

**Review Article**

**ETHNOMEDICINAL, PHYTOCHEMICAL AND PHARMACOLOGICAL ASPECTS OF *FLACOURTIA JANGOMAS*: A REVIEW**

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**ABSTRACT**

*Flacourtia jangomas* (Lour.) Raeusch., a small tree of Willow family distributed throughout tropical regions of East Africa and Asia is well-known for its culinary and medicinal uses. The plant has received increasing interest due to its limonoid constituents. Phytochemical studies have led to the isolation and characterization of an array of bioactive compounds and pharmacological investigations have validated the traditional uses of the species as well as discovered some new bioefficacies. The aim of the review is to present an updated and comprehensive overview of traditional uses, ethnomedicinal significance, phytochemical and pharmacological aspects of *F. jangomas* to highlight its ethnopharmacological use and to explore its therapeutic potentials thereby providing a basis for future research. Relevant information and literature on *F. jangomas* from electronic databases such as Academic Journals, Google, Google Scholar, PubMed, Web of Science, and Science Direct were consulted and analyzed. Available literatures evidently demonstrate that *F. jangomas* possess a wide spectrum of pharmacological activities that could be explained by the presence of varied range of chemical constituents. Phytochemical and pharmacological investigations showed that extracts of different parts and major active components of *F. jangomas* had antimicrobial, analgesic, antidiabetic, antidiarrheal, antioxidant and cytotoxic activities. This emphasizes the need for further investigation to explore more bioactive chemical constituents and new bioefficacies of the plant and to establish a credible relationship between molecular structure and activity of compounds.

**Keywords:** *Flacourtia jangomas*, Traditional uses, Ethnomedicine, Phytochemistry, Pharmacology

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**INTRODUCTION**

Plants have been used as a source of medicine from ancient to contemporary age. Initially, these were the main part of folk or ethnomedicine, practiced in India and other parts of the world like China, Middle East Africa and South America. Later, substantial part of such indigenous knowledge were organized, documented and eventually passed into the organize systems of medicines such as Ayurveda, Chinese, Yunani, Sidha, Tibetan or other systems [1]. Despite significant development of rural health services, village people still use herbal folk medicines to a good extent for treatment of common ailments like cough, cold and fever, headache and body-ache, constipation and dysentery, burns, cuts and scalds, boils, ulcers, skin diseases and respiratory troubles and others [2]. Nevertheless, a growing world-wide interest in the use of phytopharmaceuticals as complementary or alternative medicine, either for prevention or

amelioration of many diseases has been noted in recent years [3]. Among the plants often used in traditional medicine, *Flacourtia jangomas* (Lour.) Raeusch. Belonging to the genus *Flacourtia* is known to have diverse therapeutic value. The genus *Flacourtia* comprises of 15 species of shrubs and small trees of flowering plants in the Willow family, Salicaceae [4]. The genus was formerly named in the honour of Étienne de Flacourt (1607–1660), a governor of Madagascar and was placed in the now defunct family Flacourtiaceae [5]. It is native to the African and Asian tropics and subtropics. Several species of the genus are cultivated for their fruits and as ornamentals. They are especially loved in Caribbean, where locals utilize its fruits in drinks and dishes [6]. Some species of *Flacourtia* originate in India as well. It spread to other parts of the world, including Sri Lanka, Puerto Rico, northern South America, Florida, and China [7]. In this review, the ethnomedicinal, phytochemical and pharmacological aspects of *F. jangomas* are presented.

***Flacourtia jangomas*-plant profile**

**Taxonomical classification**

Kingdom	:	Plantae
Subkingdom	:	Viridiplantae
Infrakingdom	:	Streptophyta (Land plants)
Superdivision	:	Embryophyta
Division	:	Tracheophyta (Vascular plants)
Subdivision	:	Spermatophytina (Spermatophytes)
Class	:	Magnoliopsida
Superorder	:	Rosanae
Order	:	Malpighiales
Family	:	Salicaceae (Willows)
Genus	:	<i>Flacourtia</i>
Species	:	<i>jangomas</i>

**Synonyms:** *Flacourtia cataphracta* Roxb. ex Willd., *Stigmarota jangomas* Lour. [8]

**Common names:** Indian plum, Indian coffee plum [8]

## Vernacular names

Languages	Names
Arabic	: Talisfir, Zarnab
Assamese	: Paniyal
Bangladesh	: Painnagola
Bengali	: Tipafol, Luluki
Brazilian	: Cereja-De-Cameta
Chinese	: Yun Nan Ci Li Mu
English	: Indian coffee plum, Indian sour cherry
Hindi	: Talispatri
Kannada	: Chankali, Goraji
Konkani	: Jagam
Manipuri	: Heitroi
Malayalam	: Lubica, Lovlolika, Vayyamkaitha
Marathi	: Champeran
Oriya	: Baincha
Sanskrit	: Sruvavrksa, Vikankatah
Tamil	: Vaiyyankarai
Telugu	: Kuragayi
Thai	: Takhob

[9, 10]

### Botanical description

*F. jangomas* (Lour.) Raeusch commonly known as Paniala or Indian plum or Coffee plum belongs to the family Flacourtiaceae (now placed in Salicaceae) [11, 12]. It is a small deciduous tree growing up to 6-10 m but occasionally reach up to 14 m in height. Trunk and branches of old trees are thornless whereas woody thorns are present when young. The bark is light brown to copper-red or pinkish buff, flaking into thin lamels, smooth and lenticelled. Yung branches are white dotted by numerous suborbicular lenticels, puberulous or mostly glabrous. Petiole is 6.0-8.0 mm long and leaves are alternate, deciduous, pale pink when young, spirally arranged, rarely ovate-lanceolate, long point toothed, very thin, both surfaces glossy, blade elliptic, serrate, 7.0 cm-11.0 cm x 3.5 cm-4.0 cm, pappery and show 3-6 pairs of secondary nerves. Inflorescence is axillary racemes 1.0-2.0 cm long, subcorymbose, glabrous, few flowered, the male 1.5-3.0 cm and the female 1.0-1.5 cm long. Flowers are dioecious, white to greenish in colour comprising 4 or 5 ovate triangular petals bearing fragrance of honey before or with the young foliage. Pedicels are very slender, 0.5-1 (-1.5 cm). Sepals 2 mm, 4-5 in number are ovate, obtuse, greenish, and pubescent on both sides. Disk is fleshly entire or slightly lobed and is white or yellow (orange) coloured. Male flowers are filaments, glabrous and solitary or in clusters while female flowers are solitary. Male and female flowers are on separate trees. The androecium consists of many anthers, which are ovate to suborbicular. Ovary is 4-6 celled, with two ovules per locule which are initially flask shaped, soon subglobular, with 4-6 styles connate into a distinct, 1 mm high column, not or slightly free at their apices, each bearing a dilate, bilobed, recurved stigma. Flowers appear from December to April together with new leaves with very beautiful fresh green colour.

Fruits are ellipsoid berries, subglobose, 1.5-2.5 cm in diameter, dull-brownish red or purple, then blackish, with greenish-yellow pulp ripening from March to July, enclosing 4-5(-10) flat seeds. Seeds are tipped with the single, short style-column with 4-6 minute stigma points [13, 14]. The tree is propagated through seeds. However, seeds are slow to germinate; therefore propagation is usually by inarching or budding onto self-seedlings. Ripe fruits are eaten by birds and widely dispersed thus facilitating very wide distribution of the species [15].

### Origin and distribution

*F. jangomas* is lowland semi-cultivated fruit tree with uncertain wild confinement. Its wild organ is unknown however it is said to have originated from India and distributed throughout tropical regions of East Africa and tropical Asia. It is indigenous to North-eastern Terai region of Utter Pradesh, Bihar Maharashtra, Bengal, Assam and Orissa states and some parts of South India. It is often found in the Brahmaputra valley of Assam and adjoining areas of Northeast region of India [16]. It has naturalized in areas such as Hawaii, New

Caledonia, Cook Islands, La Reunion and warmer coastal districts of eastern Australia where it is occasionally cultivated usually as a rare and exotic fruit tree [17].

### Traditional uses

*F. jangomas* is well-known for its edible juicy fruits with pleasant tart flavour. The fruits are dark-red or purple when ripe and eaten raw or used for making jams and preserves [5, 18]. The flesh is firm, brownish green and fairly juicy. It is stewed as dessert, made into juice, syrup, jam, marmalade, pickles, and sauces. Sometimes, fruits may be astringent; so, they are rolled between the hands to reduce astringency. When slightly under-ripe, it is used to make jellies. In India, fruits find immense culinary and medical importance, especially in Kerala [19, 20]. The acidic young shoots are eaten in Indonesia. The wood is red or scarlet, closed grained, hard, brittle, durable, and polishes well. It is used for agricultural implements or block. The wood is sometimes harvested for lumber in the Indian states of Tamil Nadu, Kerala and Karnataka. It is often used as a cheaper alternative to Teak and other expensive wood. The plant is considered one of the primary host plants of *Bactrocera tryoni*, the Queensland fruit fly [17].

### Ethnopharmacology

*F. jangomas* is an important fruit tree having immense nutritional and medicinal significance. In the Indian system of medicine, fruits are regarded as alleviator of vitiated *doshas* and toxic conditions. The fruits are used in bilious conditions and in diarrhoea. It is also used in the treatment of bleeding gum, toothache, diabetes and the leaves after decoction are used in the treatment of diarrhoea, dysentery and piles [10]. Different parts of the plant are pharmaceutically used for the treatment of asthma, pre-and post-natal blood purification and many other ailments [21]. Barks are used for the treatment of intermittent fever. The roots are sweet, refrigerant, depurative alexipharmic and diuretic. They are useful in asthma, anaemia and so on. The leaves and young shoots, which taste like rhubarb, are astringent and stomachic. The fruits are used to overcome digestive disorders, allay thirst, biliousness, fevers, nausea and diarrhoea [22, 23]. The leaf decoction is taken to halt diarrhoea. Powdered roots are used as poultice on sores and skin eruptions and held in the mouth to soothe toothache. Decoction of the bark is useful in biliousness, bleeding gums, toothache, piles and weakness of limbs [24]. The leaves and bark are used in the treatment of diarrhoea, bleeding gums, toothache, piles and weakness of limbs and applied on bleeding gums and aching teeth, and the bark infusion is gargled to alleviate hoarseness [25]. Powdered dried leaves are employed to relieve bronchitis and cough. Fruits hold a notable status in the treatment of stomachic and digestive; allay thirst, useful in biliousness, fevers and relieves nausea. The fruits are eaten in Burma to promote digestion. In India, dried leaves are used to treat asthma [26]. In Malaysia, a decoction of leaves is used as a drink to treat diarrhoea, to promote digestion and the juice

squeezed from the roots is used to treat herpes infection. In Cambodia, Laos, and Vietnam, a decoction of the leaves is used as a drink to abort, or the fruits are eaten for the same purpose. A paste of roots is applied to sores, ulcers, and to soothe an inflamed throat. Fruits are given in jaundice and enlarged spleen. Ground bark paste is also used for curing many common ailments in the Tribal settlements of Western Ghat. Fruits are also used in liver related disorders [23].

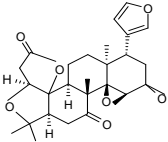
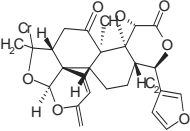
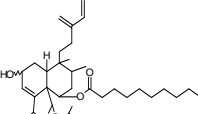
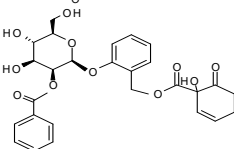
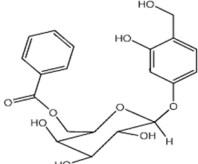
The plant is astringent, acrid, sour, refrigerant, and stomachic and used for a variety of ailments like diarrhoea, inflammation, skin disease, jaundice, tumours, nausea, dyspepsia and diabetes in south Indian traditional medicine [27]. Leaves and young shoots which taste like rhubarb are astringent and stomachic. The leaves and bark are slightly acid and acrid are useful for bleeding gums and toothache. The leaves and bark are reported to be useful in diarrhoea, piles, weakness of limbs, bleeding gums, stomatitis. An infusion of bark is used as gargle [28].

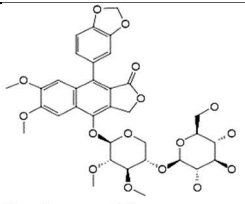
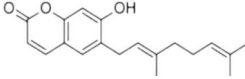
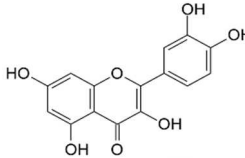
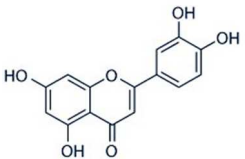
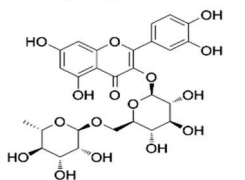
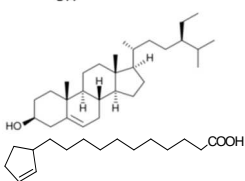
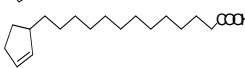
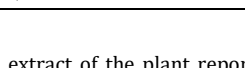
### Phytochemistry

*F. jangomas* is one among that plants which have not been adequately explored scientifically. Work on phytochemical aspects of the plant has been found scanty [28, 29]. In fact, plants of the family *Flacourtiace* received attention only during the last few years following the discovery of a series of cytotoxic diterpenes from *Casearia sylvestris* [30-32]. However, phytochemical reports are still limited to a few species and not much is understood about the chemistry of the family. Studies so far have shown that the *Flacourtiaceae* elaborates a diverse array of compound classes which include terpenoids, alkaloids, flavonoids and tannins, lignans and flavanolignans, glucosides, coumarins and isocoumarins. The plant contains tannin and a fixed oil whereas the bark principally contains tannins; leaves and young shoots are also rich in tannins [22]. There have also been reports of xanthenes, quinones, limonoids and phenazines. Two limonoids, namely limolin and jangomolide were reported from the stem and bark of *F. jangomas* [26]. The bioactive compounds including corymbulosine, tremulacin, hydnocarpic acid, chaulmoogric acid have been reported in *F.*

*jangomas* [33]. The fruit and stem bark yielded a coumarin named ostruthin [34]. The phenolic glucoside ester, flacourtin was reported in bark whereas, a butyrolactone lignan disaccharide named ramontoside and steroids including  $\beta$ -sitosterol and its  $\beta$ -D-glucopyranoside were reported in the heartwood [34]. Fruits were reported to be rich in nutrients, protein, fat, sugars (fructose,  $\alpha$ - and  $\beta$ -glucose and sucrose), amino acids, vitamin C and minerals including calcium, potassium, phosphorous, iron, magnesium, sodium, manganese, copper, and zinc [22, 35]. Analysis of fatty acids in fats revealed the presence of palmitic, hexadecadienoic, stearic, oleic, linoleic, alpha-linolenic, and a few minor unidentified acids. Further, amino acids from extract of dried ripe fruits showed the presence of proline, hydroxyproline, methionine, alanine, glycine, and valine. Paper chromatography studies on simple reducing sugars and their alditol acetates indicated the presence of arabinose, glucose, fructose and galactose [36]. The ripe fruits of *F. jangomas* contain good amount of potassium, having high bioavailability and thus, may serve as a good source for sufficient potassium intake [23]. Studies revealed that leaves and stem of the plant contain secondary metabolites such as carbohydrate, steroids, tannins, saponins and phenolic acid and flavonoids like quercetin, luteolin and rutin [37, 38]. It also constitutes coumarins, xanthenes, quinones, phenazines, lignans, flavanolignans, isocoumarins [39]. Fruits are having anthocyanin, alkaloids,  $\beta$ -carotene, flavonoids, tannins, saponins, amino acids and phenolic compounds which prove it a good antioxidant and thus having good reducing power [40]. Unripe fruits also contain phytochemicals like flavonoids, alkaloids, tannins and total phenols [41]. *F. jangomas* fruits from Bangladesh were investigated for physicochemical properties and mineral content [42]. Phytochemical screening of methanolic extract of fruits from Assam, India revealed the presence of flavonoids, phenols, tannins, terpenoids and saponins; presence of alkaloids however was not recorded. Methanol extract of the fruits was found to contain most of the bioactive compounds and the total phenol and flavonoid contents were found to be 20 mg/g and 2 mg/g respectively [43]. Chemical constituents isolated and characterized from different parts of *F. jangomas* are illustrated in table 1.

Table 1: Phytochemical isolated from *Flacourtia jangomas*

Phytochemical groups	Name of phytochemicals	Molecular formula	Molecular structure	PubChem CID	References
Limonoid	Limonin	C <sub>26</sub> H <sub>30</sub> O <sub>8</sub>		179651	26
Limonoid	Jangomolide	C <sub>26</sub> H <sub>28</sub> O <sub>8</sub>		91895448	26
Diterpene	Corymbulosine	C <sub>34</sub> H <sub>52</sub> O <sub>8</sub>		2865	33
Salicinoid Phenolic glycoside	Tremulacin	C <sub>27</sub> H <sub>28</sub> O <sub>11</sub>		442544	33
Phenolic glucoside ester	Flacourtin	C <sub>20</sub> H <sub>22</sub> O <sub>9</sub>		13889568	34

Butyrolactone lignan disaccharide	Ramontoside	C <sub>34</sub> H <sub>38</sub> O <sub>16</sub>		131684	34
Coumarin	Ostruthin	C <sub>19</sub> H <sub>22</sub> O <sub>3</sub>		5281420	34
Flavonoid	Quercetin	C <sub>15</sub> H <sub>10</sub> O <sub>7</sub>		5280343	36,37
Flavonoid	Luteolin	C <sub>15</sub> H <sub>10</sub> O <sub>6</sub>		5280445	37,38
Flavonoid	Rutin	C <sub>27</sub> H <sub>30</sub> O <sub>16</sub>		5280805	37,38
Steroid	β-sitosterol	C <sub>29</sub> H <sub>50</sub> O		222284	34
Cyclopentanoid Fatty acid	Hydnocarpic acid	C <sub>16</sub> H <sub>28</sub> O <sub>2</sub>		110680	33
Cyclopentanoid Fatty acid	Chaulmoogric acid	C <sub>18</sub> H <sub>32</sub> O <sub>2</sub>		72853	33

### Pharmacology

*F. jangomas* is pharmacologically regarded as astringent, acrid, refrigerant, stomachic, diaphoretic, analgesic, stomachic, anti-inflammatory, and antimicrobial. It is used for the treatment of skin diseases, diarrhoea, toothache, jaundice, asthma and tumours [44]. Fruits are traditionally considered to be antidiabetic [45]. The ripe fruits have high fiber content together with good protein content, low fat and higher amount of monounsaturated fatty acids as compared to polyunsaturated fatty acids. It contains a significant amount of beta-carotene followed by lutein and zeaxanthin, retinol and phyloquinone (vitamin K) which are important in the regulation of hemoglobin and fibrinogen in the human body. Besides, ascorbic acid (vitamin C) and niacin (vitamin B3) are also present in significant amounts. Ripe fruits contain a good amount of potassium which has a definite role in the regulation of blood pressure followed by phosphorus and magnesium having their role in controlling osteoporosis. The plant and some of its active chemical constituents have been investigated for various pharmacological properties including analgesic, anti-inflammatory, antibacterial, anti-diarrheal, antiviral, antioxidant, and anti-amylase activity [45]. Pharmacological studies of various parts of the plant as summarized hereunder.

### Antibacterial activity

Antibacterial activity of the crude extract of *F. jangomas* has been studied against both gram-positive and gram-negative bacteria, which showed good antibacterial activity against *Shigella shiga* and *Bacillus megaterium* and moderate activity against *Bacillus cerus* and poor activity against *Escherichia coli* [39]. Further, there is also report about the chloroform fraction of the root extract showing strong antimicrobial activity against pathogenic bacteria [46]. Fruit

extract of the plant reported to exhibit good antimicrobial activity against *Pseudomonas aeruginosa*, *Klebsiella pneumonia* and *E. coli* [47]. In another study, bacterial endophytes FjF2 and FjR1 isolated from roots showed broad spectrum antimicrobial activity against clinical pathogens gram positive (*Staphylococcus aureus*, *S. aureus*) and gram negative (*E. coli*, *Pseudomonas* sp., *Proteus vulgaris*, *Klebsiella* sp.) bacteria thus indicating promising antimicrobial activity of the bacterial endophyte isolates against human pathogenic bacteria [48]. Synthesis of AgNPs utilizing *F. jangomas* leaf extract and its potential antibacterial effect on pathogenic bacteria *E. coli* was studied. The synthesized AgNPs was found highly effective against the bacteria [49]. In a recent study, the n-butanol extract of *F. jangomas* fruits showed significant antimicrobial activity against *S. aureus* and *E. coli* as compared to the standard drug, Chloramphenicol [50].

### Antifungal activity

Methanol extracts of different parts of *F. jangomas* including leaf, flower, bark and root were evaluated for antifungal efficacy against *Candida tropicalis*, a resistant strain that ranks second or third causative agent of many candidal infections and several oral diseases such as dental caries, endodontic infections, periodontal diseases and oral candidiasis [51] using Fluconazole as a reference standard. The most significant or highest antifungal activity was shown by *F. jangomas* flowers as observed from highest inhibition zones when compared to positive control [52].

### Antidiabetic activity

Study on the effect of methanolic extract of *F. jangomas* leaves and stem (1:1) in alloxan-induced diabetic rats using glibenclamide as standard antidiabetic agent. Antidiabetic potency of the extract was

assessed by fasting blood glucose (FBG) level. The result demonstrated that methanolic extract induces significant decrease of blood glucose level in diabetic rats and this effect was more potent after repeated dose (200 mg/kg and 400 mg/kg) administration, a marked reduction of blood glucose level in these rats was achieved after 14 d of treatment [53]. Efficacy of methanolic extract of *F. jangomas* leaf and stem combination (1:1) in streptozotocin (STZ)-induced diabetic rats was also studied. Oral administration of methanolic extract for 21 d showed impressive ( $P < 0.01$ ) hypoglycemic activity and altered biochemical parameters specifically cholesterol and triglycerides were also found to be corrected significantly ( $P < 0.05$ ). Analysis of urine also revealed the absence of glucose and ketone traces in treated mice [54]. Another study also indicated the potentiality of methanolic extract of *F. jangomas* in treating hyperglycemic rats with elevated blood glucose level, body weight and serum lipid profiles along with liver and muscle glycogen level in normal and diabetic rats. Administration of methanol extract of the plant in a dose of 200 and 400 mg/kg significantly reduces the glucose level. However, low dose i.e. 100 mg/kg did not show significant reduction in blood glucose level. Therefore, the effectiveness of the extract depends on the dose and probably on the accumulative effect of active principles [55].

#### Anti-amylase activity

The ethanolic extract of *F. jangomas* fruit in several findings suggested that phenolic synergies may play a role in mediating amylase inhibition and therefore have the potential to contribute to the management of type-2 diabetes [56].

#### Analgesic activity

Analgesic activity of the ethanol extract of *F. jangomas* leaves screened by acetic acid induced writhing protocol showed significant inhibition ( $P < 0.001$ ) of writhing in dose dependent manner as compared with control. The extract exhibited 45.45 and 67.05% inhibition of writhing at the doses of 250 and 500 mg/kg, respectively while standard diclofenac sodium exhibited 76.14% inhibition of writhing in experimental mice [38]. The activity assessed by hot plate test showed that leaf extract at the concentration of 250 and 500 mg/kg and standard morphine (5 mg/kg) significantly ( $P < 0.001$ ) increased pain threshold level as compared with control in dose dependent manner. Reaction time was increased from 30 min and persisted throughout the observation period of 120 min with gradual decrease of activity with the passage of time. The extract showed maximum reaction time at 60 min at both doses and standard morphine showed at 90 min [38].

#### Antidiarrheal activity

*In vivo* antidiarrheal test of ethanolic extract of *F. jangomas* leaves by castor oil induced diarrhoeal model showed significant ( $P < 0.001$ ) increase in onset of diarrhoea and reduction in frequency of defecation as compared with control in dose dependent manner. The extract exhibited 74.05 and 85.50% inhibition of defecation at the doses of 250 and 500 mg/kg, respectively while standard loperamide showed 88.00% inhibition of defecation at the dose of 3 mg/kg thus clearly indicating promising antidiarrheal activity as substantiated by the prolongation of latent period as compared with control and standard [38].

#### Antioxidant activity

Ethanol extract of leaves of *F. jangomas* exhibited a significant DPPH radical scavenging activity in concentration dependent manner with IC50 value of 11 µg/ml whereas the IC50 value for the standard ascorbic acid was 5 µg/ml. Total phenol content of the extract was 601.03 mg GAE/100 g of dried plant material. Also, the extract showed strong ferric reducing power in concentration dependent manner as compared with standard ascorbic acid; which was substantiated by high absorbance increased with the concentration [38]. Methanol extract of fruits showed antioxidant activity against the standard ascorbic acid [50]. A comparative study of total phenol, total flavonoid contents and antioxidant potential of different extracts including chloroform, petroleum ether and methanol extract of *F. jangomas* using DPPH radical scavenging assay, reducing power method, total antioxidant capacity showed

moderate to good antioxidant activity of extracts as compared to ascorbic acid. The IC50 value of the chloroform, methanol and petroleum ether extracts were 523.15, 1623.87 and 5811.35 µg/ml respectively while, the IC50 value of well-known antioxidant Ascorbic Acid was 13.37 µg/ml. Among the extracts chloroform extract was found displaying strong DPPH radical scavenging action and also exhibited highest phenol and flavonoid content as well as total antioxidant capacity as compared to petroleum ether and methanol extracts [57]. As far as reducing power is concerned, the tested extracts demonstrated antioxidant potential in a dose dependent manner. A study on reducing power of fruits extracts showed enhancement in reducing power with increase in treatment concentration of fruit extracts [58]. Unripe fruit showed the greater reducing of as compared to that recorded for ripe fruits [59, 60]. *F. jangomas* fruits from Bangladesh reported to show DPPH free radical scavenging activity with the IC50 value 1.144 mg/ml [56]. Methanol extract of fruits contain a very good amount of phenolics also showed strong radical scavenging activity [61]. Antioxidant efficacy of different parts of the plant was studied using DPPH and ABTS radical scavenging assay; of which the flower extract of *F. jangomas* showed significant antioxidant potential with IC50 values of 11.16±0.54 µg/ml and 12.34±0.37 µg/ml for DPPH and ABTS assays [62].

#### Cytotoxic activity

Cytotoxic activity of the ethylacetate extract of *F. jangomas* was investigated following Brine shrimp lethality bioassay technique using Vincristine sulfate as a standard reference indicated significant efficacy in a dose dependant manner. Maximum mortality recorded at a concentration of 80 mg/ml, whereas least mortalities were at 5 mg/ml concentration [39]. The cytotoxic activity of the extracts was investigated on SCC9 and Calu6 through MTT assay. Methanolic extract of flower showed promising cytotoxic activity against the two cancer cell lines, Calu6 and SCC9 with IC50 values of 43.57±0.04 µg/ml and 53.42±0.15 µg/ml, respectively. The antiproliferative activity of extracts investigated by analyzing cell cycle through flow cytometry revealed that treatment with methanol extract of flower caused significant arrest in G2M phase of cell cycle [62].

#### CONCLUSION

Medicinal plants have been used for centuries as remedies for human diseases because they contain components of therapeutic value. The curative properties of medicinal plants are attributable to the presence of various bioactive phytochemicals which may explain their traditional uses against various ailments. In this review article, effort has been taken to collect and compile the details regarding ethnomedicinal, phytochemical and pharmacological pharmacological facets of *F. jangomas*, a less explored plant [63]; however, has received interest owing to its diverse ethnomedicinal significance and presence of many biofunctional phytochemicals. Literature search has shown that the plant has immense medicinal uses in different systems of medicine in India as well as throughout the world. Bioactive chemical constituents isolated and characterized so far from the plant and a variety of pharmacological activities, including antibacterial, antifungal, analgesic, antidiabetic, antidiarrheal, anti-oxidant and cytotoxic activity are presented in this review. Phytochemical and pharmacological studies of the crude extracts and compounds isolated from *F. jangomas* have received much interest recently. Extensive research with regard to isolation and characterization of the active principles responsible for the activity and to understand the precise mechanism of the therapeutic action is required so that better, safer and cost-effective drugs can be developed. Pharmacological findings evidently indicate that the plant extract and some of its biofunctional constituents can be formulated which will be useful to the society to venture in to a field of alternative systems of medicine.

#### AUTHORS CONTRIBUTIONS

All the author have contributed equally

#### CONFLICT OF INTERESTS

Declared none

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