



## Review Article

***Muntingia calabura*: A comprehensive review**Mohini Upadhye<sup>1</sup>, Mohini Kuchekar<sup>2,\*</sup>, Rohini Pujari<sup>1</sup>, Shailja Kadam<sup>1</sup>, Priya Gunjal<sup>1</sup><sup>1</sup>Dept. of Pharmacognosy, P. E. Society's Modern College of Pharmacy (For Ladies), Pune, Maharashtra, India<sup>2</sup>Dept. of Pharmacognosy, P. E. Society's Modern College of Pharmacy, Nigdi, Pune, Maharashtra, India

## ARTICLE INFO

## Article history:

Received 17-06-2021

Accepted 07-09-2021

Available online 19-11-2021

## Keywords:

Muntingia calabura

Elaeocarpaceae

Pharmacological activities

Phytochemical study

## ABSTRACT

Medicinal plants are well-known sources of important therapeutic aid for alleviate human disorders. *Muntingia calabura* (Elaeocarpaceae) is the widely used in the ayurvedic system of the medicine as very sweet, musky, fig-like flavour. *M. calabura* also known as Jamaica cherry, is a small and evergreen tree. The necessity of plant in human ailments is illustrious in old medicinal practices. The secondary metabolites are obtained from the different parts of plant alkaloids, flavonoids, tannin, phenolic compound etc. *M. calabura* are traditional medicinal uses have been reported for the leaves (headaches, prostate problems, reduce gastric ulcers), bark (antiseptic), flowers (antiseptic, reduce swelling, antispasmodic), and fruits (respiratory problems, antidiarrheic). The present study gives an overview on plant and its pharmacological activities were documented.

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## 1. Introduction

*Muntingia Calabura* [Jamaica Cherry] belonging to family muntingiaceae (Elaeocarpaceae). It is widely grown in the tropics and subtropics worldwide. Jamaica Cherry is a small and fast-growing tree.<sup>1</sup> The plant is traditionally used to reduce pain from gastric ulcer. The emergence of various types of diseases, both infectious and non-infectious. It is proven to have many pharmacological activities like anti-inflammatory activity, antipyretic activity, antiulcer activity, anti-diabetic activity, anti-hypertensive activity, cardioprotective activity, anti-bacterial activity, insecticidal activity and anti-oxidant activity.

## 1.1. Morphology

*M. calabura* is an annual fast-growing tree which flowers throughout the year and can reach up to 12-15 m height

with spreading branches. The leaves are soft evergreen and alternate, ablong phyllotaxy about 4-15 cm long and 1-6 cm wide, distinctively lanceolate, oblong with toothed margin oblique at the base with dark green color and upper surface indicates presence of minute hair. The flowers are small size with green sepals and white petals and yellow stamens in the center. The fruits are abundant small berries (1.5 cm wide) and depending on the variety have red or yellow, thin, smooth, tender skin and light-brown, soft, juicy pulp and are sweet, musky, fig-like in taste filled with exceedingly tiny, yellowish seeds.<sup>2</sup>

## 1.2. Common name

Jamaica cherry, Strawberry tree, Panama berry, Cotton candy berry, Calabur tree, Singapore cherry, Jam fruit tree, West Indian cherry.

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### 1.3. Taxonomical classification

1. Kingdom- Plantae
2. Order- Malvales
3. Family- Muntingiaceae
4. Genus- Muntingia
5. Species- *M. calabura*
6. Domain- Eukaryote
7. Phylum- Spermatophyte
8. Subphylum- Angiospermae
9. Class- Dicotyledonae

### 1.4. Habit and habitat

*M. calabura* is native to southern Mexico central America and western south America.<sup>3</sup> It is also widely cultivated in warm areas in India and Southeast Asia and also commonly cultivated as roadside trees used as an air pollution tolerance indicator.<sup>1</sup>

### 1.5. Traditional application

The various parts of *M. calabura* have been used to treat the different types of illnesses. The flowers are used as antiseptic and to reduce swelling in lower extremities. The leaves boiled or steeped in water are used to reduce gastric ulcer and swelling of the prostate gland, and to alleviate headache and cold. Flowers are used as a tranquillizer and tonic and also used to treat headache and incipient cold, antispasmodics and anti-dyspeptics. Other than that, of the roots of *M. calabura* have been used as an abortifacient in Malaysia.<sup>1-6</sup> In Peru, the extract from leaves, flowers and bark, boiled or steeped in water are used as antiseptics and in South America it is used to reduce gastric ulcers and swelling of the prostate gland. It is also believed to alleviate headache and cold. From the few places in Philippines, flowers are considered to be useful in the treatment of headache and for relieving the incipient of colds. Infusion of the flowers is used as a tonic and tranquillizer in Colombia. The plant is also used to treat mouth pimples, stomachache and measles in Mexico. It is also found to be effective as antispasmodics, tranquillizers. Other than that, the roots of plant can be used as emmenagogue in Vietnam. The fruits are sometimes eaten fresh, are frequently cooked in tarts or made into jam, while the leaf infusion is drunk as a tea-like beverage.<sup>7</sup>

### 1.6. Phytochemistry of *M. calabura*

The medicinal value of plants lies in some chemical substances that produce a definite physiological action on human body. Phytochemistry understood in pharmacy as the chemistry of natural products used as drugs or of drugs plants with the emphasis on biochemistry. The constituents are therapeutically active or inactive. The inactive constituents are structural constituents of plants

like starch, sugars, or proteins. The inactive constituents have however pharmaceutical uses. The active constituents are secondary metabolites, like alkaloids, glycosides, volatile oils, tannins etc. The use of plant extracts and phytochemicals are known antimicrobial properties, can be of great significance in therapeutic treatments. They are single substances or usually mixtures of several substances. The secondary products of metabolism are formed from primary products and the plant is not able to reutilize them, and they are deposited in the cells and so are called secondary metabolites.

The fruit extract resulted in detection of 56 compounds composed of furan derivatives sesquiterpenoids, phenolic compounds, alcohols and esters.<sup>8</sup> The dichloromethane extract of fruit of plant reported squalene, triglyceride, a mixture of palmitic acid, linoleic acid and  $\alpha$ -linolenic acid as well as contains the mixture of stigmaterol and  $\beta$ -sitosterol.<sup>9</sup> The aqueous extract of leaf reported presence of volatile compounds consist of myrcene, thymol,  $\alpha$  terpinol, linalool, geraniol, nerol, citronellol, eugenol,  $\alpha$  Ionone,  $\beta$  sitosterol,  $\alpha$  Amyrin, Lupelol,  $\alpha$  tocopherol, dan  $\beta$  carotene. The LC-MS analysis showed Fumaric acid, Succinic acid, Malic acid, Cinnamic acid, Gallic acid, Pantothenic acid, Ascorbic acid, Pyridoxinem, Niacin, Glucose, Fructose, Biotin, Thiamine, Kaempferol, Catechin, Quercetin, Riboflavin and Folic acid.<sup>10</sup>

### 1.7. Pharmacological activities

Different parts of *M. calabura* have been medicinally used to treat various ailments and many have been scientifically proven. Interestingly, various new medicinal potential of *M. calabura* have been reported based on the scientific investigations.

### 1.8. Acute toxicity studies

Acute toxicity of methanol extract of *M. calabura* leaves was attempted in doses ranging from 300, 500, and 2000 mg/kg, administered orally to rats. Observation for signs of toxicity was done for the first 2–3 h after administration of extract, percentage mortality observation starting from 24 h continued up to a period of 14 days. The results revealed that the extract was found to be safe up to the dose of 2000 mg/kg, as no signs of toxicity and mortality were recorded.<sup>10</sup>

Another attempt was carried out to study the acute toxicity of ethanol extract of *M. calabura* leaves at the doses of 2000 and 5000 mg/kg, administered orally. Up to 14 days of the extract administration, no clinical signs of weakness, morbidity and mortality were recorded. These results were confirmed by further hematological, serum biochemical and histopathological studies indicating that the ethanolic extract of *M. calabura* leaves can be safely administered up to the 5000 mg/kg<sup>9</sup>. In another study the

**Table 1:** Phytochemical constituents have been isolated from different parts of *M. calabura*.<sup>8</sup>

Sr. No	Plant Part	Compound present
1	Roots	<b>Flavonoids:</b> (2S)-50-hydroxy-7,30,40-trimethoxyflavan (2S)-7,8,30,40,50-pentamethoxyflavan (2S)-20-hydroxy-7,8,30,40,50-pentamethoxyflavan (2S)-50-hydroxy-7,8,30,40-tetramethoxyflavan (2S)-8-hydroxy-7,30,40,50-tetramethoxyflavan (2S)-8,20-dihydroxy-7,30,40,50-tetramethoxyflavan (2S)-8,50-dihydroxy-7,30,40-trimethoxyflavan 7,8,30,40,50-pentamethoxyflavone 50-hydroxy-7,8,30,40-tetramethoxyflavone (M),(2S),(200S)-(P),(2S),(200S)-8,800-50-5000-tetrahydroxy-70,700-30,3000-40,4000-hexamethoxy-50,5000-biflavan 8,50-dihydroxy-7,30,40-trimethoxyflavone 8-hydroxy-7,30,40,50-tetramethoxyflavone 8,40-dihydroxy-7,30,50-trimethoxyflavone 6,7-dimethoxy-5-hydroxyflavone,5,7-dimethoxyflavone, 3,5-dihydroxy-6,7-dimethoxyflavone (2S)-50-hydroxy-7,8,30,40-tetramethoxyflavan b-sitostenone, 6b-hydroxystigmast-4-en-3-one b-sitosterol, syringic acid vanillic acid, 3-hydroxy-1-(3,5-dimethoxy-4-hydroxyphenyl)propan-1-one tetrazolyl ferulate, 1-tetracosanol, 1-hexacosanol
2	Bark	(2R,3R)-7-methoxy-3,5,8-trihydroxyflavanone (2R,3R)-7-methoxy-3,5,8-trihydroxyflavanone
3	Fruits	[(2S)-7-hydroxyflavanone, (2S)-5,7-dihydroxyflavanone (2R,3R)-3,5,7-trihydroxyflavanone (2S)-5-hydroxy-7-methoxyflavanone 7-hydroxy-flavone,5,7-dihydroxyflavone 3-methoxy-5,7,40-trihydroxyflavone 3,30-dimethoxy-5,7,40-trihydroxyflavone 3,8-dimethoxy-5,7,40-trihydroxyflavone 3,5-dihydroxy-7,40-dimethoxyflavone 3,5-dihydroxy-7, 8-dimethoxyflavone 5-hydroxy-3,7,8-tri-methoxy flavones 5,40-dihydroxy-3,7,8-dimethoxyflavone
4	Leaves	5-hydroxy-3,7,8,40-tetramethoxyflavone 20,40- dihydroxy chalcone (isoliquiritigenin (cabreuvin) (2S)-50-hydroxy-7,8,30,40-tetramethoxyflavan 20,40-dihydroxydihydrochalcone 3,4,5-trihydroxybenzoic acid, Lupenone 2a,3b-dihydroxy-olean-12-en-28-oic acid

acute toxicity effect of ethanolic extract *M. calabura* fruits was observed at the limit test dose of 1000 mg/kg and 2000 mg/kg (OECD guidelines 420) and no signs of morbidity or mortality recorded at both doses.<sup>11</sup> In a recent attempt acute toxicity study of methanolic extract of *M. calabura* leaves was carried out at a single dose (2000 mg/kg). Again there were no signs of morbidity and mortality were observed in treated animals up to 14 days.<sup>12</sup>

### 1.9. Insecticidal activity

The study related to investigation of insecticidal activity of *M. calabura* used the flowers and fruits.<sup>13</sup> The prepared two types of extracts from *M. calabura* flowers and fruits, ethanol extracts and hexane extracts of fruits at concentrations ranging from 0.25 to 30.0 mg/mL and tested them against *Plutella xylostella* larvae and pupae using leaf disc immersion assay. All extracts were reported to be toxic to the larvae and pupae of *P. xylostella*.<sup>1–4</sup>

### 1.10. Quinone reductase activity

The quinone reductase (QR) induction potential of compounds isolated from the *M. calabura* leaves was carried out using the mouse culture Hepa ICL7 cells. In this study, the enzyme activity which is the concentration required to double the specific activity of QR (expressed as CD), half-maximal inhibitory concentration of cell viability (IC 50) and chemoprevention index (CI) were measured. All isolated compounds except for lupenone exerted significant QR induction activity.<sup>4</sup>

### 1.11. Antihypertensive activity

Antihypertensive activity of water-soluble fraction (WSF) of methanol extract of *M. calabura* leaves was reported.<sup>13</sup> The fraction was injected into femoral vein of rats at a dose of 10, 25, 50, 75, and 100 mg/kg. The Parameters studied were mean systemic arterial pressure (MSAP), heart rate (HR) and baseline blood pH, gas, and electrolytes (Na<sup>+</sup>, K<sup>+</sup>, hematocrit). The plasma nitrate levels were measured by the chemiluminescence assay and biochemical analysis involving protein extraction and Western blot analysis were carried out.

The antihypertensive effect of butanol-soluble fraction (BSF) of methanol extract of *M. calabura* leaves was conducted at a doses 10, 25, 50, 75, and 100 mg/kg. BSF were systemically injected into femoral vein of the rats. The temporal changes in MSAP and HR after the administration of test solutions were determined for 2 h. The results revealed that the intravenous administrations of BSF, in the dose range of 10–100 mg/kg, caused a dose-dependent bradycardiac and hypotensive responses in normotensive Wistar-Kyoto (WKR) and spontaneously hypertensive (SHR) rats.<sup>14</sup>

### 1.12. Cardioprotective activity

The cardioprotective activity of aqueous extract of *M. calabura* leaves was studied using isoproterenol-induced myocardial infarction model in rats. The parameters estimated were (alanine transaminase (ALT), aspartate transaminase (AST), creatinine phosphokinase (CK) and lactate dehydrogenase (LDH)) in both the heart tissues and serum and the serum uric acid level was also estimated. From the results it was concluded that the doses 200 and 300 mg/kg were found to exert significant effects.<sup>15</sup>

### 1.13. Antiplatelet aggregation activity

Antiplatelet aggregatory activity of 22 compounds isolated from *M. calabura* leaves was studied. The compounds were tested at 50 and 100 mg/mL. In the thrombin-induced assay, all compounds produced the percentage platelet aggregation inhibition ranging between 1.4 and 43.2%. In the arachidonic acid-induced assay, several compounds exhibited remarkable anti-platelet aggregation activity indicated by the high percentage of platelet aggregation inhibition (80–100%) at the concentration of 100 mg/mL.<sup>16</sup>

### 1.14. Cytotoxic activity

The cytotoxic activity of *M. calabura* was performed using crude methanolic extract. The methanolic extract was suspended in distilled water and then it was partitioned with petroleum ether and Ethyl acetate to get petroleum ether, Ethyl acetate and aqueous extracts. The seven fractions were obtained which is subjected to study cytotoxic activity against different cell lines (HL60, MCF7 and WRL68 cell lines). It was observed that Ethyl acetate extract when tested against HL60 showed significant cytotoxic activity.<sup>17</sup>

### 1.15. Antiproliferative activity and Antioxidant activity

The in vitro study by using aqueous, chloroform and methanol extracts of *M. calabura* leaves were carried out. The aqueous and methanol extracts of *M. calabura* inhibited the proliferation of HL-60 MCF-7, HT-29, HeLa and K-562 cancer cells and chloroform extract inhibited proliferation of HeLa, HL-60, MCF-7 and K-562 cancer cells. It was concluded that the plant extracts showed both activity may be due to its high phenolic content.<sup>18</sup>

### 1.16. Antimicrobial activity

In-vitro anti-microbial activity of the various leaf extracts and its fractions of *M. calabura* (Elaeocarpaceae) studied against microbes like *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans* and *Microsporium canis*. Antimicrobial activity was carried out using micro-broth dilution method. The methanol extract considered most effective extract and it was further

partitioned using aqueous, petroleum ether and ethyl acetate respectively. Out of this the ethyl acetate partition exhibited effective antibacterial activities.<sup>19</sup>

#### 1.17. Anti-oxidant activity

Anti-oxidant activity is the used in the food and natural product monitor. In the present in- vitro antioxidant activity using total phenolic assay and reducing power assay were carried out. In this study chloroform, ethyl acetate, hexane, butanol and methanol extracts of fruits of *M. calabura* L were examined total phenolics and in vitro antioxidative capacity.<sup>20</sup>

#### 1.18. Antiulcer activity

In another study on the antiulcer potential of methanolic extract of *M. calabura* leaves (at 25, 50, 100, 250, and 500 mg/kg) was conducted against ethanol and indomethacin-induced gastric ulcer models. The extract at all doses, exhibited a significant and dose-dependent decrease in ethanol-induced gastric ulcer formation. In addition, all doses of extract exerted significant and dose-dependent inhibition of indomethacin-induced gastric ulcer. Histopathological evaluation revealed the potential of extract to reverse the toxic effect of ethanol and indomethacin and returned the stomach to almost normal mucosal architecture that is comparable with protection exerted by ranitidine.<sup>21</sup>

#### 1.19. Hepatoprotective activity

In this study effect of methanol extract of leaves was investigate for plasma liver and hepatic antioxidant enzymes, pro-inflammatory cytokines concentrations as well as histopathology was examined. The qualitative phytochemicals analysis illustrate the presence of quercetin, gallic acid, ferulic acid and genistein. It was concluded that methanol extract of leaves have the ability to attenuate CCl<sub>4</sub>-induced hepatotoxicity could be helpful in the development of hepatoprotective agents.<sup>22</sup>

#### 1.20. Anti-microbial and anti-fouling Activities

The extracts from stem, fruits, leaves, and flower were prepared with solvents like acetone, acetonitrile, ethanol, methanol and water and studied for its anti-Microbial and anti-Fouling activities comparable with the standard drug, ampicillin. The methanolic extracts reported highest antimicrobial potentials against *B. megaterium*, *B. subtilis*, *K. pneumonia* and *P. aeruginosa*. This study reported anti-fouling effect against pathogenic biofilm forming bacteria.<sup>23</sup>

#### 1.21. Antioxidant activity

The aqueous extract of leaf were studied for antioxidant effect by 2,2-diphenyl-2-picrylhydrazyl (DPPH) assay. The effect of time and temperature of cherry leaves extraction affects the chemical constituents showing antioxidant activity. The highest antioxidant activity achieve in combination with 50°C in 60 minutes but after that it was reduced.<sup>10</sup>

#### 1.22. Antidiabetic activity

The *M. calabura* L. leaf ethanolic extract were given to hyperglycemic rats. It was reported that ethanolic extract of leaf shown a very significant effect on blood glucose levels of rats.<sup>24</sup> The ethanolic extract of leaves was given to Streptozotocin-induced rat to investigate Glucose and Insulin Blood Levels. It was reported that the ethanol extract of able to reduce blood glucose levels significantly so that insulin levels increase.<sup>25</sup> Antidiabetic activity of leaf water extract was studied in Type 2 Diabetes mellitus animal models. It was reported that water extract (400 mg/Kg) regenerate pancreatic  $\beta$  cells, increase insulin secretion and also increase insulin sensitivity showed significant antidiabetic activity.<sup>26</sup> The plant also reported for Hepatoprotective action of *Muntingia calabura* L. on Diabetic Rat by reducing SGOT and SGPT levels at 750 mg/200 gr dose. The data were analyzed by means of paired t test and One Way Anova method.<sup>27</sup>

#### 1.23. Anti-inflammatory activity

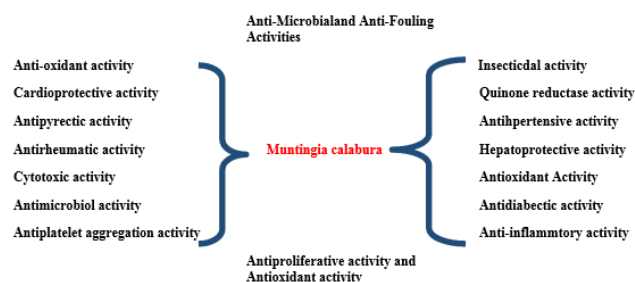
This study was intended to evaluate acute toxicity and anti-inflammatory activity of methanolic extract of *M. calabura* L. (MEMC) in in vivo models at doses 550, 2000 mg/kg body weight to evaluate acute toxicity response. There were no observable symptoms of toxicity in animals treated with extract at the dose of 2000 mg/kg body weight. The Carrageenan induced paw edema model established anti-inflammatory potential with methanolic extract and can be used as a potential anti-inflammatory drug.<sup>28</sup>

#### 1.24. Antipyretic activity

The chloroform extract of leaves of plant studied for its potential as anti-inflammatory, antinociceptive and antipyretic agents using different animal models and found to have more significant effect.<sup>29</sup>

#### 1.25. Antirheumatic activity

The antirheumatic activity of *M. calabura* ethanol extract of leaves and its different fractions lilke ethyl acetate, n-hexane and water in rheumatoid arthritic rat model were investigated. It was reported that ethanol extract and its fractions were helpful to reduce inflammation in addition to this the histopathology examination also showed a decrease



**Fig. 1:** Pharmacological activities of *Muntingia calabura*

in cartilage destruction, fibrin deposition, pannus formation, influx of inflammatory cells and synovitis.<sup>30</sup>

## 2. Conclusion

The study of *Muntingia calabura* revealed that, the plant reported for different chemical constituents summarised in Table 1 and pharmacological activities in Figure 1. It is concluded that the *Muntingia calabura* as a multipurpose medicinal plant to treat various diseases.

## 3. Conflict of Interest

None.

## 4. Source of Funding

None.

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**Cite this article:** Upadhye M, Kuchekar M, Pujari R, Kadam S, Gunjal P. *Muntingia calabura*: A comprehensive review. *J Pharm Biol Sci* 2021;9(2):81-87.