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REVIEW ARTICLE

Updated review on Indian Ficus species

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Pharmacology;
Phytochemistry

Abstract As per Ayurvedic system of medicine, Indian Ficus (Fam. – Moraceae) plants are used in the treatment of various diseases. The plants are characterized by a specific class of closed inflorescence, named syconia, and are distributed in different states of India. Total 97 species of Ficus genus are naturalized in Indian states. Indian Ficus species possess anti-inflammatory, antimicrobial, antioxidant, antidiabetic, antiarthritic, antistress, anticancer, hepatoprotective, neuroprotective and wound healing properties. The phytochemical analysis reveals the presence of alkaloids, triterpenoids, flavonoids, furanocoumarins, and polyphenolic compounds in different species. Recently, bioavailability of Indian Ficus has been increased due to the presence of antioxidative agents. However, large number of reports have been published on phytochemistry and biological activities of 31 Indian Ficus species but, no reports are available in literature on 66 species. This review summarizes and describes the current knowledge of ethnomedicinal uses, phytochemistry, pharmacological activities, bioavailability, and pharmacokinetic profiles of 31 Indian Ficus species. Moreover, it includes clinical and toxicological studies with an aim to explore their potential in the pharmaceutical industries.

1. Introduction

Medicinal plants play vital roles in primary healthcare system of various developing countries due to lack of modern healthcare infrastructure, traditional acceptance, high cost of pharmaceutical drugs as well as efficacy of medicinal plants against certain disorders that cannot be treated by modern therapeutic drugs (Abdullahi, 2011; Kipkore et al., 2014; Megersa and Tamrat, 2022). Numerous patients in these developing countries combine folklore medicines with standard medicines and use them for the treatment of chronic diseases (Kigen et al., 2013). Ficus genus includes trees, hemi-epiphytes, shrubs, creepers, and climbers and are distributed in the forests, tropical and subtropical areas of Asia, Africa, America, and Australia (Hamed, 2011; Ahmed and Urooj, 2010b). Certain Indian Ficus species do not bear fruits, but they have similar morphological characters that are problematic to be distinguished from their species and variants. Every part of Ficus plants is used in the treatment of peptic ulcers, piles, jaundice, haemorrhage, diabetes, asthma, diarrhoea, dysentery, biliousness, and leprosy (Chopra et al., 1956; Kirtikar and Basu, 1995; Cox and Balick, 1996; Khan and Khatoon, 2007).

Different species of Indian Ficus genus contain sesquiterpenes, monoterpenes, triterpenoids, phenolic compounds, flavonoids, anthocyanins, alkaloids, furanocoumarins, organic acids, volatile components, and phenylpropanoids (Khayam et al., 2019; Shao et al.,

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2018; Tamta et al., 2021). These metabolites occur in latex, leaves, fruit, stem, and roots of different species (Shahinuzzaman et al., 2021). The Indian Ficus plants possess remarkable analgesic (Mahajan et al., 2012), antimicrobial (Patil and Patil, 2010), antiarthritic (Thite et al., 2014), anticancer (Jamil and Abdul Ghani, 2017), neuroprotective (Ramakrishna et al., 2014) and antidiabetic properties (Anjum and Tripathi, 2019a).

The present review summarizes and discusses the updated knowledge of ethnomedicinal properties, phytochemistry, pharmacological activities of 31 Indian Ficus species. Moreover, toxicological, and clinical studies are also included in this review. Out of 31 species, some species possess potent biological activities, but they have not been evaluated for their clinical research. No information is available in literature on 66 species. This review also provides some critical insights into the current scientific knowledge of bioavailability and pharmacokinetic profiles and its future potential in pharmaceutical research.

2. Methods

The data of identified compounds, studies of pharmacological activities, clinical trials, and toxicological research of 31 species were extracted by using various databases and search-engines e.g., monographs, reference books, MSc/MTech dissertations, PhD theses, PubMed/Medline, Scopus, ScienceDirect, Scifinder, Microsoft Academic, eFloras, Wiley, Google Scholar, DataONE Search, and Research Gate. The *meta*-analysis of extracted information was also conducted. The authors did not include the pharmacological activities of synthetic and semisynthetic compounds in this review.

3. Results

3.1. Botany and ethnomedicinal properties

Most Indian Ficus species are deciduous and evergreen trees, shrubs, herbs, and climbers. The leaves are reticulate, palmately compound, waxy, and exude white or yellow latex when broken. Many Indian Ficus species have aerial roots, whereas few are epiphytes. The syconium is hollow, enclosing an inflorescence with small male and female flowers lining the inside (Fig. 1). Different parts (bark, fruit, leaves, roots, and latex) of Ficus plants are used in the treatment of leprosy, nose bleeding, cough, paralysis, liver diseases, chest pain, and piles (Kirtikar and Basu, 1995; Khanom et al., 2000; Jaradat, 2005). Leaf infusion of *F. carica* is recommended as remedy for the treatment of diabetes and hypercholesterolemia (Chaachouay et al., 2019). Powdered roots and leaves of *F. deltoidea* are taken in the treatment of wounds, rheumatism, and sores (Burkill and Haniff, 1930). Fruits of *F. racemosa* are given in menorrhea, haemoptysis, visceral obstruction, diarrhoea, and constipation (Chopra et al., 1958; Ahmed et al., 2012b). Mixture of *F. religiosa* leaf juice and honey is employed for the treatment of asthma, cough, diarrhoea, earache, toothache, migraine, eye troubles, and scabies (Jain et al., 1991; Bhattarai, 1993b; Yadav, 1999). The ethnomedicinal properties of 31 Indian Ficus species are presented in Table 1 and Fig. 2.

3.2. Phytochemistry

The phenylpropanoids, isoflavonoids, flavonoids, phenolic glycosides, monoterpenes, sesquiterpenes, triterpenes, and alkaloids have been isolated and identified from 25 species {*F. auriculata* (syn. *F. pomifera*), *F. bengalensis, F. benjamina, F. carica, F. curtipes, F. deltoidea, F. elastica, F. erecta, F. exasperata, F. fistulosa, F. geniculata, F. hirta, F. hispida, F. lacor, F. lyrata* (Syn. *F. pandurata*), *F. macrocarpa, F. mollis, F. palmata, F. pumila, F. racemosa* (syn. *F. glomerata*), *F. religiosa, F. retusa, F. sarmentosa, F. semicordata,* and *F. tikoua*}of Indian Ficus genus while other 72 species {*F. abelii* Miq, *F. filicauda* Hand. - Mazz., *F. ischnopoda* Miq., *F. nigrescens* King, *F. fulva* Reinw. ex Blume, *F. langkokensis* Drake, *F. pubigera* (Miq. ex Wall.) Brandis, *F. laevis* Blume, *F. diversiformis* Miq., *F. chartacea* (Wall. ex Kurz) Wall. ex-King, *F. laevis* Blume var. macrocarpa (Miq.) Corner, *F. crininervia* Miq., *F. villosa* Blume, *F. sagittata* Vahl, *F. recurva* Blume, *F. pendens* Corner, *F. hedaracea* Roxb., *F. punctata* Thunb., *F. ampelas* Burm. f., *F. andamanica* Corner, *F. assamica* Miq., *F. copiosa* Steud., *F. cyrtophylla* (Miq.) Miq., *F. heterophylla* L. f., *F. praetermissa* Corner, *F. montana* Burm. f., *F. subincisa* Buch. -Ham. ex J. E. Sm., *F. subincisa* Buch. -Ham. ex J. E. Sm. var. paucidentata (Miq.) Corner, *F. heteropleura* Blume, *F. obscura* Blume var. borneensis (Miq.) Corner, *F. sinuata* Thunb., *F. subulata* Blume, *F. guttata* (Wight) Kurz ex-King, *F. variegata* Blume, *F. prostrata* (Wall. ex Miq.) Miq., *F. squamosa* Roxb., *F. ribes* Reinwdt. ex Blume, *F. magnoliifolia* Blume, *F. nervosa* B. Heyne ex Roth, *F. albipila* (Miq.) King, *F. callosa* Willd., *F. capillipes* Gagnep., *F. alongensis* Gagnep., *F. amplissima* J. E. Sm., *F. arnottiana* (Miq.) Miq., *F. caulocarpa* (Miq.) Miq., *F. concinna* (Miq.) Miq., *F. cupulata* Haines, *F. hookeriana* Corner, *F. maclellandii* King var. rhododendrifolia (Miq.) Corner, *F. rigida* Jacq., *F. rumphii* Blume, *F. superba* (Miq.), *F. tsjahela* Burm. f., *F. virens* Aiton, *F. altissima* Blume, *F. beddomei* King, *F. costata* Aiton, *F. dalhousiae* (Miq.) Miq., *F. drupacea* Thunb., *F. fergusonii* (King) Worthington, *F. maclellandii* King, *F. pellucidopunctata* Griff., *F. stricta* (Miq.) Miq., *F. sundaica* Blume, *F. trimenii* King, *F. gasparriniana* Miq., *F. macrophylla* Desf. ex Pers, *F. lamponga* Miq., *F. neriifolia* Sm., *F. talbotii* King, and *F. tinctoria* G. Forst} have not been evaluated for the presence of phytoconstituents. The backbone structures of identified compounds are presented in Fig. 3. The state-wise location, types of extracts, parts used, and identified phytoconstituents are described in Table 2.

3.3. Pharmacological attributes

Indian Ficus species possess analgesic (Marasini et al., 2020), antioxidative (Etratkhah et al., 2019), antidiabetic (Anjum and Tripathi, 2019b), anti-inflammatory (Sabi et al., 2022), antiarthritic (Mathavi and Nethaj, 2019), anti-stress (Murugesu et al., 2021), anticancer (Jain and Jegan, 2019), hepatoprotective (El-hawary et al., 2019), neuroprotective (Hassan et al., 2020), antimicrobial (Raja et al., 2021), radioprotective (Vinutha et al., 2015), and wound healing (Ansari et al., 2021) properties. The summary and related mechanisms of various pharmacological activities are presented in Table 3 and Fig. 4.

3.3.1. Analgesic activity

Pain is a nonspecific expression of various diseases in humans. The non-steroidal anti-inflammatory molecules and opiates have been used traditionally in these conditions, but several

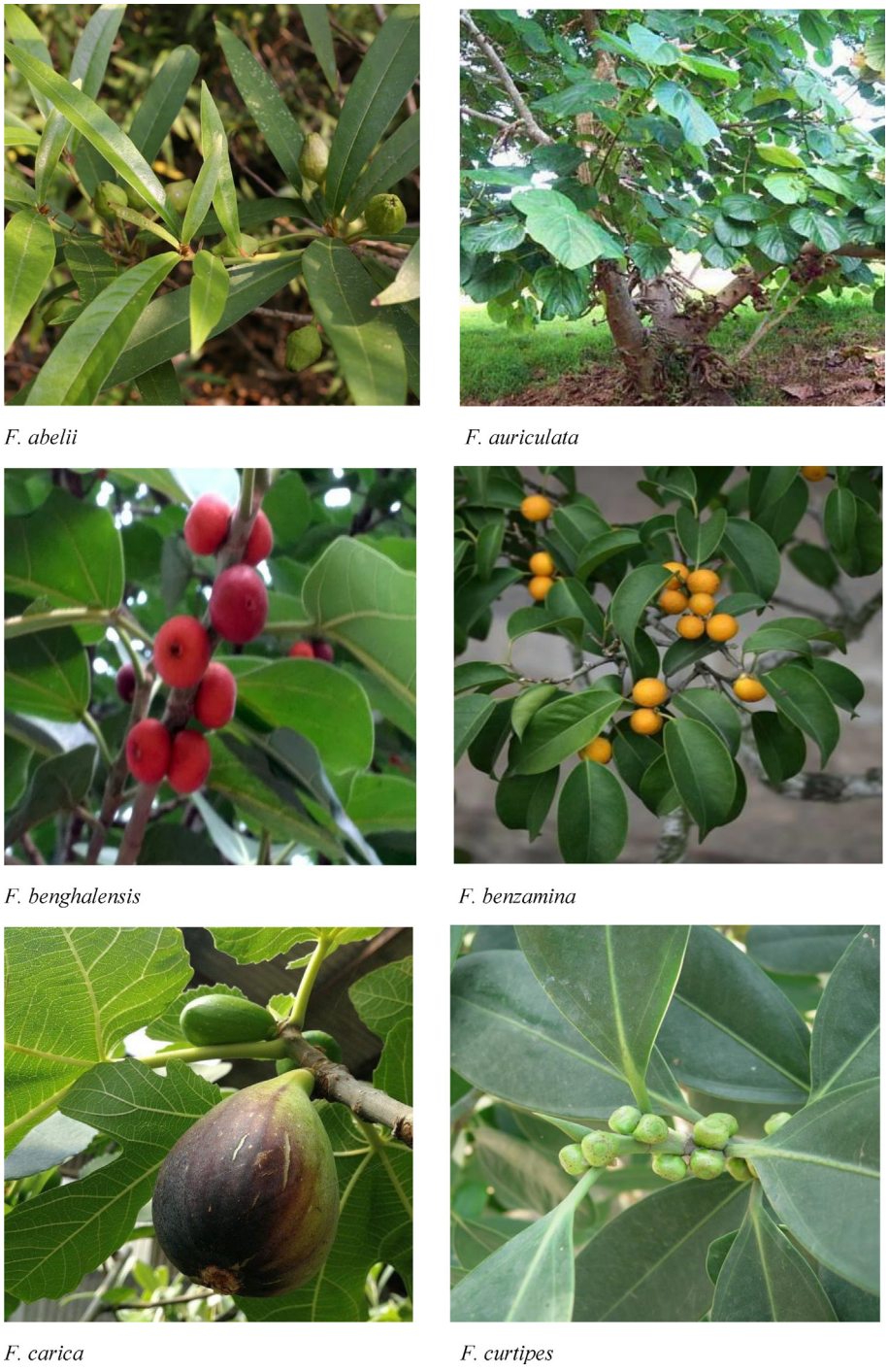


Fig. 1 Morphological features of Indian Ficus species.

adverse effects arise with these drugs such as gastrointestinal disorders, renal injury, and respiratory problems (Domaj et al., 1999; Farshchi et al., 2009). Nowadays, the researchers are showing their interests in searching of novel analgesic compounds from medicinal plants with possibly fewer adverse effects. Aqueous extract (400 mg/kg, p.o.) of *F. bengalensis,* in the early (0–5 min) and late phases (25–30 min) of pain, showed significant reduction in the duration of licking responses in formalin-induced pain model. The responses were compared to morphine-treated animals ($P < 0.001$ as compared to the control; Rajdev et al., 2018). The hot aqueous extract (500, 1000 and 2000 mg/kg) of *F. carica* fruits did not show any significant difference between control and treated animals (P greater than 0.05), but a significant variability reported in between the petroleum ether extract (1000 mg/kg) and the dimethyl sulfoxide treated animals ($P < 0.05$; Mirghazanfari et al., 2019). Ethanol extract of *F. religiosa* leaves (400 mg/kg b.w.) showed significant increase in latency time (70.81 %; $P < 0.05$) in Eddy's hot plate model when compared to control. Leaf extract (400 mg/kg b.w.) suppresses the

F. deltoidea

F. elastica

F. erecta

F. exasperata

F. fistulosa

F. gasparriniana

Fig. 1 (*continued*)

number of writhings (68.47 %), induced by acetic acid, when compared to diclofenac (68.47 %; $P < 0.05$; Marasini et al., 2020). Ethanol extract of *F. iteophylla* leaves (200 mg/kg) decreases the number of acetic acid-induced abdominal constriction (3.0 ± 0.82) when compared to ketopfofen (reference drug; 10 mg/kg; 4.30 ± 1.28; $P < 0.05$; Abdulmalik et al., 2011).

3.3.2. Anti-inflammatory activity

Ethanol extract of *F. carica* leaves (600 mg/kg b.w.) demonstrated potent anti-inflammatory activity in acute (75.90%) and chronic (71.66%) inflammations when compared to indomethacin ($P < 0.001$; Patil and Patil, 2011). Aqueous extract of *F. benjamina* leaves (264 mg/kg b.w.) exhibits higher anti-inflammatory effect (39.71%) than the negative control in experimental animals (70.12%; $P < 0.05$ Bunga and Fernandez, 2021). *F. carica* leaf extract decreases the formation of TNFα, PGE2, and VEGF in treated models ($P < 0.001$; Eteraf-Oskouei et al., 2015). Ethanol extract of *F. hispida* stem bark (400 mg/kg) showed significant inhibition (60.12%) to histamine-induced paw oedema when compared to indomethacin (69.64%; $P < 0.01$; Howlader et al., 2017).

F. geniculata

F. hirta

F. hispida

F. lacor

F. lamponga

F. lyrata

Fig. 1 (*continued*)

3.3.3. Antimicrobial activity

The microbial drug resistance to widely used antimicrobial drugs has increased the universality of microbial infections and their related problems (Ginovyan et al., 2017). Methanol extract (60 µg/disc) of *F. auriculata* fruits demonstrates strong antimicrobial effect against *S. epidermidies* (28 mm), and *M. genetalium* (MTCC 2288; 28 mm; Raja et al., 2021). Two compounds (ficuisoflavone and alpinumisoflavone) from *F. auriculata* fruits exhibit potent antibacterial effect against pathogenic bacteria (*S. aureus*, *K. pneumoniae*, *B. cereus, N. gonorrhoeae*, and *P. aeruginosa*; MIC 1.25 to 20 µg/ml; Shao et al., 2022). Four isoflavones (5,7,4′-trihydroxy-3′-hydroxymethylisoflavone, 3′-formyl-5,4′-dihydroxy-7-methoxyisoflavone, ficuisoflavone and alpinumisoflavone) from *F. auriculata* roots displays strong antibacterial activity against S. *pneumoniae*, *S. pyogenes*, *S. typhi*, *S. dysenteriae*, *E. coli* and *V. cholerae* (MIC from 1.30 to 39.93 µM; Qi et al., 2018). Methanol extract *F. religiosa* leaves (50 µL/well concentration) exhibited

F. microcarpa

F. mollis

F. neriifolia

F. palmata

F. pumila

F. racemosa

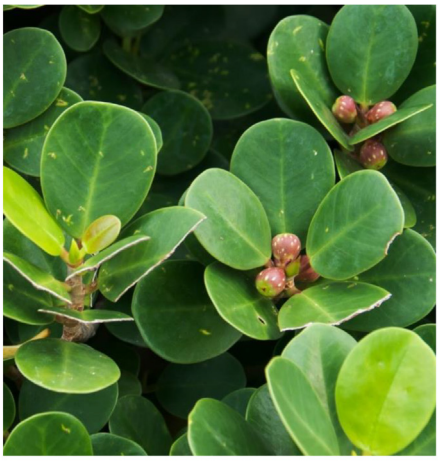
Fig. 1 (*continued*)

greater activity than aqueous extract against the tested microorganisms (*S. aureus, E. coli, P. aeruginosa, S. typhi, A. niger* and *Penicillium notatum*; Pathania et al., 2021). The n-hexane extract of *F. vogelii* leaves demonstrates potent antibacterial effect against *E. coli* and *S. typhimurium* (MIC 12.5 µg/mL; Uche Stephen, 2020).

3.3.4. Antioxidant activity

Oxidative stress is known as a main reason for the occurrence and continuance of various diseases (Singh et al., 2021). Plants are considered as a rich source of exogenous antioxidants (Sies, 1997; Singh and Sharma, 2020). Ethanol extract of *F. racemosa* fruits showed strong antioxidant activity on ABTS (EC_{50} 226.0 ± 1.77 µg/mL), FRAP (EC_{50} 234.8 ± 1.72 µg/mL), DPPH (EC_{50} 28.4 ± 0.50 µg/mL) radical scavenging, hydrogen peroxide radical scavenging (EC_{50} 376.7 ± 2.05 µg/mL), hydroxyl radical scavenging (EC_{50} 427.2 ± 3.06 µg/mL), chelating power (EC_{50} 176.6 ± 3.00 µg/mL), and reducing power (EC_{50} 356.3 ± 4.75 µg/mL) assays (Tamuly et al., 2015). The aqueous-ethanol (50:50) extract of *F. auriculata*

F. religiosa



F. retusa

F. sarmentosa

F. semicordata

F. talbotii

F. tikuoa

Fig. 1 (*continued*)

branches demonstrates inhibition to DPPH radical (IC_{50} 190. 57 ± 4.25 μg/ml) when compared to gallic acid (standard, 21.66 ± 0.19 μg/mL; Bertoletti et al., 2020). Methanol extract of *F. deltoidea* leaves displayed diverse levels of potential to DPPH (IC_{50} 288.04 μg/mL; $P < 0.001$; compared to quercetin) radical and reducing power (IC_{50} 0.02–0.24 μg/mL; compared to ascorbic acid $P < 0.001$) assays (Mohd Dom et al., 2020). The aqueous extract (5.0 mg/mL) of *F. asperifolia* leaves possesses strong DPPH scavenging effects (78.65 ± 1.15%; $P < 0.05$; Ojo and Akintayo, 2014).

3.3.5. Anti-diabetic activity

Diabetes mellitus, a metabolic disorder of carbohydrate, has caused the large number morbidity and mortality in people (Patel et al., 2011). Methanol fraction (500 μg/mL) of methanol: water (4:1) extract of *F. auriculata* fruits demonstrated strong suppressive effects against α-amylase (91.45%; IC_{50} 161.73 ± 0.43 μg/mL) and α-glucosidase (97.75%; IC_{50} 103. 43 ± 0.67 μg/mL) activities when compared with acarbose (IC_{50} 155.08 ± 1.75 and 95.63 ± 1.71 μg/mL; Anjum and Tripathi, 2019). Cycloartenol + 24-methylenecycloartanol (1 mg/

F. tinctoria

Fig. 1 (*continued*)

kg), from *F. auriculata* fruits, displayed significant antidiabetic activity in the high fat diet-streptozotocin stimulated type II diabetic rats. Cycloartenol + 24-methylenecycloartanol increased cell viability in the RIN-5F cells (*in vitro*) and showed a significant protection to β cells from glucose toxicity. Cycloartenol + 24-methylenecycloartanol presented a significant increase of insulin release from the β cells in both *in vivo* and *in vitro* studies (Nair et al., 2020).

3.3.6. Anti-arthritic activity

Arthritis and its associated disorders are characterized by swelling, pain, and stiffness of the synovial joints (Tiwari et al., 2021). The exact reasons of arthritis and its associated disorders are not known, but these are strongly associated to the autoimmune responses generated by many genetic and external factors (Alamgeer, 2017). Significant levels of terpenoids (28 mg/g), saponin (26 mg/g), flavonoids (97 mg/g) and phenol (110 mg/g) have been reported in ethanol extract of *F. benghalensis* stem bark. The ethanolic extract (400 μg/mL) showed significant inhibition (83.80 ± 5.16%) to egg albumin denaturation assay when compared to diclofenac sodium (91.45 ± 6.84%; Mathavi and Nethaj, 2019). Ethanolic (0.01 g) and petroleum ether (0.01 g) extracts of *F. benghalensis* aerial roots and Carbopol 934 (1%, w/w), glycerine (2.1 mL), Carbopol 940 (1%, w/w), and liquid paraffin (4.5 mL) were mixed to prepare Emulgel. The formulated Emulgel showed a significant homogeneity, lower levels of skin irritation and great stability. The formulated Emulgel, when compared to diclofenac, confirms the anti-arthritic activity through *in vitro* release assay (Sonali et al., 2021).

3.3.7. Anti-stress activity

Stress is a general physiological response of the body focussed on available resources and minimizing the influence on the body of pessimistic aspects (Seyle, 1973; Doreddula et al., 2014). Stress is linked to pathological processes of hypertension, peptic ulcer, immunosuppression, and reproductive complications (Piato et al., 2008; Ahmed et al., 2011b). Methanol extract of *F. benghalensis* fruits showed acetylcholinesterase inhibitory effect in SHSY5Y cells lines (IC_{50} 228.3 μg/mL; Vignesh et al., 2019). The methanol extract (500 mg/kg) also displayed dose and duration dependent significant delay in clonic convulsions (51.1 ± 1.4) on anoxia stress tolerance time in mice when compared to positive control (*Withania somnifera*, 100 mg/kg, p.o.; 64.5 ± 2.0; $P < 0.001$; Jahagirdar et al., 2020).

3.3.8. Anticancer/antitumor activity

Cancer is a one of the important causes of morbidity and mortality in humans. The proliferation of this disease is growing rapidly in the population of Central and South America, Africa, and Asia (Nguyen et al., 2020). The ethyl acetate extract of *F. benghalensis* aerial roots exhibited strong anticancer effects against A549 cell line (IC_{50} 13.027 μg/mL). The values were compared to that of doxorubicin (IC_{50} 13.0463 μg/mL). Similarly, the extract was also found effective against MDA-MB-231 cell line (IC_{50} 70.089 μg/mL) and results were compared to the doxorubicin (IC_{50} 59.2523 μg/mL; Jain and Jegan, 2019). Methanol extract *F. carica* leaves significantly suppressed the proliferation of MDA-MB-231 cell line ($P < 0.05$) in dose dependent manner (IC_{50} 0.081 mg/mL; Ergül et al., 2019). Chloroform extracts of *F. deltoidea* var. angustifolia and *F. deltoidea* var. deltoidea leaves showed cytotoxic effects against the prostate cancer cell lines (IC_{50} 23 and 29 μg/mL for PC3 and IC_{50} 19 and 23 μg/mL for LNCaP; Hanafi et al. 2017). The plectranthoic acid, from ethyl acetate extract of *F. macrocarpa* leaves, significantly suppressed the viability of DU145, PC3, CWRV1, NB26 and A375 cell lines (IC_{50} 25.4, 32.2, 41, 53.1 to 77 μM; Akhtar et al., 2015).

3.3.9. Neuroprotective activity

Neurodegenerative disorders cause slow neuronal death that led to the loss of cognitive functions and sensory dysfunctions (Mattson et al., 2004). Nowadays, these disorders are linked to various multifactorial pathologies, social, and financial issues (Adewusi et al., 2010; Saxena and Caroni, 2011). Methanolic extract of *F. benghalensis* leaves showed potent inhibitory effect to acetylcholine esterase activity (IC_{50} = 194.6 ± 7.96 1 μg/mL) when compared to donepezil (IC_{50} = 186.1 ± 7.1 μg/mL; Hassan et al., 2020). Ethanol extract of *F. erecta* leaves significantly reduced neuronal loss and neuronal nuclei expression in the brain tissues of Aβ injected mice. Extract significantly changed the Aβ-induced inhibition of cAMP response element-binding protein phosphorylation and the expression of brain-derived neurotrophic factor, showing mechanism of neuroprotection. Extract significantly suppressed the formation of interleukin-1β and tumour necrosis factor-α, and the ionized calcium-binding adaptor molecule 1 expression in brain tissues of Aβ-injected mice, proposing anti-neuroinflammatory actions (Sohn et al., 2021).

3.3.10. Radioprotective activity

Radiations can cause mutagenic alterations, and lead to the formation of cancers. Plants that could defend the body from radiation effects would be of great interest (Mamedov et al., 2011). The radioprotective effect of ethanol extract of *F. racemosa* stem bark was tested on electron beam radiation induced-DNA damage. The extract (50 μg) displayed significant inhibition on radiation induced-DNA damage when compared to control ($P < 0.001$; Vinutha et al., 2015). Ethanol extract of *F. racemosa* (20 μg/mL) showed a significant radioprotection ($P < 0.01$) to 4 Gy γ-irradiation when compared to

Table 1 Ethnomedicinal properties of Indian Ficus species found in different states of India.

Species	State/India	Disease/complaints	Mode/parts of application	References
F. abelii	Arunachal Pradesh, Assam, and Meghalaya	Used in the treatment of diabetes	Leaf decoction	Chaachouay et al. (2019)
F. auriculata (syn. *F. pomifera*)	Arunachal Pradesh, Assam, Bihar, Jammu & Kashmir, Jharkhand, Maharashtra, Manipur, Meghalaya, Mizoram, Orissa, Sikkim, Karnataka, and West Bengal	Externally applied for wound healing	Paste of crushed leaves	Kunwar and Bussmann (2006)
		Treatment of dysentery	Roasted figs	Zhang et al. (2019)
		Used in cholera mumps, and vomiting	Latex of roots	Tamta et al. (2021)
		Taken in the treatment of jaundice	Mixture of root powder and bark of *Oroxylum indicum*	Kunwar and Bussmann (2006)
		Useful in diarrhoea	Infusion of stem bark	Cox and Balick (1996)
		Employed in the treatment of diabetes	Fruits	Wangkheirakpam and Laitonjam (2012)
F. bengalensis	Uttar Pradesh, Madhya Pradesh, West Bengal, Himachal Pradesh, Rajasthan, Karnataka, Tamil Nadu, and Kerala	Employed in cold, cough and asthma	Boiled stem bark	Shakya (2000)
		Used for diarrhoea, dysentery, indigestion, joint pain, dermatitis, gum swelling, gonorrhoea, and snake bite	Milky sap from bark	
		Cause allergy to children	Leaves	Dangol (2002)
		Employed in stopping the menstruation	Aerial root juice	Mishara (1998)
		Applied externally for body pain, toothache, diabetes, joint pain, and rheumatism		Kharel and Siwakoti (2002)
		Helps in leucorrhoea control	Root bark powder is mixed with *Desmostachys bipinnata* and is taken with one spoon of sugar	Siwakoti and Siwakoti (2000)
		Treatment of boils, wounds and obstinate vomiting	Root latex	Parajuli (2001)
		It is used in diarrhoea	Aerial roots decoction and water obtained from rice wash	Chopra et al. (1956)
F. benzamina	Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Jharkhand, Madhya Pradesh, Orissa, Sikkim, and Uttar Pradesh	Applied on the treatment of boils	Latex	Kunwar and Adhikari (2005)
F. carica	Rajasthan, Uttar Pradesh, Madhya Pradesh, North-east states, Karnataka, and Tamil Nadu	Used in the treatment of diabetes and hypercholesterolemia	Leaf infusion	Chaachouay et al. (2019)
		In leprosy and nose bleeding	Fruit powder	Idolo et al. (2010)
		Useful in diarrhoea	Decoction of dried fruits and unpeeled almond	Ramazani et al. (2010)
		Treatment of abdominal pain	Fruits juice	Khan and Khatoon (2007)
		Treatment of leukoderma and ringworm infection	Root's decoction	Kirtikar and Basu (1995)
		Used as expectorant, diuretic, and anthelmintic agent	Latex	Dimomfu (1984)Akah et al. (1998)
		Bone treatment	Bark poultice	
		Bronchitis treatment	Aqueous infusion of fresh leaves	Tene et al. (2007)
		Taken orally in constipation	Fruit juice	Prajapati et al. (2007)
		Taken orally in the treatment of cough	Fruit decoction with honey	Ghazanfar and Al-Abahi (1993)
		Expectorant	Fruit	Afzal et al. (2009)
		Jaundice	20 mL of leaf juice mixed with a cup of goat milk is taken early in the morning for 3 days	Manjula et al. (2011)
		Removal of kidney stone	Bark and leaves	Afzal et al. (2009)
		Leukoderma	Roots	Kalaskar et al. (2010)
		In menstruation pain	Aqueous infusion of fresh leaf tender is taken orally as a drink	Tene et al. (2007)
		Regulates blood stream	Decoction made with dried fruits, lemon peel and *Laurus nobilis* leaves	Idolo et al. (2010)
		To remove weakness	Single dry fruit is soaked in water for a night and is consumed at morning for 15 days	Patil et al. (2011)
		Skin disease	Fruits and stem latex	Khan and Khatoon (2007)

(*continued on next page*)

Table 1 (*continued*)

Species	State/India	Disease/complaints	Mode/parts of application	References
F. curtipes	Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, Tripura, and West Bengal	Used as immune stimulant	Decoction of stem bark and leaves	Andrade et al. (2019)
F. deltoidea	Assam, and West Bengal	Treatment of wounds, rheumatism, and sores	Powdered roots and leaves	Burkill and Haniff (1930)
		Used as a tonic to contract the uterus and vaginal muscles, and to treat menstrual cycle, and leucorrhoea	Decoction of boiled leaves	Khan et al. (2011)
		Chewed to relieve toothache, cold, and headache	Fruits	Bunawan et al. (2014)
		Taken as an aphrodisiac tonic	Whole plant	Bouquet (1969)
F. elastica	Assam, Meghalaya, Sikkim, Assam, and West Bengal	Useful in skin infections and skin allergies	Boiled leaf extract	Kiem et al. (2012)
		Employed as a diuretic agent	Cold leaf extract	Teinkela et al. (2018)
		Employed as an astringent and styptics for wounds	Stem bark	Rahman and Khanom (2013)
F. erecta	Assam, Sikkim, and Meghalaya	Recommended as medicine in nephritis, and arthritis	Whole plant	Yakushiji et al. (2012)
		Treatment of inflammations	Roots, stem bark, and fruits	Kislev et al. (2006)
F. exasperata	Andaman & Nicobar Island, Central and Southern states of India	Used in the treatment of stomach disorders, coughs, epilepsy, high blood pressure, rheumatism, arthritis, intestinal pains, and wounds	Leaf decoction	Dalziel (1948)
		Employed as an antipyretic agent	Leaves	Haxaire (1979)
		Used in the treatment of malaria	The leaves are macerated in water and the decoction is taken orally	Titanji et al. (2008)
		Used in the treatment of haemorrhoids	Aqueous extract of leaves	Focho et al. (2009)
		In diarrhoea treatment	Infusion of leaves	Noumi and Yomi (2001)
		Treatment of ulcer	Few leaves are chewed and swallowed three times for 4–8 weeks	Berg (1989)
		To treat stomach-ache	Infusion of dried leaves	Akah et al. (1997)
		Remedy for peptic ulcers	50 Leaves of *F. exasperata*, 50 leaves of *Emilia coccinea* and 10 fruits of *Capsicum frutescens* are boiled in water (1 l), homogenized, and filtered. 150 mL filtrate is taken twice a day for 5 days	Noumi and Dibakto (2000)
		Treatment of asthma, bronchitis, tuberculosis, and emphysema	Leaf juice mixed with lemon juice and taken twice a day	Bafor and Igbinuwen (2009)
		Used for insomnia	Fresh leaves	Kerharo (1974)
		Applied externally to treat eczema	Stem bark crushed with the roots of *Croton roxburghii* in coconut milk	Harsha et al. (2003)
		Eaten to relieve throat pain	Dried flowers	Chhabra et al. (1984)
		Used to manage asthma, and venereal diseases	Roots	Chhabra et al. (1990)
		Inhaled in case of chest pain	Leaves are boiled in water and the steam	Assi (1990)
		Used to arrest bleeding by traditional birth attendants in hastening childbirth	Plant sap	Irene and Iheanacho (2007)
		Orally taken and rubbed on the abdomen to stimulate uterus contractions during childbirth	Dried leaf decoction	Hutchinson (1985)
F. fistulosa	Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bengal, Jharkhand, Meghalaya, Mizoram, and Tripura	Used in the post-natal treatment, and possess diaphoretic property	Whole plant	Mehra et al. (2014)
F. gasparriniana	Bihar, Arunachal Pradesh, Assam, Meghalaya, Nagaland, and Sikkim	Used in the improvement of digestion	Roots	Luo et al. (2019)
F. geniculata	Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Jharkhand, Meghalaya, Orissa, Sikkim, Tamil Nadu, and West Bengal	Medicines for haemorrhage, stomach disorder, gastrointestinal, arthritis, headache, and cardiovascular disorder	Stem bark and leaves	Kumari et al. (2019)
F. hirta	Arunachal Pradesh, Assam, Bihar, Meghalaya, Tripura, and West Bengal	Used as child snacks	Ripe female figs	Shi et al. (2014)

Table 1 (*continued*)

Species	State/India	Disease/complaints	Mode/parts of application	References
F. hispida	Arunachal Pradesh, Assam, West Bengal, Uttarakhand, Uttar Pradesh, and Rajasthan	Is taken for earache	Leaf juice	Basnet (1998)
		Used to treat liver complaints	Fumes from twigs	Dangol and Gurung (1995)
		Used as emetic and purgative agents	Fruit, seed, and bark	Kharel and Siwakoti (2002)
		Remedy to treat diabetes	Infusion of stem bark	Khan et al. (2011)
		Used as lactagogue and tonic	Seed infusion	Kirtikar and Basu (1987)
		Given to mother as a galactagogue for better milk formation	Boiled green fruits	Behera (2006)
F. lacor	Uttarakhand, West Bengal, and Uttar Pradesh	Used to treat leucorrhoea, ulcers, and boils	Decoction of buds	Manandhar (1985)
		Useful in the curing of stomach disorders	Seeds	Bhatt (1977)
		Treatment of Harsha	Dried buds	Nakarmi (2001)
		Used to treat diabetes	Powder of dried ripened fruits	Khan et al. (2011)
		In expelling round worms from stomach	Stem bark	Nadkarni and Nadkarni (1976a)
		Used for treatment of various skin problems	Leaves	Gupta and Arora (2013)
F. lamponga	Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Manipur, Meghalaya, and West Bengal	In the treatment of jaundice	Whole plant	Das et al. (2008)
F. lyrata (Syn. *F. pandurata* Sand)	Andaman & Nicobar Islands	Used as diuretic and antidepressant agent	Leaves	Dhawan et al. (1977)
F. microcarpa	Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Peninsular region,	Used as insecticide to kill housefly	Leaf extract	Kalaskar and Surana (2012)
	Punjab, Rajasthan, and Sikkim	Taken orally in the treatment of diabetes	Powder of fresh leaves and fruits (equal amounts)	Khan et al. (2011)
F. mollis	Andaman & Nicobar Islands, Bihar, Central and Southern provinces, Jharkhand, Maharashtra, Rajasthan, and Uttar Pradesh	Used to increase lactation after delivery of women	Whole plant	Shahare and Bodele (2020)
		Used to treat ulcers and wounds	Leaves	Thapa (2001)Lim (2012)
		Applied as a poultice to treat boils	Crushed leaves	
		Used for stomatitis, and to clean ulcers	Roots	Priya and Abinaya (2018)
		To treat skin infections, neck swelling and scabies	Stem bark	Ghimire et al. (2000)
F. neriifolia	Arunachal Pradesh, Assam, Meghalaya, Mizoram, Nagaland, Uttar Pradesh, and Western to Eastern Himalayas	Given in conjunctivitis	Stem bark juice	Manandhar (2001)
		Used in the treatment of boils	Milky latex of bark	Khan et al. (2011)
F. palmata	Andhra Pradesh, Bihar, Kerala Madhya Pradesh, Orissa, Rajasthan, and Uttar Pradesh	Employed in ringworm and skin diseases	Fruit paste	Thapa (2001)
		Used in dysentery and vomiting	Ripen fruits	Devkota and Karmacharya (2003)
		Applied to extract spines deeply lodged in the flesh	Stem latex	Manandhar (1995)
		Used to treat digestion complaints	Fruits	Pala et al. (2010)
F. pumila	Rajasthan, Gujarat, Punjab, Uttarakhand, Himachal Pradesh, Assam, Karnataka	Treatment of bleeding, swelling, haemorrhoids, and intestinal disorders	Leaves and fruits	Abraham et al. (2008)
		Used to treat diabetes, and high blood pressure	Leaves and fruits	Kaur (2012)
		Used for skin infections	Stem latex	Mazid et al. (2012)Sarkar and Devi (2017)Pant and Pant (2004)
		Useful in carbuncle, dysentery, haematuria, and piles	Leaves	
		Used to treat bladder inflammation and dysuria	Roots	
		Employed for backache, piles, swellings, and tuberculosis of the testicles	Stem or fruit peel	Rahman and Khanom (2013)Vihari (1995)Khare (2007a)
		Used for boils, rheumatism, and sore throat	Dried leaves and stems	
		In the treatment of hernia	Fruit decoction	
F. racemosa (syn. *F. glomerata*)	Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Sikkim, Meghalaya, and West Bengal	Used as an astringent, stomachic, carminative given in menorrhea, and constipation	Fruits	Chopra et al. (1958)
		Useful in leprosy	A bath made of fruit and bark	Nadkarni et al. (1976)
		In the treatment of diabetes	Fruit infusion	Raghunatha Iyer (1995)
		Used in bilious infections	Leaf powder mixed with honey	Kirtikar and Basu (1975)
		Taken in asthma and piles treatment	Bark decoction	Muller Boker (1999)
		Used for boils, blisters, and measles	Leaf latex	Siwakoti and Siwakoti (2000)

(*continued on next page*)

Table 1 (*continued*)

Species	State/India	Disease/complaints	Mode/parts of application	References
		Valuable medicine in diabetes	Trunk sap	Paudyal (2000)
		Used in burns, swelling, leukorrhea dysentery and diarrhoea	Paste of stem bark	Tiwari (2001)
		Used to cure heat stroke, and chronic wounds	Root sap	Thapa (2001)
		Taken as aphrodisiac agent	Stem latex	Yadav (1999)
		Used to cure stomach-ache, cholera, and mumps	Stem latex	Basnet (1998)
		Remedy for cough, asthma, fever, respiratory and liver disorders	Leaf galls	Annon (1976)
		Treatment of children's ear infections, and used to suppress nose bleeding	Leaf galls	Nadkarni (1976)
		Used in pulmonary infections, diarrhoea, and vomiting	Leaf galls	Kirthikar and Basu (1935)
F. religiosa	Arunachal Pradesh, Assam, Rajasthan, Uttar Pradesh, Karnataka, Tamil Nadu, Gujarat, Bihar, Meghalaya, and Sikkim	Employed in the treatment of asthma, cough, sexual disorders, diarrhoea, haematuria, earache, toothache, migraine, and gastric complaints	Mixture of leaf juice and honey	Jain et al. (1991)
		Used as an analgesic for toothache	Leaf decoction	Bhattarai (1993a)Bhattarai (1993b)
		Eaten to facilitate asthma and respiratory system	Fruits	
		Applied externally to treat scabies	Fruit paste	Siwakoti and Siwakoti (2000)
		Taken in scabies	Bark infusion	Chaudhary (1994)
		Used in gonorrhoea, wounds, diabetes, diarrhoea, and bone fracture	Stem bark	Shrestha (1997)
		Useful in cough, cold and mild fever	Mixture of bark paste and honey (equal amounts)	Dangol (2002)
		Employed in the treatment of menstrual complaints	Aerial root juice	Thapa (2001)
F. retusa	Goa, Assam, Meghalaya, and Uttar Pradesh	Used in wounds and bruises	Roots, stem barks, and leaves	Chopra et al. (1956)
		Applied to treat decaying or aching tooth	Dried roots are mixed with salt	(Karki 2001)
		Used in the treatment of liver diseases	Roots	Semwal et al. (2013)
F. sarmentosa	Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Mizoram, Punjab, Sikkim, Tripura, Uttar Pradesh, and West Bengal	Recommended as remedy for wounds, fever, swollen joints, inflammations, and ulcers	Whole plant	Ripu et al. (2006)
		Taken to cure boils and to increase milk secretion after delivery	Edible bark powder	
		Used in malaria	Aqueous root extract	Joshi and Joshi (2000)Guan et al. (2007)
		Cure for leprosy	A bath made from the fruit and bark	Dimri et al. (2018)Priyanka et al. (2016)Gupta and Acharya (2018)
		Curing of fever	Latex	
		Eaten in diarrhoea	Raw fruits	
		Applied on forehead to relieve headache	Young fruit juice	Lansky (2011)
F. semicordata	Rajasthan, Uttar Pradesh, Assam, West Bengal, and Karnataka	Applied on forehead to cure headache	Root paste	Rajendra and Prasad (2009)
		Taken orally at the time of pregnancy	Fresh decoction of the stem bark and leaves	Ghildiyal et al. (2014)
		Curing the fever	Latex	Kunwar and Bussmann (2006)
		Taken in typhoid fever	Milky sap of aerial parts diluted once in water	Gopal (2013)
		Applied for the growth of hairs on head	Milky latex	Phondani et al. (2010)
		Eaten in diarrhoea	Raw fruits	Shashi and Rabinarayan (2018)
		Taken orally to get relief from jaundice	Leaf decoction	Gupta and Acharya (2019)
		Used in the treatment of constipation	Ripe figs	Kunwar and Bussmann (2006)
		Applied to treat wounds and bruises	Juice and powdered stem bark	Khare (2007)
		Used to treat boils	Latex	Rajesh et al. (2017)
		Applied for curing scabies	Leaf juice	Shubhechchha (2012)
		Used in the treatment of menstrual disorders	Juice of stem bark of *F. semicordata* and *M. esculenta*	Nikomtat et al. (2011)

Table 1 (*continued*)

Species	State/India	Disease/complaints	Mode/parts of application	References
F. talbotii	Madhya Pradesh, and Peninsular region	Used for ulcers and venereal diseases Employed as diuretic, spasmolytic, and antidepressant agent	Stem bark Aerial parts	Khare (2007) Shi et al. (2018)
F. tikoua	Assam, Manipur, West Bengal	Used in the treatment of chronic bronchitis, diarrhoea, dysentery, rheumatism, oedema, and impetigo	Rhizomes	Jiangsu New Medical College (1986)
F. tinctoria	Andaman & Nicobar Islands, Bihar, Kerala, Madhya Pradesh, Meghalaya, Orissa, Tamil Nadu, and Uttar Pradesh	Used as a tonic for weakness after the childbirth Employed in dressing for broken bones	Leaf decoction Plant juice and leaves	Smith (1979) Satapathy and Kumar (2017)

the radiation controls. The cytokinesis-block proliferative index revealed that extract does not change radiation stimulated cell cycle delay (Veerapur et al., 2009).

3.3.11. Wound healing activity

Wounds are defined as physical, chemical, or thermal damages that result in an opening or breaking of skin integrity or the damage of anatomical and functional integrity of living tissues (Meenakshi et al., 2006). Ethanolic extract of *F. benghalensis* leaves (200 mg/kg, p.o.) showed significant wound-healing effects by reducing the period of epithelialization as well as enhancing the rate of wound contraction ($P < 0.05$; Imran et al., 2021). Methanolic extract of *F. carica* leaves demonstrated significant wound healing activity in the excision wound model. Extract significantly reduced the wound closure time but increased wound contraction percentage (10%, w/w) in treated animals. The wound was totally healed in treated animals within 14 ± 2 days. Healing was compared to negative (24 ± 2 days) as well as positive (12 ± 2 days) controls (Begum et al., 2013). Ethanolic extract (2.0 mg/mL) of *F. religiosa* displayed strong RBC membrane stabilization activity (90.84%, *in vitro* assay). Ethanol extract presented the significant decrease in wound size on day 20th when compared to the control (Raisagar et al., 2019).

4. Discussion

Plant-derived medicines are used in the treatment and/or management of various diseases. The large population of developing countries (70–90%) is still relies on plants and plant-derived medicines (Benzie and Watchel-Galor, 2011; Rahman et al., 2022). Ficus bark, root, leaves, fruits, and latex are frequently used in the treatment of various illnesses (Sirisha et al., 2010). Ethanol extract of *F. religiosa* leaves significantly inhibits the number of writhings, when compared to diclofenac (Marasini et al., 2020). Ethanol extract of *F. iteophylla* leaves reduces the number of acetic acid-induced abdominal constriction greater than ketopfofen (Abdulmalik et al. 2011). *F. carica* leaf extract significantly decreases the formation of TNFα, PGE2, and VEGF in rat air pouch model (Eteraf-Oskouei et al., 2015), which shows its strong anti-inflammatory effects. The ethanol extract of *F. hispida* stem bark exhibits suppression in histamine-induced paw oedema which also displays their anti-inflammatory potential (Howlader et al. 2017). Procyanidin B2, isolated from *F. tikoua* leaves, up-regulates the expression of p62 and exert a positive loop between Nrf2 and p62 for the treatment of inflammation (Lu et al., 2018; Ma et al., 2021; Chen et al., 2022). Flavanonols {(2R, 3R)-(+)-dihydroquercetin, and aromadendrin} have been reported from *F. tikoua* leaves (Zhou et al., 2022). Aromadendrin regulates the formation of IL-2 and IFNγ in Jurkat T cells (*in vitro*). It inhibits the expression of surface molecules (CD69, CD25, and CD40L) as well as the ATP hydrolysis of nuclear factor of activated T cells (Lee and Jeong, 2020). Methanol extract of *F. auriculata* fruits displays strong antimicrobial effect against *M. genetalium* and *S. epidermidies* (60 µg/disc concentration; Raja et al., 2021). The ficuisoflavone and alpinumisoflavone, from *F. auriculata* fruits, demonstrate strong antibacterial effects against pathogenic bacterial species (*S. aureus*, *K. pneumoniae*, *B. cereus, N. gonorrhoeae*, and *P. aeruginosa*; MIC 1.25 to 20 µg/ml; Shao et al., 2022). The n-

hexane extract of *F. vogelii* leaves exhibits potent antibacterial activity against *E. coli* and *S. typhimurium* (MIC 12.5 μg/mL; Uche Stephen, 2020). Ethanol extract of *F. racemosa* fruits demonstrates strong antioxidant effects on ABTS, FRAP, DPPH radical scavenging, hydrogen peroxide radical scavenging, hydroxyl radical scavenging, chelating power, and reducing power assays (Tamuly et al., 2015). The aqueous extract of *F. asperifolia* leaves possesses strong DPPH scavenging effects ($P < 0.05$; Ojo and Akintayo, 2014).

Methanol fraction of methanol: water (4:1) extract of *F. auriculata* fruits demonstrates strong inhibitory effects against α-amylase and α-glucosidase activities which compared to acarbose (Anjum and Tripathi, 2019). Ethanol extract of *F. asperifolia* leaves reduces blood glucose levels in streptozotocin-induced diabetes when compared to diabetic control (Pwaniyibo et al. 2020). The ethyl acetate fraction of acetone extract of *F. lutea* leaves exhibits significant increase in insulin secretion in RIN-m5F pancreatic β-cells when compared to glibenclamide (Olaokun et al. 2016). The formulated Emulgel (ethanol extract of *F. benghalensis*), when compared to diclofenac, validates the anti-arthritic activity through *in vitro* release assay (Sonali et al., 2021). Methanol extract of *F. vogelii* leaves significantly ($P \leq 0.05$) inhibits adjuvant-induced paw arthritis when compared to indomethacin (reference drug; 10 mg/kg; Nwaehujor, 2021). The methanol extract *F. carica* leaves significantly suppresses the proliferation of MDA-MB-231 cell line ($P < 0.05$) in dose dependent manner (Ergül et al., 2019). The petroleum ether fraction of ethanol extract of *F. glumosa* stem bark demonstrates significant cytotoxicity on HT-29 (90.26%), and on A549 (88.38%) cell lines, respectively. Similarly, ethanol extract also displays potent cytotoxic effect against HFL-1 cells (IC_{50} 232.66 μg/mL; Mutungi et al. 2021).

5. Bioavailability and pharmacokinetic profile

Indian Ficus species are used in the Ayurvedic system of medicine for treatment of various diseases in diverse geographical areas (Trivedi et al. 1969). Different species of Ficus genus (*F. racemosa, F. glomerata, F. glumosa, F. carica, F. religiosa* and *F. benghalensis*) are used to treat diabetic disorders such as regulating enzymatic activities, rate of carbohydrates assimilation, enhancing insulin sensitivity, release of insulin, formation of hepatic glycogen, and the uptake of peripheral glucose of body (You and Nicklas, 2006; Veberic et al., 2008). The figs of *F. carica* serve as excellent source of dietary carotenoids, anthocyanins, polyphenols, tocopherols, and vitamin C, therefore the consumption of *F. carica* fruits must be stimulated (Idolo et al., 2010; Manjula et al., 2011; Sirajo, 2018). Fruits have various health benefits due to the presence of phenolic constituents. The fig latex is used in the treatment of warts, toothache, haemorrhoids, cough, and cancers (Caxito et al. 2017; Abdel-Aty et al. 2019). The aqueous extract of *F. sycomorus* is useful in the treatment of sickle cell disease (Ramde-Tiendrebeogo et al. 2012).

5.1. Ascorbic acid (vitamin C)

F. carica figs contain rich amount of ascorbic acid, a potent antioxidant molecule, useful in checking of nonenzymatic browning of fruits and vegetables. The molecule is used as an alternative to synthetic antioxidants (Fasakin et al., 2011). Ascorbic acid plays essential role in strengthening of immune system, wound healing, orthogenesis, absorption of iron, biosynthesis of collagen, metabolite detoxification, and stopping the blood vessels from clotting (Tomita et al. 2005). The accumulation of ascorbic acid relies on environmental factors, species diversity, time of harvest, and stages of development and storage. Various isolation and characterization techniques also influence the reliability, and stability of ascorbic acid (Carvalho et al. 2015).

5.2. Carotenoids and anthocyanins

Carotenoids are bioactive compounds, occur in plants, responsible for the colour of Ficus species. Indian Ficus species are an

Fig. 2 Ethnomedicinal properties of some important Indian Ficus species.

excellent source of carotenoids. They act as an antioxidant agent and reduce the speed of aging process by utilizing reactive oxygen species [Campos et al. 2013]. Ficus fruit consists of diversity of health-advantageous bioactive compounds such as polyphenols (Del Caro and Piga, 2008), alkaloids, sterols (Su et al. 2002), anthocyanins (Dueñas et al. 2008), minerals, and carotenes (Adams and Richardson, 1977). The colour of fruits, and vegetables is associated to the presence of anthocyanins. Normally yellow and orange shades of many foods are developed due to the presence of carotenoids and anthocyanins. Carotenoids and anthocyanins play defensive roles against cancer and cardiovascular diseases (Stintzing and Carle, 2004).

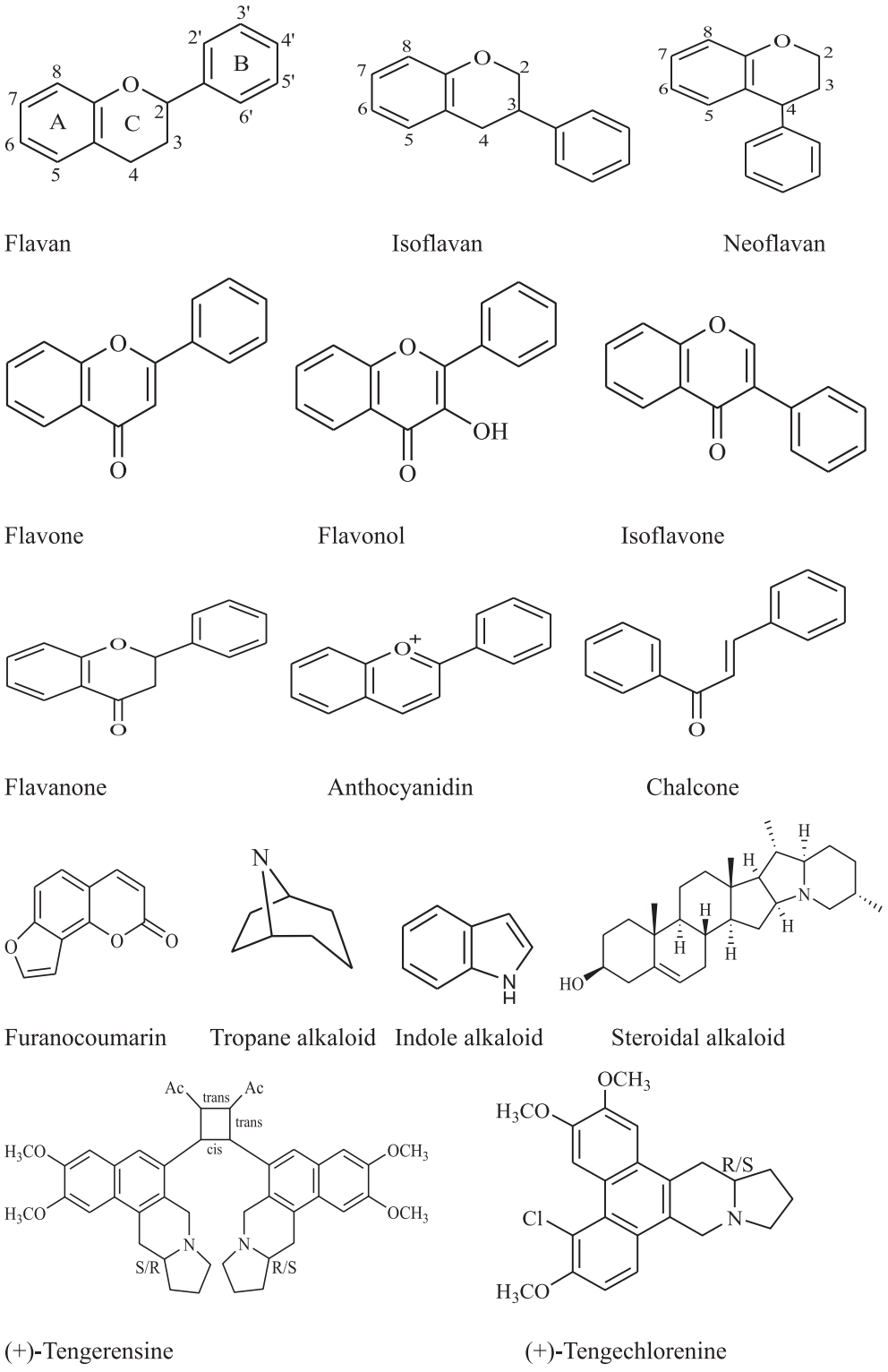


Fig. 3 Backbone structures of important isolated and identified compounds of Indian Ficus species.

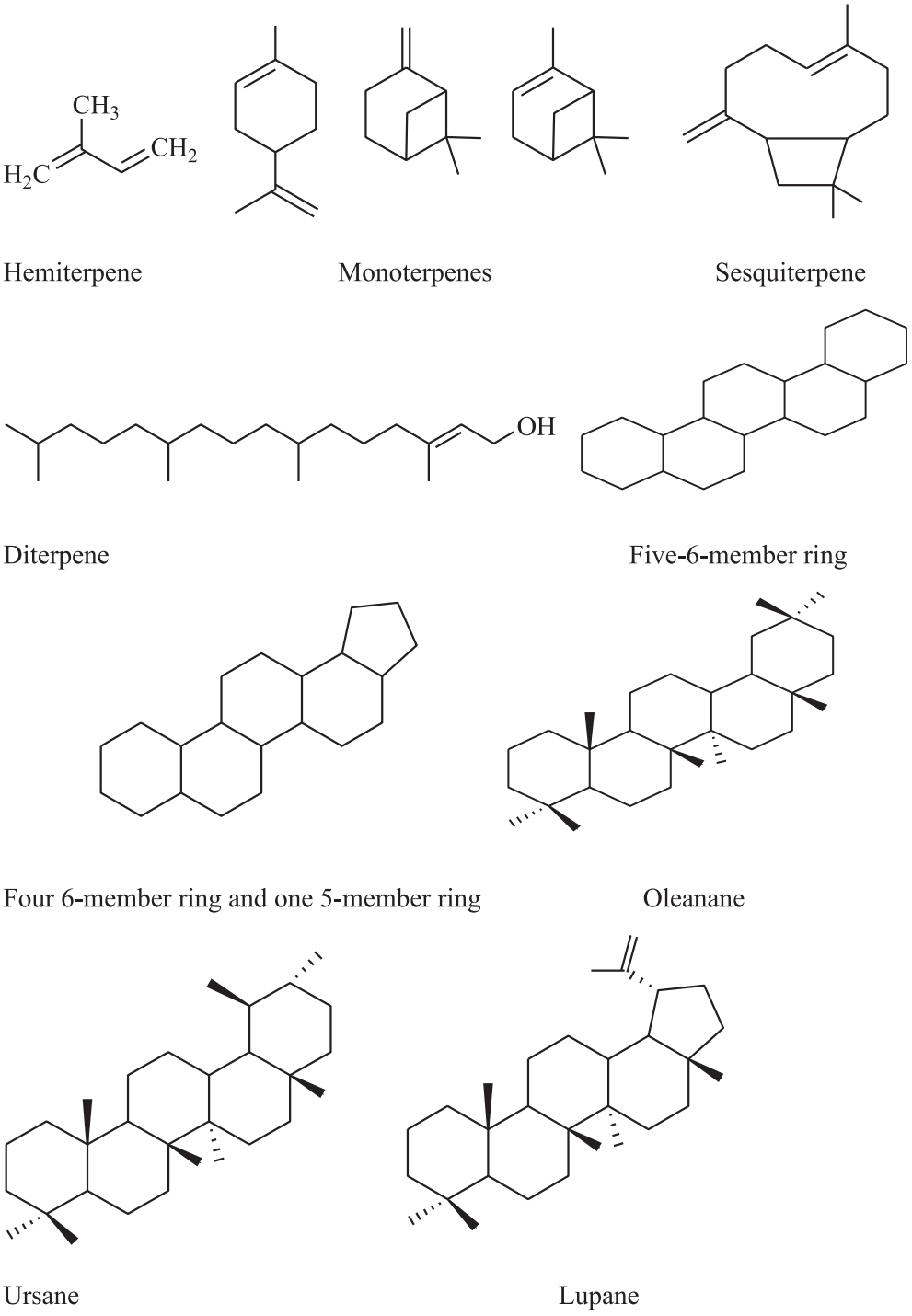


Fig. 3 (*continued*)

5.3. Phenolic compounds

Phenolic constituents play essential role in protection of cells from hydrogen peroxide injury, as well as absorption of free radicals. Ficus plants contain high quantity of phenolic compounds (Juániz et al. 2016). Due to high profiles of phenolic compounds in Ficus plants, they have explored for their health-beneficial properties such as anti-inflammatory, antitumor, and cardioprotective properties (Dias et al. 2016).

5.4. Pharmacokinetic profile

The oral bioavailability complications can emerge, *F. hispida* stem bark, leaves, and roots, due to the presence of lipophilic constituents. These lipophilic compounds can influence various metabolic activities. The lipophilic molecule delivery, through oral route, has weak bioavailability because of their poor dissolution. Therefore, it is required that assimilation of *F. hispida* into dosage form may enhance its bioavailability (Touitou and

Table 2 Isolated chemical constituents from various parts of Indian Ficus species.

Plant species	Extract type	Plant parts	Compounds type	Isolated compounds	References
F. auriculata (syn. *F. pomifera*)	Ethanolic (70%)	Dried fruits	Sesquiterpene	Aristolone	Ambarwati et al. (2021)
	Ethanolic	Roots	Isoflavones	5,7,4′-Trihydroxy-3′-hydroxymethylisoflavone, 3′-formyl-5,4′-dihydroxy-7-methoxyisoflavone, ficuisoflavone and alpinumisoflavone	Qi et al. (2018)
		Aerial parts	Flavonoids	Quercetin, epigallocatechin, kaempferol, quercetin, and myricetin	El-Fishawy et al. (2011); Khayam et al. (2019)
		Leaves	Volatile oils	4-Phenylmethyl-pyridine, dibutyl phthalate, phytol, 3β-lup-20(29)-en-3-ol-acetate and indol, 4-phenylmethyl-pyridine	Shao et al. (2013)
		Stem	Triterpenoids	Betulinic acid, lupeol, stigmasterol, scopoletin, and β-sitosteril-3-*O*-β-D-glucopyranoside,	El-Fishawy et al. (2011)
			Lactone	Ficusine D	Shao et al. (2018); Tamta et al. (2021)
		Fruit	Phenolic acids	Galloylquinic acid, 3-*O*-cafeoylquinic acid, 4-*O*-cafeoylquinic acid, 5-*O*-cafeoylquinic acid, procyanidin trimer (B-type), 4-*O*-feruloylquinic acid derivatives, methoxyl-epicatchin dimer, epicatchin-trimer (A-type), trihydroxy-octadecadienoic acid, trihydroxy octadecanoic acid, gallocatchin-*O*-hexoside, hydroxy-octadecatrienoic acid, xanthone derivatives, and 3-methyl epigallocatechin gallate	Shahinuzzaman et al. (2021)
	Ethyl acetate	Stem	12-Membered and benzoic acid lactones	(3*R*,4*R*)-4-Hydroxy-de-*O*-methyllasiodiplodin, 6-oxolasiodiplodin and ficusines A-C, (*R*)-(+)-lasiodiplodin, (+)-(*R*)-de-*O*-methyllasiodiplodin and (3*R*,6*S*)-6-hydroxylasiodiplodin	Shao et al. (2014)
	Aqueous	Dried bark	Furanocoumarins	Bergapten	Tiwari et al. (2017)
			Flavonoid	Myricetin and querecetin-3-*O*-β-D-glucopyranoside	
	Petroleum ether	Leaves	Triterpenoids	3β-Acetoxyurs-12-ene, 3β-hydroxyurs-12-ene, 3β-hydroxyurs-12-en-27-oic acid, 3β-hydroxyolean-12-en-27-oic acid and 3α-acetoxyolean-12-en-27-oic acid	Wangkheirakpam et al. (2015)
F. benghalensis	Methanolic	Leaves	Essential oils	α-Cadinol, germacrene D-4-ol, γ-cadinene, α-muurolene, β-caryophyllene epoxide, cyclosativene, cubenol, τ-cadinol, (*E*)-β-ionone, δ-cadinene, β-geranylacetone, toluene, γ-muurolene, ethylbenzene, α-copaene, α-phellandrene, linalool, β-caryophyllene, maaliene, *n*-nonanal, *n*-hexanal, β-cyclocitral, (*E*)-α-ionone and limonene	Adebayo et al. (2015)
			Flavonoids	Naringenin, and quercetin	Rao et al. (2014)
		Stem bark	Triterpenoids	Lanostadienylglucosyl cetoleate, bengalensisteroic acid ester, heneicosanyl oleate, α-amyrin acetate, and lupeol	Naquvi et al. (2015)
			Terpenoid	3, 7, 11, 15-Tetramethyl-2-hexadecen-1-ol (phytol)	Kanjikar and Londonkar (2020)
		Aerial roots	Flavones and coumarins	Bengalensinone, benganoic acid, apocarotenoid, alpinumisoflavone, 4-hydroxyacetophenone, 4-hydroxybenzoic acid, 4-hydroxymellein, and *p*-coumeric acid	Riaz et al. (2012)
			Lupane triterpenoids	Stigmasterol, lupanyl acetate, and 3-acetoxy-9(11),12-ursandiene	
	Ethanolic	Aerial roots	Phenolics	Cyanidin 3-glucoside equivalent, cyanidin 3-glucoside, chlorogenic acid, caffeic acid, quercetin, naringenin, and kaempferol	Afzal et al. (2020)
		Fruits	Phenolics	Cyanidin 3-glucoside equivalent, cyanidin 3-glucoside, chlorogenic acid, and caffeic acid	
		Aerial parts	Triterpenoids	Lanosterol, lupeol, amyrin acetate, lupenyl acetate, friedelanol, cyclolaudenol, epifriedelanol, dihydrobrassicasterol, stigmasterol, sitosterol, ergosterol acetate, furostano, 4,22-stigmastadiene-3-one, 1-heptatriacotanol, and protodioscin	Verma et al. (2015)
				Stigmasterol	Fegade Sachin and Siddaiah (2019)
		Stem bark	Flavonoids	5,7-Dimethyl ether of leucopelargonidin 3-*O*-α-L rhamnoside and 5,3′-dimethyl ether of leucocyanidin 3-*O*-α-D galactosyl cellobioside, and quercetin	Daniel et al. (1998)
		Fruits	Phenolic acid	Caffeic acid	Gopukumar and Praseetha (2015)
	Aqueous- acetone	Stem bark	Anthocyanin	Pelargonidin	Kundap et al. (2017)
	Ethyl acetate	Leaves	Flavonoids	5,6,7,3′,5′-Pentamethoxy-4′-prenyloxyflavone, rutin, quercetin and 3-acetyl ursa-14:15-en-16-one	Elgindi (2004)
	Chloroform	Leaves	Phenolics	Cinnamic acid, gallic acid, theaflavin-3,3′-digallate, rutin, quercetin-3-galactoside, leucodelphinidin, gallocatechin, kaempferol, leucocydin and apigenin	Almahy et al. (2003)
		Stem bark and leaves	Triterpenoids	Stigmasterol, friedelin, lupeol, β-amyrin, 3-friedelanol, betulinic acid, 20-traxasten-3-ol, taraxosterol, and β-sitosterol	Murugesu et al. (2021)
F. benjamina	3% formic acid in 70% methanol/dH_2O	Leaves and stem bark	Indole-type	Calycanthidine, akuammidine, ergoline, dasycarpidan, ibogamine, ajamalicine, and dasycarpidol	Novelli et al. (2014)
			Indolyzidine-type	Obscurinervinediol, and crinamidine	
			Isoquinoline-type	Columbamine, laudanosoline, methylcoridaldine, salsoline, reticuline, hydroxymorphine, and isoclaurine	
			Quinolizidine-type	Sophocarpine, matridine, scoulerine, and lycocernuine	
			Pyridine-type	Anabasine, nicodicodine, adenocarpine, and lutidine	
			Carbazol-type	Neblinine, harmine, ellipticine, and aspidospermidin	
			Pyrrolizidine-type	Indicine N-oxide, and retronecine	
			Steroidal-type	Tomatidine and solasodine	
			Quinoline-type	Cinchophen	

(*continued on next page*)

Table 2 (*continued*)

Plant species	Extract type	Plant parts	Compounds type	Isolated compounds	References
			Pyrrolidine-type	Clemastine	
			Tropane-type	*p*-Bromo atropine	
			Acridine-type	Acridine derivative	
	Petroleum ether	Leaves	Pentacyclic triterpenoids	Ursolic acid and lupeol	Singh et al. (2020)
	Ethyl acetate	Fruits	Isoflavonoids	5,7,4′-Trihydroxy-6-(3,7-dimethyl-2,6-octadienyl)isoflavone, 5,7,2′,4′-tetrahydroxy-8-(3,7-dimethyl-2,6-octadienyl)isoflavone, 6-[(1*R**,6*R**)-3-methyl-6-(1-methylethenyl)-2-cyclohexen-1-yl]-5,7,4′- trihydroxyisoflavone, 3,5,7-trihydroxy-4′-methoxycoumarano-chroman-4-one, 6-(3-methyl-2-buten-1-yl)-3,5,7-trihydroxy-4′-methoxycoumarano-chroman-4- one, 5,4′-dihydroxy- 2″-hydroxyisopropyldihydrofurano[4,5:7,8]-isoflavone, 5,4′-dihydroxy-2″-(-2-hydroxy-6-methylhept-5-en-2-yl)dihydrofurano[4,5:7,8]- isoflavone, 5,4′-dihydroxy-2″-(-2-hydroxy-6-methylhept-5-en-2-yl)dihydrofurano[4,5:6,7]- isoflavone, lespedezol E1, ficusin A, gancaonin N, lupiwighteone and erythrinin C	Dai et al. (2012); dos Anjos Cruz et al. (2022)
	Aqueous methanol (95%)	Root bark	Triterpenoids and ceramide	β-Amyrin acetate, β-amyrin, psoralen, betulinic acid, lupeol, platanic acid, β-sitosterol glucoside, and benjaminamide	Simo et al. (2008)
F. carica	Ethanolic (70%)	Leaves	Isoflavones	Quercetin, luteolin, biochanin A, kaempferol, and rutin	Vaya and Mahmood (2006); Trifunschi et al. (2015)
			Polyphenolics	3-*O*-(Rhamnopyranosyl-glucopyranosyl)-7-*O*-(glucopyranosyl)-quercetin, 2-carboxyl-1, 4-naphthohydroquinone-4-*O*-glucopyranoside, luteolin 6-C-glucopyranoside, 8-C-arabinopyranoside, schaftoside, isoorientin, isoschaftoside, rutin, 2″-*O*-rhamnosylvitexin, isovitexin, isoquercetin, kaempferol-3- *O*-rutinoside	Li et al. (2021b)
	Ethanolic	Root bark	Triterpenoids	α-Amyrin, β-sitosterol, and β-sitosterol-β-D-glucoside	Jain et al. (2007)
			Coumarins	Psoralen, bergapten, xanthotoxin, and 6-(2-methoxyvinyl)-7-methylcoumarin	
		Fruits	Prenylated isoflavone derivatives	Ficucaricones A–D	Liu et al. (2019)
			Anthocyanin	Cyanidin-3-*O*-rutinoside	Solomon et al. (2006)
		Leaves	Isoflavonoids	Rutin, isoschaftoside, isoquercetin, chlorogenic acid, caffeoyl malic acid and rutin	Takahashi et al. (2017)
			Phenolic acids and flavonoids	Chlorogenic acid, rutin, and psoralen	Teixeira et al. (2006)
		Leaves, pulps, and peels	Phenolic acids and flavonoids	3-*O*- and 5-*O*-Caffeoylquinic acids, ferulic acid, quercetin-3-*O*-glucoside, quercetin-3-*O*-rutinoside, psoralen and bergapten	Oliveira et al. (2009)
	Methanolic	Leaves	Triterpenoids	Bauerenol, lupeol acetate, methyl maslinate, calotropenyl acetate and oleanolic acid	Saeed and Sabir (2002)
			Furanocoumarin	Psoralen and bergapten	Takahashi et al. (2014); Li et al. (2021a)
			Polyphenols and furanocoumarins	Caffeoyl malic acid, psoralic acid-glucoside, rutin, psoralen and bergapten	Yu et al. (2020); Ladhari et al. (2020)
			Phenolics	Caffeoylmalic acid, psoralic acid-glucoside, rutin, psoralen and bergapten	Wang et al. (2017)
		Fruits	Pentacyclic triterpenoids	Betulinic acid, and oleanolic acid	Wojdyło et al. (2016)
	Methanol: water (80:20%)	Leaves	Phenolics	Chlorogenic acid, caffeoylmalic acid, *p*-coumaroyl derivative, *p*-coumaroylquinic acid, *p*-coumaroylmalic acid, caffeic acid, isoschaftoside, schaftoside, rutin, psolaric acid glucoside, quercetin 3-*O*- glucoside, quercetin 3-*O*-malonylglucoside, kaempferol 3-*O*-glucoside, psolaren, and bergapten	Petruccelli et al. (2018)
	Water - methanol (40:60)			Quercetin-3-glucoside, caftaric acid, quercetin-3, 7-diglucoside, and coumaroyl-hexose, kaempferol-3-*O*-sophorotrioside, cichoric acid and sinapic acid glucoside	Nadeem and Zeb (2018)
		Leaves	Polyphenol		
	Ammonium sulphate-Ethanol	Leaves	Flavonoids	3-*O*-(Rhamnopyranosyl-glucopyranosyl)-7-*O*-(glucopyrnosyl)-quercetin, 2-carboxyl-1,4-naphthohydroquinone-4-*O*-hexoside, luteolin 6-C-hexoside, 8-C-pentoside, kaempferol 6-C- hexoside −8-C-hexoside, quercetin 6-C-hexobioside, kaempferol 6-C- hexoside −8-C-hexoside, quercetin 3-*O*-hexobioside, apigenin 2″-*O*-pentoside, apigenin 6-C-hexoside, quercetin 3-*O*-hexoside, and kaempferol-3-*O*-hexobioside	Zhao et al. (2021)
F. curtipes	Methanolic	Stem bark	Phenolics	3-*O*-Caffeoylquinic acid, catechin, chlorogenic acid isomer, 5-*O*-caffeoylquinic acid, procyanidin type B, catechin/epicatechin derivative, epicatechin, vicenin-2, procyanidin type C, apigenin-7-*O*-hex-6/8-C-hex, apigenin-6-C-pt-8-C-hex, cinchonain type II, apigenin-6-C-hex-8-C-pent, cinchonain type I, vitexin, procyanidin type B, isovitexin, and aviculin	Andrade et al. (2019)
F. deltoidea	Methanolic	Leaves	Acyclic monoterpenes	6-Methyl-5-hepten-2-one, myrcene, (*Z*)-β-ocimene, (*E*)-β-ocimene, *cis*-furanoid linalool oxide, *trans*-furanoid linalool oxide, linalool, *cis*-pyranoid linalool oxide, *trans*-pyranoid linalool oxide, hotrienol, perillene	Grison-Pige et al. (2002a)
			Cyclic monoterpenes	Limonene	
		Fruits	Sesquiterpenes	Dendrolasine, α-cubebene, cyclosativene, A-ylangene, α-copaene, β-bourbonene, 1,5-diepi-β-bourbonene, β-cubebene, β-elemene, α-gurjunene, α-*cis*-bergamotene, β-caryophyllene, α-santalene, selina-3–6-diene, α-*trans*-bergamotene, α-humulene, alloaromadendrene, aciphyllene, germacrene D, β-selinene, αd-selinene, α-selinene, bicyclogermacrene, α-muurolene, germacrene A, δ-amorphene, (*E,E*) α-farnesene, 2-*epi*-α-selinene, δ-cadinene, cadina-1,4-diene, germacrene B, and caryophyllene oxide	Grison-Pige et al. (2002b)

Table 2 (*continued*)

Plant species	Extract type	Plant parts	Compounds type	Isolated compounds	References
	Ethanolic	Leaves	Flavonoids	Gallocatechin, epigallocatechin, catechin, (epi)afzelechin-(epi)catechin, (epi) afzelechin-(epi)afzelechin, (epi)catechin, epicatechin, lucenin-2, vicenin-2, luteolin-6-C-hexosyl-8-C-pentoside, luteolin-6-C-glucosyl-8-C-arabinoside, isoschaftoside, luteolin-6-C-arabinosyl-8-C-glucoside, schaftoside, orientin, apigenin-6-C-pentosyl-8-C-glucoside, vitexin, apigenin-6-C-glucosyl-8-C-pentoside, apigenin-6,8-C-dipentoside isomer, isovitexin, 4-p-coumarolyquinic acid, rutin, quercetin, and naringenin	Ong et al. (2011); Omar et al. (2011); Choo et al. (2012)
			Triterpenoid	Lupeol	Suryati et al. (2011)
	Aqueous	Leaves and fruits	Flavonoids	Epicatechin, rutin, quercetin 5,4′-di-*O*-β-D-glucopyranoside, myricetin and naringenin	Dzolin et al. (2015)
	Ethyl acetate	Leaves	Alkaloids Terpenoid	1,1′-(1,1-Ethenediyl) bis(3- methylpiperazine), and nigeglanine 1,1,2,3,3-Pentamethylindane	Triadisti et al. (2021)
F. elastica	*n*-Hexane	Leaves	Phenolics	Macluraxanthone, rutin, chlorogenic acid, and psoralen	Teixeira et al. (2009)
	Dichloromethane	Leaves	Triterpenoids	Campesterol, stigmasterol, β-sitosterol, α-amyrin, and friedelin	El-Hawary et al. (2012)
	Ethanolic (70%)	Leaves	Flavonoids	Quercitrin, morin, myricitrin, and eleutheroside B	Ginting et al. (2020)
	Ethanolic	Leaves	Pentacyclic triterpenoids	1-*O*-Caffaeoyl-D-mannitol, moretenone, glutinol, moretenol, lupeol, β-sitosterol, sakuranin, and kaempferol-3-*O*-rutinoside	El-Domiaty et al. (2002)
	Methanolic	Aerial root bark	Ceramide, cerebroside and triterpenoid saponin	Ficusamide, ficusoside and elasticoside	Mbosso et al. (2012)
F. erecta	Aqueous ethanol (50:50%)	Leaves and branches	Flavonoids	Chlorogenic acid, rutin, and keampferol-3-*O*-rutinoside	Sohn et al. (2021)
	Ethanolic (70%)	Branches	Organic acids Triterpenoids	*p*-Hydroxybenzoic acid, methyl *p*-hydroxybenzoate, vanillic acid, methyl vanillate, syringic acid, and ethyl linoleate β-Sitosterol, and α-amyrin acetate	Park et al. (2012)
F. exasperata	Methanolic	Leaves	Isoflavone glycosides	Quercetin-3,7-di-hexoside, quercetin-3-(6-rhamnoside) glucoside, quercetin-3-glucoside, kaempferol-3–92- rhamnoside)hexoside, quercetin-3-(6-malonyl) hexoside, quercetin-3-hexoside-7-ketorhamnoside, kaempferol-3 hexoside, apigenin-7-(6-rhamnoside)hexoside, luteolin 6,8-di-C-hexoside, apigenin-6-C-pentoside-8-C-hexoside pigenin-6-C-hexoside-8-C-pentoside, apigenin-6-C rhamnoside-8-C-hexoside, apigenin-6-C-pentoside-8-C- (3/4-ketorhamnoside) hexoside, apigenin-8-C-glucoside, luteolin-8-C-(3/4-ketorhamnoside)hexoside, apigenin 7-*O*-ketorhamnoside-8-C-hexoside, and apigenin-8-C-(3/4 ketorhamnoside) hexoside	Mouho et al. (2018)
	Ethanolic	Leaves	Phenolics	Quercitrin, chlorogenic acid and caffeic acid	Oboh et al. (2014)
	Aqueous- ethanol (50:50%)	Leaves	Isoflavone glycosides	Apigenin C-8 glucoside, isoquercitrin-6-*O*-4-hydroxybenzoate and quercetin-3-*O*-β-rhamnoside	Taiwo and Igbeneghu (2014)
F. fistulosa	CH_2Cl_2/MeOH	Leaves	Bis-benzopyrroloisoquinoline and chlorinated phenanthroindolizidine enantiomers	(±)-Tengerensine, (+)-Tengechlorenine, (±)-fistulosine, (+)-antofine, and (−)-seco-antofine	Al-Khdhairawi et al. (2017); Putra et al. (2020)
	Methanolic	Stem bark	Triterpenoids	3β-Acetyl ursa-14:15-en-16-one, lanosterol-11-one acetate, 3β-acetyl-22,23,24,25,26,27-hexanordamaran-20-one, 24-methylenecycloartenol, sorghumol (isoarborinol), 11α,12α-oxidotaraxeryl acetate, and ursa-9(11):12-dien-3β-ol acetate	Tuyen et al. (1998)
	Ethanolic	Stem bark	Benzopyrroloisoquinoline alkaloids Phenanthroindolizidine alkaloids	Fistulosine (−)-13aα-Antofine, (−)-14β-hydroxyantofine and (−)-13aα-secoantofine	Subramaniam et al. (2009)
		Stem bark and leaves	Septicine-type alkaloids Phenanthroindolizidine alkaloids	Fistulopsines A and B (+)-Septicine, (+)-tylophorine, (+)-tylocrebrine, (−)-3,6-didemethylisotylocrebrine and (+) -(6*S*,9*S*)-vomifoliol	Yap et al. (2016)
F. geniculata	Methanolic	Pulps and peels	Phenolics	3-*O*- and 5-*O*-Caffeoylquinic acids, ferulic acid, psoralen, and bergapten	Gupta et al. (2017)
F. hirta	Methanolic	Fruits	Flavonoids	Naringenin-7-*O*-β-D-glucoside, pinocembrin-7-*O*-β-D- glucoside, eriodictyol-7-*O*-β-D-glucoside, luteolin, apigenin, eriodictyol-7-*O*-β-D-glucoside, methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid, 2-methyl-1-methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylate, dihydrophaseic acid, vomifoliol, dehydrovomifoliol, pubinernoid A, 2-phenylethyl-*O*-β D-glucoside, 1-*O*-*trans*-cinnamoyl-β-D-glucopyranosyl-(1 → 6)-β-D-glucopyranoside, 4-*O*-benzoyl-quinic acid, 3-*O*-benzoyl-quinic acid, benzyl-β-D-glucopyranoside, (2*S*) 2-*O*-benzoyl-butanedioic acid-4-methyl ester, pinocembrin-7-*O*-β-D-glucoside, naringenin-7-*O*-β-D-glucoside, eriodictyol-7-*O*-β-D-glucoside, luteolin, apigenin, and umbelliferone	Wan et al. (2017); Chen et al. (2020)
	Methanolic (80%)	Roots	Phenolics	Luteolin, apigenin, psoralen, and bergapten	Yi et al. (2013)
	Ethyl acetate	Roots	Phenylpropanoids	(1′*S*)-Methoxy-4-(1-propionyloxy-5-methoxycarboxyl-pentyloxy)-(*E*)-formylvinyl, (8*R*)-4,5′-dihydroxy-8-hydroxymehtyl-3′-methoxydeoxybenzoin, (2′*S*)-3-[2,3-dihydro-6-hydroxy-2-(1-hydroxy-1-methylethyl)-5- benzofuranyl] methyl propionate, 3-[6-(5-*O*-β-D-glucopyranosyl) benzofuranyl] methyl propionate, methylcnidioside A, (*E*)-3-[5-(6-hydroxy) benzofuranyl] propenoic acid, ficuscarpanoside A, syringaresinol, (7*R*,8*S*)-ficusal, *trans*-*p*-hydroxycinnamic acid, 1′-*O*-β-D-glucopyranosyl (2*R*,3*S*)-3-hydroxynodakenetin, *p*-hydroxybenzoic acid,	Cheng et al. (2017a)

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Table 2 (*continued*)

Plant species	Extract type	Plant parts	Compounds type	Isolated compounds	References
				syringic acid, and ficuglucoside	
	Ethyl acetate and n-butanol	Roots	Furanocoumarin glycoside	5-*O*-[β-D-Apiofuranosyl-(1 → 2)-β-D-glucopyranosyl]- bergaptol	Dai et al. (2018)
			Phenolics	Bergapten, umbelliferone, 6-carboxy-umbelliferone, 6,7-furano-hydrocoumaric acid methyl ester, picraquassioside A, and rutin	
	Ethanolic	Roots	Triterpenoids	Stigmasterol, 22,23-dihydro-stigmasterol, α-amyrin, and β-sitosterol	Li et al. (2006)
			Phenolics	Psoralene, 3β-hydroxy-stigmast-5-en-7-one, 5-hydroxy-4′, 6, 7, 8-tetramethoxy flavone, 4′, 5, 6, 7, 8-pentamethoxy flavone, 4′, 5, 7-trihydroxy-flavone, 3β-acetoxy-β-amyrin, 3β-acetoxy-α-amyrin and hesperidin	
				Epicatechin, chlorogenic acid, (-) (2*R*,3*R*)epiafzelechin, psoralenoside, methoxypsoralenoside, hydrasine, 4,5-dihydrogenpsoralenoside, pelargonidin 7-glucoside, aloin A, isoliquiritigenin, vitexin, picraquassioside A, isoeugenitol, kaempferol, psoralen, (±)-naringenin, apigenin, bergapten, resveratrol, pinolenic acid, 2-ethylhexyl ester-2-propenoic acid, *n*-hexadecanoic acid, ethyl *iso*-allocholate, bergapten, and 2-methyl-*Z, Z*-3,13-octadecadienol	Tang et al. (2020)
			Lignan	Undescribed lignan	Ye et al. (2021)
		Leaves	Ursane triterpenoids	α-Amyrin acetate, 3*β*-acetoxy-11α-hydroxy- 12-ursenes, and 1β,3β,11α-trihydroxy-urs-12-enyl-3-stearate	Thien et al. (2021)
			Phenolics	*p*-Coumaric acid and isovitexin	Dai et al. (2020)
	Ethanolic (95%)	Roots	Phenolics	Cyclomorusin, 3-*O*-[(6-*O*-*E*-sinapoyl)-β-D-glucopyranosyl]-(1 → 2)-β-D-glucopyranoside, 3,5,4′-trihydroxy-6,7,3′-trimethoxyflavone, quercetin, tricin, acacetin, luteolin, apigenin, (*E*)-suberenol, meranzin hydrate, methyl eugenol(11),3-methoxy-4-hydroxybenzoic acid, *p*-hydroxybenzoic acid, methyl chlorogenate, and emodin	Zheng et al. (2013)
		Fruits	Isoflavonoids	1-Methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid, methyl 1-methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylate, vomifoliol, dehydrovomifoliol, icariside B2, dihydrophaseic acid, pubinernoid A, pinocembrin-7-*O*-β-D-glucoside, naringenin-7-*O*-β-D-glucoside, eriodictyol-7-*O*-β-D-glucoside, and 1-phenylpropane-1,2-diol	Wan et al. (2017)
	Ethanolic (60%)	Roots	Phenolic glycosides	Ficusides A-G, 3,4-dimethoxyphenyl-1-*O*-β-D-apiofuranosyl (1 → 2)-β-D-glucopyranoside, khaephuoside A, 2-methoxyphenol-*O*-β-D-apiofuranosyl-(1 → 2)-β-D-glucopyranoside, methyl 2-hydroxybenzoate 2-*O*-β-D-apiofuranosyl-(1 → 2)-*O*-β-D-glucopyranoside, markhamioside F, benzyl-*O*-β-D-apiofuranosyl-(1 → 2)-β-D-glucopyranoside, 3,4,5-trimethoxyphenyl 1-*O*-β-apiofuranosyl (1′′→6′)-β-glucopyranoside, di-*O*-methylcrenatin, 3,4-dimethoxyphenyl-β-D-glucopyranoside, phenyl β-D-glucopyranoside, 2,4,6-trimethoxy-1-*O*-β-D-glycoside, 2,6-dimethoxy-4-hydroxyphenol-1-*O*-β-D-glucopyranoside, uralenneoside, glucosyringic acid, 4-(β-D-glucopyranosyloxy) benzoic acid and vanillic acid 4-*O*-β-D-glucopyranoside, (1′*R*)-1′-(4-hydroxy-3,5-dimethoxyphenyl) propan-1′-ol 4-*O*-β-D-glucopyranoside, 3,4,5-Trimethoxybenzaldehyde, 4-(3′-hydroxypropyl)-2,6-dimethoxyphnol-3′-*O*-β-D-glucoside, and gentisic acid 5-*O*-β-D-xyloside	Ye et al. (2020)
	Ethanolic (75%)	Roots	Phenolics	(*Z*)-3-[5-(6-*O*-β-D-Glucopyranosyl) benzofuranyl] methyl propenoate, (*Z*)-3-[5-(6-methoxy) benzofuranyl] propenoic acid, (10*S*)-6-(2′-hydroxy-10-*O*-β-D-glucopyranoside)-7-hydroxycoumarin, (2*S*)-1-*O*-β-D-glucopyranosyl-2-*O*-(2-methoxy-4- phenylaldehyde) propane-3-ol, psoralen, umbelliferon, 7-(2′,3′-dihydroxy-3′-methylbutoxy)-coumarin, nodakenetin, (1*R*, 2*R*, 5*R*, 6*S*)-6-(4-hydroxy-3, 5-dimethoxyphenyl)-3, 7-dioxabicyclo [3, 3, 0] octan-2-ol, (+)-(7*R*, 8*R*)-4-hydroxy-3,3′,5′-trimethoxy-8′,9′-dinor-8,4′-oxyneoligna-7,9-diol-7′-aldehyde, (-)-(7*S*,8*R*)-4-hydroxy-3,3′,5′-trimethoxy-8′,9′-dinor-8,4′-oxyneo-ligna-7,9-diol-7′-aldehyde, (1*R*, 2*R*, 5*R*, 6*S*)-6-(4-hydroxy-3-methoxyphenyl)-3,7-dioxabicyclo [3,3,0] octan-2-ol, (-)-pinoresinol, 2-[4-(3-hydroxy propyl)-2-methoxyphenoxy] propane-1, 3-diol, vanillin, 3′-hydroxy-4′-metoxy-*trans*-cinnamaldehyde, vanillin acid, β-hydroxypropiovanillone, 7-*O*-ethylguaiacylglycerol, evofolin-B, (*E*)-3-[5-(6-methoxy) benzofuranyl] propenoic acid, (*E*)-isopsoralic acid 1 → 6-*O*-β-D-glucopyranoside, (*Z*)-isopsoralic acid1 → 6-*O*-β-D-glucopyranoside, phenyl β-D-glucopyranoside, 2, 3-dihydroxy-1-(4-hydroxy-3-methoxyphenyl)-propan-1-one, 3,4,5-trimethoxybenzyl β-D-glucopyranoside, 3,4-dimethoxyphenyl-1-*O*-β-D-glucopyranoside, 3,4,5-trimethoxy phenoltetraacetyl-β-D- glucopyranoside, and 1,3,5-trimethoxybenzene	Cheng et al. (2017b)
	n-Hexane	Leaves	Oleanane triterpenoids	3β-Hydroxy-11-oxo-olean-12-enyl-3-stearate, taraxerol, 3β-acetoxy-11α-methoxy-12-ursene and 3β-acetoxy-11α-hydroxy-12-ursene	Thien et al. (2019)
F. hispida	Ethanolic	Stem bark and leaves	Unusual 8,4′-oxyneolignan-alkaloid	Hispidacine	Yap et al. (2015)
			Phenanthroindolizidine alkaloids	Hispiloscine and (+)-deoxypergularinine	
		Twigs and leaves	Amine alkaloids with a rhamnosyl moiety	Ficuhismines A–D, ficushispimine C, magnosprengerine, and ficushispimine A	Jia et al. (2020)
		Twigs	Pyrrolidine alkaloids	Ficushispimine A and ficushispimine B	Shi et al. (2016)

Table 2 (*continued*)

Plant species	Extract type	Plant parts	Compounds type	Isolated compounds	References
			Pyrrolidine alkaloids	Ficushispimine A and ficushispimine B	
			ω-(Dimethylamino)caprophenone alkaloid	Ficushispimine C	
			Indolizidine alkaloid	Ficushispidine	
			Isoflavones	Isoderrone, 3′-(3-methylbut-2-en-1-yl)biochanin A, myrsininone A, ficusin A, and 4′,5,7-trihydroxy-6-[(1*R**,6*R**)-3-methyl-6-(1-methylethenyl)cyclohex-2-en-1-yl] isoflavone	
	Chloroform	Leaves and twigs	Phenanthroindolizidine alkaloid	*O*-Methyltylophorinidine	Peraza-Sánchez et al. (2002)
			Norisoprenoid	Ficustriol	
	Hexane	Fruits	Isoflavonoids	Isowigtheone hydrate, 3′-Formyl-5,7-dihydroxy-4′-methoxyisoflavone, 5,7-dihydroxy-4′-methoxy-3′-(3-methyl-2-hydroxybuten-3-yl) isoflavone, and alpinumisoflavone	Zhang et al. (2018)
			Coumarin	7-Hydroxycoumarin, 7-hydroxy-6-[2-(*R*)-hydroxy-3-methyl-but-3-enyl] coumarin, psoralen, and (–)-marmesin	
			Phenolics	Chlorogenic acid, chlorogenic acid methyl ester, chlorogenine glycoside, protocatechuic acid, gallic acid, benzyl β-D-glucopyranoside, 2-(4-hydroxy-3-methoxy phenyl) ethyl β-D-glucopyranoside	
			Indole alkaloid	Murrayaculatine	
			Triterpenoids	Betulinic acid, and sitosterol 3-*O*-β-D-glucopyranoside	
	Methanolic	Fruits	Isoflavone	5,7-Dihydroxy-4′-methoxy-3′-(3-methyl-2-hydroxybuten-3-yl) isoflavone	Cheng et al. (2021)
F. lacor	Ethanolic	Aerial roots	Triterpenoids	β-Sitosterol, lupeol, α-amyrin, β-amyrin, stigmasterol, and campesterol	Sindhu and Arora (2013a, b); Ghimire et al. (2020)
			Phenolics	Scutellarein glucoside, scutellarein, infectorin, sorbifolin, bergaptol, and bergapten	
F. lyrata (Syn. *F. pandurata* Sand)	Methanolic	Leaves	Flavonoids	(*Epi*)-catechin digalloyl rhamnoside, (*epi*)afzelechin-(*epi*) gallocatechin, epicatechin, (*epi*)afzelechin-(*epi*)catechin, (*epi*)afzelechin(*epi*)afzelechin-epigallocatechin, benzyl rutinoside, lucenin-2, vicenin-2, rutin, orientin, 3-*O*-*p*-coumaroyl epigallocatechin, isoquercetin, luteolin, quercetin, apigenin, and ficuisoflavone	Farag et al. (2014)
F. microcarpa	Ethanolic	Leaves	Triterpenoids	29(20 → 19)Abeolupane-3,20-dione, 19,20-secoursane-3,19,20-trione, (3β)-3-hydroxy-29(20 → 19)abeolupan-20-one, lupenone, and α-amyrone	Hsiung and You (2004)
		Aerial roots	Triterpenoids	3β-Acetoxy-11α-hydroxy-11(12 → 13)abeooleanan-12-al, 3β-hydroxy-20-oxo-29 (20 → 19)abeolupane, and 29,30-dinor-3β-acetoxy-18,19-dioxo-18,19-secolupane	Chiang and Kuo (2002)
				3β-Acetoxy-12,19-dioxo-13(18)-oleanene, 3β-acetoxy-19(29)-taraxasten-20α-ol, 3β-acetoxy-21α,22α-epoxytaraxastan-20α-ol, 3,22-dioxo-20-taraxastene, 3β-acetoxy-11α,12α-epoxy-16-oxo-14-taraxerene, 3β-acetoxy-25-methoxylanosta-8,23-diene, 3β-acetoxy-11α,12α-epoxy-14-taraxerene, 3β-acetoxy-25-hydroxylanosta-8,23-diene, oleanonic acid, acetylbetulinic acid, betulonic acid, acetylursolic acid, ursonic acid, ursolic acid, and 3-oxofriedelan-28-oic acid	Chiang et al. (2005)
			Peroxy triterpenoids	3β-Acetoxy-12β,13β-epoxy-11α-hydroperoxyursane, 3β-acetoxy-11α-hydroperoxy-13α*H*-ursan-12-one, 3β-acetoxy-1β,11α-epidioxy-12-ursene, (20*S*)-3β-acetoxylupan-29-oic acid, (20*S*)-3β-acetoxy-20-hydroperoxy-30-norlupane, and 3β-acetoxy-18α-hydroperoxy-12-oleanen-11-one, and 3β-acetoxy-12-oleanen-11-one	Chiang and Kuo (2001)
	Methanolic	Syconia	Terpenes	α-Cubebene, 1,2,4-metheno-1H-indene, 3,7-dimethyl-1,3,6-octatriene, (*E,E*)-2,4-hexadiene, caryophyllene, copaene, and D-limonene	Zhang et al. (2017)
		Stem bark	Phenolics	Protocatechuic acid, chlorogenic acid, methyl chlorogenate, catechin, epicatechin, procyanidin B1, and procyanidin B3	Ao et al. (2010)
F. mollis	Methanolic	Stem	Monoterpenes	Sulfurous acid, octadecyl 2-propyl ester, tetratetracontane, hexatriacontyl pentafluoropropionate, octatriacontyl pentafluoropropionate, octacosyl trifluoroacetate, hexadecanoic acid, methyl ester, heptacosanoic acid, and 25-methyl-, methyl ester	Priya and Abinaya (2018)
F. palmata	Methanolic	Fruit	Phenolics	Rutin, isoquercitin, quercitin, kaempferol, luteolin, and cinnamic acid	Sharma et al. (2021)
F. pumila	Chloroform	Stem	Flavonoid glycosides	Astragalin, isoquercitrin, apigenin 6-C-α-L-rhamnopyranosyl-(1 → 2)-β-D-glucopyranoside, kaempferol 3-*O*-α-L-rhamnopyranosyl- (1 → 6)-β-D-glucopyranoside and kaempferol 3-*O*-α-L-rhamnopyranosyl-(1 → 6)-β-D-galactopyranoside, rutin and isorhamnetin-3-*O*-glucoside, apigenin, taxifolin, tricetin, luteolin, hesperitin, and chrysin	Pistelli et al. (2000)
	n-Hexane	Stem	Triterpenoids	β-Sitosterol, α-amyrin, taraxasterol and 11α-hydroxy-β-amyrin	
	Chloroform	Leaves	Furanocoumarin derivatives	Bergapten and oxypeucedanin hydrate	Juan et al. (1997)
	Aqueous Pb(OAc)2 solution	Leaves	Triterpenoids	Neohopane	Ragasa et al. (1999)
	Ethanolic	Leaves	Norisoprenoids	3,9-Dihydroxy dihydro actinidiolide, 3α-hydroxy-5,6-epoxy-7-megastimen-9-one, dehydrovomifoliol, 3,9-dihydroxy-5,7-megastigmadien-4-one, 9,10-dihydrox-y-4,7-megastigmadien-3-one, 8,9-dihydro-8,9-dihydroxymegastigmatrienone, (6*R*,9*S*)-3-oxo-α-ionol, blumenol A, (*E*)-3-oxo-*retro*-α-ionol, (6*R*,9*R*)-3-oxo-α-ionol-β-d-glucopyranoside, roseoside, and (*E*)-4-[3′-(β-D-glucopyranosyloxy)butylidene]-3,5,5-trimethyl-2-cyclohexen-l-one	Bai et al. (2019)
			Benzofuran derivative	Pumiloside	Trinh et al. (2018)
			Flavonoid glycosides	Afzelin, astragalin, quercitrin, isoquercitrin, kaempferol 3-*O*-rutinoside, rutin and	

(*continued on next page*)

Table 2 (*continued*)

Plant species	Extract type	Plant parts	Compounds type	Isolated compounds	References
				kaempferol 3-*O*-sophoroside	
			Flavonoids and phenolic acids	Rutin, kaempferol 3-*O*-α-L-rhamnopyranosyl (1 → 6)-β-D-glucopyranoside, isoquercitrin, quercitrin, dihydrokaempferol 5-*O*-β-D-glucopyranoside, dihydro-kaempferol 7-*O*-β-D-glucopyranoside, maesopsin 6-*O*-β-D-glucopyranoside, secoisolariciresinol 9-*O*-β-D-glucopyranoside, chlorogenic acid, protocatechuic acid, caffeic acid, 5-*O*-caffeoyl quinic acid methyl ester(12), *p*-hytroxybenzoic acid, vanillic acid, and 5-*O*-caffeoyl quinic acid butyl ester	Wei et al. (2014)
	Ethyl acetate	Roots	Dinorsesquiterpenoids	(6*S*,9*R*)-Vomifoliol and (6*S*)-dehydrovomifoliol	Nguyen and Nguyen (2021)
		Stems and roots	Sesquiterpenoids	Phaseic acid, and methyl (2α,3β)-2,3-dihydroxy-olean-12-en-28-oate	
	Aqueous- ethanol (50:50)	Leaves	Flavonoid glycosides	Rutin, apigenin 6-neohesperidose, kaempferol 3-robinobioside and kaempferol 3-rutinoside	Leong et al. (2008)
	Methanolic	Fresh fruits	Acetylated dammarane- triterpenoids	3β-Acetoxy-22, 23, 24, 25, 26, 27-hexanordammaran-20-one, 3β-acetoxy-20, 21, 22, 23, 24, 25, 26, 27-octanordammaran-17β-ol, 3β-acetoxy-(20*R*, 22*E*, 24*RS*)-20, 24-dimethoxydammaran-22-en-25-ol and 3β-acetoxy-(20*S*, 22*E*, 24*RS*)-20, 24-dimethoxydammaran-22-en-25-ol	Kitajima et al. (1999, 2000)
			Sesquiterpenoid glucosides	Pumilasides A, B and C	
F. racemosa (syn. *F. glomerata*)	Ethanolic	Stem bark	Flavonoids	Kaempherol, Quercetin, Naringenin, and Baicalein	Keshari et al. (2016)
			Triterpenoid	Lupeol	Joshi et al. (2016)
			Anthocyanins	Gluanol acetate, leucocyanidin-3-*O*-β-D-glucopyranc oside, leucopelargonidin-3-*O*-β-D-glucopyranoside, leucopelargonidin-3-*O*-α-L-rhamnopyranoside, ceryl behenate	Joy et al. (2001)
			Triterpenoids	Lupeol acetate, and α-amyrin acetate, lupeol, friedelin, behenate, stigmasterol, β-sitosterol, β-sitosterol-D-glucoside, bergenin, racemosic acid, friedelin β-sitosterol, β-amyrin, and lupeol acetate	Nguyen et al. (2001); Malairajan et al. (2006); Veerapur et al. (2007)
		Fruits	Triterpenoids	β-Sitosterol, gluanol acetate, hentriacontane, tiglic acid, taraxasterol, lupeol acetate, and α-amyrin acetate	Singhal and Saharia (1980);Narender et al. (2009)
	Methanolic	Stem bark	Tetracyclic triterpenoids	Gluanol acetate	Rahuman et al. (2008)
		Leaves	Tetraterpenoids	Tetra triterpene, glauanolacetate, and racemosic acid	Patil et al. (2010)
	n-Hexane	Stem bark	Triterpenoids	Lupeol, lupeol acetate, and β-sitosterol	Bopage et al. (2018)
		Root	Triterpenoids	Cycloartenol, euphorbol, taraxerone, and tinyatoxin	Varma et al. (2009)
		Latex	Triterpenoids	α-Amyrin, β-sitosterol, cycloartenol, cycloeuphordenol, 4-deoxyphorbol and its esters, euphorbinol, isoeuphorbol, taraxerol, tinyatoxin, and trimethylellagic acid	Paarakh (2009)
F. religiosa	Methanolic	Stem bark	Naphthyl substituted phytosterol	β-Sitosteryl naphthadiolyl linoleinate	Ali et al. (2017, 2020)
			Lanostane type-triterpenic	Lanostanoic acid oleate	
			Naphthyl esters	Lanostanoic acid linolenate, Lanostanoic acid and naphthadiolyl linoleiate	Ali et al. (2014)
			Steroids	β-Sitosterol glucoside and β-sitosteryl oleate	
		Leaves	Phenolics	Eugenol, and tannic acid	Poudel et al. (2015); Rathod et al. (2018)
			Monoterpenes	Phytol, linalool, α-cadinol, α-eudesmol, β-eudesmol, epi-α-cadinol, γ-eudesmol, and *epi*-γ-eudesmol	
			Triterpenoids	Lupeol α-amyrin, campestrol, and stigmasterol	Murugesu et al. (2021)
	Ethanolic	Stem bark	Phenolics	Leucopelargonidin-3-O-β-D-glucopyranoside, leucopelargonidin-3-O-α-L-rhamnopyranoside, leucoanthocyanidin, leucoanthocyanin, bergapten, and bergaptol	Sirisha et al. (2010); Wilson et al. (2016)
			Triterpenoids and their derivatives	Lanosterol, lupen-3-one, β-sitosterol, stigmasterol, β-sitosterol-D-glucoside, lupeol acetate, and α-amyrin acetate	
		Stem	Phenolics	2,6-Dimethoxyphenol, n-hexadecanoic acid, octadecanoic acid, 4H-pyran-4-one,2,3-dihydro-3,5-dihydroxy-6-methyl, and 2,4-bis(1,1-dimethylethyl)	Manorenjitha et al. (2013)
	n-Hexane	Stem	Triterpenoids	Stigmasterol, lanosta-8,24-dien-3-ol, acetate(3β), and ergost-5-en-3-ol(3β)	
	Ethanolic	Roots	Phenolics	Ceryl behenate, leucocyanidin-3-O-β-D-glucopyrancoside, leucopelargonidin-3-O-β-D-glucopyranoside, leucoanthocyanidin, and leucoanthocyanin	Goyal (2014)
			Triterpenoids	Lupeol acetate, α-amyrin acetate, lupeol, and β-sitosterol	
		Fruits	Monoterpenes	β-Caryophyllene, α-terpinene, dendrolasine, α-trans bergamotene, (e)-β-ocimene, α-pinene, limonene, dendrolasine, α-ylangene, α- thujene, α-copaene, β-bourbonene, aromadendrene, δ-cadinene, α-humulene, β-pinene, alloaromadendrene, germacrene, γ-cadinene, bicyclogermacrene [undecane, tridecane, and tetradecane	Rathee et al. (2015); Verma and Gupta (2015)
			Triterpenoids	Stigmasterol and lupeol	
F. retusa	Ethanolic (96%)	Aerial parts	Polyphenolic	retusaphenol [2-hydroxy-4-methoxy-1,3-phenylene-bis- (4-hydroxy-benzoate)], (+)-retusa afzelechin [afzelechin - (4α → 8) - afzelechin - (4α → 8) - afzelechin], luteolin, (+) - afzelechin, (+)-catechin, and vitexin	Sarg et al. (2011)
			Triterpenoids	β-Sitosterol acetate, β-amyrin acetate, moretenone, friedelenol, β-amyrin and β-sitosterol	

Table 2 (*continued*)

Plant species	Extract type	Plant parts	Compounds type	Isolated compounds	References
F. sarmentosa	Methanolic	Stem and leaves	Flavonoids	Eriodictyol, homoeriodictyol, dihydroquercetin, luteolin, quercetin, dihydroquercetin, kaempferol, dihydrokaempferol, naringenin, luteolin, apigenin, chrysoeriol, and 3′,5′,5,7-tetrahydroxylfavanone	Wang et al. (2010a, b)
				7-Hydroxycoumarin, apigenin, eriodictyol, and quercetin	Wang et al. (2016)
F. semicordata	Ethanol (70%): acetic acid: formalin (90:5:5%)	Leaves and fruits	Aflatoxins	Aflatoxin B1, aflatoxin B2, aflatoxin G1, and aflatoxin G2	Gupta and Acharya (2019)
	Ethanolic	Leaves	Phenolics	Gallic acid and quercetin	Kaur et al. (2017)
		Stem	Phenolics	Gallocatechin, epigallocatechin, catechin, rutin, quercetin, quercetrin, (+)-catechins, quercetin and quercitrin	Nguyen (2002); Gupta et al. (2019); Al-Snafi (2020)
	Methanolic	Fruits	Monoterpenes	α-Thujene, α-Pinene, sabinene, β-pinene, β-myrcene, limonene,1,8-cineole, (*Z*)-β-ocimene, (*E*)-β-ocimene,γ-terpinene, terpinolene, linalool, and perillene	Chen et al. (2009)
			Sesquiterpenes	Ylangene, α-copaene, β-panasinsene, β-cubebene, β-elemene, α-gurjunene, β-caryophyllene, α-humulene, alloaromadendrene, γ-muurolene, germacrene D, β-Selinene, α-selinene, α-muurolene, (*E*,*E*)-α-farnesene, and δ-cadinene	
F. tikoua	Ethanolic (95%)	Whole plant	Isoprenylated flavonoids	Ficustikousins A and B, derrone, alpinumisoflavone, (*S*)- 5,7,3′,4′-tetrahydroxy-2′-(3-methylbut-2-enyl)flavanone, (*S*)-paratocarpin K, 3′-(3-methylbut-2-enyl) biochanin A, and genistein	Wu et al. (2015)
			Coumarin	Bergapten	
			Benzofuran glucoside	6-Carboxyethyl-5-hydroxybenzofuran 5-*O*-β-d-glucopyranoside, and 6-carboxyethyl-7-methoxyl-5-hydroxy-benzofuran 5-*O*-β-D-glucopyranoside	Wei et al. (2011b)
		Rhizome	Isoflavonoids	Ficusin C, 6-[(1*R**,6*R**)-3-methyl-6-(1-methylethenyl)-2-cyclohexen-1-yl]-5,7,4′-trihydroxyisoflavone, ficusin A, alpinumisoflavone, 4′-*O*-methylalpinumisoflavone, and quercetin	Fu et al. (2018)
	Methanolic	Stem	Pyranoisoflavone	5,3′,4′-trihydroxy-2″,2″-dimethylpyrano (5″,6″:7,8) isoflavone	Wei et al. (2012)
			Isoflavones	Wighteone and lupiwighteone	
			Isoflavanone	Ficustikounone A	Zhou et al. (2018)
	Ethanolic (90%)	Stem	Phenolic glycosides	2-Ethylene-3,5,6-trimethyl-4-phenol-1-*O*-β-D-xylopyranosyl-(1 → 6)-β-D-glucopyranoside, 3-methoxy-4-*O*-β-D-apiofuranosyl-(1 → 2)-β-D-glucopyranosylpropiophenone, 3-hydroxy-1-(4-*O*-β-D-glucopyranosyl-3-methoxyphenyl)propan-1-one, 4-hydroxy-3,5-bis(3′-methyl-2-butenyl)benzoic acid-*O*-β-D-glucopyranoside, 3,4,5-trimethoxyphenol-1-*O*-β-D-apiofuranosyl-(1 → 6)-β-D-glucopyranoside, 3,4,5-trimethoxyphenol-1-*O*-β-D-glucopyranoside, 3-methoxy-4-*O*-β-D-apiofuranosyl-(1 → 6)-β-D-glucopyranosylpropiophenone, baihuaqianhuoside, 3,5-dimethoxy-4-hydroxybenzoic acid-*O*-β-D-glucopyranoside and 2-methoxy-4-allylphenyl-1-*O*-β-D-apiofuranosyl-(1 → 6)-β-D-glucopyranoside	Jiang et al. (2013)

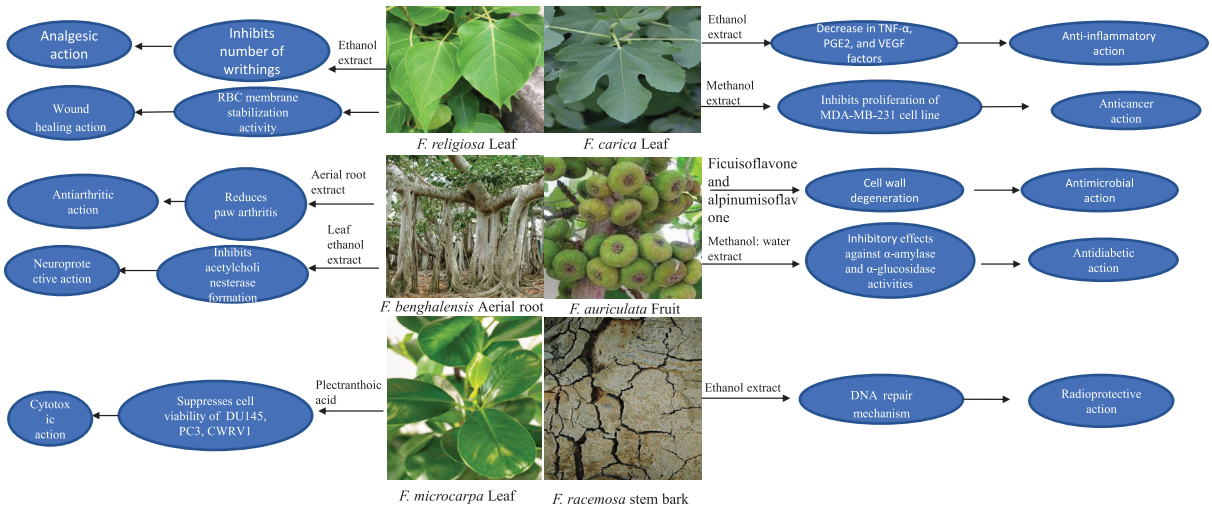

Fig. 4 Different pharmacological actions of different parts of some important Indian Ficus species.

Rubinstein, 1986; Arunkumar et al. 2009). Different strategies such as solid dispersion, microemulsion, liposome, lipid emulsion, solid lipid nanoparticle, nanosuspension, cyclodextrin complex or phospholipids are used with bioactive molecule to increase dissolution as well bioavailability (Shah et al. 2010; Ali and Chaudhary, 2011). Lanosterol, isolated from *F. religiosa*, examined for drug similarity using Five parameters of the Lipinski Rule. The reported values were found as 10 (hydrogen bond acceptor), 5 (hydrogen bond donor), 500 Dalton (molecular weight), 5 (H2O partition coefficient, logP), and 40–130 (molar refractivity). These parameters support its strong pharmacokinetics and bioavailability. Therefore, this molecule may be used as an anti-inflammatory agent and could be taken by oral route (Lipinski et al. 2001; Yueniwati et al. 2021).

6. Clinical studies

Since prehistoric times, the plant-derived medicines have been used in drug and cosmetic industries. As per WHO records, plant-derived medicines are used by millions of people of the developing countries (Al Rashid et al., 2019). Panchavalkal, prepared as per the literature available in Ras shastra, showed significant wound healing effects in 60 patients suffering from Dushta Vrana (infected wound). Dressing of patients was done with Panchavalkal ointment for 21 days and 36.7% wound healing recorded in the treated patients (Kulkarni and Dwivedi, 2019). Three *F. carica* paste packs (300 g/day) improve the colon transit time in 109 subjects of functional constipation when compared with the placebo group ($P = 0.045$). No serious adverse effects were recorded in the patients during the treatment period. The treatment was continued for 56 days (Baek et al., 2016). Consumption of fruits (90 g/day) produces a significant improvement in the irritable bowel syndrome symptoms such as pain frequency, distention, frequency of defecation and hard stool in patients. The treatment is given for 120 days (Pourmasoumi et al., 2019). Melfi cream (*F. carica* aqueous extract of sun-dried fruit and base cream; topical use) significantly increases efficacy in terms of reducing the SCORAD index, pruritus, and intensity scores when compared to hydrocortisone (1.0%; $P < 0.05$; Abbasi et al., 2017). Aqueous extract of *F. racemosa* stem bark, given two times before each meal, presents significant increase ($P < 0.05$) in insulin levels in the patients of type 2 diabetes (Ahmed et al., 2011). The details of clinical studies of Ficus species are mentioned in Table 4.

7. Toxicological effects

The large number of people of developing countries (approximately 80%) use medicinal plants regularly, without prescription, for the treatment of various diseases (WHO, 2002). Usage of medicinal plants for longer duration, in customary medicine, may cause low levels of toxicity in the people (Yuet Ping et al., 2013). Many recent studies indicate that the medicinal plants, used in traditional system of medicine, show various adverse effects (Ertekin et al. 2005; Ukwuani et al., 2012). Therefore, traditional medicines are getting substantial support in health debates world-wide (Tilburt and Kaptchuk, 2008). The rats showed negative behavioral changes at 5000, 5500, 5750 and 6000 mg/kg dosages of aqueous extract of *F. carica* leaves. The LD_{50} obtained was higher than 6000 mg/kg (Odo et al., 2016). No signs of symptoms of acute toxicity or behavioral changes and mortality were reported within 72 h to 14 days. Ethanol extract of *F. deltoidea* leaves (2000 mg/kg dose) did not affect the body weight of mice (Nugroho et al., 2020). Some symptoms of toxicity recorded were unease, sluggishness, and dizziness three hours after the administration of methanol extract of *F. exasperata* leaves (Shemishere et al., 2020). *F. religiosa* ethanol extract (2000 mg/kg/p.o.) decreased the levels of water intake in Wistar rats when compared to the control (Elavarasi et al., 2018). The results of toxicity studies of Indian Ficus species are described in Table 5.

8. Conclusions and perspectives

Ficus is the largest genus of Moraceae family and found in Neotropical America, Madagascar, Indian Ocean islands, Malaysia, the Arabian Peninsula, India–Asia, New Guinea, Pacific islands, and Australia.

Table 3 Summary of the pharmacological activities of Indian Ficus species.

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
Analgesic activity	*F. benghalensis*	Stem bark	Aqueous	400 mg/kg b.w./p.o.	Swiss albino mice/ tail-flick and formalin-induced pain assay/i.p.	Tail-flick model - extract ($P < 0.001$) increased mean tail-flick latency when compared to the control group/formalin-induced pain – extract significantly reduced pain response when compared with control group animals ($P < 0.001$)	Rajdev et al. (2018)
			Methanol	400 mg/kg b.w./p.o.	Swiss albino mice/ acetic acid-induced writhing/i.p.	Extract prevented acetic acid induced writhing movements significantly in mice ($P < 0.01$) when compared to control	Thakare et al. (2010)
		Leaves	Methanol	100 mg/kg b.w./p.o.	Swiss albino Wistar rats/ acetic acid-induced writhing and hot plate assays/i.p.	Extract showed maximum inhibition to writhing responses (43%) when compared to aspirin (20 mg/kg; $P < 0.05$)/maximum nociception inhibition of stimulus displayed by extract at 15 min ($P < 0.05$) in hot plate model	Mahajan et al. (2012)
	F. carica	Fruits	Aqueous (boiled)	2000 mg/kg b.w./i.p.	Wistar male rats/ formalin-induced paw licking/i.p.	Extract showed no significant difference between control and extract treated animals ($P > 0.05$)	Mirghazanfari et al. (2019)
	F. deltoidea	Leaves	Aqueous	100 mg/kg b.w./i.p.	Male ICR mice/acetic acid-induced abdominal writhing, formalin-induced pain, and hot plate assays/i.p.	Extract produced significant antinociceptive effect in tested assays when compared with control ($P < 0.001$)	Sulaiman et al. (2008)
		Leaves and roots	Aqueous	200 mg/kg b.w./i.p.	Male ICR mice/ acetic acid-induced abdominal writhing (i.p.)/formalin (s.c.)-induced pain and hot plate assays	Extract produced significant antinociceptive effect in acetic acid-induced abdominal writhing ($P < 0.001$ compared to control)/extract showed significant inhibition in the early phase of the formalin-induced pain assay ($P < 0.001$ compared to control)/increased latency time significantly in the hot plate assay ($P < 0.0001$)	Salihan et al. (2015)
	F. elastica	Stem bark	Methanol (98%)	10 mg/kg b.w./i.p.	Wistar albino rats/ acetic acid-induced writhing/i.p.	The inhibitory effect of extract on squirming count was significant ($P < 0.05$; compared to control)	Aziba and Sokan (2009)
	F. exasperata	Leaves	Methanol	250 mg/kg b.w./i.p.	Swiss albino mice/ acetic acid-induced writhing/i.p.	Extract reduced the numbers of writhes (36.87%) when compared with control (69.7%; $P < 0.001$)	Zubair et al. (2014)
	F. pumila	Stem and leaves	Methanol	1 g/kg b.w./p.o.	Male ICR mice/acetic acid-induced writhing and formalin-induced paw licking/i.p.	Extract significantly decreased writhing responses in the acetic acid assay ($P < 0.01$) and licking time in the formalin-induced pain ($P < 0.001$)	Liao et al. (2012)
	F. racemosa (syn. *F. glomerata*)	Leaves	Ethanol	400 mg/kg b.w./i.p.	Male Swiss albino mice/ acetic acid-induced writhing and formalin-induced paw licking/i.p.	Extract displayed significant activity ($P < 0.01$) in acetic-induced writhing/extract showed significant reduction in paw biting and licking response ($P < 0.01$)	Ghawate et al. (2012)
	F. religiosa	Leaves	Methanol	40 mg/kg b.w./p.o	Wistar albino rats/ tail flick latency period/ acetic acid- induced writhing in mice/i.p.	Extract found more effective ($P < 0.01$) in preventing acetic acid induced writhing and in increasing latency period in tail flick method ($P < 0.01$)	Gulecha et al. (2011)
		Leaves and bark	Ethanol	400 mg/kg b.w./p.o.	Swiss albino mice/ Eddy's hot plate and acetic acid-induced writhing/p.o.	Hot plate – both extracts increased latency time 70.81% (8.54 min) and 70.78% (8.53 min), respectively ($P < 0.05$)/ both extracts inhibited the number of writhings induced by acetic acid ($P < 0.05$)	Marasini et al. (2020)
Anti-inflammatory activity	*F. benghalensis*	Stem bark	Ethanol	600 mg/kg/day/b.w./p.o.	Wistar albino rats/ carrageenan-induced rat paw oedema and cotton pellet granuloma models/i.p.	Extract showed significant inhibition (69.04%; $P < 0.05$) after 3 h on carrageenan-induced paw edema/extract displayed significant (39.03%; $P < 0.05$) inhibition after 3 h on cotton pellet granuloma model	Patil and Patil (2010)
				200 mg/kg b.w./p.o.	Sprague Dawley rats/ carrageenan-induced paw edema/i.p.	Extract (69.86%) showed significant ($P < 0.0001$) inhibition at 3 h on the carrageenan-induced inflammation	Wanjari et al. (2011)
			Methanol	400 mg/kg b.w./p.o./given for 6 h	Wistar albino rats/carrageenan-induced paw edema/s.c.	Extract (3.8 ± 0.1 mL) and diclofenac sodium (2.9 ± 0.1 mL) elicited significant inhibition of edema formation at 3 h ($P < 0.01$)	Thakare et al. (2010)
				300 mg/kg b.w./i.p. in case of FCA-induced edema arthritis, formalin – induced arthritis while p.o. in case of agar- induced	Swiss albino rats/FCA-induced edema arthritis/s.c./ formalin –induced arthritis/ agar- induced edema/i.p.	FCA-induced edema arthritis - extract exhibited significant inhibition (40.48%) when compared with acetyl salicylic acid (26.98%; $P < 0.05$)/ formalin-induced paw edema-extract displayed significant inhibition (69.9%) when compared with acetyl salicylic acid (67.72%; $P < 0.05$)/agar- induced edema-extract exhibited maximum inhibition which was as good as indomethacin ($P < 0.01$)	Manocha et al. (2011)
			Methanol (70%)	60 µg/mL	RAW 246.7 cells/*in vitro* induced using LPS (500 ng/mL)	Significant decrease in the amount of uric acid, nitric oxide, lipid peroxidation and xanthine oxidase activity reported in treated cell (*in vitro*)	Sabi et al. (2022)
		Leaves	Methanol	200 mg/kg b.w./p.o.	Wistar albino rats/formalin-induced inflammation/ i.p.	Extract showed a significant ($P < 0.001$) decrease in paw volume at 3 h (inhibition 65.21% when compared to 62.31% of diclofenac)	Kothapalli et al. (2014)
	F. benjamina	Leaves	Aqueous	264 mg/kg b.w./p.o.	Wistar male albino rats/ carrageenan-induced paw edema/i.p.	Extract showed significant anti-inflammatory (inhibition 39.715%) effects when compared to the negative control (inhibition 70.12%; $P < 0.05$)	Bunga and Fernandez (2021)
	F. carica	Leaves	Ethanol	600 mg/kg b.w/p.o.	Wistar albino rats/ carrageenan-induced paw edema/i.p.	Extract showed (75.90%; $P < 0.05$) significant inhibition after 3 h when compared with indomethacin (79.72%)	Patil and Patil (2011)
					Wistar albino rats/carrageenin, serotonin, histamine, dextran-induced rat paw oedema/i.p.	Extract exhibited maximum anti-inflammatory effect (inhibition 33.73%) at the end of 3 h on carrageenin, serotonin, histamine, and dextran-induced rat paw oedema when compared to indomethacin ($P < 0.001$)	Patil et al. (2013)
			Extract gel (carbopol 940 base swelling + fig leaves)	Rats were topically treated for 3 days	BALB/c rats/croton oil-induced inflammation on the back of rats	The gel displayed significant differences in the treatment group ($P = 0.688$ negative control; gel $P = 0.470$)	Kurniawan et al. (2021)
			Methanol (50%)	500 mg/kg b.w./p.o.	Wistar albino rats/ formalin-induced rat paw oedema/ i.p.	Extract showed significant inhibition (66.43%) after 4 h ($P < 0.001$) of administration	Ali et al. (2009, 2012)
			Methanol	50 mg/pouch	Male Wistar albino rats/ carrageenan-induced pouches/ i.p.	Extract significantly reduced the formation of TNFα, PGE2, and VEGF, while angiogenesis was significantly suppressed when compared to diclofenac ($P < 0.001$)	Eteraf-Oskouei et al. (2015)
		Branches	Ethyl acetate	–	RAW264.7 cells/*in vitro* assay	Extract suppressed nitric oxide formation in RAW264.7 cells. The level of tumor necrosis factor-α was significantly decreased ($P < 0.01$)	Park et al. (2013)
		Fruits	Ficucaricones A–D	0.89 ± 0.05 to 8.49 ± 0.18 µM	RAW264.7 cells/*in vitro* assay	Compounds showed significant anti-inflammatory effects (IC_{50} 0.89 ± 0.05 to 8.49 ± 0.18 µM)	Liu et al. (2019)
	F. deltoidea	Leaves	Aqueous	300 mg/kg b.w./p.o.	Wistar albino rats/carrageenan-induced paw edema, cotton pellet-induced granuloma/i.p.	Extract showed significant ($P < 0.05$) anti-inflammatory activity in all tested assays	Zakaria et al. (2012)
			Methanol	–	Wistar albino rats/lipoxygenase inhibitory activity/ hyaluronidase inhibition assay and 12-otetradecanoylphorbol 13-acetate (TPA)-induced ear oedema	Extract exhibited 10.35 ± 0.04% inhibition in case of lipoxygenase activity/ extract showed 51.0% inhibition in case of hyaluronidase inhibition assay/extract showed strong decrease of oedema (85.46 ± 8%; $P < 0.05$) in (TPA)-induced ear oedema	Abdullah et al. (2009); Ashraf et al. (2021)
	F. elastica	Root bark	Aqueous	10 mg/kg b.w./p.o.	Male Wistar albino rats/ carrageenin-induced paw oedema/i.p.	Extract and indomethacin produced potent inhibition (68.92% and 69.26%) to paw edema	Sackeyfio and Lugeleka (1986)
		Stem bark	Methanol (98%)	10 mg/kg b.w/p.o.	Wistar albino rats/carrageenan-induced paw oedema/i.p.	Extract significantly inhibited carrageenan induced inflammation when compared with control ($P < 0.05$)	Aziba and Sokan (2009)
	F. erecta	Leaves	Dichloromethane	1 µg/mL	Raw 264.7 murine macrophage cell lines /LPS-induced *in vitro* assay	Extract inhibited the production of pro-inflammatory factors (NO, iNOS, COX-2, and PGE2)	Jung et al. (2018)
	F. exasperata	Stem bark	Ethanol (70%)	300 mg/kg b.w./p.o	Male Wistar rats/carrageenan- induced foot edema/ i.p.	Extract significantly suppressed carrageenan induced foot edema (68.57 ± 3.342%) when compared to diclofenac (71.56 ± 3.43%) and dexamethasone (74.53 ± 5.21%)	Amponsah et al. (2013)

(*continued on next page*)

Table 3 (*continued*)

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
	F. hirta	Roots	(1′*S*)-methoxy-4-(1-propionyloxy-5-methoxycarboxyl-pentyloxy)- (*E*)-formylviny, (8*R*)-4,5′-dihydroxy-8-hydroxymehtyl-3′-methoxydeoxybenzoin, (2′*S*)-3-[2,3-dihydro-6-hydroxy-2-(1-hydroxy-1-methylethyl)-5- benzofuranyl] methyl propionate, 3-[6-(5-*O*-β-D-glucopyranosyl) benzofuranyl] methyl propionate	–	Murine macrophage RAW 264.7 cells/*in vitro* assay	Isolated compounds (1, IC_{50} > 100 μM; 2, IC_{50} 68.42 ± 4.96 μM; 3, IC_{50} 46.32 ± 3.67 μM; 4, IC_{50} > 100 μM) showed pronounced inhibitory effects on the LPS induced NO production in murine macrophage RAW 264.7 cells when compared to indomethacin (IC_{50} 48.3 ± 2.8 μM)	Cheng et al. (2017)
	F. hispida	Twigs and leaves	Ficuhismines A–D	–	HEK293/NF-κB cells/*in vitro* luciferase assay	Ficuhismine B exhibited significant inhibitory effects in NF-κB pathway luciferase assay (IC_{50} 0.52 ± 0.11 μM) when compared with bortezomib (IC_{50} 0.12 ± 0.04 μM)	Jia et al. (2020)
		Fruits	Methanol	200 mg/kg b.w./p.o.	Male Wistar albino rats/ carrageenan and histamine-induced inflammation/i.p./ RAW 264.7 cells/LPS *in vitro* assay	Extract showed significant activity in a dose dependent manner on carrageenan and histamine-induced inflammation/MTT assay – extract (IC_{50} 125 μg/mL) and indomethacin on RAW 264.7 (IC_{50} 50 μg/mL)	Choudhury et al. (2021b)
		Leaves	Ethanol	800 mg/kg b.w./p.o.	Female Wistar albino rats/ acetic acid-induced colitis/intra-colonic administration/disease activity index/colon mucosal damage index were determined	Acetic acid group-mucosal disease index 4.33 ± 0.51 (control)/sulfasalazine score 2.00 ± 0.63/extract score 2.50 ± 0.54 (P < 0.001) which was significantly less than control/disease activity index - acetic acid group score (5.50 ± 0.54)/ sulfasalazine score (1.83 ± 0.75)/extract score (2.50 ± 0.54) which was significantly less than control (P < 0.001)	Gunaseelan et al. (2015)
			Methanol	400 mg/kg b.w./ p.o.	Swiss albino mice/xylene-induced ear edema test/i.p.	Extract exhibited significant (P < 0.05, vs. control) ear weight differences and inhibition of ear edema	Mushiur Rahman et al. (2018)
			Hexane	300 mg/kg b.w./p.o.	Sprague Dawley rats/carrageenan-induced paw edema/i.p.	Extract showed significant inhibition within 90 min when compared with prednisolone (control; P < 0.05) and dichlofenac sodium (control; P < 0.01)	Anasane and Chaturvedi (2017)
		Stem bark	Ethanol	400 mg/kg b.w./p.o.	Wistar albino rats/histamine and carrageenan-induced paw oedema/i.p.	Extract (59.49%) and indomethacin (67.72%) inhibited the inflammation significantly in carrageenan-induced paw edema/extract (60.12%) and indomethacin (69.64%) inhibited inflammation significantly (P < 0.01) in histamine-induced paw edema	Howlader et al. (2017)
	F. lacor	Aerial roots	Ethanol	100 mg/kg b.w./p.o.	Wistar albino rats/carrageenan-induced paw edema/i.p.	Extract showed (75.40%) inhibition on carrageenan-induced paw edema when compared with indomethacin (80.80%; P < 0.001)	Sindhu and Arora (2014)
				100 mg/kg b.w./p.o.	Wistar albino rats/ carrageenan and histamine-induced paw edema/i.p.	Extract showed maximum inhibition (75.11%) on carrageenan induced edema (P < 0.001) when compared with indomethacin (81.83%)/ extract exhibited significant inhibition on histamine-induced edema (35.66%; P < 0.05)	Pandey et al. (2019)
	F. Microcarpa	Leaves	Methanol	200 mg/kg b.w./p.o.	Male Wistar albino rats/carrageenan- induced edema, histamine, and serotonin- induced paw edema/i.p.	Extract significantly reduced the formation of oedema induced by carrageenan, histamine and serotonin when compared with control (P < 0.05)	Bairagi et al. (2012)
	F. palmata	Fruits	Methanol	150 mg/kg b.w./p.o.given for 4 h	Male Wistar albino rats/ carrageenan-induced paw edema/i.p.	Paw volume was significantly reduced (P < 0.01) in treated animals as compared to control group	Chandra and Saklani (2016)
			Ethanol	100 μg/mL concentration	RAW264.7 cells/*in vitro* assay/ lipopolysaccharide-induced inflammation assay	NO and PGE_2 production was significantly inhibited by the extracts in a dose-dependent manner (P < 0.05)	Khajuria et al. (2018)
	F. pumila	Fruits	Methanol (75%)	250 mg/kg b.w./p.o.	Clean Kunming mice/carrageenan-induced toe swelling/ear swelling in mice with bilateral adrenalectomy induced by xylene	Extract reduced the swelling significantly in carrageenan-induced model (P < 0.001)/extract also inhibited xylene-induced ear swelling (P < 0.05) when compared with control	Zeng et al. (2020)
		Stems and leaves	Methanol	1.0 g/kg b.w./p.o.	Male ICR mice/carrageenan-induced mouse paw edema/i.p.	Extract showed about equal amount of inhibition as exhibited by indomethacin (P < 0.01 and P < 0.001) when compared to control	Liao et al. (2012)
	F. racemosa (syn. *F. glomerata*)	Stem bark	Ethanol	400 mg/kg b.w./p.o.	Wistar albino rats/ carrageenan-induced paw edema (i.p.)/ formalin induced peritonitis (i.p.)/ cotton pellet induced granuloma (s.c.)	Extract (P < 0.001) produced 61.37% inhibition to carrageenan-induced paw edema when compared with diclofenac (62.95%) after 3 h/extract decreased formalin-induced peritonitis when compared with diclofenac significantly (P < 0.001)/in cotton pellet induced granuloma, extract and diclofenac decreased the formation of granuloma significantly (P < 0.001)	Priya Mohan et al. (2021)
			Aqueous (hot)	0.1 μg/mL	Albumin denaturation assay/ inhibition of protein denaturation (%)	Extract showed higher inhibition (0.1 μg/mL) than the reference drugs (P < 0.05)	Dharmadeva et al. (2018)
		Fruits	Ethanol	500 mg/kg b.w./p.o.	Swiss albino mice/ carrageenan-induced rat paw edema/i.p.	Extract showed significant inhibition (P < 0.001) when compared with the vehicle control (distilled water) and indomethacin (standard) after 3 h	Rahman et al. (2016)
			Methanol	500 mg/kg b.w./p.o.	Male albino Wistar rats/ carrageenan-induced paw oedema/i.p.	Extract (37.8%) caused significant inhibition on carrageenan-induced rat paw oedema when compared to control (P < 0.001)	Saneja et al. (2008)
	F. religiosa	Leaves	Kaempferol	–	*In silico* approach using molecular docking/cyclooxygenase-2 receptor	Kaempferol strongly was tied to TYR385 and SER530 of the receptor	Utami et al. (2020); Biju et al. (2020)
	F. retusa	Fruits	Methanol	400 mg/kg b.w./p.o.	Wistar albino rats/ carrageenan-induced paw edema/i.p.	Extract produced significant reduction on paw oedema when compared with diclofenac sodium (50 mg/kg; P < 0.05)	Raju and Sreekanth (2011)
Antimicrobial activity	*F. auriculata* (syn. *F. pomifera*)	Fruits	Methanol: water (80:20)	60 μg concentration/disc	*P. vulgaris, S. epidermidis, E. coli, K. pneumoniae, N. gonorrhoeae, M. genitalium* and *P. aeruginosa*/disc diffusion assay	Potent activity displayed against *M. genitalium* and *S. epidermidis*	Raja et al. (2021)
			Ethanol	50 mg/mL/ disc	*E. coli, K. pneumoniae, E. gergoviae, S. enterica, S. flexneri, S. aureus, S. epidermidis, S. pyogenes,* and *B. cereus*/ disc diffusion assay	Extract showed strong activity (inhibition zone 14 ± 1 mm, 13 ± 1 mm and 12 ± 1 mm) against *S. flexneri, E. coli* and *S. epidermidis*	Saklani and Chandra (2012)
			(*Z*)-5,7,4′-trihydroxy-3′-[3-hydroxy-3-methyl-1-butenyl] isoflavone	1.25 to 20 μg/mL	*E. coli, S. aureus, S. epidermidis, S. pyogenes*/ MIC determination	Compound exhibited significant antibacterial effects against selected pathogenic bacterial strains (MIC 1.25 to 20 μg/mL)	Shao et al. (2022)
		Roots	5,7,4′-Trihydroxy-3′-hydroxymethylisoflavone, 3′-formyl-5,4′-dihydroxy-7-methoxyisoflavone, ficuisoflavone and alpinumisoflavone	1.30 to 39.93 μM concentration	*B. cereus, S. epidermidis, S. albus, E. coli, P. solanacearum and P. aeruginosa* /MIC determination	Isolated compounds showed strong antibacterial activity against selected pathogenic bacteria (MIC 1.30 to 39.93 μM)	Qi et al. (2018)
	F. benghalensis	Roots	Ethanol	75 mg/mL/disc	*K. pneumoniae, S. aureus* and *E. coli* /disc diffusion assay	Extract showed potent antibacterial activity against *S. aureus* (IZ 30 mm) when compared with ampicillin (IZ 30 mm)	Murti and Kumar (2011)
		Leaves	Ethanol	100, 50, 25, 12.5, 6.25 mg/mL	*S. mutans*, Lactobacillus species, *K. pneumoniae,* and *C. albicans*	Extract showed maximum antimicrobial activity against *K. pneumoniae* (IZ 23 mm; MIC 6.25 mg/mL)	Samuel et al. (2022)
		Fruit latex	Latex	100 μL concentration	*S. aureus, S. pyogenes, E. coli, P. aeruginosa, P. mirabilis, K. pneumoniae,* Salmonella spp., Seratia spp., *C. albican, C. tropicalis, C. cruzii, C. kefyr, C. sojae*	Candida species were found more susceptible to latex than selected bacterial pathogens	Faisal (2017)

Table 3 (*continued*)

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
	F. benjamina	Leaves	Methanol	40 mg/ mL/disc	*S. typhimurium, P. aeruginosa, S. typhimurium* and *E. coli*	*S. typhimurium* [3.0 mm] > *P. aeruginosa* [2.0 mm] > *S. typhimurium* (TA100) [1.0 mm] = *E. coli* [2.5 mm]	Bhawana et al. (2018)
			Ethanol (96%)	50 µL/disc	*K. pneumoniae, P. aeruginosa, E. coli, S. aureus, S. aureus and S. pneumoniae*/ disc diffusion assay	Extract showed varied levels of inhibitory effects against all the test organisms	Truchan et al. (2017)
	F. deltoidea	Leaves	Methanol	50 mg/mL/disc	*S. aureus* (IMR S-277), *B. subtilis* (IMR K-1), *E. coli* (IMR E-940), *P. aeroginosa* (IMR P-84)} and *C. albicans* (IMR C-44)	Extract showed greater activity to *S. aureus* (IZ 15.67 ± 0.58 mm; MIC 3.125 mg/mL) than other bacterial strains	Abdsamah et al. (2012)
			Lupeol	150, 220 and 130 µg/mL concentration	*E. coli, B. subtilis* and *S. aureus*/MIC determination	Potent activity displayed against *E. coli, B. subtilis* and *S. aureus* with different concentrations (MIC 150, 220 and 130 µg/mL)	Suryati et al. (2011)
	F. exasperata	Leaves	Ethanol	100 mg/mL/disc	*A. flavus, A. niger, B. theobromae, F. oxysporum, F. solani, P. chrysogenum, P. oxalicum, R. stolonifera*, Pseudomonas spp. and Klebsiella spp.	Extract exerted significant antimicrobial effects against the test organisms	Oyelana et al. (2011)
	F. microcarpa	Stem bark	Methanol	10 mg/mL/disc	*B. brevis, B. cereus, B. subtilis, E. coli* and *A. polymorph*/ disc diffusion assay	Maximum activity displayed against *E. coli* (inhibition zone 17.8 mm) when compared with ampicillin (IZ 34.5 mm) while mild activity against other microbes	Ao et al. (2008)
		Whole plant	Aqueous	37.5 mg/mL/disc	*S. aureus, P. aeruginosa* and *E. coli*/disc diffusion assay/MIC determination	Extract showed moderate inhibitory effect against *P. aeruginosa* (18 mm) followed by *S. aureus* and *E. coli*	Nair and Mahesh (2016)
	F. palmata	Leaves	Catechin, genistein, β-sitosterol, stigmasterol	100 µg /mL/disc	*B. cereus, S. enterica, S. aureus, S. epidermidis* and *S. pyogenes*/disc diffusion assay	Genistein demonstrated potent antibacterial activity against *B. cereus* (IZ 23 mm) when compared to erythromycin (35 mm)	Chandra and Saklani (2017)
		Fruits	Ethanol	20 mg/10 mL/disc	*E. coli* and *S. aureus*/disc diffusion assay	Extract showed maximum activity against *E. coli* (IZ 8 mm)	Kumar et al. (2012)
	F. pumila	Leaves	Ethanol	200 µL/disc	*A. hydrophila, C. freundii, P. fluorescens, Y. ruckeri*/ disc diffusion assay	Extract showed maximum activity against *Y. ruckeri* (IZ 14 mm)	Halyna et al. (2018)
	F. racemosa (syn. *F. glomerata*)	Roots	Ethanol	75 mg/mL/disc	*K. pneumoniae, S. aureus* and *E. coli*/disc diffusion assay	Extract showed maximum activity against *S. aureus* (IZ 35 mm) when compared to ampicillin (10 µg/disc; IZ 40 mm)	Murti and Kumar (2011)
		Leaves	Ethanol	100 µL/disc	*E. coli, P. aeruginosa, and S. aureus, A. flavus*, Rhizopus species and *R. solani*/ disc diffusion assay	Extract showed moderate activity against *E. coli* (IZ 10 mm), *S. aureus* (IZ 14 mm) and Rhizopus (6 mm)	Thilagavathi and Kathiravan (2017)
				100 µL/well	*E. coli, B. subtilis, P. aeruginosa, K. pneumonia, S. aureus and S. mutans*/ well-diffusion assay	Extract manifested strong zone of inhibition against *E. coli* (13. 1 mm), *B. subtilis* (10.5 mm), *P. aeruginosa* (10.4 mm), *S. aureus* (11.0 mm) and *S. mutans* (12.4 mm)	Danie Kingsley et al. (2014)
		Fruits	Ethanol	100 µg/mL/disc	Staphylococcus spp, Pseudomonas spp, Klebsiella spp and *E. coli*/MIC determination/disc diffusion assay	Extract showed strong antibacterial activity against Staphylococcus spp. and Klebsiella spp. (IZ 26 ± 0.10 and 24 ± 0.13 mm)/ Staphylococcus spp. showed lowest MIC (0.07 mg/mL)	Bagyalakshmi et al. (2019)
			Ethyl acetate	1 mg/mL	*E. coli, K. pneumoniae, S. aureus, S. typhi, C. albicans* and *A. niger*/agar well diffusion assay	In well diffusion method- ethyl acetate extract showed significant bactericidal activity against *S. aureus* (0.98 mg/mL) and fungistatic against *A. niger* (1.39 mg/mL)	Pingale et al. (2019)
			Methanol	200 µg/disc for bacteria and 150 µg/disc for fungal organisms	*S. aureus, B. subtilis, V. cholera, B. cereus, S. typhi, S. dysenteriae, P. aeruginosa*, Klebsiella spp., Proteus spp., Alternaria spp., Colletotrichum spp., Curvularia spp. and Fusarium spp/disc diffusion assay	Maximum activity displayed against *S. aureus* (IZ 18 mm) and Fusarium spp. (IZ 12 mm)	Hossain et al. (2014)
		Stem bark	Methanol	–	*S. aureus, B. cereus, P. aeruginosa, E. coli* and *B. subtilis*/ disc diffusion assays	Disc diffusion assay - extract showed antibacterial effect against *S. aureus* (IZ 12.1 mm) *B. cereus* (10.3 mm), *B. subtilis* (8.14 mm)	Faiyaz et al. (2010)
	F. religiosa	Leaves	Methanol	50 µL/disc	*E. coli*/disc diffusion assay	Methanolic extract showed activity to *E. coli* (12 mm)	Parasharami et al. (2014)
				50 µL/well	*S. aureus, E. coli, P. aeruginosa, S. typhi, A. niger* and *Penicillium notatum*/well diffusion method	Methanolic extract exhibited greater activity against *E. coli* than other tested microbes	Pathania et al. (2021)
	F. retusa	Aerial parts	Ethanol	–	*S. aureus, P. aeruginosa, E. coli* and *P. mirabilis*/disc diffusion assay	Extract showed moderate activity against *S. aureus* (7.00 ± 0.32 mm), *E. coli* (7.04 ± 0.32 mm) and *P. aeruginosa* (7.05 ± 0.32 mm)	Subramani et al. (2014)
	F. sarmentosa	Fruits	Eriodictyol, homoeriodictyol, dihydroquercetin, and luteolin	–	*F. graminearum, P. fusarium, C. lunata, S. zeicola, B. cinerea*, and *R. solani*/MIC determination	Luteolin showed the strongest inhibitory activity (IC_{50} 56.38 and 81.48 mg/L) against *F. graminearum* and *S. zeicola*	Wang et al. (2010)
	F. tikoua	Whole plant	Essential oil	0.20–6.25 mg/mL	*S. aureus, B. subtilis, E. faecalis, E. coli, P. aeruginosa* and *P. vulgaris*/MIC determination	Essential oil showed strong antibacterial activity (IZ 7.89–10.59 mm), MIC (0.20–6.25 mg/mL) and MBC (0.20–12.50 mg/mL) against *S. aureus, B. subtilis, E. faecalis, E. coli, P. aeruginosa* and *P. vulgaris*	Tian et al. (2020)
Antioxidant activity	*F. auriculata* (syn. *F. pomifera*)	Stem bark	Methanol	0.1 mg/mL	DPPH free radical scavenging assay/ *in vitro* assay	DPPH - IC_{50} 0.042 mg/mL; inhibition − 84.088%	Gaire et al., (2011)
		Branches	Ethanol: water (50:50)	50 µL	DPPH radical scavenging assay/*in vitro* assay	DPPH – IC_{50} 190.57 ± 4.25 µg/mL	Bertoletti et al. (2020)
	F. benghalensis	Roots	Ethyl acetate fraction	250 µg/mL	DPPH free radical scavenging and FRAP reducing power assays/*in vitro* assays	DPPH – IC_{50} 315.5 ± 7.98 µg/mL/FRAP – 173.5 ± 4.32 µmol Fe^{2+}mg dry weight	Etratkhah et al. (2019)
		Fruit	Methanol	–	DPPH radical scavenging, and total reducing power assays/*in vitro* assays	DPPH - IC_{50} 3.18 µg/mL/ total reducing power – 243.89 ± 1.6 µg ascorbic acid equivalents/mg extract	Ahmed et al. (2017)
		Leaves	Hydroalcoholic	1,000 µg/mL	DPPH, and ABTS radical scavenging assays/*in vitro* assays	DPPH – IC_{50} 32.3 ± 1.320 µg/mL/ABTS – IC_{50} 52 ± 0.722 µg/mL	Bhanwase and Alagawadi (2016)
	F. benjamina	Leaves	Methanol	200 µg/mL	DPPH, iron chelating, and FRAP assays/*in vitro* assays	DPPH - IC_{50} 59.07 µg/mL/ iron chelating – 131.12 µg/mL/g ascorbic acid equivalents/FRAP – 433.32 µg/mL/g ascorbic acid equivalents	Jain et al. (2013)
	F. carica	Latex	Ethanol (75%)	500 µg/mL	DPPH and ABTS radical scavenging and FRAP reducing power assays/*in vitro* assays	Significant activity to DPPH − 65.91 ± 1.73% inhibition/ABTS − 98.96 ± 1.06% inhibition/ FRAP − 27.08 ± 0.34 mg Trolox equivalents/g	Shahinuzzaman et al. (2020)
		Fruit	Peel juice	–	DPPH scavenging assay/*in vitro* assays	DPPH - TPC of juices extracts 74.16 mg gallic acid equivalents/g fresh weight	Harzallah et al. (2016)
			Methanol (80%)	21 µL extract (for DPPH) and 10 µL extract (for ABTS)	DPPH and ABTS assays/*in vitro* assays	DPPH – 418.51 mg Trolox equivalent antioxidant capacity/100 g dry matter/ ABTS – 207.43 mg Trolox equivalent antioxidant capacity/100 g dry matter (significant difference at $P < 0.05$)	Khadhraoui et al. (2019)
				1 mL	DPPH radical and ABTS scavenging assays/*in vitro* assays	DDPH – 41.63% inhibition/ABTS – 676.13 equivalent vitamin C mg/100 g fresh weight/ difference $P < 0.05$	Aljane et al. (2020)
		Leaves and twigs	Aqueous- methanol (80:20)	0.25 mg/mL	DPPH, ABTS and FRAP assays/*in vitro* assays	DPPH - IC_{50} 346.2 µg/mL (leaf extract) with significant difference ($P < 0.05$)/ ABTS - IC_{50} 288.3 µg/mL (leaf extract) with significant difference ($P < 0.05$)/ FRAP - IC_{50} 50.8 µg/mL (leaf extract) with significant difference ($P < 0.05$)	Farid et al. (2018)
		Leaves	Methanol	250 µg/mL	DPPH radical scavenging assay/*in vitro* assay	DPPH – 10.222% scavenging inhibition	Ahmad et al. (2013)
	F. deltoidea	Leaves	Methanol	1 mg/mL	DPPH radical scavenging and reducing power assays/*in vitro* assays	DPPH - IC_{50} 288.04 µg/mL/reducing power IC_{50} 0.02–0.24 µg/mL/DPPH ($P < 0.001$ compared to quercetin – DPPH)/reducing power assay ($P < 0.001$ compared to ascorbic acid – reducing power)	Mohd Dom et al. (2020)
	F. elastica	Leaves	Ethanol (50%)	2 mg/mL	DPPH, ABTS, and ferric ion reducing power assays/*in vitro* assays	DPPH - EC_{50} 6.4166 ± 0.3329 mg/mL/ ABTS EC_{50} 0.0768 ± 0.0020 mg/mL/ ferric reducing power EC_{50} 0.4027 ± 0.0016 mg/mL	Flayyh et al. (2019)
			Methanol	500 µg/mL	DPPH, iron chelating, and reducing power assay/ *in vitro* assays	DPPH - IC_{50} 20.17 µg/mL ($P < 0.05$)/ iron chelating - IC_{50} 300 µg/mL ($P < 0.05$)/ reducing power OD 1.25 ± 0.047 at 1 mg/mL ($P < 0.05$)	Preeti et al. (2015)
	F. erecta	Leaves	Ethyl acetate fraction of Ethanol (70%) extract	500 µg/mL	DPPH, xanthine oxidase, nitric oxide, and superoxide dismutase assays/*in vitro* assay	DPPH - IC_{50} 75.02 ± 0.02 µg/mL/xanthine oxidase - IC_{50} 422.69 ± 10.09 µg/mL/ SOD - IC_{50} 85.72 ± 1.23 µg/mL	Jung et al. (2018)
		Fruits	Petroleum ether	500 µg/mL	DPPH radical scavenging assay/*in vitro* assay	DPPH - IC_{50} 7.35 ± 0.08 µg/mL, whereas standard ascorbic acid - IC_{50} 5.80 ± 0.22 µg/mL	Al Faysal et al. (2018)

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Table 3 (*continued*)

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
	F. fistulosa	Leaves	Methanol	250 µg/mL	DPPH free radical scavenging assay/*in vitro* assay	Extract displayed significant radical scavenging activity (IC_{50} 16.66 µg/mL) when compared with ascorbic acid (IC_{50} 11.93 µg/mL)	Raka et al. (2019)
		Fruits	Acetone	–	DPPH, FRAP, and ORAC assays/*in vitro* assays	High content of FRAP (321.75 mg/g dry weight; $P < 0.05$)/DPPH – 90.54% ($P < 0.05$)/ORAC 158.36 ± 0.65 Trolox equivalents/100 g ($P < 0.05$)	Hlail et al. (2014)
	F. hirta	Fruits	Ethanol (90%)	0.2 mg/mL (DPPH and other radicals)/ reducing power assays (10 mg/mL)	DPPH, FRAP, ABST, hydrogen peroxide, hydroxyl radicals, chelating and reducing power assays/ *in vitro* assays	Extract showed significant antioxidant activity {DPPH- EC_{50} – 345.9 ± 2.71 µg/mL/FRAP - EC_{50} 327.5 ± 3.71 µg/mL/ABST radicals – EC_{50} 325.4 ± 3.15 µg/mL/ hydrogen peroxide - EC_{50} 486.5 ± 2.96 µg/mL/ hydroxyl radical - EC_{50} 551.1 ± 3.88 µg/mL/ chelating power - EC_{50} 380.6 ± 2.25 µg/mL/ reducing power assay – 646.6 ± 3.50 µg/mL}	Tamuly et al. (2015)
			Ethyl acetate	–	DPPH, ABTS, and FRAP assays/*in vitro* assays	DPPH - IC_{50} 2.52 mg/mL/ABTS IC_{50} 3.06 mg/mL/extract showed maximum antioxidant potential to reduce ferric ions ($P < 0.05$)	Chen et al. (2020)
	F. lyrata	Leaves	Methanol	–	DPPH radical scavenging assay/ *in vitro* assay	DPPH - SC_{50} = 8.27 µg/mL	El-SayedSaleh (2009)
	F. microcarpa	Stem bark	Ethyl acetate	4.83, 1.62 and 63.2 µg/mL	DPPH, ABTS radical dot+, superoxide radicals scavenging assays/*in vitro* assays	DPPH – EC_{50} 4.83 µg/mL/ABTS radical dot + EC_{50} 1.62 µg/mL/superoxide radicals scavenging – EC_{50} 63.2 µg/mL	Ao et al. (2008)
	F. palmata	Leaves	Ethyl acetate	500 µg/mL	DPPH radical scavenging assay/*in vitro* assay	Extract showed strong DPPH scavenging effects (97.0%) when compared with ascorbic acid (98.1%)	Alqasoumi et al. (2014)
		Fruits	Aqueous	2 mg/mL	DPPH and ABTS radical scavenging assays/*in vitro* assays	DPPH radical scavenging 175.08 mg TE/g with maximum potency/ABTS radical scavenging activity was 265 mg TE/g	Tewari et al. (2021)
	F. racemosa (syn. *F. glomerata*)	Stem bark	Methanol	200 µg/mL	DPPH scavenging assay/*in vitro* assay	DPPH scavenging activity - IC_{50} 73.46154%	Sultana et al. (2013)
		Leaf gall	Aqueous and methanol	125, 250 and 500 µg/mL	DPPH, NO scavenging, hydroxyl scavenging and FRAP reducing power assays/*in vitro* assays	DPPH - Inhibition 59% (250 µg/mL aqueous)/NO - IC_{50} 172.37 ± 02 µg/mL (methanol)/hydroxyl radical scavenging activity – 42.31% inhibition (125 µg/mL methanol)/FRAP – methanol extract showed maximum reducing ability at 500 µg/mL	Eshwarappa et al. (2015)
		Fruits	Ethanol (90%)	0.2 mg/mL (DPPH and other radicals); reducing power assays (10 mg/ml)	DPPH, FRAP, ABST, hydrogen peroxide, hydroxyl radicals, chelating and reducing power assays/ *in vitro* assays	Extract showed significant antioxidant activity {DPPH- EC_{50} 256.1 ± 5.03 µg/mL; FRAP - EC_{50} 260.7 ± 2.55 µg/mL; ABST radicals – EC_{50} 262.7 ± 2.68 µg/mL; hydrogen peroxide - EC_{50} 402.6 ± 2.47 µg/mL; hydroxyl radical - EC_{50} 433.3 ± 4.33 µg/mL; chelating power - EC_{50} 172.1 ± 1.28 µg/mL; reducing power assay – 470.7 ± 4.17 µg/mL}	Tamuly et al. (2015)
	F. religiosa	Leaves	Chloroform and aqueous	80 µg/mL	DPPH, and ABTS assays/*in vitro* assays	DPPH – IC_{50} – 4.76 ± 0.15 µg/mL (chloroform)/ ABTS – IC_{50} – 0.14 ± 0.04 µg/mL (aqueous)	Sharma et al. (2020)
	F. semicordata	Fruits	Ethanol (90%)	0.2 mg/mL (DPPH and other radicals)/ reducing power assays (10 mg/mL)	DPPH, FRAP, ABST, hydrogen peroxide, hydroxyl radicals, chelating and reducing power assays/ *in vitro* assays	DPPH- EC_{50} – 301.0 ± 1.23 µg/mL/FRAP - EC_{50} 305.3 ± 3.73 µg/mL/ABST radicals – EC_{50} 316.9 ± 3.07 µg/mL/hydrogen peroxide - EC_{50} 430.2 ± 4.01 µg/mL/hydroxyl radical - EC_{50} 517.2 ± 3.06 µg/mL/chelating power - EC_{50} 251.7 ± 2.70 µg/mL/reducing power assays – 579.1 ± 4.50 µg/mL	Tamuly et al. (2015)
Anti-diabetic activity	*F. auriculata* (syn. *F. pomifera*)	Stem bark	Aqueous	100 µg/mL	α-Amylase inhibitory assay/*in vitro* assay	Extract showed significant inhibition (31.3%)	Tiwari et al. (2017)
		Fruits	Methanol	500 µg/mL	α-Amylase and α-glucosidase inhibitory activity/ *in vitro* assay	Methanol showed maximum α-amylase and α-glucosidase inhibitory activity (IC_{50} 161.73 ± 0.43 and 103.43 ± 0.67 µg/mL) when compared to acarbose (IC_{50} 155.08 ± 1.75 and 95.63 ± 1.71 µg/mL)	Anjum and Tripathi (2019a)
	F. benghalensis	Aerial roots	Aqueous	300 mg/kg b.w./p.o.	Female albino Wistar rats/p.o./ streptozotocin-induced diabetic rats/glucose tolerance test	Extract significantly reduced the fasting blood glucose level (43.8%) when compared with control after 6 h ($P < 0.01$)/extract showed significant reduction (40.7%) in glucose tolerance test after 3 h ($P < 0.01$)	Singh et al. (2009)
		Leaf	Petroleum ether	200 mg/kg b.w./p.o.	Alloxan monohydrate- induced diabetic male Wistar albino rats/i.p./blood glucose test	Extract reduced the blood glucose level to 537 ± 31.9, 451 ± 43.8 and 310 ± 12.6 mg/dl on 7, 14 and 21 days, respectively ($P \leq 0{\cdot}05$ compared to diabetic control)	Sidhu and Sharma (2014)
		Stem bark	Hexane extract, cycloartenol and 24-methylenecycloartanol	100 mg/kg b.w./p.o. and 1 mg/kg (for isolated compounds)/given for 25 days	Male Wistar albino rats and male Swiss albino diabetic mice/glucose administered/p.o./ high fat diet-streptozotocin- induced type II diabetic rats/ oral glucose tolerance test	Extract reduced the levels of glucose [test/control values are 100.2 ± 3.2 mg/dl and 124 ± 4.1 mg/dl)] at 150 min after glucose administration [$P < 0.001$ when compared to control)/Both compounds showed significant activity in high fat diet-streptozotocin-induced diabetic rats and normalized the derailed blood glucose levels {from 348.4 ± 6.8 mg/dl to 153.7 ± 2.5 mg/dl; $P < 0.001$}	Nair et al. (2020)
			Lcucodelphinidin derivative	250 mg/kg b.w./p.o.	Alloxan monohydrate- induced diabetic Wistar albino rats/ i.p./glucose tolerance test	In glucose tolerant test - blood glucose (%) in leucodelphinidin and glibenclamide treated groups were 48% and 33% when compared with control (71%)	Geetha and Mathew (1994)
		Fruits	Ethanol	120 mg/kg b.w./p.o./once a daily for 15 days	Alloxan-induced diabetic male Wistar albino rats/i.v./GOD-POD kit method	Extract reduced the levels of blood glucose in treated animals (31.72% when compared with glibenclamide positive control 34.43%; $P < 0.01$)	Sharma et al. (2007)
		Stem bark and leaves	Aqueous	300 mg/kg b.w./p.o./given for 28 days	Alloxan monohydrate- induced male Wistar albino diabetic rats/i.p.	Extract showed significant decrease in the blood glucose levels when compared with control ($P < 0.0001$)	Chikaraddy and Maniyar (2017)
	F. benjamina	Leaves	Ethanol (80%)	30 µ/mL	α-Glucosidase and α-amylase inhibitory assays/ *in vitro* assays	Extract exhibits strong α-glucosidase and α-amylase inhibitory effects (IC_{50} 9.65 ± 1.04 µg/mL and IC_{50} 13.08 ± 1.06 µg/ mL, respectively)	Mumtaz et al. (2018)
	F. carica	Leaves	Basic and chloroform fraction of aqueous extract	0.5 mL olive oil per animal/i.p.	Streptozotocin-induced diabetic Wistar albino rats/ p.o./erythrocyte assays/CAT and MDA assays	Both fractions tended to normalize the values of fatty acids and plasma vitamin E values ($P < 0.01$ versus normal rats)/diabetic group injected with the basic fraction (1.00 ± 0.19 µg/mg; $P < 0.01$)/diabetic group injected with the chloroform fraction (0.99 ± 0.15 µg/mg; $P < 0.05$)	Pérez et al. (2003)
			Methanol (70%)	2 mg/mL	α-Amylase inhibitory activity/*in vitro* assay	Extract showed significant inhibition (IC_{50} 0.896 µg/mL; $P < 0.001$) when compared with control	Ara et al. (2020)
			Aqueous	500 mg/kg b.w./p.o./given twice daily for 9 days	Streptozotocin- induced diabetic Wistar albino (male and female) rats/ i.p./glucose tolerance test	Extract showed significant reduction in the blood glucose level when compared to diabetic control ($P < 0.001$)/ maximum glucose tolerance was reported (106.5 ± 2.1) in 90 min	Roy et al. (2021)
			Ethyl acetate	500 mg/kg b.w./p.o./given for 28 days	High fat diet-fed streptozotocin -induced type 2 diabetic Wistar rats/i.p./ biochemical and immunohistochemical parameters were analyzed	Extract treatment significantly ($P < 0.005$) reduced the increase of blood glucose levels (129.14 ± 8.23 mg/dl) at 120 min	Irudayaraj et al. (2017)
			Chloroform		Streptozotocin-induced hyperglycaemic and hypertriglyceridaemic female Wistar albino diabetic rats/i.p./glucose oxidase method, triglycerides, total cholesterol methods	Plasma glucose levels in treated animals: 38.22 ± 3.63 mM, basal; 33.55 ± 4.12 mM, 60 min ($P < 0.001$ compared to the basal value); 36.08 ± 3.85 mM, at 24 h ($P < 0.05$ compared to the 60 min value)	Canal et al. (2000)
	F. deltoidea	Leaves	Vitexin or isovitexin	1 mg/kg b.w./ 30 min	Sucrose loaded normoglycemic mice and induced diabetic rats/p.o./ α-glucosidase inhibition assay	Vitexin or isovitexin significantly ($P < 0.05$) decreased the levels of postprandial blood glucose in sucrose loaded normoglycemic mice	Choo et al. (2012)
			Vitexin, and isovitexin	–	α-Amylase inhibition assay/*in vitro* assay	α-Amylase inhibition – vitexin IC_{50} 0.02 µg/mL/isovitexin IC_{50} 0.06 µg/mL ($P < 0.05$)	Abu Bakar et al. (2018)
	F. exasperata	Leaves	Aqueous	100 mg/kg/day/ p.o./given for 30 days	Streptozotocin-induced spontaneously hypertensive Wistar albino rats/i.p./ serum cholesterol, lipoproteins and triglyceride levels were determined	Extract significantly reduced ($P < 0.05$) blood glucose concentrations/ lipid parameters were significantly improved ($P < 0.05$) towards normal values	Adewole et al. (2011)
	E. hirta	Leaves	Ethanol (90%)	400 mg/kg b.w./p.o./given for 28 days	Streptozotocin-induced male Wistar albino rats/i.p./ triglycerides, cholesterol, HDL-cholesterol, and LDL-cholesterol were estimated	Extract significantly reduced the levels of blood glucose (113.23 ± 9.22 mg/dl) on 28th day when compared with diabetic control (278.92 ± 11.90 mg/dl)/showed significant reduction ($P < 0.05$) in total cholesterol, LDL, VLDL, triglycerides and significant increase ($P < 0.05$) in HDL level	Maurya et al. (2012)

Table 3 (*continued*)

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
	F. hispida	Stem bark	Aqueous suspension (water soluble portion of alcoholic extract)	1.25 g/kg b.w./p.o.	Alloxan monohydrate-induced diabetic rats/ i.v.	Extract reduced the levels of fasting blood sugar (14.75% of extract and 25.37% of glibenclamide $P < 0.01$)/extract displayed significant decrease in the blood glucose levels both in the normal ($P < 0.01$) and diabetic ($P < 0.001$) rats	Ghosh et al. (2004)
	F. lacor	Fruits	Ethanol	400 mg/kg b.w./p.o./given daily for 21 days	Streptozotocin-induced diabetic female Wistar albino rats/i.p./ oral glucose tolerance test	Extract reduced the elevated levels of blood glucose when compared to diabetic control group ($P < 0.001$)	Mule and Naikwade (2022)
	F. lyrata	Leaves	Ethanol (80%)	400 mg/kg /given for 30 days	Alloxan-induced diabetic Sprague–Dawely rats/i.p./ plasma total cholesterol, triglycerides, and LDL-cholesterol levels estimated	Extract reduced the blood glucose levels significantly (127.7 ± 6.889 mg/dl when compared with gliclazide 110.8 ± 7.240 mg/dl; $P < 0.05$)/LDL 80.51 ± 8.235 mg/dl/cholesterol 163.0 ± 7.922 mg/dl/ triglycerides 81.80 ± 1.686 mg/dl	El-Kashoury et al. (2013)
	F. microcarpa	Leaves	Ethanol (60%)	200 mg/ kg b.w./ p.o./given for 15 days	Alloxan-induced Wistar albino rats/i.p./ total cholesterol, triglycerides, HDL, LDL and VLDL levels estimated	Extract showed significant decrease in the levels of blood glucose (101.5 ± 8.58 mg/dl) better than the glibenclamide (5 mg/kg: 101. 26 ± 8.16 mg/dl)	Kumar et al. (2007)
	F. mollis	Leaves	Ethyl acetate	400 mg/kg b.w./p.o./given for 30 days	Dexamethasone-induced hyperglycemia and hyperlipidemia Wistar albino rats/ s.c./biochemical parameters studied	Extract significantly ($P < 0.01$ and $P < 0.05$) reduced the level of glucose (123.5 ± 7.5 mg/dl), cholesterol (88 ± 8 mmol/L), LDL (37.5 ± 2.5 mmol/L), triacyl glycerides (63.5 ± 2.5 mmol/L), SGOT (305 ± 6.5 IU/L), SGPT (77.5 ± 0.5 IU/L) but, significantly ($P < 0.01$ and $P < 0.05$) increased the level of HDL (22.5 ± 0.5 mmol/L)	Munna and Saleem (2013)
	F. palmata	Fruits	Methanol	500 µg/mL	α-Amylase and α-glucosidase inhibitory assays/ *in vitro*	Extract showed strong α-amylase and α-glucosidase inhibitory effects (IC_{50} 166.91 ± 2.73 and 118.73 ± 0.67 µg/mL) when compared with acarbose (IC_{50} 154.87 ± 2.33 and 105.63 ± 1.71 µg/mL)	Anjum and Tripathi (2019b)
	F. racemosa (syn. *F. glomerata*)	Leaves	Petroleum ether	300 mg/kg b.w./p.o./given twice a day for 7 days	Streptozotocin- induced diabetic Wistar albino rats/ p.o./high density lipoprotein, total triglycerides, and total cholesterol, GSH, SOD, CAT and MDA levels were estimated	Extract exhibited maximum hypoglycemic effect/reduced glucose concentration (from 290 to 205 mg/dl; $P < 0.001$) when compared with control /reduced cholesterol level (157.5 ± 6.45 and 150.33 ± 2.43 mg/dl)/ extract reduced thiobarbituric acid reactive substances and protein carbonyl levels in liver of diabetic rats	Yadav et al. (2015)
			Ethanol (70%)	500 mg/kg b.w./p.o./given for 10 days	Alloxan monohydrate induced male Wistar albino rats/p.o./ levels of serum urea, serum creatinine, serum cholesterol, and serum protein were estimated	Extract significantly reduced the levels of fasting blood glucose (189.83 ± 3.31 mg/dl when compared with control; $P < 0.001$ vs diabetic control)/also reduced the levels of biochemical parameters ($P < 0.001$)	Sharma et al. (2010)
			Benzene	–	α-Amylase and α-glucosidase inhibitory assay/ *in vitro*	Benzene extract showed significant inhibition to α-amylase and α-glucosidase activities ($P < 0.05$)	Abusufyan et al. (2018)
		Fruits	α-Amyrin acetate	100 mg/kg b.w./p.o.	Streptozotocin- induced diabetic Wistar albino rats/ p.o.	Isolated compound reduced the levels of blood glucose (18.4% and 17.0%) at 24 h ($P < 0.05$)	Narender et al. (2009)
			Petroleum ether	300 mg/kg b.w./ p.o./given once a daily for 14 days	Alloxan-induced diabetic male Wistar rats/i.p./ the levels of blood glucose level, serum urea level, serum cholesterol level and serum triglycerides were estimated	Extract reduced the levels of serum glucose significantly ($P < 0.01$ vs. control)/ levels of the serum urea, serum cholesterol and serum triglyceride were reduced in treated diabetic animals significantly ($P < 0.01$ vs. control)	Patil et al. (2006)
		Stem bark	Baicalein, kaempferol, naringenin, and quercetin	100 mg/kg b.w./p.o. given once a day for 7 days	Streptozotocin-induced diabetic Wistar albino rats/ p.o./lipid profile parameters and high-density lipoproteins estimated	Baicalein reduced the blood glucose level and restored biochemical parameters significantly ($P < 0.001$)	Keshari et al. (2016)
			Methanol	400 mg/kg b.w./p.o.	Alloxan-induced diabetic Wistar albino rats/i.p.	Extract exhibited significant hypoglycemic effects by reducing the levels of glucose ($P < 0.001$)	Rao et al. (2002)
			Ethanol	400 mg/kg/p.o.	High-fat diet and streptozotocin-induced diabetic Wistar albino rats/i.p./glucose tolerance assay	Extract altered the biochemical parameters and significantly improved glucose tolerance and HDL-c levels/extract showed inhibition of PTP-1B (IC_{50} 12.1 µg/mL) and DPP-IV (42.5%)	Veerapur et al. (2012)
				400 mg/kg b.w./p.o.	Streptozotocin-induced diabetic male Wistar albino rats/i.v./levels of the serum TG, T-C and LDL-C1 were estimated	Extract restored the levels of blood glucose and lipids ($P < 0.001$), also decreased creatinine kinase ($P < 0.001$), lactate dehydrogenase ($P < 0.001$), C-reactive protein ($P < 0.001$), creatinine ($P < 0.001$), blood urea nitrogen ($P < 0.001$), collagen ($P < 0.05$) and albumin ($P < 0.001$) levels/ reduced the level of sodium ($P < 0.001$), creatinine ($P < 0.001$), albumin ($P < 0.001$) and malondialdehyde ($P < 0.01$) in heart and kidney tissue along with enhanced activities of superoxide dismutase ($P < 0.001$) and reduced glutathione ($P < 0.001$)	Joshi et al. (2016)
			Ethanol (90%)	400 mg/kg b.w./i.p./given for 1–3 h	Alloxan-induced diabetic Sprague-Dawley rats/i.v./ blood glucose levels measured	Extract significantly lowered the blood sugar levels (28.66 %)/also reduced blood glucose level (45.03%)	Sachan et al. (2009)
		Roots	Ethanol	200 mg/kg b.w./p.o./given for 11 days	Alloxan-induced male Wistar albino diabetic rats/i.p./ levels of glucose, cholesterol, triglycerides, and high-density lipoprotein were estimated	Extract significantly reduced the levels of glucose, cholesterol, triglycerides, but increased high-density lipoprotein in diabetic rats ($P < 0.05$)	Upadhye et al. (2020)
	F. religiosa	Leaves	Ethanol	500 mg/kg b.w./p.o./ given for 9 weeks	High-fat-diet-induced hypercholesterolemic rats/p.o.	Extract exerted significant hypolipidaemic and antioxidant effects ($P < 0.001$)	Hamed (2011)
			Aqueous	250 mg/kg b.w./i.p./given once a daily for 21 days	Alloxan-induced diabetic male Wistar albino rats/plasma glucose, total cholesterol, triglyceride, phospholipids, HDL-cholesterol, lipoprotein lipase, HMG CoA reductase activity	Extract showed moderate decrease in the blood glucose, serum cholesterol, triglyceride and increase phospholipids levels ($P < 0.001$)	Pochhi and Muddeshwar (2017)
		Fruits	Ethanol	250 mg/kg b.w./p.o./ administered once a daily for 30 days	Alloxan-induced male Wistar albino rats/i.p./ biochemical parameters (blood glucose, total cholesterol, and triglyceride) were evaluated	Extract and glibenclamide significantly reduced ($P < 0.001$) the levels of blood sugar and other parameters	Choudhary et al. (2011)
		Stem bark	Aqueous	100 mg/kg b.w./p.o./ given a daily for 3 weeks	Glucose-loaded hyperglycemic and streptozotocin-induced diabetic Wistar albino rats/p.o./ serum insulin, body weight and glycogen estimation assays	Extract reduced the blood glucose levels (26.2%); $P < 0.05$)/showed significant reduction in the levels of serum triglyceride and total cholesterol ($P < 0.05$ and $P < 0.01$)	Pandit et al. (2010)
	F. sarmentosa	Leaves	Aqueous	500 mg/kg/p.o./given a daily for 9 days	Streptozotocin-induced diabetic Wistar albino rats/ i..p./oral glucose tolerance test	Extract significantly reduced the levels of blood glucose (201.8 ± 22.1 mg/100 mL) when compared to diabetic control (339.8 ± 1.81 mg/100 mL)/extract showed maximum glucose tolerance (106.5 ± 2.1 mg/100 mL) when compared with normal control (135.7 ± 2.917 mg/100 mL)	Negi et al. (2021)
	F. semicordata	Leaves	Ethanol	50 mg/kg b.w./p.o./given a daily for 21 days	α-Amylase and α-glycosidase inhibitory assays/ *in vitro* assays/ streptozotocin-induced Wistar albino rats/i.p./*in vivo* assay/blood glucose levels estimated	Extract showed significant α-amylase (IC_{50} 3.352 µg/mL) and α-glycosidase inhibitory effects (IC_{50} 3.448 µg/mL) when compared to standard acarbose (IC_{50} 3.175 µg/mL)/extract also significantly reduced the levels of blood glucose ($P < 0.001$)	Kaur et al. (2017)
	F. tinctoria	Leaves and stem bark	Aqueous- alcohol (50:50%)	250 mg/kg/p.o./ administered a daily for 35 days	Streptozotocin-induced diabetic male Sprague Dawley rats/i.p./ glucose tolerance test	Leaf extract showed significant ($P < 0.05$) decrease in the elevated blood glucose levels at 120 min/similarly stem bark extract significantly ($P < 0.01$) reduced the elevated glucose levels at 120 min	Kumar et al. (2020)

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Table 3 (*continued*)

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
Anti-arthritic activity	*F. benghalensis*	Stem bark	Methanol	400 mg/kg b.w./p.o./given daily for 21 days	Formalin and CFA- induced arthritis in Wistar albino rats (i.p./formalin/s.c./ CFA/ AST, ALT and LDH were assayed	Extract significantly inhibited on 8th day ($P < 0.05$) and the order of edema inhibition was diclofenac sodium > extract > dexamethasone > methotrexate reduced the arthritic score significantly on the 10th day ($P < 0.05$)/ maximum edema inhibition reported on the 21st day (methotrexate > dexamethasone ≥ diclofenac sodium > extract/extract, methotrexate, dexamethasone, and diclofenac sodium treatment to arthritic rats prevented the increase in serum AST, ALT and LDH levels significantly ($P < 0.001$)	Thite et al. (2014)
				300 mg/kg/i.p./given for 16 days	CFA and formalin, agar induced-induced arthritis in Swiss albino rats/s.c.	Extract showed significant anti-inflammatory effects, especially on the secondary immunological arthritis ($P < 0.05$)/extract also showed dose dependent inhibition in early (69.9%) and late phases (78.42%) of licking responses ($P < 0.01$)/extract significantly ($P < 0.05$) suppressed the development of acute edema of rat paw ($P < 0.05$)	Manocha et al. (2011)
			Methanol-water (50:50)	400 µg/mL	Egg albumin denaturation assay/*in vitro* assay	Extract showed maximum inhibition of denaturation (83.80 ± 5.16%) when compared with diclofenac sodium (91.45 ± 6.84%; $P < 0.01$)	Mathavi and Nethaj (2019)
		Aerial roots	Emulgel	Emugel (ethanol extract – 0.01 g + glycerin −2.1 mL + triethanolamine-2.0% +ethanol − 0.1 mL	Drug release analysis/*in vitro* assay/ franz diffusion cell assay	Emugel activity compared to diclofenac/emulgel confirms (spread ability, and viscosity) the anti-arthritic activity ($P < 0.001$)	Sonali et al. (2021)
			Ethanol (95%)	300 mg/kg b.w./p.o./given for 28 days	CFA-induced arthritis Wistar albino rats/i.p./ hemoglobin content, total WBC, RBC, and erythrocyte sedimentation rate were estimated	Extract (63.64%) and indomethacin (62.34%) showed significant decreases in paw swelling on 28th day as compared to control group ($P < 0.01$)	Bhardwaj et al. (2016)
		Leaves	Ethanol (95%)	300 mg/kg b.w./p.o./given daily for 21 days	CFA-induced arthritic male Wistar albino rats/s.c./ hemoglobin content, total WBC, RBC, and erythrocyte sedimentation rate were estimated	Extract significantly ($P < 0.01$) inhibited the development of swelling/extract showed maximum inhibition (66.88%) of paw edema compared to indomethacin (75.42%)/extract presented significant increase in the WBC count, a decrease in RBC count, and hemoglobin content	Bhardwaj et al. (2010)
	F. carica	Leaves	Aqueous	500 µg/mL	Bovine serum denaturation/egg albumin denaturation assays/*in vitro* assays	BSA method - denaturation of protein was increased in dose dependent manner (inhibition 76.9% extract and 86.44% diclofenac sodium)/egg albumin method - denaturation of protein was increased (inhibition 64.64% extract and 76.16% diclofenac sodium; $P < 0.01$) significantly	Rajesh et al. (2020)
	F. erecta	Leaves	Ethanol (70%)	500 mg/kg/p.o./given for 21 days	Monosodium iodoacetate (MIA)-induced osteoarthritis/i.p.	Behavioral score began to reduce from week 1st when compared with MIA-treated arthritis-induced model. The decrease was lower than that of the positive control indomethacin ($P < 0.05$)	South Korean Patent (2018)
	F. exasperata	Leaves	Ethanol (70%)	300 mg/kg b.w./ p.o./ given for 28 days	CFA-induced arthritis/Sprague Dawley rats/i.p.	Extract significantly reduced the total ipsilateral paw edema (inhibition 34.46 ± 11.42%)/extract reduced the maximum arthritic index (67.35%) than dexamethasone (95.91%) and methotrexate (85.71%; $P < 0.001$), respectively	Abotsi et al. (2010)
	F. lacor	Aerial roots	Petroleum ether and ethanol	150 mg/kg b.w./p.o./given for given 21 days	CFA-induced arthritis/Wistar albino rats/i.p.	Both extracts showed statistically significant inhibition of arthritic lesions ($P < 0.05$) from day 16, ($P < 0.01$) from day, 20 and ($P < 0.001$) from day 21 onwards/both extracts showed significant increase in body weight ($P < 0.001$) as compared to arthritic control group and increase in liver weight ($P < 0.01$), decrease in liver weight ($P < 0.001$), and increase in spleen weight ($P < 0.001$) in arthritis control	Sindhu and Arora (2013)
	F. religiosa	Stem bark	Methanol	400 mg/kg b.w./p.o./given for 28 days	CFA-induced arthritic Wistar albino rats/i.p./serum parameter (glutamic oxaloacetic transaminase, serum glutamate-pyruvate transaminase, urea, and creatinine) were estimated	Extract reduced paw volume significantly (0.99 ± 0.12 mL) on day 28 when compared to Piroxicam (0.96 ± 0.32 mL)/higher arthritic score (control 3 + 2 + 1), and the individuals treated with extract have the least arthritic score/ the levels of SGOT (102.8 ± 1.50 U/L), SGPT (42.4 ± 1.24 U/L) were decreased with piroxicam and extract (SGOT 107.5 ± 1.08U/L, SGPT 43.6 ± 1.23 U/L)	Garg et al. (2018)
		Leaves	Ethanol	400 mg/kg/p.o./given for 3 weeks	CFA-induced arthritic male Wistar albino rats/ i.d./body weight, arthritic score, paw volume and ankle diameter were estimated	The weight loss was significantly ($P < 0.001$) reduced by extract in adjuvant induced arthritis/extract attenuated mean arthritic severity score significantly ($P < 0.001$)/extract significantly ($P < 0.001$) reduced ankle diameter ($P < 0.001$)	Rathod et al. (2018)
Anti-stress activity	*F. benghalensis*	Fruits	Methanol	500 mg/kg/ p.o/given for 21 days	Anoxia stress tolerance test, swimming endurance test/ Wistar albino rats	Anoxia stress tolerance time – extract (51.1 ± 1.4 min) showed antistress activity closer to that of the standard drug (64.5 ± 2.0 min)/swimming endurance test in mice – extract displayed increase in swimming performance time (402.80 ± 6.14 min) when compared with (*Withania somnifera*) standard (418.56 ± 5.71 min; $P < 0.001$)	Jahagirdar et al. (2020)
		Stem bark	Methanol	228.3 µg/mL concentration	Acetylcholinesterase inhibitory effect against SHSY5Y cell lines/*in vitro* assay	Showed significant stress-relieving effects (IC_{50} 228.3 µg/mL; $P < 0.05$)	Vignesh et al. (2019); Murugesu et al. (2021)
			Ethyl acetate	50 mg/kg each/p.o.	Milk-induced leucocytosis and Milk-induced eosinophilia/*in vivo*/ Male Swiss albino mice/s.c.	Extract showed significant protective effect against milk-induced leucocytosis ($P < 0.05$) compared with control group/extract displayed significant decrease in eosinophil count when ($P < 0.05$) compared to the control group	Taur et al. (2007)
	F. carica	Leaf-derived callus	Aqueous	–	Stress-hormone-induced damage in skin	Extract reduced the *trans*-epidermal water loss, the sebum production, the desquamation, and facial skin turning to a pale color from acute stress	Dini et al. (2021)
Anticancer/antitumor activity	*F. auriculata* (syn. *F. pomifera*)	Leaves	Methanol and chloroform	100 µg/mL	Lung carcinoma A549 cells/*in vitro*/ cytotoxicity MTT assay	Both extracts did not show any significant cancer cell killing efficacy against P1C, P1M, P2C and P2M	Kumari et al. (2018)
			3β-Acetoxyurs-12-ene and 3β-hydroxyurs-12-ene	3 and 15 µg/mL concentration	Human lung cancer cell line A549/*in vitro* MTT assay	Both compounds displayed significant cytotoxicity against selected cell lines (IC_{50} 15 µg/mL and 3 µg/mL)	Wangkheirakpam et al. (2015)
		Fruits	Ethanol (70%)	50 µg/mL	Human lung adenocarcinoma cell line (A549)/ *in vitro* assay/cell cycle phase distribution and cell death analysis	Extract induced significant decrease in G0/G1 phase ($P < 0.05$) and accumulation of A549 cells in G2/M phase/extract triggered A549 cells to undergo late apoptosis (Annexin V + PI +) after 48 h of treatment (14.7 ± 3.4%; $P < 0.05$)	Jamil and Abdul Ghani (2017)
	F. benghalensis	Aerial roots	Ethyl acetate	100, 50, 25, 12.5, 6.25, and 3.125 µg/mL	A549 cell line, MDA-MB-231 cell line, Hela cell lines/*in vitro* MTT assay	Extract showed significant activity against A549 cell line (IC_{50} 17.817 µg/mL)/ MDA-MB-231 cell line (IC_{50} 97.8992 µg/mL)/Hela cell line (IC_{50} 49.27276 µg/mL)	Jain and Jegan (2019)
		Leaf	Methanol	100 µg/mL concentration	Human cervical cancer cell line/*in vitro* mitochondrial reduction assay	Extract showed increased cell toxicity/increase in concentration of extract displayed decrease in the rate of cell proliferation	Kumaresan et al. (2018)
		Roots	Aqueous	10 mg/mL	Antimitotic activity by mitotic index determination	Extract showed significant mitotic index (22 ± 1.15%) when compared with methotrexate (30 ± 1.35%)	Ahirrao et al. (2020)
	F. carica	Leaves	Leaf latex	0.1% concentration	MDA-MB-231 cells/*in vitro* MTT assay/ genotoxicity and cytotoxicity analysis	Latex showed stress and apoptosis after 24 h/latex showed significant ($P < 0.05$) decrease in cell viability when compared to control/treated cells demonstrate a range of unhealthy morphological changes like nucleus blebbing, shrinkage, crescent shape	AlGhalban et al. (2021)
			Methanol and aqueous	1.0 mg/mL concentration	Human breast adenocarcinoma (MDA-MB-231) cells and mouse fibroblast (L929) cells/ *in vitro* cell viability assay	Methanol extract significantly suppressed MDA-MB-231 cell proliferation ($P < 0.05$) in a dose dependent manner (IC_{50} 0.081 mg/mL)/ aqueous extract decreased the cell viability (IC_{50} > 1 mg/mL; $P < 0.05$) significantly	Ergül et al. (2019)
		Leaves	Methanol	2000 µL/well	Huh7it cells/*in vitro*/ cancer cell proliferation test/ apoptosis and necrosis test	Extract showed significant inhibition (82.78%) of cell growth/extract displayed IC_{50} > 653 µg/mL/about 0.44% cells experienced total apoptosis at the 2000 µL/ well of extract	Purnamasari et al. (2019)

Table 3 (*continued*)

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
		Fruits	Ethanol	1000 µg/mL	Breast cancer (MCF-7) cell lines/*in vitro* MTT assay	Extract showed significant inhibition (90.5%) at 72 h/also reduced cell viability in time and dose dependent manner	Jasmine et al. (2015)
	F. deltoidea	Aerial parts	Chloroform and isovitexin	–	PC-3 cell line, LNCaP clone FGC cell, and human dermal fibroblasts/ cell viability/ apoptosis and cell migration and invasion assays	Extract induced cell death ($P < 0.05$) via apoptosis as evidenced by nuclear DNA fragmentation accompanied by an increase in MMP depolarization ($P < 0.05$), activation of caspases 3 and 7 ($P < 0.05$) in both PC3 and LNCaP cell lines/ inhibited both migration and invasion of PC3 cells ($P < 0.05$)/isovitexin showed an antiproliferative effect (IC_{50} = 43 µg/mL) against PC-3 cells	Hanafi et al. (2017)
		Leaves	Aqueous	500 mg/kg b.w./p.o./ given for 10 weeks	Male Sprague-Dawley rats/*in vivo*/4-nitroquinoline-1-oxide-induced tongue neoplastic and preneoplastic lesions/p.o./chemo preventive and chemotherapeutic study	Extract significantly decreased the incidence of oral squamous cell carcinoma (100%)/extract reduced the expression of the key tumor marker cyclin D1 but, significantly enhanced the expression of the β-catenin and e-cadherin antibodies which are associated with enhanced cellular adhesion	Al-koshab et al. (2020)
			Ethanol (20%)	100 µg/mL concentration	Prostate cancer cell line (DU145)/*in vitro* MTT assay/ Acridine orange and propidium iodode staining assay/ Annexin V-FITC/PI by flow cytometry assay	Extract showed 54.55 ± 0.36% cell viability when compared to vitexin (90.29 ± 0.35%) and curcumin (89.63 ± 0.09%)/early-stage apoptotic cells-induced by extract statistically higher than the control, paclitaxel was statistically higher than control ($P < 0.05$)	Soib et al. (2019)
			Ethanol	125 µg/mL	Human breast adenocarcinoma (MCF-7) cells/ *in vitro* MTT assay	Extract did not show any anticancer activity against MCF-7 cell	Wei et al. (2011a)
	F. elastica	Aerial roots	Methanol	62.5 µg/mL	HeLa cancer cell line/*in vitro* assay	Extract showed potent anticancer activity (IC_{50} 20 µg/mL) when compared with standard drug emetine (IC_{50} 0.04 µM)	Teinkela et al. (2018)
	F. exasperata	Leaves	Hexane	100 µg/mL concentration	A2780 human ovarian carcinoma cell lines/*in vitro* MTT assay	Extract showed potent inhibitory effects (97.2%) when compared to control ($P < 0.05$)	Bafor et al. (2017)
		Roots and stem barks	Methanol	1200 µg/mL concentration	PC-3 human prostate cancer cell line/ *in vitro* MTT assay	Both extracts significantly reduced the cell viability ($P < 0.05$ to $P < 0.001$)/both extracts suppressed the growth of PC-3 cells by modulating the $[Ca^{2+}]_i$ and stimulating apoptosis through Bax/Cytochrome *C*/Caspase 3–9 signaling pathway	Deeh et al. (2022)
	F. hirta	Fruits	Ethyl acetate	–	HeLa cells cell viability assay	Extract showed significant decrease in G1 population of cancerous cells ($P < 0.01$)	Zeng et al. (2012)
	F. hispida	Fruits	Isowigtheone hydrate, 3′-formyl-5,7-dihydroxy-4′-methoxyisoflavone, 5,7-dihydroxy-4′-methoxy-3′-(3-methyl-2-hydroxybuten-3-yl) isoflavone, chlorogenic, and sitosterol 3-*O*-β-D-glucopyranoside	400 µg/mL concentrations	Human cancer cell lines (HL60, A549, SKBR3, KB, Hela, HT29, and HepG2) and a normal cell (LO2)/ *in vitro* MTT assay	Isowigtheone hydrate, 3′-formyl-5,7-dihydroxy-4′-methoxyisoflavone, 5,7-dihydroxy-4′-methoxy-3′-(3-methyl-2-hydroxybuten-3-yl) isoflavone, chlorogenic acid, and sitosterol 3-*O*-β-D-glucopyranoside showed potent inhibitory activities on EBV-EA induction (IC_{50} 271 to 340 M ratio 32 $pmol^{-1}$ TPA; $P < 0.05$)	Zhang et al. (2018)
	F. microcarpa	Leaves	Ethyl acetate and plectranthoic acid	100 µg/mL concentration	Melanoma (A375) and prostate (DU145, PC3, CWRV1 and NB26) cancer cells /*in vitro* MTT assay	Ethyl acetate extract showed potent antiproliferative effect against tested cells in dose dependent manner/ plectranthoic acid significantly suppressed the viability of DU145, PC3, CWRV1, NB26 and A375 cells (IC_{50} 25.4, 32.2, 41, 53.1 to 77 µM; $P < 0.001$)	Akhtar et al. (2015)
	F. palmata	Stem	Ethanol	100 µg/mL concentration	RAW264.7 cells/ *in vitro* assay	MTT assay confirmed that there were no significant changes in cell viabilities reported with extract treatments ($P < 0.05$)	Khajuria et al. (2018)
	F. pumila	Leaves	Aqueous- alcoholic (50:50%)	–	CEM, Jurkat, HL-60 and PNT2 cell line/ *in vitro* MTT assay	Extract showed strong inhibitory effect against the cells (Jurkat cells, IC_{50} 130.97 µg/mL)/extract displayed strong inhibitory activity (HL-60, IC_{50} 56.31 µg/mL)	Larbie et al. (2015)
	F. racemosa (syn. *F. glomerata*)	Fruits	Chloroform	–	Human hepatocellular carcinoma cell line (HepG-2)/*in vitro* apoptosis assay/ DAPI method	Extract showed greater fluorescence glow in ethidium bromide, acridine orange and DAPI when compared to the IC_{50} concentration and control of HepG-2 cells ($P < 0.05$)	Sivakumar et al. (2019)
			Ethanol (70%)	80 µg/mL concentration	MCF7 human breast cancer cell line/ *in vitro* SRB assay	Extract showed significant reduction against cell lines (LC_{50}, TGI and $GI_{50} \geq 80$ µg/mL)	Gavhane et al. (2016)
		Leaves	Ethanol	200 µg/mL concentration	Dalton lymphoma ascites cell line/*in vitro* MTT assay	Extract showed potent cell death (57.37% of cell death; IC_{50} 175 µg/mL)	Khan et al. (2017a)
			Methanol	0.005 – 100 µg/mL	Cancer cell lines (HL-60, HepG2, NCI-H23 and HEK-293 T)/*in vitro* MTT assay	Extract showed cytotoxic activity against HL-60 and HepG2 cell lines (IC_{50} 276.85 and 362.95 µM) but did not show any activity against HEK-293 T and NCI-H23 cell lines	Sukhramani et al. (2013)
		Stem bark	Methanol	100 µg/mL concentration	HEK-293 T, NCI-H23, HepG2 and HL-60/*in vitro* XTT assay	Extract displayed significant cytotoxicity against HepG2 and HL-60 (IC_{50} 321.742 and 287.126 µM) but did not show any activity against HEK-293 T, and NCI-H23 cell lines	Sukhramani and Patel (2013)
	F. religiosa	Leaves	Chloroform	1000 µg/mL concentration	Human breast cancer cell (MDA-MB-231) lines/ *in vitro* cytotoxicity SRB assay	Extract showed maximum dead cell percentage (25%)/extract found mild cytotoxic at 1000 µg/mL (CC_{50} 4944.772 µg/mL)	Shaikh et al. (2020)
Hepatoprotective activity	*F. auriculata* (syn. *F. pomifera*)	Leaves	Ethanol	100 mg/kg/day/p.o./given for 14 days	Male Wistar albino rats/intrahepatic cholestasis-induced with 17α-ethinyl estradiol/serum liver function test/ 5′-nucleotidase, total bile acids, total cholesterol and phospholipids were assayed	Extract preserved liver functions, total bile acids, total cholesterol, and phospholipids/suppressed the pro-inflammatory cytokines but, increased hepatic regeneration and antioxidant defense system	El-hawary et al. (2019)
			Ethanol (70%)	800 mg/kg b.w./p.o.	Adult mice/CCl_4-induced hepatotoxicity/ levels of serum aspartate aminotransferase and alanine aminotransferase were estimated	Extract restored the increased levels of serum aspartate aminotransferase and alanine aminotransferase to the normal levels in treated animals ($P < 0.01$)	El-Fishawy et al. (2011)
		Fruit	Methanol	400 mg/kg b.w./given for 28 days/p.o.	Wistar albino male rats/CCl_4-induced hepatotoxicity/ SGPT, SGOT, ALP and bilirubin levels estimated	Extract caused significant reduction in SGPT, SGOT, ALP and bilirubin levels/ also showed moderate improvement with mild vacuolization of hepatocytes ($P < 0.05$)	Tamta et al. (2021)
	F. benghalensis	Stem bark	Methanol	250 mg/kg b.w./p.o./ given a daily for seven days	Wistar albino rats/CCl_4-induced hepatotoxicity/ SGPT/SGOT, alkaline phosphatase, ALP were estimated	Extract significantly ($P < 0.001$) decreased the levels of enzymes (SGOT, SGPT, ALP and bilirubin total and direct levels)/when compared to silymarin ($P < 0.05$)	Baheti and Goyal (2011)
		Fruits	Ethanol	500 mg/kg b.w./p.o./given for 7 days	Wistar albino rats/CCl_4-induced hepatotoxicity	Extract showed strong activity in terms of the restoration of reduced enzyme level as compared to the standard drug silymarin, which also restored the altered level of catalase enzyme ($P < 0.01$)	Karmakar et al. (2020)
		Leaves	Ethanol	400 mg/kg/p.o./given for 7 days	Male Wistar albino rats/CCl_4 and ethanol-induced hepatotoxicity/ AST, ALT, total protein, and total albumin were determined	Extract ameliorated the effects of hepatotoxins and significantly ($P < 0.05$) reduced the elevated levels of the biochemical marker enzymes in treated animals	Shinde et al. (2012)
	F. benjamina	Leaves	Aqueous	500 mg/ml b.w./p.o./given daily for 7 days	Male Balb/c mice/ethanol-induced hepatotoxicity/p.o./ alanine aminotransferase levels estimated/ distortion of the liver architecture, presence of foci of necrosis and presence of mild to moderate steatosis was also studied	Alanine aminotransferase showed significant hepatic damage to the negative control group (mean = 196.88 U/L) as compared to the positive control group (mean = 42.58 U/L) and the treated group (mean = 52.40 U/L) ($P < 0.05$)/A mild distortion of liver parenchymal architecture was observed in extract-treated mice while a moderate distortion of liver parenchymal architecture was observed in untreated mice	Pilapil et al. (2017)
			Ethanol	500 mg/kg b.w./p.o.	Wistar albino rats/CCl_4-induced hepatotoxicity/i.p./ SGOT, SGPT, and serum alkaline phosphatase were estimated	Extract showed significant decrease in the increased levels of SGPT, SGOT, ALP, TBL and comparable with the standard silymarin hepatoprotective drug/extract restored the altered level of enzymes significantly ($P < 0.01$).	Kanaujia et al. (2011)

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Table 3 (*continued*)

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
	F. carica	Leaves	Petroleum ether	200 mg/100 g/p.o./given for 10 days	Wistar albino rats with rifampicin-induced hepatic damage/SGOT, SGPT determined by the Reitman and Frankel method/ bilirubin by the Malloy and Evelyn method	A significant decrease was observed in SGPT, SGOT levels in the animals of treated group/a significant decrease in liver weight was also observed ($P < 0.05$)	Gond and Khadabadi (2008)
			Methanol	500 mg/kg b.w./p.o.	Wistar albino rats/CCl_4-induced hepatotoxicity/ serum ASP, ALT, total serum bilirubin, and malondialdehyde equivalent, and an index of lipid peroxidation were estimated	Extract significantly ($P < 0.001$) lowered the serum enzyme levels. ALT, AST, total bilirubin serum enzyme levels in treated animals were like the normal control values/ Malondialdehyde levels in the extract treated animals were significantly lower ($P < 0.001$) than those of toxic control values	Krishna Mohan et al. (2007)
			Ethyl acetate	400 mg/kg b.w./p.o./given for 7 days	Male albino mice/CCl_4-induced hepatotoxicity/ alanine transaminase, aspartate aminotransferase, alkaline phosphatase and total bilirubin were estimated	Extract showed significant decrease ($P < 0.05$) in the serum ALT, ASP, alkaline phosphatase, and total bilirubin levels almost like those in the silymarin treated animals	Hira et al. (2021)
			Ethanol (80%)	200 mg/kg b.w./p.o./given for 5 days	Male albino mice/CCl_4-induced hepatotoxicity/ ALT and ASP levels were estimated	Extract increased significant protection against CCl_4- induced hepatic damage ($P < 0.05$) in treated animals	Aghel et al. (2011)
			Ethanol	200 mg/kg b.w./p.o./given daily for 4 days	Male albino rats/ CCl_4-induced hepatotoxicity/ SGOT, SGPT, and total bilirubin were estimated	Extract showed significant hepatoprotection in carbon tetrachloride intoxicated rats ($P < 0.05$)	Mujeeb et al. (2011)
		Stem	Aqueous	–	Male Wistar albino rats/methanol-induced hepatotoxicity/i.p./administered for 30 days/ ALT, AST, ALP, and LDH and hepatic lipid peroxidation were estimated	Extract reverts the enzyme activities near to normal status in the treated animals ($P < 0.001$)	Saoudi and El Feki (2012)
	F. hirta	Leaves	Aqueous	300 mg/kg b.w./p.o./given for 5 days	C57BL/6 mice and ICR mice/N, N-dimethylformamide induced acute liver injury/i.p./ ALT, AST and LDH and the pathological changes were determined	Extract significantly reduced the elevated levels of ALT, AST and LDH liver injury ($P < 0.05$)	Lv et al. (2008)
		Roots	Aqueous	300 mg/kg b.w./p.o./given for 5 days	Male ICR mice/cocaine-induced hepatotoxicity/ serum ALT, AST activity and the activity of CAT in liver homogenate were estimated	The serum transferase and catalase levels in liver homogenate were reduced significantly ($P < 0.01$)	Cai et al. (2007)
	F. hispida	Leaves	Methanol	400 mg/kg b.w./p.o./given daily for 7 days	Male albino mice/paracetamol-induced hepatotoxicity/p.o./ serum levels of transaminase, bilirubin and alkaline phosphatase were estimated	Extract exhibited a significant protective effect by reducing the serum levels of transaminase (SGOT and SGPT), bilirubin and alkaline phosphatase ($P < 0.01$)	Mandel et al. (2000)
	F. lacor	Stem bark	Ethanol (90%)	50 mg/kg b.w./p.o./given for 5 days	Adult albino rats/CCl_4-induced hepatotoxicity/ SGOT, SGPT and total bilirubin were determined	Extract showed significant levels of protection against hepatotoxicity ($P < 0.05$) and reduced the levels of enzyme parameters	Tripathi and Patel (2007)
	F. lyrata	Leaves	Butanol (95%)	100 mg/kg b.w./p.o./given for 14 days	Male Wistar albino rats/CCl_4-induced hepatotoxicity/ AST, ALT, ALP, and GGT levels were estimated	Extract significantly decreased the elevated levels of AST, ALT, ALP, GGT, and total protein levels when compared to the CCl_4 group ($P \leq 0.05$)	Awad et al. (2019)
	F. microcarpa	Stem bark	Ethyl acetate	200 mg/kg/p.o./given for 21 days	Male Wistar albino rats/CCl_4- and paracetamol-induced hepatotoxicities/ AST, ALT, and ALP levels were estimated	Extract reduced the elevated levels of AST, ALT and ALP enzymes and showed their protective effects in treated animals ($P < 0.01$)	Kalaskar and Surana (2011)
	F. mollis	Leaves	Petroleum ether	250 mg/kg b.w./p.o./given for 14 days	Wistar albino rats/ CCl_4-induced hepatic damage/ ALT, AST, ALP, bilirubin, and total protein levels were measured	Extract showed significant liver protection against the toxicant as evident by the presence of normal hepatic cords, absence of necrosis and lesser fatty infiltration ($P < 0.01$)	Rama Devi et al. (2010)
	F. palmata	Leaves	Ethanol (95%)	400 mg/kg b.w./p.o./given for 7 days	Wistar albino rats/CCl_4-induced hepatotoxicity/ ASP, ALT, γ- glutamyl transpeptidase, alkaline phosphatase and total bilirubin were estimated	Extract showed a significant ($P < 0.001$) reduction in the levels of AST, ALT, GGT, ALP and bilirubin indicating good protection against liver damage	Alqasoumi et al. (2014)
	F. pumila	Leaves	Aqueous-ethanol (50:50)	100 mg/kg b.w./p.o./given for 7 days	Sprague-Dawley rats/CCl_4-induced hepatotoxicity/ ALT, ALP, GGT and total bilirubin were estimated	CCl_4 produced a 2-fold increase in the levels of ALT, ALP, GGT and total bilirubin and a 1.5-fold increase in AST and direct bilirubin levels/extract restored these increases to near normal levels ($P < 0.05$)	Larbie et al. (2016)
	F. racemosa (syn. *F. glomerata*)	Stem bark	Methanol	500 mg/kg b.w./p.o./given for 7 days	Male Wistar rats/CCl_4-induced hepatotoxicity/ ALT, ASP and alkaline phosphatase activities were determined	Extract attenuated the increase of AST, ALT and ALP activities and showed their protective effect against CCl_4-induced hepatotoxicity ($P < 0.05$)/extract exhibited maximum suppression of AST, ALT, and ALP activities nearer to the normal levels ($P < 0.001$)	Ahmed and Urooj (2010b)
				500 mg/kg b.w./p.o./given daily for 7 days	Wistar albino rats/ CCl_4-induced hepatotoxicity/ serum levels of transaminase, bilirubin and alkaline phosphatase were estimated	Extract showed a significant reversal of the serum enzyme changes towards the normal when compared to control values ($P < 0.05$)	Channabasavaraj et al. (2008)
	F. religiosa	Leaves	Methanol	300 mg/kg b.w./ p.o./given for once daily for 7 days	Male Wistar albino rats/isoniazid and rifampicin-induced hepatotoxicity/i.p./ ALP, ALT, AST, total protein, and bilirubin levels were estimated	Extract significantly stopped isoniazid-rifampicin and paracetamol-induced increase in the levels of serum diagnostic liver marker enzymes and TBARS level/total protein and reduced glutathione levels were significantly ($P < 0.001$) increased	Parameswari et al. (2013)
			Ethanol	200 mg/kg b.w./p.o./given for 7 days	Male Wistar rats/CCl_4 and paracetamol- induced hepatotoxicity/ ASP, and ALT were estimated	Extract prevented the paracetamol-induced rise in serum enzymes. The hepatotoxic dose of carbon tetrachloride (1.5 mL/kg; p.o.) also raised the serum AST and ALT levels/ extract also prevented the CCl_4-induced rise in serum enzymes ($P < 0.05$)	Selvan and Chourasia (2017)
		Stem bark	Methanol	200 mg/kg/p.o./given for 10 days	Male albino Wistar rats/paracetamol- induced hepatotoxicity/ ALT, ASP, alkaline phosphatase, and total bilirubin were estimated	Extract showed significant hepatoprotective activity by reducing the elevated levels of SGOT, SGPT, ALP, and total bilirubin ($P < 0.01$)	Suryawanshi et al. (2011)
		Latex	Methanol	300 mg/kg b.w./p.o./given for 10 days	Male Wistar albino rat/cisplatin induced liver injury/ ALT, ALP and AST and lipid peroxidation, GSH, and SOD were estimated	Extract normalized the levels of serum ALT, ALP and AST and lipid peroxidation, GSH, SOD in the liver of treated animals ($P < 0.05$)	Yadav (2015)
	F. retusa	Leaves	Ethyl acetate	400 mg/kg b.w./p.o./given for 7 days	Wistar albino rats/ CCl_4-induced hepatotoxicity/ SGOT, SGPT, alkaline phosphatase and total bilirubin were estimated	Extract showed significant decrease in SGOT, SGPT, SALKP and total bilirubin levels when compared to control ($P < 0.01$)	Jaya Raju and Sreekanth (2011)
	F. semicordata	Leaves	Aqueous	200 µg/mL/*in vitro*/	HepG2 cell line/ D-galactosamine induced toxicity	Extract showed significant protection against toxicity as compared to D-galactosamine control ($P < 0.05$)	Gupta et al. (2020)
Neuroprotective and neuroregenerative activity	*F. benghalensis*	Stem bark	Aqueous	1.0 mg/mL media for 24 h	SK-N-SH cell line/ hydrogen peroxide- induced DNA damage/*in vitro* neutral comet assay	Extract showed a significant reduction in the intensity of DNA damage in terms of comet tail length and brought to control level ($P < 0.05$)	Ramakrishna et al. (2014)
		Leaves	Methanol	10 µL concentration	Acetylcholinesterase inhibition *in vitro* assay/ 50% enzyme inhibition was determined	Extract was found most potent acetylcholine esterase inhibitor (IC_{50} = 194.6 ± 7.961 µg/mL) that is close to that of donepezil (IC_{50} = 186.1 ± 7.1 µg/mL)	Hassan et al. (2020)
	F. deltoidea	Fruits	Aqueous	1 mg/mL concentration	Human neuroblastoma SH-SY5Y cell lines/ hydrogen peroxide toxicity test (IC_{50} concentration) of cells was determined	Extract showed strong neuroprotective effect ($P < 0.05$; 80–160% of cell viability)	Dzolin et al. (2012)
	F. erecta	Leaves and	Aqueous-ethanol	100 mg/kg b.w./p.o./given for	Male C57BL6 mice/amyloid-β aggregates were	Extract significantly suppressed the inflammatory cytokines such as interleukin 1β	Sohn et al. (2021)

Table 3 (*continued*)

Pharmacological activity	Plant species	Used plant parts	Tested extract/ compound	Tested concentration/dose	Tested model/mode of administration	Study outcomes	References
		branches		20 days	injected at intracerebroventricular area/passive avoidance task was performed	and tumor necrosis factor-α, and expression of ionized calcium-binding adaptor molecule 1, a marker of microglial activation, in brain tissues of Aβ-injected mice, suggesting anti-neuroinflammatory effects ($P < 0.001$)	
	F. racemosa (syn. *F. glomerata*)	Stem bark	Aqueous	500 mg/kg b.w./p.o./given for 28 days	Male Wistar albino rats/anticholinesterase levels were determined	Extract significantly increased ($P \leq 0.05$) Ach levels in hippocampi of rats (38%)	Ahmed et al. (2011)
	F. religiosa	Leaves	Petroleum ether	400 mg/kg b.w./p.o./given for 7 days	Male Wistar albino rats/ 3-nitropropionic acid-induced Huntington's disease/i.p.	Extract significantly improved motor and cognitive performance and significantly attenuated oxidative damage ($P < 0.001$)	Bhangale et al. (2015)
Radioprotective activity	*F. racemosa* (syn. *F. glomerata*)	Stem bark	Ethanol	200 µg b.w./p.o./given once a daily for 15 days	Swiss albino mice/radiation dose rate of 72 Gy/min/ p.o./comet assay	Extract significantly reduced the radiation effects induced DNA damage ($P < 0.001$) in treated animals	Vinutha et al. (2015)
				150 mg/mL	V79 cells exposed to γ-irradiation at a dose of 1.0 Gy/min/*in vitro* assay with cytokinesis-block and proliferation index	Extract resulted in a significant ($P < 0.05$ and $P < 0.001$) decrease in the percentage of micronucleated binucleate cells	Veerapur et al. (2009)
Wound healing	*F. benghalensis*	Stem bark	Aqueous	200 mg/kg/ day /p.o./given for 10 days	Female Wistar albino rats/excision and incision wound models	Excision wound model - extract showed a significant reduction in the wound area ($P < 0.001$) and epithelialization period/ extract showed healing in 18.33 days as compared with 21.50 days of control/ incision wound model - a significant increase in the wound-breaking strength recorded ($P < 0.001$)	Garg and Paliwal (2011)
		Leaves	Ethanol	200 mg/kg b.w./p.o.	Wistar albino rats/ excision wound and inclusion models	Extract showed significant wound-healing activity by decreasing the period of epithelialization and increasing in the rate of wound contraction ($P < 0.05$)	Imran et al. (2021)
			Aqueous	Extract ointment 100 mg/g concentration	Wistar albino rats/ excision wound model/topically applied	Extract increased wound closure and completed in 12 days (activity 96%; $P < 0.05$)	Mothilal et al. (2020)
		Roots	Aqueous and ethanol	–	Wistar albino rats/excision, incision wound, and dead space wound models/ topically applied	Incision wounds model – breaking strength was increased significantly (502.30 ± 2.26%) when compared with control (305.20 ± 5.15%; $P < 0.05$)/ extract showed significant wound contraction and achieved 100% with the wound closure time of 14.17 days ($P < 0.05$)	Murti et al. (2011)
	F. carica	Leaves	Methanol	Ointment (5% extract)	Wistar albino rats/ excision wound model/applied topically once a day	The wounds were completely healed in treated group (epithelization period – 14 ± 2 days in treated whereas 24 ± 2 days in the control animals ($P < 0.001$)	Begum et al. (2013)
	F. deltoidea	Leaves	Aqueous	50 µg/mL	Human skin fibroblast (HSF 1184) cell/scratch *in vitro* assay	Extract reduced the wound area significantly (6 h treatment; 5.96%; $P < 0.05$)	Mustaffa et al. (2015)
		Whole plant	Aqueous	Ointment (10%; extract)	Male Sprague Dawley rats/ experimentally wounded in the posterior neck area/ topically applied	Extract showed lesser scar width at the wound enclosure and more fibroblast proliferation in the granulation tissue greater than blank placebo-treated wounds ($P < 0.05$) and intrasite gel (positive control)	Abdulla et al. (2010)
	F. exasperata	Leaves	Aqueous	Ointment (base of the extract)	Adult albino rats/excision wounds model/ topically applied	Significant wound contraction was observed in ointment treated animals (25%; $P < 0.05$) /contraction like that of cicatrin powder (standard) on the11th day	Umeh et al. (2014)
	F. hispida	Leaves	Methanol	150 mg/kg/b.w.	Albino Wistar rats/excision wound model/ topical application	Significant increase in wound healing reported on 20th day successively in treated animals ($P < 0.05$)	Singh et al. (2014)
		Roots	Ethanol (95%)	150 mg/kg/b.w./p.o./given for 10 days	Wistar albino rats/excision, incision, and dead space wound models	Extract showed maximum breaking strength compared to control group. The rate of epithelialization and wound contraction in excision model was better as compared to control groups ($P < 0.05$).	Murti et al. (2011a, b)
	F. racemosa (syn. *F. glomerata*)	Roots	Aqueous	Extract ointment (10%)/ applied topically	Wistar albino rats/ incision and excision wound models/wound closure, epithelization time and scar area on complete epithelization were measured	Incision model - extract increased breaking strength (394.70 ± 6.61) when compared to povidone iodine (352.00 ± 2.83; $P < 0.05$)/ extract showed 100% contraction which was almost better than that of the povidone iodine (17 days)	Murti and Kumar (2012)
		Stem bark	Lupeol and β-sitosterol	35 µM concentration	BHK 21 (ATCC, CCL-10) and MDCK (ATCC, PTA 6502) cell lines/*in vitro* scratch wound assay	Both compounds showed significant wound healing by cell migration enhancement activity on BHK 21 and MDCK cell lines (> 80%) in par with the asiaticoside (25 µM; $P < 0.001$)	Bopage et al. (2018)
		Leaves	Methanol	Extract ointment (10%)	Wistar albino rats/ excision and incision wound models/topically applied	Excision model - extract showed significant ($P < 0.01$) increase in wound contraction (5%age)/incision wound model – extract displayed significant ($P < 0.01$) increase in breaking strength	Londhe et al. (2013)
	F. religiosa	Stem bark	Ethanol	Topical gel (10%)	*In vitro* wound healing model /albino Wistar rats/ excision wound model	Extract increased the RBC membrane stabilization activity in *in vivo* and *in vitro* wound healing models ($P < 0.001$)	Raisagar et al. (2019)
		Leaves	Ethanol (70%)	Extract ointment	Wistar albino rats/excision and incision wound models	Excision model - extract showed faster epithelialization of wound (18 ± 0.60%) when compared with povidine iodine ointment treated animals ($P < 0.001$ vs control)/incision model - showed increase in breaking strength (562.2 ± 6.93 g)	Roy et al. (2009); Verma and Kumar (2021)
			Aqueous	Ointment (50 mg of simple ointment base)	Male Sprague Dawley rats/ incision wound, excision wound and dead space wound models/ topical application	Incision model - extract showed significant tensile strength (76.31%) when compared with povidone iodine (94.36%; $P < 0.05$)/rapid wound closure in standard and extract treated groups was observed between 4 and 12 days/maximum percentage inhibition (%) of wet and dry granuloma were reported	Chowdhary et al. (2014)
			Methanol (70%)	10% emulsifying ointment	Sprague Dawley rats/excision wound, incision wound and burn wound models/ topically applied once a day	Excision wound and the burn wound models-extract showed significant decrease in the period of epithelization and in wound contraction (50%; $P < 0.001$)/a significant increase in the breaking strength was observed in the incision wound model ($P < 0.001$)	Nayeem et al. (2008); Putra et al. (2020)
	F. retusa	Aerial parts	Ethanol	Extract ointment (5%)	Wistar albino rats/ excision wound, and incision wound model/topically applied	Excision wound model - extract showed significant decrease in wound area on day 21 (5%) when compared with framycetin (20%; $P < 0.05$)/incision wound model – increase in tensile strength reveals better wound healing induced by the applied ointment	Asija and Pareek (2014)
	F. sarmentosa	Stem bark	Ethanol	200 mg/kg b.w/p.o./given daily for 10 days	Wistar albino rats/ excision and incision wound models/base ointment applied topically	Excision wound model - showed a significant reduction in the wound area ($P < 0.001$) and epithelialization period (17.16 days)/incision wound model – extract showed significant increase in the wound-breaking strength ($P < 0.001$)	Dimri et al. (2018)

Table 4 Clinical studies of Indian Ficus species.

Study	Age (years)	Treatment	Dose	Recommended time	Useful outcomes	References
F. benghalensis						
Randomized comparative clinical study	60 Patients (males and females) suffering from Dushta Vrana (infected wound)/ 16 to 60 years	Wound cleaning was done with normal saline. In group A, dressing was done with Panchavalkal ointment and in group B with framycetin sulfate, using sterile gauze	Panchavalkal (stem bark of *F. Benghalensis*, *F. glomerata*, *F. religiosa*, *F. lacor* and *T. populnea*, tila tail and bees wax) was prepared as per mentioned in Ras shastra	21 days	Group A – 36.7% healed, 26.7 regenerated and 6.7% improved. Group B – 30.0% healed, 43.3% regenerated and 13.3% improved. Panchvalkal ointment was found effective cream in the management of infected wound	Kulkarni and Dwivedi (2019)
F. carica						
A randomized, double-blind, placebo-controlled study	109 subjects (both sexes) with functional constipation/19 to 39 years	Three *F. carica* paste packs given to subjects with functional constipation/ given three times a daily before meals	Three paste per day (300 g/day)	56 days	Colon transit time was significantly improved in the paste treated group compared with the placebo group ($P = 0.045$)/no serious adverse effects were reported during treatment period/ no significant differences in dietary intake (calorie, carbohydrate, protein, fat, and fiber) were observed between the groups during the intervention period	Baek et al. (2016)
A single-blind randomized clinical trial	150 patients with irritable bowel syndrome with predominant constipation/18 to 70 years	45 g fruits before breakfast and lunch were taken with a glass of water every day	90 g/day	120 days	Consumption of fruits caused a significant improvement in irritable bowel syndrome symptoms such as frequency of pain, distention, frequency of defecation and hard stool. The consumption also showed a significant increase in the quality of life, as well as satisfaction with overall bowel habits	Pourmasoumi et al. (2019)
A single center, randomized, double-blind crossover study	10 healthy adults (7 women and 3 men; 7 White/ Caucasian, 1 Hispanic, and 2 Asian) acute postprandial glucose and insulin homeostasis /18 to 45 years	Glucodin™ powder (abscisic acid $\geq$ 300 ppm, drug extract ratio of native extract is 50–60:1) and extract-50× (abscisic acid $\geq$ 50 ppm with drug extract ration of native extract is 7–1:1)	51.4 g Glucodin™ powder (Valeant Pharmaceuticals, Australia) dissolved in 250 mL water/taken daily	120 min	Extract supplementation is a promising nutritional intervention for the management of acute postprandial glucose and insulin homeostasis, and it is a possible adjunctive treatment for glycemic management of chronic metabolic disorders such as prediabetes and type 2 diabetes mellitus	Atkinson et al. (2019)
A double-blind cross-over clinical trial	28 patients with type 2 diabetic mellitus/40 to 60 years	Aqueous decoction once a day	13 g of leaf powder boiled in 500 mL of distilled water (aqueous decoction)	21 days	The postprandial blood sugar was significantly altered after treatment with aqueous decoction {decreased from 230 ± 64.67 mg/dL at baseline to 193 ± 61.70 mg/dL in the intervention group, while it was 229 ± 70.13 mg/dL in the control group ($P < 0.001$)}	Mazhin et al. (2016)

Table 4 (*continued*)

Study	Age (years)	Treatment	Dose	Recommended time	Useful outcomes	References
A double blind randomized clinical trial	40 patients with multiple sclerosis and constipation/ 25 to 50 years	Carica paste three times a day	10 g	90 days	Mean reductions in the frequency of hard stool in intervention group showed no significant difference ($P = 0.518$) with the placebo group. One patient in fig paste group reported nausea after taking the supplement	Sardari et al. (2015)
A double-blinded, randomized, and placebo-controlled trial	45 children with mild to moderate atopic dermatitis /4 months to 14 years	Melfi cream (aqueous extract of sundried fruit and base cream)/ cream applied twice a day for two weeks	30 g for topical use	14 days	The treatment had significantly increased efficacy in terms of reducing the SCORAD index, pruritus, and intensity scores in comparison with hydrocortisone (1.0%; $P < 0.05$) and the placebo failed to ameliorate the symptoms	Abbasi et al. (2017)
A randomized controlled parallel group clinical trial	56 patients with rheumatoid arthritis/over 18 years	Herbal supplement (combination of olive oil, olive fruit and *F. carica* fruit/2:5:1 w/w)/supplement given with meals and were asked not to change the usual dietary intake	15 g (equal to 1 tablespoonful)	10 days	The supplement treatment did not show any adverse effects on the concentration of plasma lipids and fasting blood sugar. No other significant adverse effects contributed to the herbal supplement was seen in the study groups except one case with severe unclassified hiccup in the intervention group that lead to his withdrawal from the study	Bahadori et al. (2016)
A randomized, open, single-blinded, placebo-controlled, observer-blinded study	31 female subjects with facial wrinkle, especially the crow's feet region of eyes/45–65 years	2% Combined fruit extracts (*Punica granatum*, *Ginkgo biloba, Ficus carica*, and *Morus alba*) were mixed with a formulation containing water, carbomer, glycerine, disodium EDTA, methyl paraben, triethanolamine, tocopheryl acetate, polysorbate 60, stearyl alcohol, PEG-100 stearate, sorbitan stearate, caprylic/capric triglyceride, dimethicone, mineral oil, propylparaben, butylene glycol, beeswax, and fragrance/ formulated fruit extract topically applied on one side of the face (crow's feet) twice a day	2% topical formulated fruit cream	56 days	Treatment significantly reduced the percentage of wrinkle depth, length, and area by 11.5%, 10.07%, and 29.55%, respectively, when compared to the placebo. The dermatological scores of the treated sides decreased significantly ($P = 0.05$) with 1.5-fold lower than that of the placebo	Ghimeray et al. (2015)

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Table 4 (*continued*)

Study	Age (years)	Treatment	Dose	Recommended time	Useful outcomes	References
Single blinded and comparison study	11 Asian healthy males with skin irritation/ between 20 and 35 years	Cream containing *F. carica* fruits/ formulation were applied to the cheeks of human volunteers	Cream (4% concentrated extract of fruits)	56 days	Cream reduced the skin melanin, trans–epidermal water loss and skin sebum significantly but enhanced the skin hydration significantly	Khan et al. (2014)
Open right/left comparative trial	25 patients with common warts/5 to 20 years	Patients were asked the self-application of fig tree latex to warts on one side of the body	Latex	180 days	Fig tree latex therapy of warts offers several beneficial effects including short-duration therapy, no reports of any side-effects, ease-of-use, patient compliance, and a low recurrence rate	Bohlooli et al. (2007)
A randomized, placebo-controlled study	10 Patients (6 men and 4 women) with insulin-dependent diabetes mellitus/ 22–38 years	Patients were given a decoction as a non-sweet commercial tea	Aqueous decoction of fig leaves	30 days	Post-prandial glycemia was significantly lowered during treatment (156.6 ± 75.9 mg/dl versus control 293.7 ± 45.0 mg/dl; $P < 0.001$). Medium average capillary profiles were also lowered in the treated patients (166.7 ± 23.6 mg/dl, versus control 245.8 ± 14.2 mg/dl; $P < 0.05$)	Serraclara et al. (1998)
F. fistulosa						
–	10 healthy volunteers with oily skin/20 to 25 years old	Aqueous extract tested for safety and *in-vivo* sebum controlled efficacy	Hydrogel containing extract	28 days	After 28 days of application, the sebum levels of volunteers were significantly decreased ($P < 0.05$)/ mean percentage of sebum content was also reduced in hydrogel treated patients (54.36% ± 13.7%) on day 28	Ditthawutthikul et al. (2021)
F. hispida						
–	30 Patients of vitiligo/20 to 30 years	Fine powder of the fruits given orally twice a day with equal quantity of jaggery/bark powder was also applied to the lesion of vitiligo in the form of an ointment with *Til Tail*	24 g/day	42 days	More than 50% of patients attained rapid pigmentation. Lesions of the neck, leg, hand, chest responded rapidly while the lesion of the lips and hips were slow to respond	Morale (2021)
F. lacor						
–	A male patient having non healing ulcer on right leg medially above the ankle joint, associated pain and foul-smelling discharge from the wound/55 years old	Ointment (malahar) was applied locally for thirty days followed by alternate day for next fifteen days. Supportive treatment of Vitamin B and C along with zinc was also given orally	Aqueous extract of stem bark was used for the preparation of ointment/ ointment prepared as per the formulation described in 'Ras tarangini', an ancient compendium	45 days	After 45 days, the wound was healed with healthy granulation tissue, purulent discharge and foul smell was totally absent. Bark extract rich in caffeic acid, have regulatory mechanism on glucose metabolism in diabetes	Changade et al. (2021)
F. pumila						
–	3814 Japanese patients with upper borderline high BP and dyslipidaemia/20 to 50 years	Ishimaki tea, prepared from dried stems and leaves, followed by extraction of the major components with water. Patients were asked to	200–300 mL	90	Ishimaki tea significantly reduced mean body mass index/systolic BP/diastolic BP/total cholesterol/low density lipoproteins/γ-glutamyl trans	Suzuki et al. (2021)

Table 4 (*continued*)

Study	Age (years)	Treatment	Dose	Recommended time	Useful outcomes	References
		drink Ishimaki tea a day			peptidase /uric acid/ triglyceride/ and total glycerides/ high-density lipoprotein cholesterol-C, whereas high-density lipoprotein cholesterol was significantly increased	
–	28 Human T-cell leukemia virus type 1/19 were female (58 to 97 years old) and 9 were male (82 to 94 years old)	Ishimaki tea administered to the patients	2.441 mg/200–300 g leaves/day of rutin and approximately 1.411 mg/200–300 g leaves/day of apigenin	–	Those who were administered extracts had no human T-cell leukemia virus type 1-related symptoms, while those who were not administered extracts had human T-cell leukemia virus type 1-related diseases	Gonda et al. (2021)
F. racemosa						
–	Volunteers were healthy, non-smokers, had not taken any medications, including aspirin	Two concentrations (50 and 100 µg/mL) dissolved in 25 µL phosphate buffered saline to 450 µL aliquots of platelet-rich plasma were given to volunteers	Hot and cold aqueous bark extracts (100 µg/mL)	14 days	Both the extracts induced aggregation of platelets to an extent of 3–51% compared to control. However, the extent of aggregation induced by both extracts were significantly lower ($P \leq 0.05$) than those induced by collagen (2 µg/mL), adenosine diphosphate (10 µM) and epinephrine (10 µM), respectively	Ahmed et al. (2012b)
A double-blinded, randomized, placebo-controlled trial	30 (18 men and 12 women) patients with type 2 diabetes/ 35 to 50 years	Aqueous extract of stem bark given two times before each meal	1.2 g/day (400 mg × 3 hard gelatin capsules)	360 days	A significant increase ($P < 0.05$) in insulin levels was observed in the extract-supplemented group, but no significant ($P > 0.05$) changes were observed in the control group	Ahmed et al. (2011a)
A single/double blinded, randomized placebo-controlled trial	50 Patients with type 2 diabetes/35 to 50 years	Aqueous extract (1 gelatin capsule) of leaves taken thrice a day before each meal	1 capsule (400 mg)	56 days	A significant reduction in fasting and postprandial blood glucose levels were achieved in the patients. Moreover, a significant increase in the serum insulin level was recorded in treated patients. Regenerated pancreatic β-cells resulting in increased synthesis and secretion of insulin into the blood stream	Urooj and Ahmed (2013)
F. religiosa						
A randomized clinical trial	30 Patients with type II diabetes mellitus/30 to 70 years	Aqueous extract of stem bark taken twice a day before meals with water	500 mg	30 days	Extract showed beneficial effects on fasting & post meal blood sugar levels. The drug was well tolerated by all patients throughout the treatment period. There was no evidence of adverse side-effects reported in the patients	Vaishali et al. (2014)

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Table 4 (*continued*)

Study	Age (years)	Treatment	Dose	Recommended time	Useful outcomes	References
A multicentric double blind homoeopathic pathogenetic trial	24 healthy volunteers (19 males and 5 females)/18 to 50 years/ elicit the pharmacodynamic response	4–6 globules given four times a day, dry on tongue/ two stages of two different potencies viz. 30C and 200C	56 doses	14 days	Heaviness with coryza and pain in throat (2, 30C)/headache with malaise and pain in left hip and left foot (1, 30C)/constipation with headache (1, 200C)/bursting pain in eyeballs, walking (1, 200C)/pain in joints of lower extremities, sensation as if broken down (1, 30C) observed in volunteers	Dey et al. (2008)
	44 patients with diabetes mellitus and erectile dysfunction/21 to 60 years	Ashvattha powder made from its root and stem barks, fruit and tender leaf buds/powder dissolved in 1 glass of milk and taken twice a day (morning – before meal and evening – after dinner)	10 g	45 days	In both the diabetic and the nondiabetic subjects, Ashvattha provided encouraging results on erectile dysfunction as well as on seminal parameters in comparison to the placebo	Virani et al. (2010)
–	18 normal healthy subjects/post prandial glycemic response and glycemic index/24 to 32 years	The food products: dal samose (10% leaf powder) and bati (5% bark powder) were given for two days	The dal samose and bati were supplemented with 5 and 10% powder of leaves and stem bark	2	The dal samose (10% leaves) and Bati (5% bark) were insignificant at $P \leq 0.05$ level which was comparable with standard. Glycemic index and glycemic load values were found to be lowest for 10% leaves incorporated dal samose (35 and 13) when compared to 5% bark incorporated Bati (53 and 20)	Chaturvedi et al. (2014)

Table 5 Toxicological effects of Indian Ficus species.

Plant species	Plant parts	Extract/compound	Dose	Type of toxicity	Model/symptoms	References
F. benghalensis	Root	Ethanol and aqueous	3000 mg/kg b.w. of each extract	Behavioral, neurological, autonomic profiles and lethality were observed for 28 days during antiarthritic study	Extracts were found safe/no behavioral changes and mortality recorded up to 28 days in male Wistar rats	Bhardwaj et al. (2016)
F. carica	Leaf	Aqueous	Rats fasted for 12 h/first phase animals received 2000, 3000, 4000 and 5000 mg/kg b.w. for 24 h/in second phase animals received 5500, 5750 and 6000 mg/kg b.w. of extract	Hematological and some biochemical parameters	There was no mortality recorded when all the doses of the extract were administered orally to the rats. The rats showed negative behavioral changes at 5000, 5500, 57,250 and 6000 mg/kg dosages. The LD_{50} obtained was higher than 6000 mg/kg by implication	Odo et al. (2016)
F. deltoidea	Leaf	Ethanol	2000 mg/kg b.w. given for 14 days in case of acute toxicity while 1000 mg/kg b.w. given for 28 days in case of sub-chronic toxicity	Acute and subchronic toxicities were studied in mice	Acute toxicity - no signs of symptoms of toxicity or behavioral changes and mortality reported within 72 h–14 days. Extract at this dose did not affect the body weight of mice. Sub-chronic toxicity - extract did not produce any symptoms of toxicity, changes in behavior, and mortality in mice	Nugroho et al. (2020)
			2000 mg/kg b.w./p.o./monitored for 14 days in case of acute and 1000 mg/kg/p.o. monitored for 28 days in case of subchronic toxicity	Symptoms of physical and behavioral changes, mortality rate were determined (LD50)	Acute toxicity - Extract did not show any symptoms of toxicity and mortality, LD50 was above 2000 mg/kg b.w. Subchronic toxicity - Extract did not produce any symptoms of toxicity, changes in behavior, and mortality in animals	Nugroho et al. (2020)
		Methanol	5000 mg/kg given for 14 days in case of genotoxicity and acute and subchronic toxicities recorded at 2500 mg/kg dose (monitored for 28 days)	Mortality, clinical signs, body weight changes, hematological and biochemical parameters, gross findings, organ weights, and histological parameters were studied	Acute toxicity - there were no significant changes in behavior, such as apathy, hyperactivity, or morbidity reported in any of the animals. Subchronic toxicity - did not show any mortality, body weight gains, behavioral changes or food and water consumption between the animals of the treated and control group	Farsi et al. (2013)
F. exasperata	Leaf	Aqueous	2.5, 5, 10 and 20 g/kg administered daily for 14 days	Hematological parameters, body weight and body temperature in mice/ acute toxicity over 24 h and 14-day periods	Extract caused neither mortality nor changes in behavior, body weight and body temperatures. No significant differences in hematological parameters (WBC count, platelet, and hemoglobin estimation) in control or treated animals were recorded. However, the daily dose up to 14 days showed significant increase in body temperature ($P < 0.05$) but, a significant decrease in the red blood cells count, hemoglobin count and hematocrit values ($P < 0.05$) were recorded	Bafor and Igbinuwen (2009)
		Methanol	1500, 3000, and 5000 mg/kg/p.o./ acute toxicity observed for 14 days	Changes in behavior, and body weight parameters were measured	Symptoms of toxicity recorded were as unease, sluggishness, and dizziness three	Shemishere et al. (2020)

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Table 5 (*continued*)

Plant species	Plant parts	Extract/compound	Dose	Type of toxicity	Model/symptoms	References
					hours after administration of extract in male Wistar rats	
F. hispida	Leaf	Methanol	4000 mg/kg b.w./p.o./acute toxicity observed for 14 days	Rate of mortality, behavioral pattern changes such as weakness, aggressiveness, food or water refusal, diarrhea, salivation, discharge from eyes and ears, noisy breathing, changes in locomotor activity, convulsion, coma, injury, pain, or any sign of toxicity in each group of animals were recorded	No mortality and behavioral changes or symptoms of toxicity observed in treated animals during this period of study	Mushiur Rahman et al. (2018)
F. racemosa	Stem bark	Aqueous	2000 mg/kg b.w./p.o./acute toxicity observed for 7 days	Acute toxicity/the observation in tremors, convulsion, salivation, diarrhea, lethargy, or unusual behaviors such as self-mutilation, walking backward, and difference in body weights were studied	No lethal effect or mortality was observed in animals throughout the test period following single oral administration. Animals did not show any tremors, convulsion, salivation, diarrhea, lethargy, or unusual behaviors such as self-mutilation, walking backward, and difference in body weights before and after the study period	Solanki and Bhavsar (2014)
F. religiosa	Stem bark	Ethanol	2000 mg/kg b.w./p.o./acute toxicity monitored for 14 days	Acute toxicity/changes in body weight, food intake, water intake, relative organ weight, hematological parameters and histoarchitecture of vital organs were studied	There were no remarkable alterations in the general behavior, toxicity signs and mortality recorded in rats treated with extracts (p.o.). In extract treated rats, a significant decrease in the levels of water intake recorded when compared to the control	Elavarasi et al. (2018)
		Acetone	2000 mg/kg b.w.	Acute toxicity studied in Wistar albino rats (p.o.)/ animals were observed for general behavioral, neurological, autonomic profiles, any toxicity and mortality during antiulcer study	Extract did not show any mortality, changes related to behavior, autonomic, neurologic, and physical disorder within the first 24 h and during the 14 days follow-up. The plant extracts were found to be safe at the tested dose.	Panchawat and Pradhan (2020)

The leaves, stem, aerial roots, and stem bark of Ficus plants have been used in alleviating fever and relieving pain and to treat flu, malaria, acute enteritis, tonsillitis, bronchitis, and rheumatism. Ficus plants contain various classes of compounds including monoterpenes, diterpenes, sesquiterpene, triterpenes, alkaloids, and flavonoids. The isolated compounds from Indian Ficus species possess antioxidant, antimicrobial, anticancer, anti-inflammatory, radioprotective, neuroprotective, and wound healing properties. The clinical study of *F. carica* capsules reveals its applications in the treatment of constipation. Panchavalkal formulation (ethanol extract of *F. benghalensis*) improves the healing of Dushta Vrana (infected wound) in the patients. Many studies on ethnomedicinal properties, characterization of phytoconstituents, pharmacological activities of 31 Ficus species have been conducted but there is still a need to perform further experimental studies on the exploration of chemical characterizations and pharmacological evaluations of 66 Indian Ficus species. Very few clinical studies (only 8 Ficus species) have been performed on the Indian Ficus species whereas no clinical studies have attempted on 23 Indian Ficus species. Therefore, intensive research is to be conducted by the researchers on the examination of therapeutic and toxicological effects of Indian Ficus species that will help in the development of new pharmaceutical drugs in the future.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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