) regarded as one of the most significant plant species in traditional system of medicine. The plant is used in different parts of the world for the treatment of several ailments like diarrhea, fever, dysentery, candidacies, scabies, baby rash, stomach pains, and constipation joint pains, chest pains, and relapsing sickness etc., *Xylocarpus moluccensis* is the source of a diverse kind of chemical constituents such as swietemahonolide, febrifugin, khayasin T, febrifugin A, gedunin, isolariciresinol, phaseic acid, aromadendrin, 4-hydroxy cinnamic acid, 4-hydroxybenzoic acid, 4-hydroxyphenylacetic acid, and xylogranatinin. The isolated phytochemicals as well as different extracts exhibited significant biological activities such as antibacterial, anti diabetic, antioxidant activity, antifilarial, anti diarrheal, CNS depressant and cytotoxic activities. Exhaustive research regarding isolation of more phytochemicals and pharmacology study on this medicinal plant is still necessary so as to explore the plant regarding its medicinal importance. Therefore, the aim of this review is to boost up present day researchers in this direction to undertake further investigations of this plant.

**Key words:** *Xylocarpus moluccensis*, Swietemahonolide, Febrifugin, Khayasin T.

### **INTRODUCTION**

In typically medicative plants characterizes an expensive supply of antibiotic, antifungal, antiseptic and analgesic qualities [1], and that they square measure used medicinary in numerous countries. *Xylocarpus moluccensis* typically thought of to be an example of a medicative plant with a use in fashionable herbal drugs. The *Xylocarpus moluccensis* belongs to the family meliaceae. The genus *Xylocarpus* is distributed in the coastal regions of India, Ceylon, Burma and Malaya and Indonesia.

The fruit of *Xylocarpus moluccensis* is a green colour, lemon fruit sized, hard and heavy, leading to the common name 'cannon ball tree'. So far in depth researches are done on this plant, suggesting that *Xylocarpus moluccensis* has varied medical specialty actions and chemical composition. In recent times there are several reports of medical specialty roles and activities of *Xylocarpus moluccensis* and its active principals on the nervous system, antibacterial, cytotoxic, anti diarrhoeal, etc. This review tries to indicate the advances in

phytology, chemistry and pharmacological aspects of *Xylocarpus moluccensis*.

### **BOTANICAL DESCRIPTION**

Botanical *Xylocarpus* means woody fruit (in Latin), and refers to the large and distinctly woody fruit and seeds of this genus. The taxonomical classification of *Xylocarpus moluccensis* was mentioned in Table 1. This is an evergreen, small to medium-sized mangrove tree that can grow up to 10-20m tall. It is monoecious plant grows up to 30 metres (100 ft) tall with a trunk diameter of up to 70 cm (28 in). The Flowers are creamy-white.

The tree bears small buttresses and short pneumatophores, the bark is dark brown, rough, longitudinally fissured and flaking into oblong pieces. Leaves are simple pinnate, spirally arranged, with 2-4 pairs of leaflets, 10-20 x 3.5-5.5 cm, leathery and withering yellow. Flowers are 8 mm wide, pale cream yellow and grouped in an axillary inflorescence 7-15 cm long.

**GEOGRAPHIC DISTRIBUTION**

*Xylocarpus moluccensis* occurs through Asia and Indonesia to New Guinea, the south western Pacific Islands and northern Australia. In Australia, the species occurs in estuaries and embayments along the northern coast from King Sound, Western Australia in the west, across the Northern Territory, to South Trees Inlet, Queensland in the east.

Table 1: Taxonomical classification of *Xylocarpus moluccensis*

Kingdom	Plantae
Phylum/Division	Magnoliophyta
Class	Eudicots
Order	Sapindales
Family	Meliaceae
Genus	<i>Xylocarpus</i>
Species	<i>moluccensis</i>
Common names	Cannonball tree cedar mangrove, mangrove cedar, apple mangrove.

**ETHANOMEDICAL INFORMATION OF *XYLOCARPUS MOLUCCENSIS***

Traditionally, in Bangladesh the bark of the plant is used to treat gastrointestinal disorders such as dysentery, diarrhoea, fever including that from malaria and possesses astringent properties [2]; In Tonga, the bark is used for candidacies, scabies, baby rash, stomach pains, and constipation [3]. In Malaya, it is used for treating cholera, colic diarrhoea, and other abdominal affections [4]. In Fiji, bark used for headaches, fatigue, candidacies (leaves and bark), joint pains, chest pains, and relapsing sickness [5]. The oil extracted from seeds is used in the Philippines to treat insect bites [6]. The dried fruit peel is used as an appetizer the astringent bark has some medicinal uses. It is reported to cure dysentery, diarrhoea and other abdominal troubles, and is also used as a febrifuge. The fruit is used as an aphrodisiac and used as a cure for elephantiasis and swelling of the breast [5]. Different parts of *Xylocarpus moluccensis* with ethnomedical information are stated in Table No 2.

Table 2: Ethnomedical information of *Xylocarpus moluccensis*

Country	Part of the plant	Uses	References
-----	Dried fruit	Aphrodisiac, elephantiasis and swelling of the breast	[5]
Tonga	Bark	Candidacies, scabies, baby rash, stomach pains, constipation	[3]
Malaya	Bark	Cholera, colic diarrhoea, and other abdominal affections	[4]
Fiji	Bark	headaches, fatigue, joint pains, chest pains and buccal pains	[5]
Fiji	Leaves and bark	Candidacies	[3]
Bangladesh	Bark	Gastrointestinal disturbances such as cholera, dysentery, diarrhoea; also for fever	[2]
Philippines	Oil	Treat insect bites	[6]

**PHARMACOLOGICAL INFORMATION OF *XYLOCARPUS MOLUCCENSIS***

Different parts of *Xylocarpus moluccensis* with pharmacological information are mentioned in Table 3.

**CNS depressant activity of *Xylocarpus moluccensis*:** The bark and pneumatophore extracts of *Xylocarpus moluccensis* possess robust CNS depressant activity [7]. The pneumatophores extract possessing more potent action than the bark. It produced dose-dependent reduction of pentobarbitone.

**Anti-bacterial activity of *Xylocarpus moluccensis*:** The methanolic extract of bark of *Xylocarpus moluccensis* showed significant antimicrobial activity against *Sepidermis*, *Staphylococcus aureus*, *Shigella boydii* and *Proteus species*, and moderate activity against *Escherichia coli* and *Streptococcus pyogenes* [8].

**Antidiabetic activity of *Xylocarpus moluccensis*:** Antidiabetic activity of fruit part of *Xylocarpus moluccensis* was deliberated [9].

**Cytotoxicity activity of *Xylocarpus moluccensis*:** The methanol extract of *Xylocarpus moluccensis* leaves and bark showed promising cytotoxic

activity against human hepatocellular carcinoma (HepG2) cell line [10]

**Anti diarrheal activity of *Xylocarpus moluccensis*:** The methanol extract of bark of *Xylocarpus moluccensis* showed robust antidiarrheal activity in experimental induced diarrhoea by castor oil and magnesium sulphate in mice. The results suggested that the plant extract showed significant dose-dependent anti diarrheal activity and supports its use in traditional herbal medicine [11].

**Antioxidant activity of *Xylocarpus moluccensis*:** Methanol extract of *Xylocarpus moluccensis* fruit husk possesses a robust in vitro antioxidant activity [12]. This study was focused on invitro inhibitor

activity by victimization completely different parameters like 2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay, superoxide scavenging impact, reducing power and in-vitro lipid peroxidation. Results prompt that methanol extract of *Xylocarpus moluccensis* was found to be significantly effective in scavenging DPPH.

**Antifilarial activity of *Xylocarpus moluccensis*:** Study in experimental rodent host evaluating the antifilarial activity [13] of *Xylocarpus moluccensis* showed the fruit extract contains promising in vitro and in vivo antifilarial activity against human lymphatic filarial parasite *B. malayi*. The activity was attributed to two pure compounds gedunin and photogedunin.

**Table 3: Pharmacological information of *Xylocarpus moluccensis***

Part of the plant	Solvent used for extraction	Uses	References
Bark	Methanol	CNS depressant activity	[7]
Bark	Methanol	Anti-bacterial activity	[8]
Leaves and bark	Methanol	Cytotoxicity activity	[10]
Bark	Methanol	Anti diarrheal activity	[11]
Fruit	-----	Antifilarial activity	[13]
Fruit husk	Methanol	Antioxidant activity	[12]
Fruit	-----	Anti diabetic activity	[9]

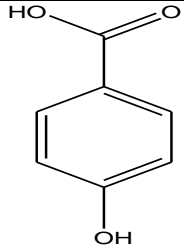

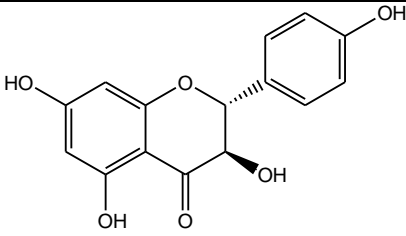
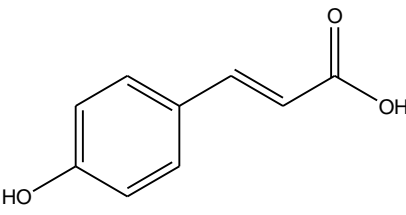
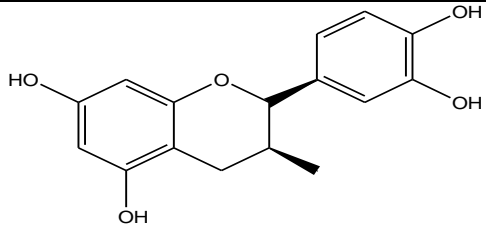
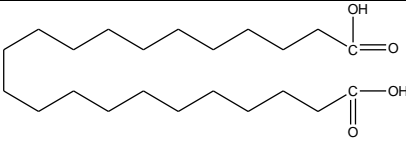
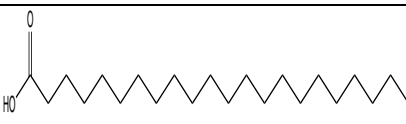
**Phytoconstitutes information of *Xylocarpus moluccensis*:** *Xylocarpus moluccensis* seeds contained different type's minerals such as copper, iron, manganese, zinc, potassium, and calcium. Myristic acid, stearic acid, palmitic acid, oleic acid, linoleic acid, linolenic acid, arachidic acid, and docosanoic acid were isolated from hexane extracts of *Xylocarpus moluccensis* fruit seeds [10]. Together with known compounds

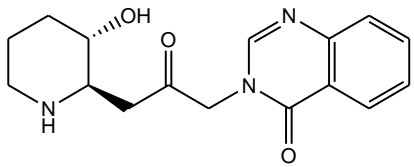
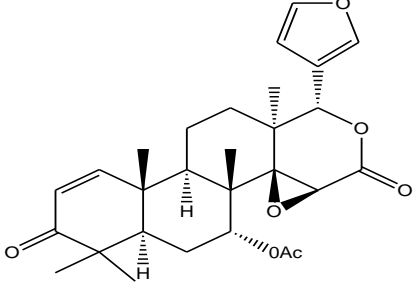
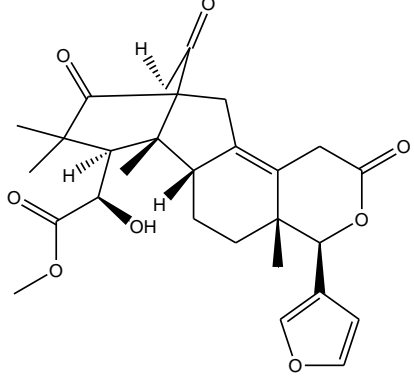
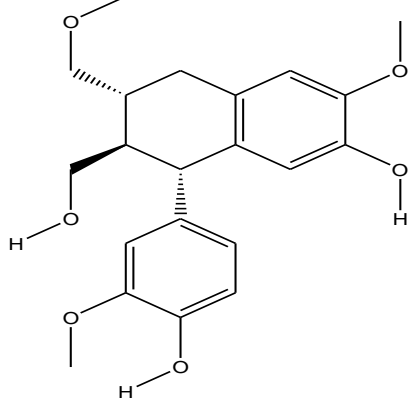
swietemahonolide, febrifugin, khayasin T, febrifugin A, gedunin, isolariciresinol, phaseic acid, aromadendrin, 4-hydroxy cinnamic acid, 4-hydroxybenzoic acid, 4-hydroxyphenylacetic acid, and xylogranatinin were isolated [14]. Seed kernels yielded three new phragmalin limonoids, moluccensins H-J [15]. Active constituents with their IUPAC names and structures are given in Table 4 and 5.

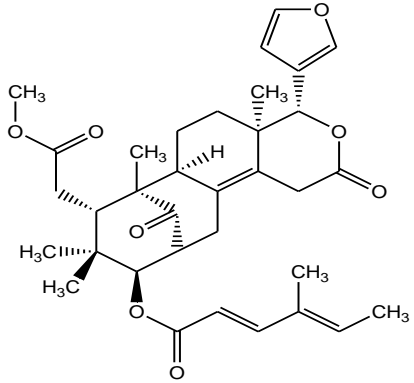
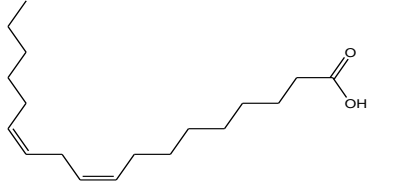
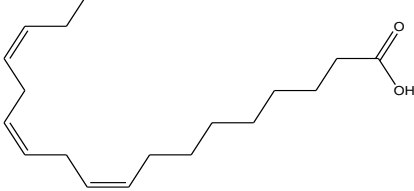
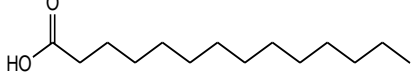
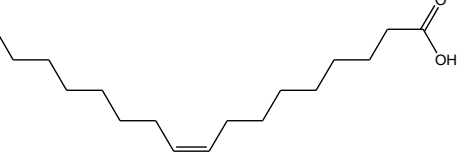
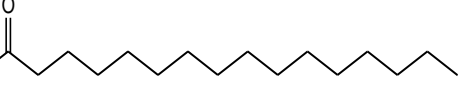
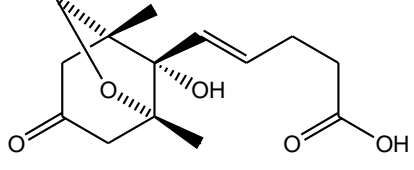
**Table 4: Active constituent's information of *Xylocarpus moluccensis***

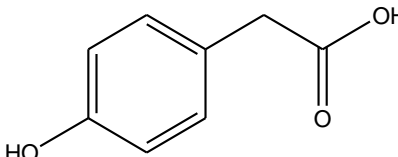
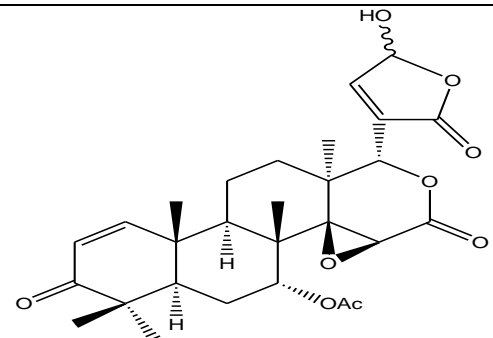
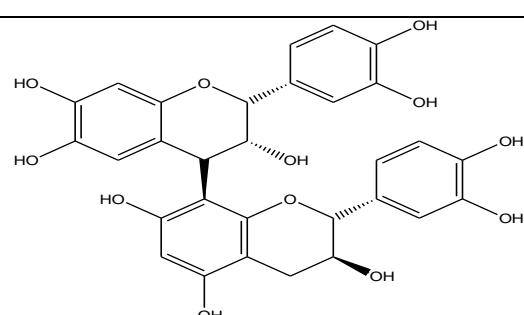
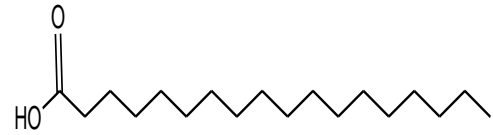
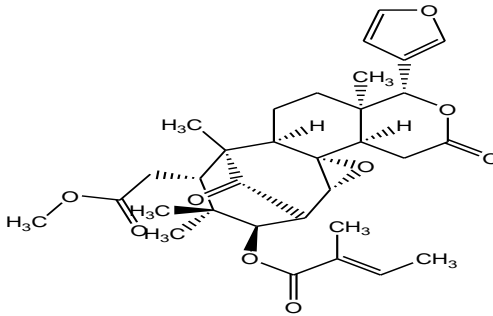
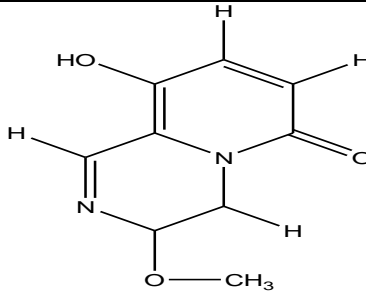
Plant part	Solvent used for Extraction	Use	Reference
Fruit seeds	Hexane	Myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, linolenic acid, arachidic acid, and docosanoic acid.	[10]
Seeds	-----	Copper, iron, manganese, zinc, potassium, and calcium.	[10]
Seed kernels	-----	Swietemahonolide, febrifugin, khayasin T, febrifugin A, gedunin, isolariciresinol, phaseic acid, aromadendrin, 4-hydroxy cinnamic acid, 4-hydroxybenzoic acid, 4-hydroxyphenylacetic acid, and xylogranatinin.	[14]
Seed kernels	-----	Phragmalin limonoids, moluccensins.	[15]

Table 5: Active constituents and IUPAC names of *Xylocarpus moluccensis*

NAME	IUPAC NAME	STRUCTURE
4-hydroxybenzoic acid	<i>p</i> -Hydroxybenzoic acid	
Arachidic acid	Icosanoic acid	
Aromadedrin	(2 <i>R</i> ,3 <i>R</i> )-2,3-dihydro-3,5,7-trihydroxy-2-(4-hydroxyphenyl)chromen-4-one	
Coumaric acid	( <i>E</i> )-3-(4-hydroxyphenyl)acrylic acid	
Catechin	(2 <i>S</i> ,3 <i>S</i> )-3,4-dihydro-2-(3,4-dihydroxyphenyl)-3-methyl-2H-chromene-5,7-diol	
Docosanedioic acid	Docosanedioic acid	
Behinic acid	Docosanoic acid	

<p>Febrifugin</p>	<p>3-(3-((2R,3S)-3-hydroxypiperidin-2-yl)-2-oxopropyl)quinazolin-4(3H)-one</p>	
<p>Gedunin</p>	<p>(1S,3aS,4aR,4bS,5R,6aR,10aR,10bR,12-aS)-5-(Acetyloxy)-1-(3-furanyl)-1,5,6,6a,7,10a,10b-,11,12,12a,decahydro-4b,7,7,10a,12a,-pentamethylox-ireno[c]phenanthro[1,2-d]pyran-3,8(3aH,4bH)-dione</p>	
<p>Hydroxymexicanolide</p>	<p>4-(3-furyl)-1,4,4a,5,6,6a,7,8[alpha],9,10,11[alpha],12-dodecahydro-4a,7,9,9-tetramethyl-2,10,13-trioxo-7,11-methanocycloocta[f][2]benzopyran-8-hydroxyacetic acid methyl ester</p>	
<p>Isolariciresinol</p>	<p>(6R,7R,8S)-5,6,7,8-tetrahydro-8-(4-hydroxy-3-methoxyphenyl)-7-(hydroxymethyl)-3-methoxy-6-(methoxymethyl)naphthalen-2-ol</p>	

<p>Khayasin T</p>	<p>(1R,2S,5R,6R,14R,16S)-6-(3-Furyl)-16-(2-methoxy-2-oxoethyl)-1,5,15,15-tetramethyl-8,17-dioxo-7-oxatetracyclo[11.3.1.0<sup>2,11</sup>.0<sup>5,10</sup>]heptadec-10-en-14-yl (2E)-2-methyl-2-butenolate</p>	
<p>Linoleic acid</p>	<p>cis-9,12-Octadecadienoic acid</p>	
<p>Linolenic acid</p>	<p>cis-9,12-Octadecadienoic acid</p>	
<p>Myristic acid</p>	<p>Tetradecanoic acid</p>	
<p>Oleic acid</p>	<p>(9Z)-Octadec-9-enoic acid</p>	
<p>Palmitic acid</p>	<p>Hexadecanoic acid</p>	
<p>Phaseic acid</p>	<p>(2Z,4E)-5-[(1R,5R,8S)-8-hydroxy-1,5-dimethyl-3-oxo-6-oxabicyclo[3.2.1]octan-8-yl]-3-methylpenta-2,4-dienoic acid</p>	

Phenyl acetic acid	2-(4-hydroxyphenyl)acetic acid	
Photogedunin	(1S,3aS,4aR,4bS,5R,6aR,10aR,10bR,12-aS)-5-(Acetyloxy)-1-(3-furanyl)-1,5,6,6a,7,10a,10b-,11,12,12a,decahydro-4b,7,7,10a,12a,-pentamethylox-ireno[c]phenanthro[1,2-d]pyran-3,8(3aH,4bH)-dione	
Procyanidin	(2R,3R,4S)-3,4-dihydro-4-((2R,3S)-3,4-dihydro-3,5,7-trihydroxy-2-(3,4-dihydroxyphenyl)-2H-chromen-8-yl)-2-(3,4-dihydroxyphenyl)-2H-chromene-3,6,7-triol	
Stearic acid	Octadecanoic acid	
Swietemahanolide	(1R,2R,4S,5R,9R,10R,13R,14S,15S,17R)-9-(3-Furyl)-15-(2-methoxy-2-oxoethyl)-10,14,16,16-tetramethyl-7,18-dioxo-3,8-dioxapentacyclo[12.3.1.02,4.04,13.05,10]octadec-17-yl (2E)-2-methyl-2-butenate	
Xylogranatinin	3,4-dihydro-9-hydroxy-3-methoxypyrido[1,2-a]pyrazin-6-one	

**CONCLUSION**

The present article deals with an up-to-date review on the ethnomedical, active constituents and pharmacological information of *Xylocarpus moluccensis*, a useful medicinal plant from Meliaceae family finding applications in indigenous systems of medicine. The plant is used in different parts of the world for the treatment of several ailments like diarrhoea, fever, dysentery, candidiasis, scabies, baby rash, stomach pains, and constipation joint pains, chest pains, and relapsing sickness etc., and is the source of a diverse kind of chemical constituents chemical constituents such as swietemahonolide, febrifugin, khayasin T, febrifugin A, gedunin, isolariciresinol, phaseic acid, aromadendrin, 4-hydroxy cinnamic acid, 4-hydroxybenzoic acid, 4-hydroxyphenylacetic acid, and xylogranatinin. The isolated phytochemicals as well as different extracts exhibited significant

biological activities such as antibacterial, anti diabetic, antioxidant activity, antifilarial activity, anti diarrheal activity, CNS depressant activity and cytotoxic activities. Exhaustive research regarding isolation of more phytochemicals and pharmacology study on this medicinal plant is still necessary so as to explore the plant regarding its medicinal importance. Therefore, the aim of this review is to boost up present day researchers in this direction to undertake further investigations of this plant and we do anticipate that this plant will be much effective in drug development programme in near future.

**ACKNOWLEDGEMENTS**

The authors are thankful to UGC (New Delhi, India) for providing financial assistance to GITAM Institute of Pharmacy, GITAM University, Visakhapatnam, Andhra Pradesh, India.

**REFERENCES**

1. Nelson EK, and Wheeler DH. Some constituents of the Cannonball fruits. J Am Chem Soc 1937; 59(12): 2499-2500.
2. Wangenstein H, Alamgir M, Duong GM, Gronhaug TE, Samuelsen AB, Malterud KE. Chemical and biological studies of medicinal plants from the Sundarbans mangrove forest. In: Eddouks M, editor. Adv Phyto Res 2009; 59-78.
3. Chong KY, Tan H T W & Corlett RT. A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore.2009; 273.
4. Corner E.J.H. Waysides Trees of Malaya. Malayan Nature Society, Kuala Lumpur.1988; 1-2.
5. Uddin SJ, Shilpi JA, Alam SM, Alamgir M, Rahman MT, Sarker SD. Antidiarrhoeal activity of the methanol extract of the barks of *Xylocarpus moluccensis* in castor oil- and magnesium sulphate-induced diarrhoea models in mice. J Ethnopharmacol 2005; 101(1-3):139-43.
6. Ghani A. Medicinal plants of Bangladesh. Asiatic Society of Bangladesh, Dhaka. 1998; 233
7. Sarker SD, Uddin SJ, Shilpi JA, Rouf R, Ferdous ME, Nahar L. Neuropharmacological properties of *Xylocarpus moluccensis*. Fitoterapia 2007; 78 (2): 107-111.
8. Alam MA, Sarder M, Awal MA, Sikder MMH and Daulla KA. Anti-bacterial activities of the crude ethanolic extract of *Xylocarpus moluccensis* stem barks. Bangl J Vet Med 2006; 4(1): 69-72.
9. Sarika Singh S, Sharma S, C. Nath , Srikant Kumar Rath, R. K. Singh, Smrati Bhadauria, Poonam Singh1, R.k. Shukla, Manoj Barthwal and M Dikshi. Essential Safety Pharmacology and safety evaluation of bioactive fraction of *Xylocarpus moluccensis*: an antidyslipidaemic agent. Int J of Med Sci Clin Inv 2014; 1(1): 24-47 10.
10. Rouf R, Uddin SJ, Shilpi JA, Alamgir M. Assessment of antidiarrhoeal activity of the methanol extract of *Xylocarpus granatum* bark in mice model. J Ethnopharmacol 2007; 109(3): 539-542.
11. Prihanto AA. Cytotoxic, antioxidant and antibacterial activity of methanol extract of *Xylocarpus moluccensis* fruit husk. In Proceeding of The International Conference on Basic Science held at Malang, Indonesia: Galaxy Science publisher 2011; 2-5.
12. Misra S, Verma M, Mishra SK, Srivastava S, Lakshmi V, Misra-Bhattacharya S. Gedunin and photogedunin of *Xylocarpus moluccensis* possess antifilarial activity against human lymphatic filarial parasite *Brugia malayi* in experimental rodent host. Parasitol Res 2011; 109 (5):1351-60.
13. Li MY, Yang XB, Pan JY, Feng G, Xiao Q, Sinkkonen J, Satyanandamurty T, Wu J. Granatumins A-G, limonoids from the seeds of a Krishna mangrove, *Xylocarpus granatum*. J Nat Prod 2009; 72 (12):2110-4.
14. Pudhom K, Sommit D, Nuclear P, Ngamrojanavanich N, Petsom A. Moluccensins H-J, 30-ketophragmalin limonoids from *Xylocarpus moluccensis*. J Nat Prod 2010; 73(2):263-6.