Review Article

A Comprehensive Review on Pharmacology OF *Flacourtia Indica* (BURM.F.) Merr. (governor's Plum)

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ABSTRACT

Flacourtia indica (Burm.f.) Merr. is an important neutraceutical plant belonging to the family Flacourtiaceae. It is one of the rare plant and not much scientifically explored but its medicinal properties has been reported in Ayurveda and found to be an effective remedy for the treatment of a various diseases. Several phytochemical investigation on the plant showed that the presence of range of phytochemicals like alkaloids, flavonoids, tannins, terpenoids, glycosides etc. various findings suggested that the plant is having very good pharmacological properties like antimicrobial, antioxidant, antimalarial, antiasthmatic, anticancerous, and being hepatoprotective. The leaves are useful in pruritus and scabies; fruits are used as appetizing and digestive, diuretic, jaundice and enlarged spleen. When barks are used for the treatment of intermittent fever. The roots are sweet, refrigerant, depurative alexipharmic and diuretic. They are useful in vitiated condition of 'pitta' and useful in poisonous bites, skin diseases, pruritus, erysipelas, strangury, nephropathy and psychopathy and in nephritic colic and gum is used in cholera. It is now considered as a valuable source of unique natural products for development of medicines and targeting against various diseases. In the present article, an effort has been made to reveal various pharmacological potentiality of *Flacourtia indica* that are found in Malanad region of India.

Keywords: *Flacourtia indica*, Antimicrobial; Antioxidant; Anticancer.

1. INTRODUCTION

Medicinal plants being the effective source of both traditional and modern medicines are genuinely for primary health care. Over the years, World Health Organization (WHO) advocated traditional medicines as safe remedies for ailments of both microbial and non-microbial origins[1,2]. Herbal medicines widely used in health-care in both developed and developing countries are the chemical complexes prepared from plants and are limited in their effectiveness because they are poorly absorbed when taken orally. According to an estimate of the World Health Organization (WHO), about 80% of the world population still uses herbs and other traditional medicines for their primary health care[3]. Since the conventional antibiotics to which the pathogenic microorganisms are developing antibiotic or drug resistance, there is an urgent need to discover new antimicrobial agents for human and veterinary. In this context, plants are invaluable sources of pharmaceutical products[4]. Some of the medicinal plants being used successfully as remedy against various types of diseases include *Abutilon indicum*, *Acacia leucophloea, Bacopa monnieri, Flacourtia indica, Mimosa pudica* etc (Table-1).

Plants belonging to family Flacourtiaceae are well known for their physiological and medicinal properties[5]. *Flacourtia indica* (Burm.f) Merr is a shrub has been widely distributed in Bangladesh and India from Punjab eastward to Bihar, the Deccan and the Southern Peninsula. It is a small deciduous thorny shrub, found in shrub forests and rocky hills up to 900 meters. The botanical name is of particular historical and geographical interest in South Africa. 'Flacourtia' honours E. de Flacourt (1607-60), a governor of Madagascar, who knew the Cape before van Riebeeck, and indica indicates that the east is equally the home of this little tree of the Transvaal bushveld. *F. indica* is also common in tropical dry deciduous and thorn forests, though more abundant in the former (Fig.1). The species is drought resistant though somewhat frost tender[13]. Usually, 2–4 m tall

sometimes 10 m. Thorny, bark gray yellow, old branches usually not spiny, young branches with axillary, simple spines. Inflorescences are racemose. Flowers greenish-yellow, unisexual or occasionally bisexual, fruit globular, fleshy, reddish to reddish-black or purple when ripe, globose, 8–10 mm in diameter. Nutritional values of fruits are mentioned in Table.1. Seeds are of five or six, pale brown and plant is attractive, ornamental and serves as a hedge, fodder for cattle and fuel[12, 13].

F.indica tree is usually leafless just before flowering and slow growing. In India, the flowers appear from December to April together with the new leaves, which are a very beautiful fresh green color. Fruits ripen from March to July. They are eaten by birds, thus the seeds are widely dispersed, accounting for the very wide distribution of the species[13]. In Tamil Nadu, India, coppice shoots reached 3.4 m in height and 9.4 cm in girth in 15 years, corresponding to a mean annual increment of only 0.63 cm. Seed can be stored in air-dry hermetic storage at 5°C and viability can be maintained for over 1 year[13].

Table 1: Selected Indian medicinal plants used to treat various kinds of human diseases

S. no.	Botanical name of plant and family	Plant part used	Ayurvedic or Traditional Uses	Source
1	*Abutilon indicum* (Malvaceae)	Whole plant	The plant is used to treat impotency, rheumatism, menorrhoea, polyuria, gout and hemorrhagic diseases	[38]
2	*Acacia modesta* Wall (Mimosaceae)	Leaves, gum	Demulcent, dysentery, tonic, stimulant.	[39]
3	*Acacia leucophloea* (Fabaceae)	Bark	Bark of plant is used as antimicrobial, anthelmintic, expectorant, and blood purifier. It is also treat skin diseases (leprosy), ulcer, gum bleeding, mouth ulcer, dry cough, dysentery, diabetes and fever.	[38]
4	*Aegle marmelos* (Rutaceae)	Fruit	Fruits are used in diarrhea and dysentery.	[38]
5	*Bacopa monnieri* (Scophulararіaceae)	Leaves	Leaves of plant are used to treat epilepsy, insanity and other nervous disorders	[38]
7	*Datura stramonium* (Solanaceae)	Fruits, leaves	Fruits and leaves used to treat epilepsy, cough and asthma	[40]
8	*Flacourtia indica* (Burm.f) Merr. (Flacourtiaceae)	Bark, Leaf, fruit	Leaves are crushed and applied topically on the point of snakebite, anticancer, antidiabetic and hepato-protective.	[35,41]
9	*Flacourtia sepiaria* Roxb. (Flacourtiaceae)	Bark	Gouty arthritis.	[35]
10	*Holoptelea integrifolia* (Urticaceae)	Stem bark	Stem bark is externally used in inflammation and internally used to treat piles, skin diseases, antihelmentic, obesity.	[38]
11	*Mangifera indica (*Anacardiaceae)	Root	Menorrhoea, leucorrhoea and scabies.	[42]
12	*Mimosa pudica* (Fabaceae)	Root	Toothache	[42]
13	*Phyllanthus emblica* (Euphorbiaceae)	Fruit and seed	Fruits and seeds are used to treat asthma, bronchitis and biliousness.	[38]
14	*Pithecolobium dulce* (Phyllanthaceae)	Root	Root and bark decoctions are taken orally to treat diarrhoea; fruit pulp is taken orally to stop blood flow in case of heamoptysis. The seed juice is inhaled into the nostrils against chest congestion.	[38]
15	*Solanum surattense* (Solanaceae)	Whole plant	Plant is used to treat skin disease, cough, cold, bronchitis and asthma.	[38]
16	*Syzygium cordatum* (Myrtaceae)	Bark and leaves	Stomach troubles, cold and fever, babies food, diarrhoea wounds.	[43]
17	*Tamarindus indica* (Fabaceae)	Whole Plant	Plant is used to treat diarrhoea, lotions and pustules, sores, boils, asthma and amenorrhea.	[38]
18	*Tinospora cardifolia* (Menispermaceae)	Fruit	Tuberculosis	[42]
19	*Thevetia nerifolia* (Apocyanaceae)	Root	Paste of root is recommended to apply externally to treat Leprosy (Skin disease), Syphilis, internally heart disease (action like digitalis) and fever.	[38]
20	*Vitex negundo* (Verbenaceae)	Stem	Body swelling, common cold, influenza and bone Fracture.	[42]
21	*Woodfordia fruticosa* (Lytheraceae)	Flower	Flowers are used to treat ulcer, wounds, cough and small pox.	[38]

The plant has a very good folkloric reputation and is used as indigenous medicine for various purposes: fruits are used in the treatment of jaundice and enlarged spleen, seeds are used with turmeric to prevent rheumatic pain, bark is applied to the body during intermittent fever, and the root is used in the nephritic colic[6]. In the Comoros Islands, the aerial parts of the plant are used in traditional medicine to treat malaria[7]. Previous phytochemical studies on *F. indica* reported the isolation of phenolic glycosides, such as flacourtin (3-hydroxy-4-hydroxymethyl phenyl-6-O-benzyl-β-D-glucopyranoside)[8,9]. Further, phytochemical analysis of this plant and isolated several other phenolic glycosides with promising free radical scavenging activity. Kaou *et al.,* (2010) isolated pyrocatechol, homaloside D and poliothrysoside from *F. indica*. Of these compounds, poliothrysoside showed strong antiplasmodial activity against *Plasmodium falciparum*[7]. The present article describes the medicinal and pharmacological properties of less known *F. indica.*

Fig: 1. Habitat, flowering and fruiting stage of *Flacourtia indica*

2. Taxonomy

Flacourtia indica has been classified under angiosperme, belonged to the order violales under the family Flacourtiaceae and the genus *Flacourtia,* species *Flacourtia indica* (Burm. f.) Merr. – Governor's plum.

3.Vernacular names

Kan.-Liumanika, Dodda Gejjalakai, Jedey Mullu, Eng.-Governors Plum, Madagascar Plum, Mauritius Plum, Batoka Plum , Hindi.-Bilangra, *Beng*.-Bincha, Bainchi, Bewich, Guj.-Kankata, Mal.-Vavankataku, Vikamkath, Yaliya Nzerinigal, Loloikka, Mar.-Kaker, Ori.-Kantheikoli, Vaincha, Uincha, Punj.-Kakoa, Kukoya, Sansk.-Vikankata, Gopakanta, Tam.-Sottaikala, Kat Ukala, Tel.-Putregu, Kanvegu Chettu, Vikankata[11].

4. Nutritional value of *Flacourtia indica* fruit

Table 2: Nutritional Value of *Flacourtia indica* Fruit (Encyclopedia of fruits and nuts)

S. No.	Composition	Nutritional value
1	Energy	94 kcal
2	Protein (negligible)	0.5g
3	Fat	0.6g
4	Carbohydrate	24.2g
5	Fiber	1.2g
6	Calcium	33mg
7	Iron (3.8% RDI)	0.7mg
8	Phosphorous(>1% RDI)	17mg
9	Potassium (4.8% RDI)	171mg
10	Vitamin C (8.3% RDI)	5mg
11	Thiamine/B1 (negligible)	0.01mg
12	Riboflavin/B2 (negligible)	0.02mg
13	Niacin/B3 (2% RDI)	0.4m
14	Vitamin A (negligible)	30 iu

5. Pharmacological Properties

5.1. Antimicrobial activity

Antimicrobial activity of different members of Flacourtiaceae has been explored. Among them *Flacourtia indica* is one of the much less explored medicinal plant with potential pharmacological activities. *Flacourtia indica* whole plant is used in Ayurvedic medicine. The aerial parts like leaves, is carminative, astringent and used as a tonic, an expectorant and for asthma, pain relief, and gynaecological problems and also as an antihelmintic, and treatment for hydrocele, pneumonia and intestinal worms, useful in pruritus and scabies[11,13]. *In vitro* antimicrobial activity of different solvent extracts of leaves of *F. indica* against Gram positive and Gram negative bacteria as well as fungi has been studied by disc diffusion assay. The ethanolic extract of *F.indica* leaves showed good activity against all the tested bacteria among them *Staphylococcus aureus* and *Bacillus subtilis* are found to be most susceptible and methanolic extract showed better antifungal activity as compared to other solvents. Further determined potential MIC value[15]. The roots of the plant are sweet, refrigerant, depurative, alexipharmic and diuretic. They are useful in vitiated conditions of *pitta* and *vata* aphthae, poisonous bites, skin diseases, pruritus, erysipelas, strangury, nephropathy (root and ash have been used as a remedy for kidney complaints) and psychopathy. The decoction of the root used for the relief of body pains. In a study, root extract of plant have been evaluated for antimicrobial potential, *in vitro* antibacterial potential of methanolic root extract of *F.indica* showed better activity against *Pseudomonas* sp. and *Shigella dysenteriae* producing wider zone of 12 ± 0.2 and 12 ± 0.5 respectively when compared to other bacteria. Further it was revealed that the potential MIC and MBC values at different concentrations viz, 25, 50, 100, and 200 mg/ml[16]. Therefore the extracts of *F. indica* have the potential in controlling bacteria perhaps useful for *in vitro* applications.

5.2. Antioxidant activity

A wide variety of oxygen free radicals and other reactive species can be formed in the human body that leads to oxidative stress[18]. Oxidative stress plays a role in heart diseases, neurodegenerative diseases, cancer and also in the aging process. This concept is supported by increasing evidence that oxidative damage leading to the development of chronic, age-related degenerative diseases, and thus dietary antioxidants lowers the risk of disease.

Antioxidants are the substances that when present in low concentrations compared to those of an oxidisable substrate significantly delays or prevents oxidation of that substance[17,19]. Antioxidants are one of such substance which has the capability to neutralize free radicals or their action. Plants are the important source of antioxidants and phytochemicals having strong scavenging and oxidation-inhibiting properties and are commonly referred to as scavengers[17,21]. Apart from their role of health benefactors, antioxidants are added in foods to prevent or delay oxidation of food, initiated by free radicals formed during their exposure to environmental factors such as air, light and temperature. At present most of the antioxidants are manufactured synthetically as a class of synthetic antioxidants. The major disadvantage with the synthetic antioxidants is the side effects when taken *in vivo*. Strict governmental rules regarding the safety of the food has necessitated the search for alternatives as food preservatives[20]. The usage of antioxidants, particularly in fruits and vegetables has gained increasing interest among consumers and the scientific community as indicated by epidemiological studies. There is lower risk of cardiovascular disease and cancer[22].

Phytochemical and *in vitro* antioxidant activity of *F. indica* leaves revealed the presence of alkaloids, tannins, saponins, flavonoids, glycosides, phenolic compounds, terpenoids and steroids. Further *in vitro* antioxidant activity of methanolic extract exhibited potent free radical scavenging activity and concluded that *F.indica* leaves could be a potential source of natural antioxidants[11, 23]. Phytochemical investigation and thin layer chromatography of methanolic extract of *F. indica* root showed the presence of flavonoids, saponins, tannins, terpenoids, phenols, alkaloids, steroids, anthraquinons, cardiac glycosides and coumarins. Further GC-MS results indicated the presence of 4-Benzyol-3-methoxyisocoumarin compound with Molecular formula: $C_{17}H_{12}O_4$ and Molecular weight: 280 with retention time 7.69[16].

5.3. Anti-asthmatic activity

In vivo study on ethanolic leaves extract of *F. indica* (EEFT) was conducted on guinea pigs and the results of the study indicated that the EEFT has significant bronchodilator activity when experimental models were exposed to histamine an important mediator of allergy, inflammation and bronchoconstriction. The study suggested the possible mechanism was due to its bronchodilator and mast cell

stabilizing property which may be due to the blockade of H1 and Ach receptors (antihistaminic H_1 receptor antagonist) thereby inhibiting bronchoconstriction and concluded that *F. indica* ethanolic leaves extract exhibit anti-asthmatic activity apart from folklore use as antioxidant[24].

5.4. Antimalarial activity

Malaria is a devastating infectious disease, causing great suffering and loss of human life. The global incidence of malaria is around 120 million clinical cases annually, with some 300 million people infected and 1-2 million dying from the disease each year. Out of the five species infecting humans, the majority of disease is due to *Plasmodium falciparum*. The resistance of *P. falciparum* to chloroquine and other antimalarial drugs has created an urgent need for new drugs that are safe and effective for the treatment of malaria. Plants have played a pivotal role in the drug discovery and development for malaria chemotherapy[25]. Koneni *et al*., (2013) carried out study on ethyl acetate extract of the aerial part of the *F. indica* showed good *in vitro* antiplasmodial activity, in which poliothrysoside was identified as a molecule showing significant activity against the chloroquine-resistant strain (W2) of *P. falciparum*. Further, the study reported the isolation of six compounds (**1**-**6**) from the ethyl acetate fraction of leaves and twigs of *F. indica* using repeated column chromatography; among six (Fig.2), five of the known compounds were identified as **(1)** poliothrysoside (**2**), catechin-[5,6-*e*]-4*β*-(3,4-dihydroxyphenyl)-dihydro-2(3*H*)-pyranone (**3**), 2-(6-benzoyl-*β*-glucopyranosyloxy)-7- (1*α*, 2*α*, 6*α*-trihydroxy-3-oxocyclo-hex-4-enoyl)-5-hydroxybenzyl alcohol (**4**), chrysoeriol-7-O-*β*-D- glucopyranoside (**5**) and mururin A (**6**). Compound **6** significantly inhibited the *in vitro* growth of both a chloroquine-sensitive (3D7) and a chloroquine-resistant (K1) strain of *Plasmodium falciparum*. It forms a complex with hematin and inhibits the *β*-hematin formation, suggesting that this compound act on a heme polymerization target[25].

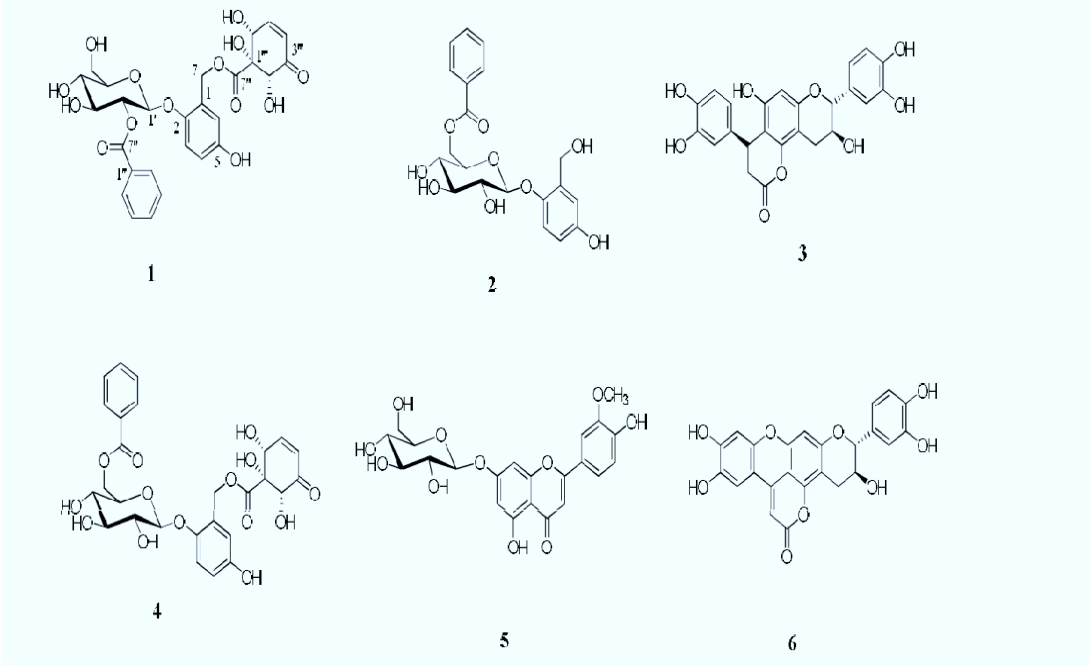

Fig. 2: Chemical structure of the six isolated compounds from the leaves and twigs of *F. indica*[25]

In vitro anti-plasmodial activity on the chloroquine resistant strain (W2) of *Plasmodium falcifarum* and the cytotoxicity on two complementary human cell lines (THP1 and HepG2) and phytochemical screening AcOEt extract of aerial parts of *F. indica* plant material indicated the presence of three compounds[7], and was concluded with pyrocatechol, homaloside D and poliothrysoside and a poliothrysoside showed strong anti-plasmodial activity(IC (50) =7.4 µM) and a good selectivity index (>28) similar to chloroquine. Thus, AcOEt extract of aerial parts of *F. indica* showed potent anti-plasmodial activity majorly due to the presence of three constituents[11].

5.5. Hepatoprotective activity

Liver is considered to be one of the most vital organs that functions as a center of

metabolism of nutrients such as carbohydrates, proteins and lipids and excretion of waste metabolites. Additionally, it is also handling the metabolism and excretion of drugs and other xenobiotic from the body thereby providing protection against foreign substances by detoxifying and eliminating them. The bile secreted by the liver has, among other things, plays an important role in digestion. Liver cell injury caused by various toxicants such as certain chemotherapeutic agents, carbon tetrachloride, thioacetamide etc., chronic alcohol consumption and microbial infection has been studied. Herbal-based therapeutics for liver disorders has been in use in India for a long time and has been popularized world over by leading pharmaceuticals[26]. Despite the significant popularity of several herbal medicines in general, and for liver diseases in particular, there are still unacceptable treatment modalities for liver diseases. The limiting factors that contribute to this eventuality are lack of standardization of the herbal drugs; lack of identification of active ingredient(s)/principles(s); lack of randomized controlled clinical trials (RCTs), and lack of toxicological evaluation[27,28].

Some of the plant based drugs used as hepatoprotectives include curcumin, mangiferin, silymarin, brahmine, betacyanin, hyperin, botulin, bacoside etc.[29, 30]. Further, the hepatoprotective effect of aerial parts of *Flacourtia indica* (Burm. f.) Merr. has been studied in animal model system by using paracetamol and methotrexate effective drugs in the therapy of cancer. But, these drugs produce acute liver damage in high doses. Any toxicity of the liver is reflected in serum biochemistry. Liver injury is often associated with a rise in serum ALT, AST and ALP levels. Treatment with *Flacourtia indica* extract caused a significant reversal of these elevated enzyme levels supporting the hepatoprotective effect of the drug extract[31,32]. In paracetamol-induced hepatic necrosis in rat models, all extracts were found to reduce serum aspartate transaminase (AST), serum alanine transaminase (ALT) and serum alkaline phosphatase (ALP). The most significant reduction of the serum level of AST and ALT were exhibited by petroleum ether and ethyl acetate extracts at a single oral of dose of 1.5g/kg of body weight with a reduction of 29.0% AST & 24.0% ALT level by petroleum ether extract, and 10.57% AST & 6.7% ALT level by ethyl acetate extract compared to paracetamol (3 g/kg of body weight) treated animals. Histopathological examination also showed good recovery of paracetamol-induced necrosis by petroleum ether and ethyl acetate extracts. The hepatoprotective effects exhibited by petroleum ether and ethyl acetate extract might be mediated through the inhibition of microsomal drug metabolizing enzymes[31]. Methotrexate (MTX) induced hepatotoxicity in albino mice characterized by significant alterations in marker enzymes for liver function and oxidative stress has been observed. The *Flacourtia indica* extract treatment in a dose of 350mg/kg orally for 5 days significantly improved the level of marker enzymes for liver function and oxidative stress which was evident in histopathology also where a relative degree of reversal of methotrexate induced necrosis has been observed and indicated that the extract of aerial parts of *Flacourtia indica* (Burm.f.) Merr. protected liver tissues probably by its antioxidant and cytoprotective or other unknown properties. The study suggested that the *Flacourtia* extract could be used along with MTX in cancer chemotherapy or other clinical conditions like rheumatoid arthritis; psoriasis etc where long term MTX therapy was indicated and there is need a further study to confirm the effectiveness[31].

Carbon tetra chloride CCl_4 is an extensively studied environmental toxicant, the most likely candidate is the trichloromethyl radical to damage the liver. CCl_4 is metabolized by the cytochrome P450-dependent monooxygenase systems followed by its conversion to more chemically active form, trichloromethyl radical ($-CCl_3$). Enzymes involved in this process are located in the endoplasmic reticulum of the liver and their activities are dependent on many environmental factors. Some herbal extracts are known to prevent the oxidative damages in different organs by altering the levels of cytochrome P-450 through their antioxidant properties. The aqueous extract of leaves of *Flacourtia indica* possessed potent hepatoprotective activity and protected the liver against CCl_4 induced oxidative stress probably via the alteration of cytochrome P-450[32,33].

5.6. Anticancer activity

Treatment of cancer and microbial infections has drawn the attention and interest of researchers due to their great impact on the population's health. 2 to 3% of deaths recorded worldwide annually arise from different types of cancer. Due to the uncontrolled use of antibiotics, bacteria and fungi have evolved numerous mechanisms to evade old and new antimicrobial agents. In the quest for new therapeutics, plants were and still are considered as one of the main sources

of biologically active materials. It has been estimated that about 50% of the prescription products in Europe and USA are originated from natural products, including plants or their derivatives[34].

The Flacourtiaceae has received greater attention from chemists in the last few years following the discovery of a series of cytotoxic diterpenes from *Casearia sylvestris*. 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 if compound classes which include terpenoids, alkaloids, flavonoids and tannins, lignans and flavanolignans, glucosides, coumarins and isocoumarins in addition to xanthones, quinones, limonoids and phenazines[1]. A study reported the anticancer activity of *F. indica* against Ehrilch Ascites Carcinoma in animal model. The study suggested that the ethanolic extract of *F. indica* significantly increased the life span of the mice when compared to Ehrilch Ascites Carcinoma (EAC) control. Results of the study further revealed that, ethanolic extract delayed the cell division thereby suggesting the reduction in EAC volume and increased survival time in mice and cytotoxicity and anticancer activity is probably due to presence of flavonoids. Flavonoids have been shown to possess antimutagenic and antimalignant effects and have a chemopreventive role in cancer through signal transduction in cell proliferation and angiogenesis[35].

5.7. Cardioprotective activity

Cardioprotective activity of an ethanolic extract of *Flacourtia indica* (FI) against doxorubicin (DOX)-induced myocardial infarction (MI) in rats has been studied[34]. Different phytoconstituents were identified by GC-MS. DOX is a chemotherapeutic agent which produces free oxygen radicals that result in serious dose-limiting cardiotoxicity. A DOX dose of 20 mg kg^{-1} body weight is used to bring significant changes in biochemical parameters, endogenous antioxidants, and moderate necrosis in the heart. The pretreatment with FI at two doses (250 and 500 mg kg^{-1}) to DOX-treated rats significantly prevented the altered biochemical parameters such as serum marker enzymes serum glutamate-pyruvate transaminase, serum glutamate oxaloacetate transaminase, creatine phosphokinase, and lactate dehydrogenase, lipid profile such as low-density lipoprotein, very low-density lipoprotein, triglycerides, high-density lipoprotein, total cholesterol, and antioxidant parameters such as superoxide dismutase, glutathione, catalase, glutathione peroxidase, and malondialdehyde to near normal level. Serum urea, uric acid, and alkaline phosphate which are increased on DOX administration registered near normal values on pretreatment with FI. In conclusion, these data suggest that the ethanol extract of FI can prevent heart damage by DOX-induced MI in rats and this is likely mediated through its antioxidant activities[36].

5.8. Diuretic activity

The diuretic activity of ethanolic root extract of *F. indica* was studied by Ancy *et al*., 2013. The study was conducted by determining the urine volume and electrolyte concentration in albino rats. For the study, Frusemide (10 mg/kg) was used as standard while normal saline (0.9%) was used as control. Ethanolic root extract of the plant at the concentration 250 mg/kg and 500mg/kg were used as tests. Further, the research revealed that the ethanolic extract showed significant diuretic activity at dose of 500mg/kg and significant increase in urine volume as well as Na+, K+ and Cl^- ion concentration in albino rats. The activity may be attributed to the polyphenolic constituents present in it[37].

6. 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 compounds such as alkaloids, flavonoids, glycosides, phenols, saponins and sterols, which may explain its traditional uses against various ailments. In this review article, effort has been taken to collect and compile the details regarding pharmacological properties of less explored *Flacourtia indica.* Literature search has shown that this plant has immense medicinal & economic uses in different systems of medicine in India as well as throughout the world. Extensive research in the area of isolation and characterization of the active principles responsible for the activity and to understand the precise mechanism of the extracts of *F. indica* is required so that better, safer and cost effective drugs for treating microbial infections can be developed. Few of these constituents can be formulated which will be useful to the society to venture in to a field of alternative systems of medicine.

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