

## Review on ethnobotanical status and pharmacological activities of *Artocarpus hirsutus* Lam

Surabhi G S<sup>1</sup>, Santhan Nehru Narkilli<sup>2</sup>, Dr. Prasobh G R<sup>3</sup>, Jiji Mohan M U<sup>4</sup>,  
Dr. Shivalekshmi S P<sup>5</sup>, Rupitha N S<sup>6</sup>

<sup>1</sup> Assistant professor, Department of Pharmacognosy, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

<sup>2</sup> Head, Department of Pharmacognosy, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

<sup>3</sup> Principal, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

<sup>4</sup> Assistant professor, Department of Pharmacognosy, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

<sup>5</sup> Assistant professor, Department of Pharmacy practice, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

<sup>6</sup> Assistant professor, Department of Pharmacology, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram

Corresponding Author: Surabhi G S

Submitted: 01-12-2021

Revised: 11-12-2021

Accepted: 14-12-2021

**ABSTRACT:** *Artocarpus* is a plant genus of the family Moraceae which comprises of about 1000 species. A wide range of *Artocarpus* species are used for food and traditional folk medicines. *Artocarpus hirsutus* Lam, commonly called wild jackfruit or jungle jackfruit is a tree which belongs to the plant genus 'Artocarpus'. It is the endemic species of Western Ghats in India. It is mainly found in Karnataka, Kerala Tamil Nadu and Maharashtra. Present review focuses on the reports available in various literatures. The ethnobotanical surveys reveal the various traditional uses of wild jack fruit such as joint pain and rigidity, swelling, haemorrhage, wound healing, fractures, snake bite, ulcer, pimples etc. Literature search shows the presence of alkaloids, flavonoids, tannins, carbohydrates and saponins in various parts of this tree. Pharmacological studies show significant antioxidant, hepato protective, anti-ulcer, anti-diabetic, diuretic, anti-microbial, anti-acne, skin brightening, anti-inflammatory, anti-arthritis activity etc.

**KEY WORDS:** *Artocarpushirsutus*; Botanical description, Chemical constituents, *Artocarpin*, Ethnobotanical status, Pharmacological activity.

### INTRODUCTION

#### Plant profile

*Artocarpus hirsutus* Lam, commonly called wild jackfruit or jungle jackfruit is a perennial tree which belonging to genus

*Artocarpus* of family, Moraceae. It is the key stone species of Western Ghats in India. It is mainly found in Karnataka, Kerala Tamil Nadu and Maharashtra. The word *Artocarpus* means evergreen tree which are grown in the tropical region and *hirsutus* means prickly and hairy which resembles the morphological feature of the fruit of the tree. The suffix Lam is given as a remembrance of a French naturalist Lamarck. This tree is reported in early scientific literature on the natural plant wealth of Asia 'Hortus Indicus Malabaricus'.<sup>(2)</sup>

#### Synonyms of *Artocarpus hirsutus* Lam<sup>(3,4)</sup>

- *Artocarpus pubescens* Wild
- *Saccus hirsutus* (Lam) Kuntze

#### Vernacular Names of *Artocarpushirsutus* Lam<sup>(1,2,3,4,5,6)</sup>

- Tamil : Kattuppala, Akkini, Anjili, Aiyinipila, Kandambala, Pevupala
- Kannada : Hebbalasu, Hebbalasu, Kaduhalasu, Pugguhalasu
- Malayalam : Annili, Ayini, Ayani, Ayaniplavu, Annali
- Sanskrit : Iravatam, Dahu, Lakucuh
- Marathi : Pat-phanas, Ranphanas
- Tulu : Katupanasu, Paja

• Hindi	:	Vadahaar	Order	:	Rosales
• Telugu	:	Pejuta	Family	:	Moraceae
<b>Scientific classification of <i>Artocarpushirsutus</i> Lam<sup>(5)</sup></b>			Tribe	:	Artocarpeae
Kingdom	:	Plantae	Genus	:	Artocarpus
Division	:	Angiosperms	Species	:	hirsutus
Phylum	:	Eudicots	Species authority	:	Lam
Class	:	Rosids			

**Table no. 1: Botanical description of *Artocarpus hirsutus* Lam<sup>(3,4,6)</sup>**

<b>Habitat</b>	Altitude- 1300 m, Annual rainfall - 1500 mm Grown in moist evergreen forest and plains
<b>Habit</b>	Large evergreen deciduous tree
<b>Height</b>	45-70 m
<b>Girth</b>	4.5 m deeper into the soil
<b>Life span</b>	Perennial- 25 – 40 years
<b>Flowering season</b>	December to January
<b>Fruiting season</b>	May and June
<b>Flowering class</b>	Dicot
<b>Wood</b>	Sapwood - white, 10-15 cm thick Heartwood - bright or golden yellow
<b>Bark</b>	Size- 1-1.5 cm thick, Colour- brownish grey Texture- smooth when young and later lenticellate
<b>Bark latex</b>	Colour- milky white, Nature- thick, sticky
<b>Branchlets</b>	Robust, horizontally drooping, hairy
<b>Leaves</b>	Simple, alternate, spiral, clustered at twigs end, egg shaped or elliptic, 12-25 x 7-15 cm, sub – acute-apex, margin-entire and wavy, lateral nerves-7-11 pairs, hairy
<b>Petiole</b>	Size-3 cm long, stout, Shape- planoconvex
<b>Lamina</b>	Size- 10-30.5 x 5-14 cm, Shape- ovate to elliptic
<b>Stipules</b>	Stipules-2.5 cm long, lanceolate, with scattered hairs
<b>Flowers</b>	Separate male and female flowers, minute, Colour- greenish yellow and separately seen in different heads of same plant in the leaf axils. Male heads- Shape- cylindrical, Size - 15 x 1cm, Female heads- Shape- ovoid, Size- 3 x 1.5 cm
<b>Fruits</b>	Syncarpous, covered with numerous spines like projections. Colour- yellow to orange when ripe Shape- globose to ovoid, Size- 10-15 x 8-12 cm

Seeds	Shape- ovoid, Colour- white, Size- 1.3-2cm long
-------	---



**Bark**



**Stipule**



**Whitelatex**



**Leaves and fruits**



**Upper side of leaf**



**Leaf margin**



**Seeds Fruits**

**Male flower**



**Tender leaves**

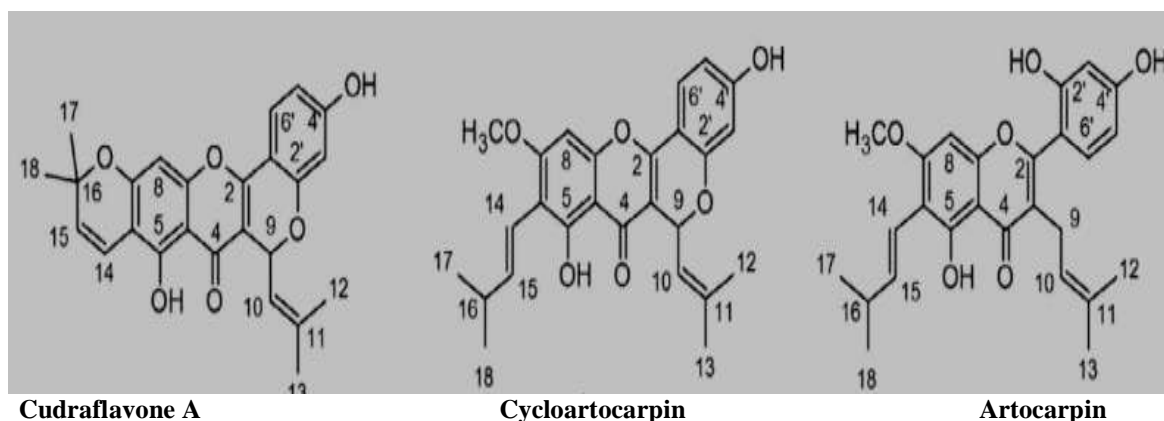
**CHEMICAL CONSTITUENTS**

Flavonoids, terpenes, coumarin, saponin glycosides were isolated from tender leaves. Flavonoids,

tannins, sterols, saponins & carbohydrates were found from leaves. <sup>(7,8,9,10)</sup>

Proteins, triterpenoids, alkaloids, flavonoids, lactones, tannins, saponins and carbohydrates were isolated from the stem bark and wood.<sup>(11)</sup> Alkaloids, flavonoids and carbohydrates were isolated from fruits.<sup>(9,12,13)</sup>

Artocarpin, cycloartocarpin, cudraflavone A are found to be the main chemical constituents of this tree.<sup>(14,15)</sup>



#### ETHNOBOTANICAL STATUS

**Sam P Mathew et al. (2006)** reported the bio-cultural diversity of endemic 'wild jack tree', *Artocarpus hirsutus* Lam on the Malabar coast of South India. This article discusses various aspects and medicinal claims of this tree. Ash of the plant bark mixed with coconut oil is used for Dhobi's itch' and ring worm infections. Bark paste in coconut oil is used externally for snake bite and paste of bark with palm sugar is applied for animal bone fractures. Dried leaves are used for Joint pain and rigidity. Leaves crushed with turmeric can treat Chronic haemorrhage. Dry leaves are used for the treatment of swelling of testicles originating from contusion. Seeds roasted with crushed onion fried in yogurt and inserted rectally to treat constipation. Seed oil is an appetite stimulant.<sup>(2)</sup>

**V P Silja et al. (2008)** conducted an ethnomedicinal survey on plant knowledge of Mullu Kuruma tribe of Wayanad in Kerala and revealed the use of 136 plant species for medicinal purposes. They reported that the bark of *Artocarpus hirsutus* Lam were applied to cure small pimples and cracks on the skin.<sup>(16)</sup>

**Shyma T B and G Devi Prasad (2012)** studied the traditional uses of medicinal plants among the tribes in Mananthavady of Wayanad district in Kerala. The five major tribes Kurichia, Kuruma, Adiyam, Kattunaik, Paniya, residing at Thirunelly, Kartikkulam, Thalappuzha, Mangalassery forest etc. are using plants for the treatment of various health problems. About 295 medicinal plant species belonging to 93 families have been recorded. They reported that ash of leaves of *Artocarpus hirsutus*

Lam was taken internally to treat abdominal problems.<sup>(17)</sup>

**R Latha and Agastian (2015)** reported that the latex and seed of *Artocarpus hirsutus* Lam were used for asthma and as appetizer respectively after their investigation about ethnobotanicals used by the primitive tribes in the Eastern Ghats of India.<sup>(18)</sup>

**Deepa M R et al. (2016)** conducted an ethnobotanical survey on floristic diversities and medicinal importance of selected sacred groves in Thrissur district, Kerala. About 119 species coming under 51 families were reported. They reported that fruits, leaves, bark of *Artocarpus hirsutus* Lam were used for anorexia, small pimples, cracks on the skin and sores.<sup>(19)</sup>

#### PHARMACOLOGICAL ACTIVITIES

##### Anti-oxidant activity

**Vinay Suvarna et al. (2013)** reported the antioxidant potential of methanolic fruit extract of *Artocarpus hirsutus* Lam by DPPH radical scavenging activity. The reducing power of the extract was found out using ascorbic acid as a standard reducing agent. Antioxidant effect of the extract was increased with increasing concentration of crude extract.<sup>(20)</sup>

**Sireesha K et al. (2016)** evaluated the in-vivo antioxidant effect of ethyl acetate seed extract of *Artocarpus hirsutus* Lam. Anti-oxidant effect was studied by measuring the levels of liver enzymes like superoxide dismutase (SOD), lipid peroxidation, and CAT (catalase) etc. The results



suggested that *A. hirsutus* seed extract showed a potential antioxidant effect.<sup>(21)</sup>

**Nayak M et al. (2017)** evaluated in-vitro antioxidant potential of ethanolic extract of leaf, wood and bark of *Artocarpus hirsutus* by DPPH method and oxygen radical absorbance capacity. It was observed that antioxidant activity was higher in wood extract compared to the other extracts. Activity guided fractionation of wood extract yielded oxyresveratrol that was characterized by NMR spectra and LCMS analysis. Isolated pure oxyresveratrol exhibited a significant antioxidant potential.<sup>(22)</sup>

**Rajeswari et al. (2019)** conducted antioxidant study of ethanolic leaf extract of *Artocarpus hirsutus* Lam. Antioxidant activity was performed using the liver homogenate of the animal by determination of Anti-oxidant enzymes like superoxide dismutase, catalase, peroxidase, glutathione peroxidase, glutathione reductase, reduced glutathione. The findings indicate that the ethanolic extract of *A. hirsutus* leaves have significant anti-oxidant activity.<sup>(10)</sup>

#### **Antiulcer activity**

**Dibinlal et al. (2013)** reported the antiulcer activity of the ethanolic bark extract of *Artocarpus hirsutus* Lam that is, the extract effectively reduces gastric secretory volume, acidity and gastric ulceration of pylorus ligated rats.<sup>(23)</sup>

#### **Diuretic activity**

**A K Azeem et al. (2013)** investigated and reported the diuretic activity of the aqueous fruit extract of the *Artocarpus hirsutus* Lam by modified Lipchitz method. The parameters studied were volume of urine, concentration of excreted ions of sodium and potassium, ratio of sodium ions to potassium ions excreted using furosemide as the reference standard.<sup>(24)</sup>

#### **Hepatoprotective activity**

**Patel J et al. (2016)** reported the significant hepatoprotective activity of methanolic leaf extract of *Artocarpus hirsutus* Lam due to the presence of flavanoids and tannins. Liver damage was induced by carbon tetra chloride and herbal extract is given. Standard drug used is silymarin. The degree of protection was determined by measuring the level of biochemical markers like alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase, bilirubin, total bilirubin and Cholesterol. The histopathology study also showed the hepatic protection of extracts.<sup>(8)</sup>

#### **Anti-diabetic activity**

**Sireesha K et al. (2016)** evaluated the antihyperglycemic activity of ethyl acetate seed extract of *Artocarpus hirsutus* Lam in both normal and Streptozocin-induced diabetic male wistar rats. Metformin was used as a standard. Blood glucose levels were estimated by the glucose oxidase method, and insulin levels were measured by chemiluminescence assay. The results suggested that *A. hirsutus* seed extract have potential antidiabetic activity so can be used for the treatment of diabetes mellitus.<sup>(21)</sup>

**Rajeswari et al. (2019)** conducted antidiabetic activity of ethanolic leaf extract of *Artocarpus hirsutus* Lam. The conclusions of the study are, protective action and regeneration of beta cells in pancreas by *A. hirsutus* extract against Streptozocin induced diabetes in rats using glibenclamide as standard and this may be due to the presence of constituents such as alkaloids, flavonoids, saponins and terpenoids.<sup>(10)</sup>

#### **Anti-microbial activity**

**Jim Thomas et al. (2016)** studied the phytochemical constituents and antimicrobial efficacy of the aqueous bark extract of *A. hirsutus*. This study concluded that the aqueous bark extract of *Artocarpus hirsutus* Lam is a suitable antimicrobial agent against *E. coli*, *Pseudomonas* and *Bacillus* sp. even at low concentrations.<sup>(11)</sup>

**Shanmugapriya K et al. (2017)** evaluated the antimicrobial activity of acetone and ethanolic extract of *Artocarpus hirsutus* Lam fruits and leaves. The study reported the presence of alkaloids, flavonoids, glycosides, terpenoids, tannins, phenols, and saponins. Antimicrobial activity of fruit and leaf extract of were tested against fungal and bacterial strains and acetone extract of both leaf and fruit showed good antibacterial activity.<sup>(9)</sup>

**Lakshmi Pethamkamsetty et al. (2013)** performed the phytochemical and biological examination of root extract of *Artocarpus hirsutus* Lam and showed the presence of isoprenylated flavonoids and then screened its antibacterial and antifungal activities. The results showed that *Artocarpus hirsutus* Lam have considerable activity against selected bacterial and fungal strains which can be attributed to the presence of steroidal and phenolic compounds in the tree.<sup>(25)</sup>

**Vinay Suvarna et al. (2014)** evaluated the antimicrobial activity of methanolic and petroleum ether extract of fruits of *Artocarpus hirsutus* Lam. This study revealed that methanolic extract of *A. hirsutus* Lam have effective antimicrobial activity against *S. aureus* and *Klebsiella pneumoniae* than

petroleum ether extract, compared with standard drug tetracycline. <sup>(12)</sup>

#### Anti-acne activity

**Nayak M et al. (2017)** evaluated the anti-acne potential of the ethanolic stem wood, stem bark and leaf extract of *Artocarpus hirsutus* Lam, some chemical components such as cudraflavone A, cycloartocarpin, artocarpin isolated from the extracts, acetate and prenyl derivatives synthesised from the isolated flavonoids and a cream formulated using the artocarpin in three different concentrations against *Propionibacterium acnes*. Isolated compounds, cudraflavone A, cycloartocarpin and artocarpin showed significant in-vitro anti-acne activity than its derivatives which is comparable with commercially available anti-acne agent tea tree oil and standard antibiotic, Clindamycin. <sup>(14)</sup>

**Nayak M et al. (2017)** isolated pyranocycloartobioxanthone A and artonine E from the ethanolic stem bark extract of *Artocarpus hirsutus* Lam. In-vitro antiacne activity of two isolated compounds were done by agar well diffusion method using clindamycin as standard <sup>(26)</sup>

#### Skin-brightening activity

**Nayak M et al. (2017)** evaluated skin-brightening activity of ethanolic extract of leaf, wood and bark of *Artocarpus hirsutus* Lam by tyrosinase inhibition, melanogenesis inhibition using murine melanoma cells. Activity guided fractionation of wood extract yielded oxyresveratrol. Isolated pure oxyresveratrol exhibited a significant tyrosinase inhibition, melanogenesis inhibition. <sup>(22)</sup>

#### Anti-inflammatory activity

**Nayak M et al. (2017)** evaluated the anti-inflammatory activity of ethanolic extract of leaf, wood and bark of *Artocarpus hirsutus* Lam. Results shows that isolated pure oxyresveratrol exhibited significant inhibition of lipopolysaccharide induced TNF- $\alpha$  secretion. <sup>(22)</sup>

**Anupriya Thomas et al. (2017)** proved the in-vivo anti-inflammatory activity of the ethanolic extract of tender leaves of *Artocarpus hirsutus* Lam on a croton oil induced ear edema in Sprague-Dawley male rat using dexamethasone as standard and they concluded that this activity may be due to the presence of flavanoids, saponin and coumarin glycosides, and terpenoids. Percentage inhibition of inflammation increases with increase in extract concentration. <sup>(27)</sup>

#### Anti -arthritic activity

**Anupriya Thomas et al. (2017)** reported the in-vitro antiarthritic potential of ethanolic extract of tender leaves of *Artocarpus hirsutus* Lam by

inhibition of protein denaturation method using diclofenac sodium as standard and bovine albumin serum protein. From the results, they concluded that tender leaves of *A. hirsutus* possesses significant antiarthritic activity and this may be due to the presence of flavanoids, saponins, and terpenoids present in the leaf. <sup>(28)</sup>

### CONCLUSION

*Artocarpus hirsutus* Lam is a commonly used tree by folk people for agricultural, food, health care uses and timber purpose. Ethnobotanical studies show that various parts of this tree are useful for pain, snake bite, swelling, venereal bubones, hydrocele, chronic haemorrhage, pimples and cracks of the skin, joint pain and rigidity, asthma, ringworm infections, wound healing, fractures, abdominal problems like ulcers, diarrhoea etc. Artocarpin, cycloartocarpin, cudra flavone A, and some other flavonoids are found to be the main chemical constituents of this tree. Tannins, alkaloids, saponins, terpenoids, carbohydrates are also present. The reported pharmacological activities are antioxidant (fruit, leaf, seed), hepato protective (leaf), anti-ulcer (bark), anti-diabetic (seed), diuretic (fruit), antimicrobial (stem wood, bark, root, fruit, leaf), anti-acne and skin brightening (leaf, stem), anti-inflammatory (leaf, stem, wood), antiarthritic (tender leaves) etc. Still many of potentials of the tree towards a number of diseases are unexplored.

### REFERENCES

- [1]. Hari A, Revikumar K G, Divya D. *Artocarpus*: A Review of Its phytochemistry and pharmacology. *Journal of Pharma Search*. 2014; 9 (1):7-12.
- [2]. Mathew S P, Mohandas A, Shareef S M, Nair G M. Bio cultural diversity of the endemic 'Wild Jack Tree' on the Malabar coast of south India. *Ethno Botany Research and Applications*. 2006; 4: 25-40.
- [3]. <https://indiabiodiversity.org/biodiv/species/show/8066>
- [4]. Kirtikar K R, Basu B D. *Indian Medicinal Plants*. 2<sup>nd</sup> edition. 3, P.2336.
- [5]. Ankita, Hebbar S, Chaitra et al. Pharmacognostical and analytical analysis of *Artocarpus hirsutus* Lam- A Folk Plant. *International Ayurvedic Medical Journal*. 2017; 5 (2):411-417.
- [6]. Orient Longman. *Indian Medicinal Plants-A Compendium of 500 Species*. 1, P.215-217.

- [7]. Patel J, Reddy V, Kumar G S et al. GC-MS analysis of bioactive components on the leaves extract of *Artocarpus hirsutus*: A potential folklore medicinal plant. *International Journal of Herbal Medicine*. 2016; 4 (6): 95-97.
- [8]. Patel J, Reddy V, Kumar G S. Preliminary phytochemical screening and hepatoprotective activity of methanol extract of *Artocarpus hirsutus* leaves. *International Journal of Phytomedicine*. 2016; 8: 379-383.
- [9]. Kaminidevi S, Akanya S, Clinton A B, Nanzy B S, Prakash P R, Suganya V. Phytochemical screening of *Artocarpus hirsutus* and its antimicrobial potential. *Asian Journal of Pharmaceutical and Clinical Research*. 2017; 10(6): 298-302.
- [10]. Rajeswari R, Lalitha V, Korah M C, Rahman P V J, Kumar A S. Phytochemical and pharmacological evaluation of ethanolic extract of the *Artocarpus hirsutus* Lam leaves. *International Journal of Pharmaceutical Sciences and Research*. 2019; 10(4): 1972-1980.
- [11]. Thomas J, Kumar S M, Kumar V N, Wesley E G, Pandian R M. Antimicrobial activity and phytochemical evaluation of aqueous extract of *Artocarpus hirsutus* Lam bark. *Global Journal for Research Analysis*. 2016; 5(6): 42-44.
- [12]. Suvarna V M N, Ramesh B S, Hanumanthappa M K et al. Phytochemical analysis and antimicrobial activity of *Artocarpus hirsutus*: An In-Vitro Study. *International Journal of Pharma and Bio Science*. 2014; 5(3): 98 – 104.
- [13]. Neha C P, Abdussalam A K. Phytochemical evaluation of *Artocarpus hirsutus* Lam fruit extract: A potential wild endemic plant. *International Journal of Current Pharmaceutical Research*. 2020; 12 (2): 53-56.
- [14]. Nayak M, Nagarajan A, Majeed M, Jamsheeda M, Choudhury A K. Flavonoids from *Artocarpus hirsutus* Lam: Synthesis of new prenyl ethers, acetates and their anti-acne activity. *Cogent Chemistry*. 2017; 3: 1-12.
- [15]. Chiang Chan E W, Wong S K, Tangah J, Chan H T. Chemistry and pharmacology of *Artocarpin* -An isoprenylflavone from *Artocarpus* Species. *Systematic Reviews in Pharmacy*. 2018; 9(1): 58-63.
- [16]. Silja V P, Samitha V K, Mohanan V K. Ethnomedicinal plant knowledge of the Mullu kuruma tribe of Wayanad district, Kerala. *International journal of traditional knowledge*. 2008; 7 (4): 604-612.
- [17]. Shyma T B, Devi Prasad A G. Traditional use of medicinal plants and its status among the tribes in Mananthavady of Wayanad district, Kerala. *World Research Journal of Medicinal and Aromatic Plants*. 2012; 1(2): 22-26.
- [18]. Latha R, Agastian P. An investigation on pharmaceutical ethno botanicals used by the primitive tribes of five areas in the Eastern ghats of India. *World Journal of Pharmaceutical Research*. 2015; 4(9): 1437-1464.
- [19]. Deepa M R, Sheema Dharmapal P, Udayan P S. Floristic diversities and medicinal importance of selected sacred groves in Thrissur district, Kerala. *Tropical Plant Research*. 2016; 3 (1): 230–242.
- [20]. Vinay S, Ramesh B S, Venkatachalapathy R, Makari H K et al. Evaluation of antioxidant activity of *Artocarpus hirsutus* methanolic fruit extract: An in -vitro study. *International Journal of Scientific Research*. 2013; 2(12): 58-59.
- [21]. Sireesha K, Raghunandan N. Evaluation of in-vivo antidiabetic and antioxidant activity of *Artocarpus hirsutus* seeds in streptozotocin induced diabetic rats. *Asian Journal of Pharmaceutical and Clinical Research*. 2016; 9 (1): 170-173.
- [22]. Nayak M, Nagarajan A, Majeed M, Mundkur L A. Evaluation of in-vitro antioxidant potential, anti-inflammatory activity and melanogenesis inhibition of *Artocarpus hirsutus* Lam extracts. *International Journal of Scientific and Technology Research*. 2017; 6(1): 196-203.
- [23]. Dibilal D, Seethadevi B. Antiulcer activity of the bark of *Artocarpus hirsutus* Lam. *Journal of Pharma Search*. 2013; 8(2): 3-5.
- [24]. Azeem A K, Rasheed A, Dilip C, Junise V, Rani S. Diuretic activity of fruits of *Artocarpus hirsutus* Lam. *Journal of Current Science*. 2013. 1(1): 16-19.
- [25]. Pethamkamsetty L, Ganapaty S M, Bharathi K. Phytochemical and biological examination of the root extract of *Artocarpus hirsutus* Lam. *International Journal of Bioassays*. 2013; 2 (4): 735-738.



- [26]. Nayak M, Nagarajan A, Majeed M, Nagabhushanam K, Choudhury A K. In-vitro anti-acne activity of phytoactives from the stem barks of *Artocarpus hirsutus* Lam and characterization of pyranocycloartobioxanthone A as a mixture of two anomers. *National Product Research*. 2017;32(17):2116-2120.
- [27]. Thomas A, Gnanasekaran D, Antony J. In-vivo anti-inflammatory activity on tender leaves of *Artocarpus hirsutus* Lam. *Asian Journal of Research in Biological and Pharmaceutical Sciences*. 2017; 5(2):39 - 43.
- [28]. Thomas A, Gnanasekaran D, Antony J. In-vitro anti-arthritis activity on tender leaves of *Artocarpus hirsutus* Lam. *World Journal of Pharmaceutical Research*. 2017; 6 (5): 700-706.