

***Artabotrys hexapetalus* (L.f.) Bhandari: Ethnomedicinal Uses, Pharmacological Properties and Bioactive Compounds-Review**

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Abstract : *Artabotrys hexapetalus* (L.f.) Bhandari belongs to the Annonaceae family. This species has been reported in India, Sri Lanka and southern China. *Artabotrys hexapetalus* has various bioactive compounds which possess pharmacological activity. *Artabotrys hexapetalus* possess antimicrobial, anthelmintic, anticancer, anti-inflammatory, antibacterial, mosquito repellency, antifertility, antioxidant and antileishmanial activity. *Artabotrys hexapetalus* can act as a uterine stimulant, muscle relaxant and cardiac stimulant properties.

Key words: *Artabotrys hexapetalus*, Pharmacological properties, Ethnomedicinal uses, Secondary metabolites, Bioactive compounds.

1. Introduction

Artabotrys hexapetalus is a liana or scandent shrub that can reach a height of 8 to 10 meters [1]. *Artabotrys hexapetalus* is indigenous shrub to southern India and Sri Lanka. It is widely grown in southern China, Philippines, Indochina and Java [1]. Leaves alternating (6-15×2-4.5cm), elliptic-oblong, slightly acuminate at apex. Petiole is of 0.4-0.8 cm long [1,2,3]. Flowers are solitary or paired with fragrant, greenish yellow in colour. Hooked penduncle, 2cm across and 1cm long pedicle. Sepals are ovate, 5-7.5×5-6mm [3,4]. Fruitlets are ovoid with 14-20 fruits. Seed are brown in colour. Stamen and carpels are many, anther is beaked, 2 ovules are present [3,4]. This review elaborates on ethnomedicinal uses, various pharmacological properties and bioactive compounds of *Artabotrys hexapetalus*.

2. Ethnomedicinal uses of *Artabotrys hexapetalus*

Artabotrys hexapetalus flowers are used to treat bad breath, vomiting, itching and leucoderma [3]. *Artabotrys hexapetalus* leaves decoction was used to treat cholera and malaria [5]. Decoction of *Artabotrys hexapetalus* roots and leaves mixed with roots decoction

of *Uvaria leptocladoni* were used against abdomen and kidney pains [6]. *Artabotrys hexapetalus* fruits and roots were used to treat malaria and scrofula, in Chinese folk medicine[7]. Decoction of *Artabotrys hexapetalus* leaves was used in the treatment of chlorea [4, 8]. *Artabotrys hexapetalus* leaves are used to treat itching [9]. Flowers are used in the treatment of heart disease, blood disease, bladder disease, bad breath, leucoderma, biliousness, itching, thirst, sweating and vomiting [8]. *Artabotrys hexapetalus* was used as an insect repellent [10]. *Artabotrys hexapetalus* was used as cardiogenic[11], cardiac stimulant, muscle relaxant, hypotensive and uterine stimulant[12]. In experimental animals pericarp of *Artabotrys hexapetalus* showed ionotropic effect and chronotropic effect [12]. *Artabotrys hexapetalus* flowers are used as a flavoring in tea [13]. *Artabotrys hexapetalus* flowers contain essential oils which are used in the aromatherapy and preparation of perfumes [14,15]. *Artabotrys hexapetalus* was grown in gardens as a screen plant and as an ornamental plant.

3. Taxonomic classification of *Artabotrys hexapetalus*

Artabotrys hexapetalus belongs to the annonaceae family. Taxonomic classification and vernacular names [16,17] of *Artabotrys hexapetalus* are listed in the Table-1.

Table 1:Taxonomic classification and vernacular names of *Artabotrys hexapetalus* (L.f.) Bhandari

Taxonomic classification of <i>Artabotrys hexapetalus</i> (L.F.) Bhandari	
Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Magnoliales
Family	Annonaceae
Genus	<i>Artabotrys</i>
Species	<i>Artabotrys hexapetalus</i> (L.f.) Bhandari
Vernacular names	Hindi- Harichampa, Tamil- Manoranjitham, Sanskrit- Harachampaka, Kannada-Madana masthi hoo, Telugu- Manoranjidamu.



Figure-1: *Artabotrys hexapetalus* (L.f.) Bhandari leaves, Flower and Fruits

4. Phytochemicals in *Artabotrys hexapetalus*

Artabotrys hexapetalus leaves ethanolic extract contain various phytochemicals like carbohydrates, proteins, alkaloids, flavonoids, terpenoids, glycoside, saponins and phytosterol [18]. *Artabotrys hexapetalus* leaves hydro ethanol extract revealed the presence of reducing sugars, fatty acids, phenolic compounds, alkaloids, flavonoids, tannins, saponins, emodins, anthroquinones, anthocyanin, steroids, coumarins and leucoanthocyanins [19]. Qualitative analysis of *Artabotrys hexapetalus* aqueous leaves extract showed the presence of various phytochemicals like alkaloids, flavonoids, tannins, phenols, glycosides, diterpenes, saponins, carbohydrates, proteins and amino acids [20]. Quantitative estimation of *Artabotrys hexapetalus* aqueous leaves extract showed the presence of flavonoids (28.3 ± 0.91 mg/g extract), phenols (7.63 ± 0.85 mg/g extract), tannins (24.53 ± 1.02 mg/g extract), carbohydrates (43.16 ± 1.0 mg/g extract), amino acids (19.33 ± 1.30 mg/g extract) and proteins (60.4 ± 0.88 mg/g extract) [20].

5. Antioxidant potential of *Artabotrys hexapetalus*

Ethanolic extract of flowers of *Artabotrys hexapetalus* possess antioxidant capacity, nitric oxide radical scavenging activity, reducing ability and scavenging of hydrogen peroxide [21]. Methanolic extract of *Artabotrys hexapetalus* leaves showed DPPH radical scavenging activity. Phenol and flavonoids were reported to be high in *Artabotrys hexapetalus* leaves [22].

6. Antimicrobial activity of *Artabotrys hexapetalus*

Artabotrys hexapetalus flowers aqueous extract showed antifungal activity against *Candida albicans* and *Aspergillus niger*. Antibacterial activity of *Artabotrys hexapetalus* flowers aqueous extract was reported against *Pseudomonas aeruginosa*, *Salmonella typhi*, *Escherichia coli* and *Staphylococcus aureus* [23]. Butanol extract of *Artabotrys hexapetalus* flowers showed antibacterial activity against *Salmonella*, *Staphylococcus*, *Pseudomonas*, *Vibrio cholera*, *Streptococcus*, *Corynebacterium*, *Proteus vulgaris* and *Escherichia coli* [24].

Artabotrys hexapetalus leaves possess antifungal activity [25]. *Artabotrys hexapetalus* leaves methanolic extract showed antibacterial activity against *Streptococcus entericus*, *Streptococcus mutans*, *Salmonella typhi*, *Escherichia coli*, *Lactobacillus casei*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Enterococcus faecalis*, *Xanthomonas campestris* and *Bacillus megaterium* [19]. Antifungal activity of *Artabotrys hexapetalus* leaves methanolic extract was reported against *Rhizopus oryzae*, *Candida albicans*, *Candida rogasa* and *Aspergillus niger* [19].

7. Hepatoprotective activity of *Artabotrys hexapetalus*

Alcoholic extract of *Artabotrys hexapetalus* leaves and fruits showed hepatoprotective activity in the rats treated with paracetamol [26]. Rats treated with paracetamol showed elevated levels of serum enzymes like ALP, ACP, SGPT, SGOT, total bilirubin and direct bilirubin. Whereas rats treated with alcoholic extract of *Artabotrys hexapetalus* showed decreased serum enzymes when compared with normal group [26]. Rats treated with 500mg/kg of alcoholic extract of *Artabotrys hexapetalus* showed increased SOD, catalase, vitamin C and decreased lipid peroxidation. Alcoholic extract of *Artabotrys hexapetalus* protects DNA from fragmentation due to the toxicity of paracetamol [26]. Ether

extract of *Artabotrys hexapetalus* protects the liver against CCl₄ injury [27]. Ethanolic extract of *Artabotrys hexapetalus* leaves showed hepatoprotective activity in wistar albino rats treated with paracetamol, ethanol and IR (Isoniazid and Rifampicin) [28].

8. Anthelmintic activity of *Artabotrys hexapetalus*

Methanolic barks extract of *Artabotrys hexapetalus* showed anthelmintic activity against adult earthworms *Pheretima posthuma* [29]. *Artabotrys hexapetalus* leaves possess anthelmintic and anti-diarrhoeal activity [4].

9. Anti-Inflammatory activity of *Artabotrys hexapetalus*

Ethanolic leaves extract of *Artabotrys hexapetalus* showed anti-inflammatory activity against carrageenan and papaya latex induced acute paw edema models in albino rats [30]. *Artabotrys hexapetalus* ethanolic extract of aerial parts possess anti-inflammatory activity [31]. Alkaloids and polyphenols in *Artabotrys hexapetalus* contribute to anti-inflammatory properties [31].

10. Antifertility activity of *Artabotrys hexapetalus*

Hydro alcoholic extract of *Artabotrys hexapetalus* leaves showed antifertility activity in male rats. Hydro alcoholic extract of *Artabotrys hexapetalus* leaves treated rats showed reduction in the sperm count [18]. Histopathology of testes showed abnormal, immature spermatogenic activity in the seminiferous tubules, decrease in diameter in seminiferous tubules, presence of nucleated cells [18]. Serum testosterone level was reduced in male rats treated with hydro alcoholic *Artabotrys hexapetalus* leaves extract [18]. *Artabotrys hexapetalus* seeds showed antifertility activity, reduction in sperm anti-implantation, abortifacient and immobility of spermatozoa in the *in vitro* studies [8].

11. Antileishmanial activity of *Artabotrys hexapetalus*

Aerial parts of *Artabotrys hexapetalus* were extracted with different solvents like petroleum ether, dichloromethane, ethanol and distilled water. Petroleum ether extract of aerial parts of *Artabotrys hexapetalus* showed *in vitro* antileishmanial activity when compared to other extracts [31].

12. Mosquito repellency activity of *Artabotrys hexapetalus*

Essential oils were produced by hydrodistillation methods using *Artabotrys hexapetalus* leaves and stem bark. β -caryophyllene oxide was reported to be present in larger quantities in stem bark of *Artabotrys hexapetalus* [32]. Caryophyllene oxide and 11-hexadecyn-1-ol was present in leaves of *Artabotrys hexapetalus* [32]. Essential oils from leaves possess increased mosquito repellency activity against *Anopheles gambiae* s.s female mosquito [32]. Essential oils from stem bark showed less mosquito repellency activity against *Anopheles gambiae* s.s female mosquito. Mosquito repellency activity is due to the presence of β -caryophyllene oxide [32].

13. Nanoparticles synthesis and characterization from *Artabotrys hexapetalus*

Nanoparticles of leaves extract of *Artabotrys hexapetalus* was synthesized with Cadmium sulphide. Synthesized nanoparticles showed antibacterial activity against *Staphylococcus aureus* and antifungal activity against *Aspergillus niger* [33]. Characterization of synthesized Cadmium Sulphide nanoparticles of *Artabotrys hexapetalus* leaves extract was performed using Scanning Electron Microscope, X-ray Powder Diffraction, Transmission Electron Microscope, Fourier Transformer Infrared Spectroscopy and UV-Visible spectrophotometer [33].

14. Immunomodulatory activity of *Artabotrys hexapetalus*

Artabotrys hexapetalus possess immunomodulatory activity by increasing the neutrophil counts [26]. Ether extracts of *Artabotrys hexapetalus* exhibited a stronger activity in delayed type hypersensitivity assay [26].

15. Antiulcer and wound healing activity of *Artabotrys hexapetalus*

Methanolic, chloroform and diethylether extract of *Artabotrys hexapetalus* possess antiulcer activity against aspirin, alcohol and pylorus ligation induced ulcer [26]. Methanolic extract of *Artabotrys hexapetalus* possess good antiulcer activity against aspirin, alcohol and pylorus ligation induced ulcer when compared to other extracts [26]. Methanolic extract of *Artabotrys hexapetalus* possess wound healing activity [26].

16. Anticancer activity of *Artabotrys hexapetalus*

Methanolic extract of *Artabotrys hexapetalus* leaves showed anticancer activity against MC-7, human breast cancer cell lines [34].

17. Bioactive compounds in *Artabotrys hexapetalus*

Artabotrys hexapetalus leaves, flowers, seeds and roots possess various biologically active compounds like alkaloids, flavonoids, phenols, tannins, terpenoids, essential oils and glycosides. Bioactive compounds so far identified and isolated in *Artabotrys hexapetalus* are listed in the Table-2.

Table 2: Bioactive compounds in *Artabotrys hexapetalus*

S.No.	<i>A.hexapetalus</i> Parts	Bioactive Compound	References
1.	Leaves	Phenolic acid : Gallic acid	[8]
2.	Leaves	Flavonoid: Apigenin 7-O-β-D-glucopyranoside	[35]
3.	Leaves	Flavonoid: Apiin (Apigenin 7-O-β-D-apiosyl-(1→2)-β-D-glucoside)	[8,36]
4.	Leaves	Flavonoid :Cynaroside (Luteolin 7-O-β-D-glucoside)	[8,36]
5.	Leaves	Flavonol :Kaempferol	[8]

6.	Leaves	Flavonol glycoside : Arapetaloside A (Quercetin 3-O- α -L-rhamnopyranosyl-(1 \rightarrow 2)- α -L-arabinofuranoside	[35,36]
7.	Leaves	Flavonol glycoside : Arapetaloside B (Kaempferol 3-O- α -L-rhamnopyranosyl-(1 \rightarrow 2)- α -L-arabinofuranoside	[8,36,37]
8.	Leaves	Flavononol: Taxifolin	[37]
9.	Leaves	Flavonoid: Myrecetin	[8]
10.	Leaves	Flavonoid: Quercetin	[8]
11.	Leaves	Phenolic compound: Guaijaverin (Quercetin 3-O- α -L-arabinopyranoside)	[8]
12.	Leaves	Phenolic compound: Hyperoside (Quercetin 3-O- β -D-galactopyranoside)	[8]
13.	Leaves	Phenolic compound: Isoquercetin (Quercetin 3-O- β -D-glucopyranoside)	[8]
14.	Leaves	Flavonol diglycoside: Rutin (Quercetin 3-O- α -L-rhamnopyranosyl-(1 \rightarrow 6)- β -D-glucopyranoside	[36]
15.	Leaves	Phenolic compound: Quercetin 3-O- α -L-rhamnopyranosyl rutinoside (Quercetin 3-O- α -L-rhamnopyranosyl-(1 \rightarrow 3)-O-[α -L-rhamnopyranosyl-(1 \rightarrow 6)- β -D-glucopyranoside])	[35]
16.	Leaves	Norterpeneoid : 7E-9-hydroxy-4,7-megastigmane-3-one-10-O- β -D-glucopyranoside	[35]
17.	Leaves	Succinic acid	[7]
18.	Leaves	Fumaric acid	[7]
19.	Leaves	Trisaccharide	[34]
20.	Leaves	n-Hexadecanoic acid	[34]
21.	Leaves	Z-8-Methyl-9-tetradecenoic acid	[34]
22.	Seeds	Neolignans: Isoamericanin A	[7,8,37]
23.	Seeds	Neolignans: Isoamericanol A	[7,8,37]
24.	Seeds	Neolignans: Americanin B	[7,8,37]
25.	Seeds	Neolignans: Artabotrycinol	[7,8,37]
26.	Seeds	Hemiterpenoid: Artabotriol	[7,8,37]
27.	Seeds	Palmitic acid	[7,8,37]
28.	Seeds	β -Sitosterol (Stigmasta-5-en- γ -ol)	[7,8,37]
29.	Seeds	Daucosterol (β -Sitosterol 3-O- β -D-glucopyranoside)	[7,8,37]
30.	Aerial Parts	Sesquiterpene: Humulene (α -Caryophyllene)	[38]
31.	Aerial Parts	Sesquiterene: β -Caryophyllene	[38,39]
32.	Aerial Parts and Flowers	Caryophyllene oxide	[38,40]
33.	Aerial Parts	Tetraterpenoid: Lutein	[38]
34.	Aerial Parts	Lactone: (2R,3R)-3-hydroxy-2-methylbutyrolactone	[38]
35.	Aerial Parts	Artapetalin A	[8,38]

36.	Aerial Parts	Artapetalin B	[8,41]
37.	Aerial Parts	Artapetalin C	[8,38]
38.	Aerial Parts	Tulipalin B	[38]
39.	Flowers	Ethyl acetate	[7]
40.	Flowers	Ethyl propanoate	[39]
41.	Flowers	Propyl acetate	[39]
42.	Flowers	Methyl butanoate	[39]
43.	Flowers	Ethyl isobutanoate	[39]
44.	Flowers	Isobutyl acetate	[39]
45.	Flowers	Ethyl methacrylate	[39]
46.	Flowers	Ethyl butanoate	[39]
47.	Flowers	Ethyl 2-methyl butanoate	[39]
48.	Flowers	Ethyl isovalerate	[39]
49.	Flowers	Isopentanyl acetate	[39]
50.	Flowers	2-Methylbutyl acetate	[39]
51.	Flowers	Isobutyl isobutanoate	[39]
52.	Flowers	Ethyl 3-methyl-2-butenate	[39]
53.	Flowers	Isobutyl butanoate	[39]
54.	Flowers	Ethyl hexanoate	[39]
55.	Flowers	Terpenoid: Acyclic Linalool	[39]
56.	Flowers	Terpenoid: Limonene	[39]
57.	Flowers	Terpenoid: β -Gurjunene	[39]
58.	Flowers	Terpenoid: Globulol	[39]
59.	Flowers	3-Methyl butanol	[39]
60.	Flowers	2-Methyl butanol	[39]
61.	Flowers	β -caryophyllene	[40]
62.	Flowers	Caryophyllene oxide	[39,40]
63.	Flowers	α -Cubebene	[40]
64.	Flowers	α -Ylangene	[40]
65.	Flowers	α -Copaene	[40]
66.	Flowers	β -Elemene	[40]
67.	Flowers	Sativene	[40]
68.	Flowers	Ylanga-2,4(15)-diene	[40]
69.	Flowers	Isocaryophyllene	[40]
70.	Flowers	β -Copaene	[40]
71.	Flowers	α -Humulene	[40]
72.	Flowers	Allo-aromadendrene	[40]
73.	Flowers	γ -Muurolene	[40]
74.	Flowers	Bicyclosquisphellandrene	[40]
75.	Flowers	α -Muurolene	[40]
76.	Flowers	γ -Cadinene	[40]
77.	Flowers	Calamenene	[40]
78.	Flowers	δ -Cadinene	[40]
79.	Flowers	α -Calacorene	[40]
80.	Flowers	Globulol	[40]
81.	Flowers	1-Epi-cubenol	[40]
82.	Flowers	1(10)-spirovetiven-7 β -ol	[40]
83.	Flowers	Selin-11-en-4-ol	[40]

84.	Flowers	Saccogynol	[40]
85.	Roots	Sesquiterpenoids	[41,42]
86.	Roots	Artaboterpenoid A	[41]
87.	Roots	Artaboterpenoid B	[41]
88.	Stem	Benzylisoquinoline alkaloid: Hexapetalins A	[43]
89.	Stem	Benzylisoquinoline alkaloid: Hexapetalins B	[43]
90.	Stem	Alkaloid: Reticuline	[43]
91.	Stem	Alkaloid: Norisocorydine	[43]
92.	Stem	Alkaloid: Nornuciferine	[43]
93.	Stem	Alkaloid: Stepbarine	[43]
94.	Stem	Alkaloid: Isocorydine	[43]
95.	Stem	Alkaloid: Anonaine	[43]
96.	Stem	Alkaloid: Roemerine	[43]
97.	Stem	Alkaloid: Liriodenine	[43]
98.	Stem	Alkaloid: Atherospermidine	[43]
99.	Stem	Alkaloid: Laureline	[43]
100.	Stem	Alkaloid: Artabonatin B	[43]

18. Conclusion

Artabotrys hexapetalus (L.f.) Bhandari possess various phytochemicals, antioxidants, bioactive compounds and ethnomedicinal uses. Studies on *Artabotrys hexapetalus* reported various pharmacological properties like hepatoprotective activity, anticancer activity, antimicrobial activity, anthelmintic activity, anti-inflammatory activity, antifertility activity, antileishmanial activity, mosquito repellency, immunomodulatory, anti ulcer and wound healing activity. In future further research can be done with *Artabotrys hexapetalus* (L.f.) Bhandari to explore more pharmacological properties.

Conflicts of interest statement

The authors declare no conflicts of interest.

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