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Review Article

ETHNOMEDICINAL, PHYTOCHEMICAL, AND PHARMACOLOGICAL INSIGHTS INTO *TEPHROSIA PURPUREA* (FABACEAE): A COMPREHENSIVE UPDATE

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ABSTRACT

Tephrosia purpurea (Fabaceae) is a widely used medicinal plant in traditional systems of medicine, known for its diverse therapeutic applications. This review comprehensively summarizes the pharmacological activities of *T. purpurea*, highlighting its hepatoprotective, anti-diabetic, anti-cancer, anti-ulcer, anti-inflammatory, antimicrobial, anthelmintic, antioxidant, and wound-healing properties. The broad spectrum of biological effects is primarily attributed to its rich phytochemical composition, including flavonoids, phenolic, rotenoids, alkaloids, and glycosides, which act synergistically to modulate multiple biochemical pathways. Preclinical studies further demonstrate its potential in cardiovascular protection, cataract prevention, and lipid regulation. The evidence supports *T. purpurea* as a promising source of bioactive compounds for the development of novel, safe, and cost-effective therapeutic agents. However, further pharmacokinetic, toxicological, and clinical studies are needed to standardize active constituents, elucidate mechanisms of action, and confirm safety and efficacy for therapeutic use. The bioactive constituents of *T. purpurea*, particularly karanjin and deguelin, show significant potential for the development of multitarget therapies, especially for metabolic and inflammatory disorders. Further research is needed to fully explore their pharmacological efficacy and therapeutic applications.

Keywords: *Tephrosia purpurea*, Fabaceae, Ethnomedicinal, Phytochemicals, Pharmacological activity.

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INTRODUCTION

Over the past 5 years, drug discovery has increasingly focused on herbal medicines to address challenges such as antimicrobial resistance, chronic diseases, and the limitations of single-target drugs. Plant-derived natural products offer unique chemical scaffolds and multifunctional bioactive mixtures with favorable safety and cultural acceptance [1,2]. Recent studies highlight their promising antimicrobial, antivirulence, and antibiofilm effects against multidrug-resistant pathogens, yet only a small fraction of medicinal plants have been thoroughly investigated [3].

Fabaceae plays a crucial role in the management and cure of a wide variety of diseases due to its rich diversity of bioactive compounds and high medicinal value. Many species in this family are integral to traditional and ethnomedicinal practices worldwide, serving as primary healthcare resources, especially in marginalized and rural communities. The therapeutic versatility of Fabaceae is attributed to phytochemicals such as alkaloids, flavonoids, saponins, tannins, and polyphenols, which impart analgesic, anti-inflammatory, anticancer, antidiabetic, antimicrobial, antioxidant, antiproliferative, healing, cardioprotective, and antiulcerogenic. Distinct genera such as Indigofera, Senna, Albizia, Rhynchosia, and Vachellia are widely recognized for managing gastrointestinal, respiratory, reproductive, and infectious conditions [4,5].

Tephrosia purpurea (L.) Pers., also called "Sarapunkha," is a plant referenced in classical Ayurvedic literature. Tephrosia species have traditionally been used by indigenous cultures as fish toxins. Several species of Tephrosia are also medicinally significant and are found across the globe [6].

T. purpurea has a long history of ethnopharmacological use, as documented in ancient texts. It is a key ingredient in herbal remedies such as Tephroli and Yakrifti, commonly used to treat liver disorders. Known for its efficacy in treating inflammation and liver and spleen enlargement, the plant has also been traditionally used to address impotence, gonorrhea, asthma, gastrointestinal issues, and diseases of the heart, blood, and kidneys. In addition, it is used to alleviate pain, inflammation, and prevent vomiting [7].

Although *T. purpurea* has a long history of use in traditional medicine, there is limited scientific research on its chemical components and their molecular mechanisms. While *T. purpurea* has shown promising therapeutic potential based on traditional uses and anecdotal evidence, rigorous preclinical and clinical studies are still needed to scientifically validate these claims. There is also a lack of standardized methods for isolating and characterizing the plant's bioactive compounds, especially those that target metabolic, inflammatory, and infectious diseases. Most current research has focused on individual compounds, but the synergistic interactions between these compounds within the whole plant have not been fully explored. In addition, more extensive research is needed to assess the safety, toxicity, and pharmacokinetics of *T. purpurea* preparations to support their clinical use. Addressing these gaps is crucial for translating its traditional therapeutic applications into evidence-based treatments for modern medicine.

METHODS

The phytopharmacological data were sourced from research and review articles accessed through Google Scholar, Scopus, Web of Science, PubMed, ScienceDirect, and Springer, as well as authoritative texts including "The Flora of Orissa," "Indian Medicinal Plant," "Compendium of Indian Medicinal Plants," and similar references.

TAXONOMY AND IDENTIFICATION OF *T. PURPUREA*

Scientific classification

- Family: Fabaceae
- Subfamily: Faboideae
- Scientific name: *T. purpurea*
- Genus: Tephrosia
- Order: Fabales
- Kingdom: Plantae.

Morphological description

T. purpurea is a perennial herb or subshrub that may grow erect or trail along the ground, reaching heights of up to 50 cm. It is commonly found throughout the Indo-Malesian region, with particularly dense populations in the Himalayas and the Western Ghats. The plant exhibits an extended flowering and fruiting season, typically from March through October. Detailed morphological descriptions are presented in Table 1 [8,9].

Microscopical description

The transverse section of the mature root of *T. purpurea* exhibits a well-defined periderm composed of 6–10 layers of cork cells, 2–4 layers of phelloderm, and several layers of cortex. The cork cells are tangentially elongated and suberized, while the phelloderm consists of thin-walled parenchymatous cells containing starch grains and calcium oxalate crystal prisms. The cortex also contains parenchyma with similar crystal inclusions and starch grains. Groups of thick-walled pericyclic fibers are positioned at the lower cortex, with thick-walled fibers present singly or in clusters within the phloem. Calcium oxalate crystals and starch grains are abundant in the medullary rays, and xylem vessels are found singly or in small groups, some showing reticulate thickening. These microscopic features serve as important diagnostic markers for species identification and differentiation. Microscopic examination of the powder revealed the presence of phloem fibers, concentric starch grains, pitted and border-pitted xylem vessels, reticulate xylem vessels, crystal fibers, and groups of cork cells [10].

Ethnopharmacology of *T. purpurea*

The ethnomedicinal investigation revealed that *T. purpurea* is employed by tribal and local communities to alleviate various health issues and disorders. Table 2 represents various health issues along with their corresponding indications [6,11].

Chemical constituents of *T. purpurea*

The aerial parts of *T. purpurea* contained a variety of compounds, including aromatic esters, terpenoids, phytosterols, fatty acids, methyl ketones, and steroids. The compounds exhibited; 2-propenoic acid, 3-(4-(acetyloxy) -3-methoxypheny)-3(4-actyloxy)-3-methoxyphenyl)-2-propenyl ester, sesquiterpene, Stigmasta-5,24(28)-dien-3-ol, (3β,24Z)-, Ethyl iso-allocholate, docosahexaenoic acid, 1,2,3-propanetriyl ester, 10,13-Eicosadienoic acid, methyl ester, docosanoic acid nonyl ester, 2-Tridecanone, pentacosanoic acid, methyl ester, n-Hexadecanoic acid, phytol, 9,12,15-Octadecatrienoic acid, (Z, Z, Z)-, 2-Benzoylamino-3-(p-tolyl-)-N, N-dimethyl-propenamide, psi., psi. -Carotene, 7,7',8,8',11,11',12,12',15,15'-decahydro, trimethylsilyl (5E,13E)-9,11,15-tris[(trimethylsilyl) oxy] prosta-5,13-dien-1-oate #, Docosanoic acid, 1,2,3-propanetriyl ester, Pregnane-12,18,20-triol, 18,20-isopropylidene-3,3-ethylenedioxy, Phytol, Demeclocycline, Hyocholic acid, Xanthophyll, 4a-Phorbol 12,13-didecanoate, octadecane, 1,1'-[1,3-propanediylbis(oxy)] bis, 25-Norisopropyl-9,19-cyclolanostan-22- en-24-one,3-acetoxy-24-phenyl-4,4,14- trimethyl, and 7,8,12-Tri-O-acetyl-3-desoxy-ingol-3-one. These compounds exhibited pharmacological activities such as anti-inflammatory, antioxidant, antimicrobial, antitumor, antidiabetic, hepatoprotective, anticancer, antiulcer, antiasthmatic, antispasmodic, analgesic, antihyperlipidemic, anticonvulsant, antifungal, anti-allergic, antipyretic, and wound healing effects. Notably, sesquiterpene and n-hexadecanoic acid displayed broad-spectrum effects, including antimalarial, antiplasmodial, and anti-arthritic activities. Compounds such as stigmasterol, pentacosanoic acid methyl ester, and phytol revealed multitarget activities relevant to metabolic, inflammatory, infectious, and degenerative diseases (Table 3).

Chemical profiling of the flower identified two main compounds: delphinidin, a polyphenolic compound, and cyanidin chloride, a flavonoid. Delphinidin exhibited anti-inflammatory, antioxidant, anti-mutagenesis, and antiangiogenic activities, while cyanidin chloride showed antioxidant and anti-inflammatory effects (Table 3).

Table 1: Morphological characteristics of *Tephrosia purpurea*

Parts	Description	Shape	Size
Leaves	The leaves contain 7–15 leaflets	Obovate to narrowing oblanceolate, base cuneate, apex blunt, notched or truncate.	1–2.8×0.3–1 cm
Flowers	Flowers are papilionaceous, pink to purplish in color.	-	Standard length 7 mm, Pedicels 3–4 mm, bracts 2 mm
Calyx	The calyx is described as being covered with velvety or hispid (bristly) hairs and possesses five teeth that may be equal or slightly unequal in length, with the lower tooth typically being longer and narrower than the others.	Tapering to a sharp point	3–4 mm long
Corolla	The corolla displays a papilionaceous structure, consisting of a large standard (vexillum) petal, two lateral wing petals, and a fused keel formed by the two lower petals that enclose the stamens and pistil. The petals typically range in color from white to shades of purple or pink	Rounded, broad, wings and keel slightly short, curved inward	4 mm
Androecium	The androecium consists of ten stamens arranged in a diadelphous manner, wherein nine staminal filaments are fused into a single bundle, while one filament remains free.	Staminal tube	4 mm long
Gynoecium	The ovary is superior and bears a pubescent (hairy) surface. The style is flattened and becomes glabrescent (loses hairs) with maturity, terminating in a stigma that ranges from penicillate bearing fine brush-like hairs to nearly glabrous (smooth and hairless).	Flattened, glabrous	-
Fruit	The fruit of *Tephrosia purpurea* is described botanically as a flat, pubescent (hairy) leguminous pod that is initially green and undergoes maturation to a brown coloration. Multiple seeds (5–7) are enclosed within the pod at maturity.	Pod linear-oblong, pubescent, and dehiscent	2.5 cm long, and 3–4 mm broad
Seed	The seeds are enclosed within a long, flattened, and pubescent (hairy) pod, and possess a smooth surface with a mottled or variegated appearance. Their coloration ranges from yellowish to dark brown or black, and the seeds are typically oblong to ellipsoid in shape.	Oblong, slightly flattened	4 mm long and 2.5 mm wide

Table 2: Ethnopharmacology of *Tephrosia purpurea*

Sl. No.	Parts Used	Condition	Application	Ethnic group
1	Whole plant	Jaundice and hepatomegaly	Used as a whole for treatment	Vedic literature of India (between 8–10 AD)
		Wounds healing	Known as *Sarwa Wrana Vishapaka*, used for wound healing	Tribal and non-tribal of district Bargarh, Odisha
2	Dried herb	General weakness, constipation, and water retention		-
		Bronchitis, bilious fever, boils, pimples, dental diseases, scrofula, painful labor, bleeding piles, laxative, and diuretic	Used directly for treatment	
3	Leaf extract (3 teaspoons)	Edema	Taken twice daily on an empty stomach	Tribal and non-tribal of district Bargarh, Odisha
4	Leaves	Dyspepsia, chest diseases, and hemorrhoids	Prescribed for consumption	-
5	Leaves smoke	Asthma	Inhaled through mouth	Tribal and non-tribal of district Bargarh, Odisha
6	Roots	Leprous wounds, skin eruptions	Root juice applied topically	
		Chronic diarrhea	Decoction (4 teaspoons), 2–3 times daily	
		Old, dirty wounds	Treated with rice water containing root	-
		Spleen enlargement	Chewed directly or with butter	Tribal and non-tribal of district Bargarh, Odisha
		Intestinal worms in children	Used as an anthelmintic in Sri Lanka	In Sri Lanka
		Fish poisoning	Used to stupefy or poison fish in French Guiana	French Guiana
7	Root+fruit powder of *Piper nigrum*	Gonorrhea	Crushed together, paste (1 g), taken 3 times daily	Tribal and non-tribal of district Bargarh, Odisha
8	Roots+leaves of *Tagetes erecta*	Stool with blood	Crushed in a 1:4 proportion, paste (1 g), taken 3 times daily	
		Piles	Crushed in a 1:4 proportion, paste (1 g), taken 3 times daily	
9	Root bark	Enlargement of spleen	Crushed with curd (1 g), taken 3 times daily	
10	Root powder+honey	Pimples	Applied externally	
11	Root powder	Dental caries	Rubbed on teeth	
12	Seeds, roots, ash	Soil fertility	Used as fertilizer	-
13	Seed powder	Rodent bites	Mixed with buttermilk and applied	-
		Plague	Taken in warm water 3 times daily	Tribal and non-tribal of district Bargarh, Odisha
14	Seed paste+turmeric	Itch	Applied externally	
15	Seed oil	Scabies, itch, and ringworm	Used externally	
16	Stem	Dental caries	Used as a toothbrush	
17	Smoke from the whole plant	Cough and cold	Inhalation of the smoke	-
18	Burnt ash of plant	Abdominal swelling	Taken with *Terminalia chebula* powder	-

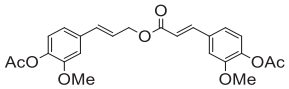
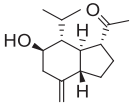
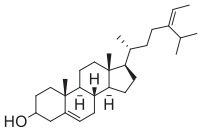
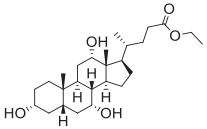
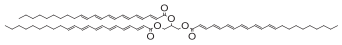
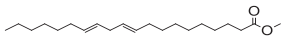
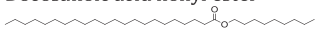
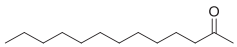
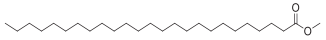
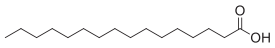
The leaf part of TP exhibited a broad range of bioactive molecules, including flavonoid glycosides, polyunsaturated fatty acids, phytosterols, polyphenolics, pentacyclic triterpenoids, rotenoids, alkaloids, neoflavonoids, and furanoflavonols. Key compounds included rutin, linoleic acid, beta-sitosterol, Vitamin P, lupeol, tephrosin, caffeic acid, oleic acid, palmitoleic acid, semialibrinol, (-)-isolonchocaprin, palmitic acid, purpurin, rotenone, beta-hydroxychalcone, lanceolatin A, steric acid, quercetin, maxima isoflavone C, purpurinetin B, kanjone, 4H-1-benzopyran-4-one, purpurinone, karanjin, (+)-tephrosin B, and 2-phenylfuro[2,3-H]chromen-4-one. These molecules showed diverse activities, including antioxidant, anti-inflammatory, antimicrobial, cytoprotective, cardioprotective, anticancer, anti-ulcer, antidiabetic, antihypertensive, antiobesity, antiaging, antimalarial, neuroprotective, antiallergic, antiviral, wound healing, immunomodulatory, analgesic, and anti-mutagenic functions. Some also exhibited antiprotozoal, antitubercular, and antischistosomal properties (Table 3).

The root part of TP primarily contained phytosterols, isoflavonoids, pterocarpans, flavonoids, furanoflavones, and indole alkaloids. Major constituents included beta-sitosterol, tephrosin, maackiain, tephroglabrin, elemichapparin C, anhydropristatin, rotenone, teturnidine, lanceolatin A, O-methylpongamol, kanjone, purpurenone, karanjin, and 2-phenylfuro[2,3-H] chromen-4-one. The predominant pharmacological activities encompassed anticancer, antioxidant, anti-inflammatory, antimicrobial, and hepatoprotective effects, along with antidiabetic, antifungal, analgesic, antiulcer, anti-asthmatic, antiviral, antimalarial, immunomodulatory, cytotoxic, neuroprotective, anti-leukemic, anti-aging, thrombolytic, and wound healing properties. Compounds such as beta-sitosterol and tephroglabrin showed multi-therapeutic benefits, including lipid-lowering, sedative, and cardiovascular protective effects (Table 3).

T. purpurea seed constituents comprised phytosterols, polyphenols, flavanones, hydroxyanthraquinones, flavonoids, neoflavonoids, furanoflavonoids, and fluoro-chalcones. Principal compounds included beta-sitosterol, caffeic acid, (-)-isolonchocarpin, purpurin, lanceolatin A, purpurinetin B, karanjin, purpurinetin A, and 2-phenylfuro[2,3-H] chromen-4-one. These demonstrated anticancer, antioxidant, anti-inflammatory, antimicrobial, hepatoprotective, cardioprotective, antidiabetic, antiulcer, antiparasitic, antimalarial, anti-Alzheimer, vasodilatory, antihyperglycemic, neuroprotective, wound healing, and immunomodulatory activities. Several compounds also possessed antifungal, antiviral, antiprotozoal, antiplasmodial, antigenotoxic, and antimutagenic effects. The wood part of TP contained the flavonoid compound rutin (Table 3).

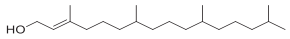
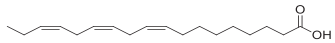
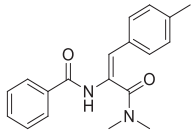
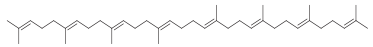
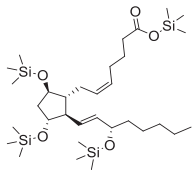
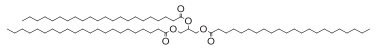
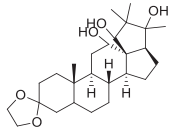
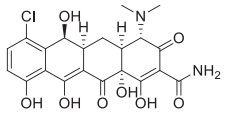
The whole plant of TP contained flavonoid glycosides, phytosterols, pentacyclic triterpenoids, rotenoids, chalcones, flavonoids, pterocarpans, polyhydroxy flavonoids, piperidinyl indoles, furanoflavones, and colorless crystalline isoflavones. Key identified compounds were rutin, sitosterol, beta-sitosterol, lupeol, tephrosin, 12a-hydroxyrotenone, betulinic acid, ursolic acid, alpha-spinasterol,

Table 3: Chemical constituents of *Tephrosia Purpurea*

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
1	2-propenoic acid, 3-(4-(acetyloxy) -3-methoxypheny)-3 (4-actyloxy)-3-methoxyphenyl)-2-propenyl ester 	$C_{24}H_{24}O_8$	440.44	Aromatic ester	Not reported	
2	Sesquiterpene 	$C_{15}H_{24}O_2$	236.35	Terpenoid	Anti-inflammatory, antimalarial, antiplasmodial, antimicrobial, and antifungal.	[12]
3	Stigmasta-5,24 (28)-dien-3-ol, (3β,24Z)- 	$C_{29}H_{48}O$	412.69	Phytosterol	Anti-oxidant activity, anti-diabetes activity, anti-tumor activity, anti-cervical cancer activity, and anti-bacterial activity.	[13]
4	Ethyl iso-allocholate 	$C_{26}H_{44}O_5$	436.6	Steroid	Antimicrobial activity	[14]
5	Docosahexaenoic acid, 1,2,3-propanetriyl ester 	$C_{69}H_{98}O_6$	1023.5	Triglyceride	Not reported	
6	10,13-Eicosadienoic acid, methyl ester 	$C_{21}H_{38}O_2$	322.5	-	-	
7	Docosanoic acid nonyl ester 	$C_{31}H_{62}O_2$	466.8	Fatty acid	Urinary acidulants and arachidonic acid inhibitor.	[15]
8	2-Tridecanone 	$C_{13}H_{26}O$	198.34	Methyl ketone	Antioxidant, antibiotic, and antifungal.	[16,17]
9	Pentacosanoic acid, methyl ester 	$C_{26}H_{52}O_2$	396.7	Fatty acid	Antioxidant, antiviral, antifungal, antibacterial, anticancer, antimicrobial, antiseptic, antidiabetic, wound healing properties, anti-inflammatory, antipyretic, anthelmintic, antimalarial, antihepatotoxic, hepatoprotective, and analgesic.	[18]
10	n-Hexadecanoic acid 	$C_{16}H_{32}O_2$	256.42	Long-chain fatty acid	Anti-inflammatory, antioxidant, antimicrobial, antiulcer, anticancer, antihistamine-release, antidiabetic, antitumor, antiasthma, and anti-arthritic.	[19]

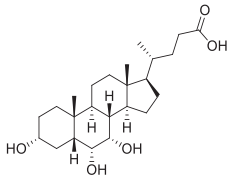
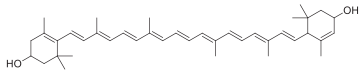
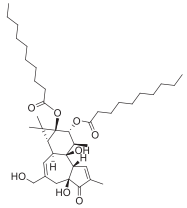
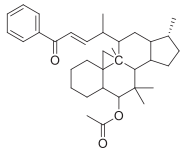
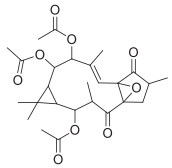
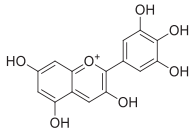
(Contd...)

Table 3: ***(Continued)***

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
11	Phytol 	$C_{20}H_{40}O$	296.5	Diterpenoid	Anti-fungal, antibacterial, anticonvulsant, anti-arthritis, insulin-sensitizing, anti-cancer, antidiabetic effect, antioxidant, neuroprotective, antimicrobial, anti-inflammatory, and antidiuretic activities.	[20]
12	9,12,15-Octadecatrienoic acid, (Z, Z, Z)- 	$C_{18}H_{30}O_2$	278.4	Steroid	Antidiabetic, anti-inflammatory, anti-fungal, anticancer, and hemolytic activity.	[18]
13	2-Benzoylamino-3-(p-tolyl-)-N, N-dimethyl-propenamide 	$C_{19}H_{20}N_2O_2$	308.4	-	Not reported	
14	psi.,. psi. -Carotene, 7,7',8,8',11,11',12,12',15,15'-decahydro 	$C_{40}H_{66}$	547.0	Carotenoid	Antibiotic, antibacterial, antimicrobial, antioxidant, antidiabetic, anti-inflammatory, antidiabetic, antifungal, and antidepressant.	[21,22]
15	Trimethylsilyl (5E,13E)-9,11,15-tris[(trimethylsilyl) oxy] prosta-5,13-dien-1-oate # 	$C_{32}H_{66}O_5Si_4$	643.2	-	Not reported	
16	Docosanoic acid, 1,2,3-propanetriyl ester 	$C_{69}H_{134}O_6$	1059.8	-	Anti-inflammatory, antioxidant, antibacterial, antiviral, candidacidal, hypocholesterolemic, antiarthritis, hepatoprotective, mosquito repellent, antimicrobial, anticancer, and cosmetics.	[23]
17	Pregnane-12,18,20-triol, 18,20-isopropylidene-3,3-ethylenedioxy 	$C_{26}H_{42}O_5$	434.6	-	Antipyretic, anti-inflammatory, analgesic, migraine, general tonic, and antioxidant.	[24]
18	Demeclocycline 	$C_{21}H_{21}ClN_2O_8$	464.86	-	Antibiotic and antidiuretic.	[25,26]

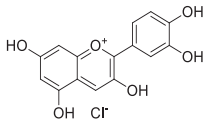
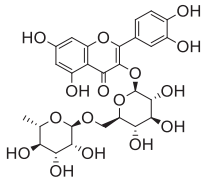
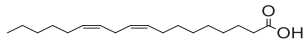
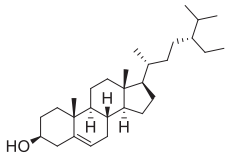
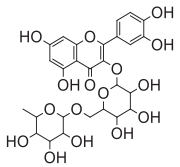
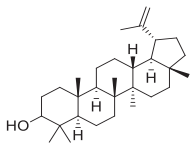
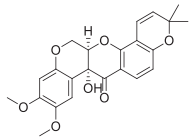
(Contd...)

Table 3: ***(Continued)***

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
19	Hyocholic acid 	$C_{24}H_{40}O_5$	408.6	Conjugate acid	Antidiabetic.	[27]
20	Xanthophyll 	$C_{40}H_{56}O_2$	568.9	Carotenol	Antioxidant, anticancer, anti-inflammatory, anti-allergic, and anti-obesity.	[28,29]
21	4a-Phorbol 12,13-didecanoate 	$C_{40}H_{64}O_8$	672.9	Phorbol ester	Not reported	
22	Octadecane, 1,1'-[1,3-propanediylbis (oxy)] bis 	$C_{39}H_{80}O_2$	581.1	Lipid	Antioxidant, anti-inflammatory, and antimicrobial.	[30]
23	25-Norisopropyl-9,19-cyclolanostan-22- en-24-one, 3-acetoxy-24-phenyl-4,4,14- trimethyl 	$C_{35}H_{48}O_3$	516.8	Terpenoids	Antiviral, antihistaminic, antiulcer, local anesthetic, fungal infection, antimicrobial, and anti-inflammation.	[31]
24	7,8,12-Tri-O-acetyl-3-desoxy-ingol-3-one 	$C_{26}H_{34}O_9$	490.5	-	Antitumor, anti-inflammatory, antileishmanial, antiprotease, immunomodulatory, irritant, and neuroprotective.	[32]
25	Delphinidin 	$C_{15}H_{11}O_7^+$	303.24	Polyphenolic	Anti-inflammatory, antioxidant, anti- mutagenesis, and antiangiogenic activity.	[33]

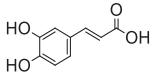
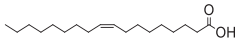
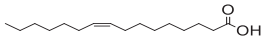
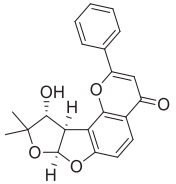
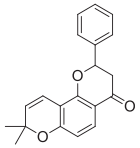
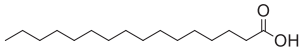
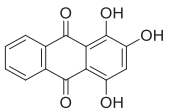
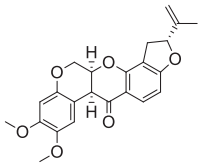
(Contd...)

Table 3: ***(Continued)***

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
26	Cyanidin Chloride 	$C_{15}H_{11}ClO_6$	322.69	Flavonoids	Antioxidant and anti-inflammatory activity.	[34]
27	Rutin 	$C_{27}H_{30}O_{16}$	610.5	Flavonoid glycoside	Antioxidant, cytoprotective, vasoprotective, anticarcinogenic, neuroprotective, cardioprotective, anti-inflammatory, anti-ulcer, antimicrobial, antifungal, antiallergic, antithrombic, anti-diarrheal, antimutagenic, immunomodulatory, antiradical, antiproliferative, and antimetastatic.	[35,36]
28	Linoleic acid 	$C_{18}H_{32}O_2$	280.4	Polyunsaturated fatty acid (PUFA)	Anti-inflammatory, antimicrobial, and antiviral.	[37]
29	Beta-sitosterol 	$C_{29}H_{50}O$	414.7	Phytosterol	Anticancer, angiogenesis, metastasis, anti-inflammatory, hepatoprotective, antioxidant, cardioprotective, antidiabetic, antibacterial, antineoplastic, wound healing, and lipid-lowering.	[38]
30	Vitamin P 	$C_{37}H_{30}O_{16}$	610.5	Polyphenolic	Antioxidant, anti-inflammatory, anticancer, anti-hypertensive, coronary heart disease prevention, and anti-human immunodeficiency virus function.	[39]
31	Lupeol 	$C_{30}H_{50}OH$	426.7	Pentacyclic triterpenoid	Anticancer, antioxidant, anti-inflammatory, antimicrobial, immunomodulating, anti-proliferative, anti-invasive, anti-angiogenic, anti-protozoal, and cholesterol-lowering agent.	[40,41]
32	Tephrosin 	$C_{32}H_{22}O_7$	410.4	Rotenoid isoflavonoid	Antimicrobial, antioxidative, anti-inflammatory, antitumor, cytotoxic activities, antifungal and antibacterial, anti-inflammatory, antimicrobial, anthelmintic, and anti-insecticidal.	[42]

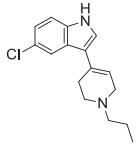
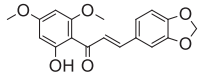
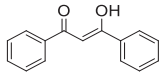
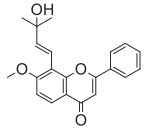
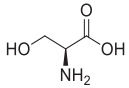
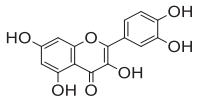
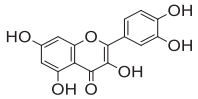
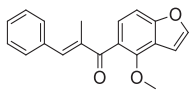
(Contd...)

Table 3: ***(Continued)***

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
33	Caffeic acid 	$C_9H_8O_4$	180.16	Polyphenolic	Antioxidant, anti-inflammatory, anticancer, antibacterial, antiviral, antiatherosclerotic, immunostimulatory, antidiabetic, cardioprotective, antiproliferative, hepatoprotective, anti-hepatocellular, carcinoma, antihyperglycemic, and anticoagulatory.	[43]
34	Oleic acid 	$C_{18}H_{34}O_2$	282.5	Monosaturated omega-9 fatty acid	Antitumor, anti-inflammatory, and antifungal.	[44]
35	Palmitoleic acid 	$C_{16}H_{30}O_2$	454.41	Omega-7 monosaturated fatty acid	Antioxidant and ferroptosis.	[45]
36	Semiglabrinol 	$C_{21}H_{18}O_5$	350.4	Flavonoid	Anti-obesity, anti-hyperglycemic, anti-oxidant, anti-inflammatory, hypotensive, antihypertrophic, and antiarrhythmic	[46,47]
37	(-)-Isolonchocarpin 	$C_{20}H_{18}O_3$	306.4	Flavonoid	Antibacterial, antifungal, anti-inflammatory, anticancer, antimalarial, antiprotozoal, anti-filarial, and anti-infective.	[48]
38	Palmitic acid 	$C_{16}H_{32}O_2$	256.42	Saturated fatty acid	Anti-inflammatory, antioxidant, immune-enhancing, anti-tumor, antiviral, and analgesic.	[49]
39	Purpurin 	$C_{14}H_8O_5$	256.209	Hydroxyanthraquinone	Antigenotoxic, anticancer, neuromodulatory, antimicrobial, antioxidant, anti-inflammatory, antidepressant, anti-Alzheimer, antimutagenic, and photodynamic.	[50]
40	Rotenone 	$C_{23}H_{22}O_6$	394.4	Alkaloid	Antiparkinson's, antiparasitic, and cytotoxicity.	[51]

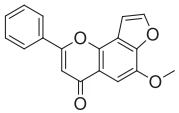
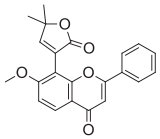
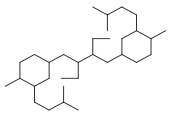
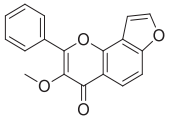
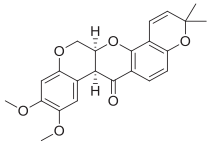
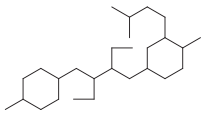
(Contd...)

Table 3: ***(Continued)***

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
41	Tepirindole 	$C_{16}H_{19}ClN_2$	274.79	Piperidinyl indole	Antiviral, antitumor, analgesic, antimicrobial, anti-inflammatory, and antihypertensive.	[52,53]
42	Tephrone 	$C_{18}H_{16}O_6$	328.3	-	Insecticidal, antiviral, antiprotozoal, antiplasmodial, cytotoxic, anti-allergic, anti-lipid, peroxidative, hepatoprotective, immunomodulatory, and antimicrobial.	[54,55]
43	Beta-hydroxychalcone 	-	-	Chalcone	Antidiabetic, anticancer, anti-inflammatory, antimicrobial, antioxidant, antiparasitic, psychoactive, neuroprotective, antispasmodic, chemopreventive, antimalarial, antifungal, antibacterial, analgesic, antiplatelet, antiulcerative, antimalarial, antitubercular, and antihyperglycemic.	[56,57]
44	Lanceolatin A 	$C_{21}H_{20}O_4$	336.4	Flavonoids	Anti-inflammatory and antitumor	[58]
45	Steric acid 	$C_{18}H_{36}O_2$	284.5	Saturated fatty acid	Antithrombotic, cytotoxic, and anti-inflammatory.	[59]
46	Quercetin 	$C_{15}H_{10}O_7$	302.23	Flavonoid polyphenol	Antioxidant, antibacterial, antiparasitic, anticancer, cardiovascular protection, anti-immunosuppression, anti-aging, anti-obesity, and anti-diabetics.	[60]
47	Maxima isoflavone C 	$C_{22}H_{20}O_6$	380.4	Isoflavone	Antioxidant, anti-inflammatory, anticancer, anti-angiogenetic, hepatoprotective, antidiabetic, antilipidemic, antiosteoporotic, and neuroprotective.	[61]
48	Purpuritenin B 	$C_{19}H_{16}O_3$	292.3	Neoflavonoid	Hepatoprotective, antidiabetic, antioxidant, antibacterial, antifungal, antidiuretic, hypolipidemic, insecticidal, antiviral, antiprotozoal, antiplasmodial, and cytotoxic.	[62]

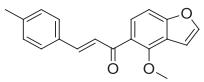
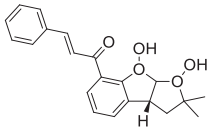
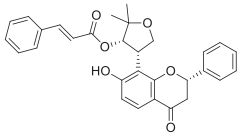
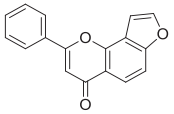
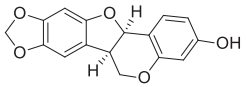
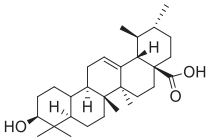
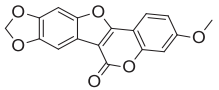
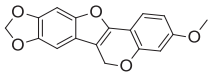
(Contd...)

Table 3: *(Continued)*

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
49	Kanjone 	$C_{18}H_{12}O_4$	292.3	Furanoflavonol	Antidiarrheal, antioxidant, cytotoxic, antimicrobial, thrombolytic, antibacterial, anti-inflammatory, hepatoprotective, and antidote.	[63]
50	8-(2,5-Dihydro-5,5-Dimethyl-2-Oxo-3-Furanyl)-7-Methoxy-2-Phenyl 	$C_{20}H_{18}O_5$	362.4	-	Anticonvulsant and antibacterial.	[64]
51	4H-1-Benzopyran-4-One 	$C_9H_6O_2$	146.14	Flavonoid	Anti-inflammatory, antiproliferative, anticancer, antibacterial, antifungal, and antidiabetic.	[65]
52	Purpurnone 	-	-	-	Antioxidant, anti-inflammation, and hepatoprotective.	[66]
53	Karanjin 	$C_{18}H_{12}O_4$	292.3	Fluranoflavonoid	Anti-diabetic, anticancer, anti-inflammatory, antihyperglycemic, antioxidant, anti-colitis, antiulcer, anti-Alzheimer, anti-ischemic, vasodilatory, antibacterial, and antiviral.	[67,68]
54	Deguelin 	$C_{23}H_{22}O_6$	394.4	Flavonoid	Inhibits tumor cell propagation and malignant transformation	[69]
55	Purpurin B 	$C_{27}H_{52}$	376.70	Anthraquinone	Anti-rheumatic, antibacterial, antigenotoxic, anticancer, antioxidant, neuromodulatory, antimicrobial, anti-inflammatory, antidepressant, anti-Alzheimer, and antimutagenic.	[50]

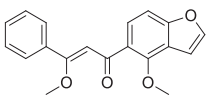
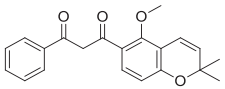
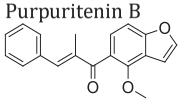
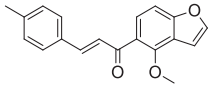
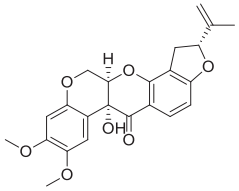
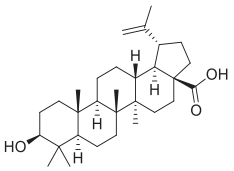
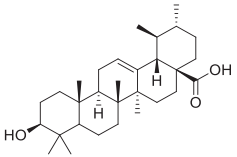
(Contd...)

Table 3: ***(Continued)***

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
56	Purpuritenin A 	$C_{19}H_{16}O_3$	292.3	Fluranochalcone	-	
57	(+)-Tephrosone 	$C_{21}H_{20}O_5$	352.4	Isoflavone	Anticancer, antimicrobial, antioxidative, and anti-inflammatory.	[70]
58	(+)-Tephrorin B 	$C_{30}H_{28}O_6$	484.5	Rotenoid isoflavonoid	Insecticidal, antiviral, antiprotozoal, antiplasmodial, cytotoxic, antidote, anti-inflammatory, antimicrobial, antioxidant, antiallergic, antidiabetic, and antitumor.	[6,71]
59	2-Phenylfuro[2,3-H] Chromen-4-One 	-	-	-	Anticancer, anti-TB, anti-inflammatory, antimalarial, and HIV inhibitory.	[72]
60	Maackiain 	$C_{16}H_{12}O_5$	284.26	Pterocarpan Isoflavonoid	Anti-inflammatory, sepsis prevention, anti-cancer, anti-allergic, anti-osteolytic, anti-obesity, nephroprotective, antifungal, neuroprotective, anti-leukemic, antimalarial, and inflammasome activation, anti-asthmatic, and antimicrobial.	[73]
61	Tephroglabrin 	-	-	Flavonoid	Wound healing, anti-inflammatory, analgesic, anti-ulcer, antimicrobial, antiviral, antioxidant, hepatoprotective, antidiarrheal, anticancer, immunomodulatory, antileishmanial, antihyperglycemic, cardioprotective, and bronchodilator.	[7,74]
62	Flemichapparin C 	$C_{17}H_{10}O_6$	310.26	Flavonoid	Anticancer, cytotoxic, antibacterial, antifungal, antioxidant, hepatoprotective, and neuroprotective activity.	[75,76]
63	Anhydropisatin 	$C_{17}H_{12}O_5$	296.27	Pterocarpan	Not reported	

(Contd...)

Table 3: *(Continued)*

Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
64	O-Methylpongamol 	$C_{19}H_{16}O_4$	308.3	Methoxylated flavonoid	Anticancer, anti-inflammatory, antioxidant, antimicrobial, and anti-diabetic activities, antioxidant, anti-aging, and anti-inflammatory.	[77]
65	Purpurenone 	-	-	-	Not reported	
66	1,3- Propanedione 	-	-	-	Not reported	
67	Purpuritenin B 	$C_{19}H_{16}O_3$	292.3	Neoflavonoid	Hepatoprotective, antidiabetic, antioxidant, antibacterial, antifungal, antidiuretic, hypolipidemic, insecticidal, antiviral, antiprotozoal, antiplasmodial, and cytotoxic.	[62,78]
68	Purpuritenin A 	$C_{19}H_{16}O_3$	292.3	Fluranochalcone	Not reported	
69	12a- Hydroxyrotenone 	$C_{23}H_{22}O_7$	410.4	Rotenoid	Anti-cancer, antimigration, anti-angiogenic, and insecticidal.	[79]
70	Betulinic Acid 	$C_{30}H_{48}O_3$	456.7	Pentacyclic triterpenoid	Anticancer, anti-HIV, antiviral, anti-inflammatory, antiparasitic, antimalarial, anti-protozoal, antimesatatic, anti-angiogenic, and neuroprotective.	[80]
71	Ursolic Acid 	$C_{30}H_{48}O_3$	456.7	Pentacyclic triterpenoid	Not reported	

(Contd...)

Table 3: ***(Continued)***

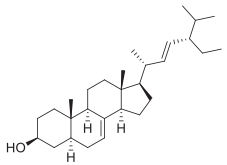
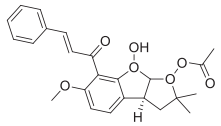
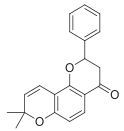
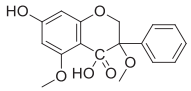
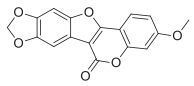
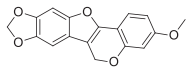
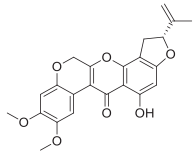
Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
72	Alpha-Spinasterol 	$C_{29}H_{48}O$	412.7	Phytosterol	Not reported	
73	(+)- Tephropurpurin 	$C_{24}H_{24}O_7$	424.4	Chalcone	Not reported	
74	(+)- Isolonchocarpin 	$C_{20}H_{18}O_3$	306.4	Flavonoid	Antibacterial, antifungal, anti-inflammatory, anticancer, antimalarial, antiprotozoal, anti-filarial, and anti-infective.	[48]
75	7,4-Dihydroxy-3,5- Dimethoxy isoflavone 				Not reported	
76	Flemichapparin C 	$C_{17}H_{10}O_6$	310.2	Flavonoid	Not reported	
77	Anhydropisatin 	$C_{17}O_{12}O_5$	296.2	Pterocarpan	Not reported	
78	1-Triacontanol	$C_{30}H_{62}O$	438.8	Fatty alcohol	Not reported	
79	Villosol 	$C_{23}H_{20}O_7$	408.4	-	Not reported	

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Table 3: ***(Continued)***

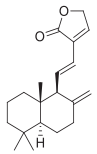
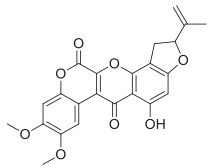
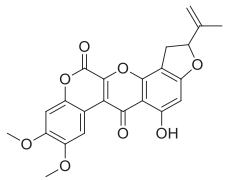
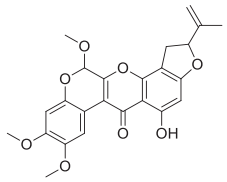
Sl. No.	Name of compounds	M.F.	M.W (g/mol)	Nature of compound	Pharmacological activity	References
80	Villosin 	$C_{20}H_{28}O_2$	300.4	Diterpenoids	Not reported	
81	Villosone 	$C_{23}H_{18}O_8$	422.4	Flavonoids	Not reported	
82	Villosinol 	$C_{23}H_{22}O_8$	426.4	Isoflavonoids	Not reported	
83	Villinol 	$C_{24}H_{22}O_8$	438.4	Flavonoids	Not reported	

Table 4: Pharmacological activity of *Tephrosia purpurea*

Sl. No.	Parts used	Extract type	Activity	Model (*in vitro*/*in vivo*)	Dose	Key outcomes	References
1	Aerial parts	Hydro-alcoholic extract	Hepatoprotective	Arsenic-induced hepatotoxicity model	sodium arsenite 10 mg/kg daily, test 100, 300, and 500 mg/kg daily	500 mg/kg significantly reduced serum ALT, AST, and ALP and increased TP levels. Higher LPO and lower GSH levels without a change in SOD level	[81,82]
2	Aerial parts	Ethyl acetate fraction of ethanolic extract	Hepatoprotective	Carbon tetrachloride-induced hepatocellular injury model	0.5 mg/kg, p.o., Silymarin 25 mg/kg, p.o., test 25, and 50 mg/kg, p.o.	50 mg/kg, p.o., showed significant alteration in the biochemical parameters and histopathology.	[83]
3	Stem	Methanolic extract	Hepatoprotective	Carbon tetrachloride-induced hepatotoxicity	CCl4 1.4 ml/kg, p.o., Silymarin 25 mg/kg, p.o., test 75, and 150 mg/kg, p.o.	150 mg/kg, p.o., found significant hepatoprotective activity	[84]
4	Aerial parts	Ethanol fraction	Anti-diabetic	Streptozotocin induced	STZ 45 mg/kg, i.v., 40 mg/kg/day p.o.	40 mg/kg showed the maximum activity	[85]
5	Leave	Benzene and ethyl acetate fractions	Anti-cancer	*In vitro* assay using human MCF-7 cell lines	0, 20, 40 – 200 µg/mL	Benzene and ethyl acetate exhibited anticancer activity, with IC_{50} values of 152.4 µM and 158.71 µM, respectively.	[86]
6	Aerial parts	Ethyl acetate extract	wound healing	Externally applied ointment (5% w/w) on wound-induced rats	0.005% Fluticasone propionate, 5% ethanolic extract ointment of *T. purpurea*	Improved wound contraction, tensile strength, and biochemical markers, along with increased fibroblast cells, collagen fibers, and blood vessel formation.	[87]
7	Aerial parts	Ethyl acetate extract	Cutaneous wound healing	Dead-space and burn models	5% w/w ointment	TPF-A, MAF-C, luteolin, and pongamol ointments (5% w/w) enhanced hydroxyproline, protein levels, and wound healing.	[88]
8	Roots	Aqueous extract	Anti-ulcer	Pyloric ligation	Cysteamine HCl 400 mg/kg, p.o. in 10% aqueous solution, Indomethacin 10 mg/kg, p.o., omeprazole 10 mg/kg, p.o., test extracts 5, 10, and 20 mg/kg, p.o.	Produced significantly less antiulcer activity than omeprazole	[89]
9	Roots	Ethanolic extract	Anti-inflammatory	Carrageenan-induced inflammation model	5, 10, and 20 mg/kg of TP, 5 mg/kg diclofenac, and 0.1 mL of 1% carrageenan	20 mg/kg body weight showed maximum activity	[90]
10	Leaves	Methanolic and aqueous extracts	Anthelmintic	*In-vitro* assay	Albendazole, and test extracts 20,40, and 60 mg/mL	The aqueous extract showed maximum effect at 60 mg/mL (paralysis time 14.16±1.51, and death time 19.01±3.12) as compared to the methanol extract	[94]
11	Leaf, root, stem, and seed	Ethanol extracts, ethyl acetate fraction	Anti-oxidant	Superoxide generation assay, CCl_4-induced lipid peroxidation	CCl4 (50% solution in arachis oil) 4 ml/kg. TP (100, 200, and 400 mg/kg) p.o.	The Superoxide generation assay showed inhibition of 25.9%, 42.8%, and 58.9%. CCl_4-induced showed inhibition of 25.9, 42.8, and 58.9%	[98]
12	Root	Alcohol, aqueous, and ethyl acetate fraction	Anti-oxidant	ABTS, DPPH, FRAP	*In vitro* antioxidant: dilution expressed in µM trolox per 100 g dry weight. *In vivo* antioxidant: CCl4 (0.5 mL/kg), Vitamin E+CCl4 (50 mg/kg+ 0.5 mL/kg), Plant extracts+CCl4 (50 mg/kg+0.5 mL/kg)	The values ranged from 45.8–140 µM (ABTS), 85–430 µM (DPPH), and 185–560 µM Trolox/100 g dry weight (FRAP	[101]

(Contd...)

Table 4: *(Continued)*

Sl. No.	Parts used	Extract type	Activity	Model (*in vitro*/*in vivo*)	Dose	Key outcomes	References
13	Leave, root, stem, and seed	Methanol extract	Antioxidant and Cytotoxic	DPPH, FRAP, reducing power assay, and antihemolytic assay.	50–500 µg/mL	Leaves extract showed the highest antioxidant activity, DPPH - 186.3±14.0 µg/mL, FRAP - 754.2±50.9 µmol Fe (II)/mg, and reducing power activity - 65.7±4.2 µg/mg	[99]
14	Whole plant	Petroleum ether and ethyl acetate	Larvicidal	*In vitro* against *Culex quinquefasciatus* larvae	50–250 ppm for petroleum ether, and 50–300 ppm ethyl acetate	larvicidal activity with LC_{50}/LC_{90} values of 152.5/261.9 ppm (petroleum ether) and 70.2/205.2 ppm (ethyl acetate)	[95]
15	Whole plant	Novel compound benzofuran	Anti-allergic	Gene expression assay	-	MBCA from *T. purpurea* exhibited anti-allergic activity by suppressing H1R gene upregulation in HeLa cells.	[96]
16	Root	Alcohol, aqueous, and ethyl acetate fraction	Anti-gout	Xanthine oxidase inhibition	Allopurinol 25–100 µg/mL	55.56% inhibitory activity at 100 µg/mL	[101]
17	Whole plant	Aqueous extract	Cardiovascular protection and cataract prevention	*In vivo* study in diabetic rats	STZ (45 mg/kg), test extracts (300 and 500 mg/kg/day, p.o.)	500 mg/kg/day altered biochemical, hemodynamic parameters, and histopathology	[100]
18	Stem, root, leaves, whole plant (excluding leaves)	Stem and whole plant	Anti-hyperlipidemic	Biochemical lipid profile analysis	Fenofibrate (5 mg/kg) + fat diet, test extracts+fat diet 400 mg/kg	Leaf extract (200–400 mg/kg) showed strong antihyperlipidemic activity	[97]
19	Leaves, stem, and root	Extract from various parts	Anti-fungal	Dual culture testing	-	61 endophytic fungi (16 genera, Ascomycota) isolated from *T. purpurea*; 6 (9.84%) showed antifungal activity, with TPL25 and TPL35 exhibiting>80% inhibition of S. sclerotiorum.	[93]
20	Roots	Ethanolic extract	Anti-bacterial	Minimum inhibitory concentration (MIC), agar dilution method	100–1,000 µg/mL	250–1,000 µg/mL showed inhibitory activity	[91]
21	Roots	Root extract	Anti-microbial	Disk diffusion assay	0–128 mg/L	128 mg/L showed maximum inhibitory activity	[92]

MBCA: 4-methoxybenzofuran-5-carboxamide

tephroglabrin, (+)-isolonchocarpin, cyanidin chloride, 7,4-dihydroxy-3,5-dimethoxyisoflavone, elemichapparin C, anhydropristatin, purpurin, rotenone, delphinidin, teturnidine, kanjone. These compounds exhibited activities such as anticancer, antioxidant, anti-inflammatory, antimicrobial, cardioprotective, antidiabetic, hepatoprotective, anti-ulcer, antiprotozoal, antimalarial, antifungal, antiviral, antihyperglycemic, immunomodulatory, wound healing, anti-Alzheimer, neuroprotective, antiaging, thrombolytic, antimutagenic, antiasthmatic, and pesticidal effects. Several compounds showed multi-target effects, including antimigratory, apoptotic, sedative, anxiolytic, and cholesterol-lowering activities (Table 3).

The fruit part of *T. purpurea* contained phytochemicals such as Beta-Sitosterol, Tephrone, 1-Triacontanol, Villosol, Villosin, Villosone, Villosinol, and Villinol. The chemical constituents, structure of the compounds, molecular formula, molecular weight, and biological activity of *T. purpurea* are represented in Table 3.

Pharmacological activity

Hepatoprotective activity

The hydro-alcoholic extract of *T. purpurea* aerial parts was administered to rats subjected to arsenic exposure to assess its potential hepatoprotective effects against acute hepatic injury and hepatocellular necrosis. Enzyme leakage, including serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP), was measured as biomarkers of liver damage. The extract demonstrated significant protective activity, as evidenced by a reduction in the leakage of these liver enzymes, suggesting its potential to mitigate arsenic-induced hepatic injury [81,82]. The ethyl acetate fraction of the ethanolic extract from the aerial parts of *T. purpurea* exhibited substantial hepatoprotective effects in the carbon tetrachloride (CCl_4)-induced hepatocellular injury model. Treatment with this extract resulted in significant reductions in serum ALT, AST, ALP, total bilirubin levels, and lipid peroxidation markers, all indicative of liver damage. In addition, the extract enhanced the levels of reduced glutathione (GSH), suggesting a modulation of oxidative stress. Moreover, a reduction in hepatic inflammation was observed, further confirming the anti-inflammatory potential of the ethyl acetate fraction in this model [83]. The methanolic extract of the stem parts of *T. purpurea* was also evaluated for its hepatoprotective effects in the CCl_4-induced hepatotoxicity model. The results revealed that the methanolic extract significantly attenuated the increase in serum ALP, serum glutamate-pyruvate transaminase, serum glutamate-oxaloacetate transaminase, and bilirubin levels, all of which are markers of hepatotoxicity. These findings suggest that the methanolic extract of *T. purpurea* stem parts effectively ameliorates liver damage induced by CCl_4 exposure, further supporting its hepatoprotective activity (Table 4) [84].

Anti-diabetic activity

The ethanolic fraction of *T. purpurea* aerial parts, rich in flavonoids, was administered to STZ-induced type 1 diabetic rats for 8 weeks at 40 mg/kg/day. Treatment significantly reduced hyperglycemia, improved the lipid profile, and normalized cardiac biomarkers (lactate dehydrogenase and creatine kinase). In addition, it restored antioxidant status in lenticular tissues, as indicated by increased reduced GSH levels and decreased lipid peroxidation [85].

Anticancer activity

The benzene and ethyl acetate fractions of *T. purpurea* were evaluated for their anticancer activity *in vitro* using human MCF-7 breast cancer cell lines. Both fractions demonstrated notable anticancer effects, with IC_{50} values of 152.4 μM and 158.71 μM, respectively, indicating their potential as cytotoxic agents against MCF-7 cells [86].

Wound healing activity

The ethyl acetate extract of *T. purpurea* aerial parts was formulated into a 5% w/w ointment and applied topically to wounds in rats. Wound healing was significantly enhanced, as evidenced by improved collagen maturation, increased collagen cross-linking, and elevated hydroxyproline levels [87]. The ethyl acetate extract of *T. purpurea* (TPF-A) was evaluated for its cutaneous wound healing potential using both dead-space and burn models. A 5% w/w ointment was applied topically twice daily and compared to povidone-iodine treatment. Biochemical and histopathological assessments were performed to evaluate the healing outcomes (Table 4) [88].

Anti-ulcer activity

The aqueous extract of *T. purpurea* roots demonstrated significant anti-ulcer activity in models of HCl, indomethacin, and pyloric ligation-induced gastric ulcers. Although its potency was lower than that of omeprazole (8 mg/kg), the extract exhibited marked gastroprotective effects, as evidenced by a significant reduction in the ulcer index (Table 4) [89].

Anti-inflammatory activity

The ethanolic extract of *T. purpurea* roots was assessed for anti-inflammatory activity using the carrageenan-induced paw edema model in rats. Doses of 5, 10, and 20 mg/kg (p.o.) were administered 1 h before carrageenan injection (0.1 mL of 1% into the left hind paw). The extract produced a significant, dose-dependent reduction in paw edema, with the maximum effect observed at 20 mg/kg (Table 4) [90].

Antimicrobial activity

The ethanolic extract of *T. purpurea* roots was evaluated for antibacterial activity using the minimum inhibitory concentration (MIC) and agar dilution method. The extract demonstrated inhibition against *Staphylococcus aureus, Pseudomonas aeruginosa,* and *Escherichia coli*, with varying levels of effectiveness against each bacterial strain [91]. The root extract of *T. purpurea* was tested for antimicrobial activity using the disk diffusion assay. It exhibited selective activity, showing significant inhibition against *P. aeruginosa* (active) but limited or no activity against *S. aureus* and *E. coli* (inactive), indicating its potential as a selective antimicrobial agent [92]. Endophytic fungi were isolated from the leaves, stem, and root of *T. purpurea* and classified into 16 genera of Ascomycota using dual culture testing. A total of 61 isolates were obtained, six of which demonstrated significant antifungal activity. Among these, isolates TPL25 and TPL35 exhibited the highest potency, inhibiting the growth of *Sclerotinia sclerotiorum* by over 80% (Table 4) [93].

Anthelmintic activity

Both methanolic and aqueous extracts of *T. purpurea* leaves were assessed for anthelmintic activity *in vitro*. The results confirmed the extracts' potential use in combating parasitic worm infestations, demonstrating notable anthelmintic effects (Table 4) [94].

Larvicidal activity

The petroleum ether and ethyl acetate extracts of *T. purpurea* whole plant were tested for larvicidal activity *in vitro* against Culex quinquefasciatus larvae. Both extracts demonstrated promising, selective, and biodegradable larvicidal properties, indicating their potential as environmentally safe mosquito control agents. Larvicidal assays of *T. purpurea* extracts against late third and early fourth instar larvae of Culex quinquefasciatus (as per World Health Organization [WHO] guidelines) demonstrated 100% mortality with petroleum ether and ethyl acetate extracts at 250 ppm and 300 ppm, respectively (Table 4) [95].

Anti-allergic activity

A novel benzofuran compound, 4-methoxybenzofuran-5-carboxamide (MBCA), isolated and synthesized from *T. purpurea*, was investigated for its anti-allergic activity. MBCA inhibited phorbol 12-myristate-13-acetate and histamine-induced upregulation of the H1R gene in HeLa cells, revealing its potential antihistaminic mechanism (Table 4) [96].

Anti-hyperlipidemia

The anti-hyperlipidemic activity of extracts from the stem, root, leaves, and whole plant (excluding leaves) of *T. purpurea* was evaluated in rats induced with hyperlipidemia using Poloxamer 407. The whole plant extract (600 mg/kg) significantly reduced total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL), while increasing high-density lipoprotein (HDL) levels. These effects were comparable to those of atorvastatin. The observed activity was attributed to the inhibition of HMG-CoA reductase and the enhancement of lipoprotein lipase activity, suggesting a strong lipid-lowering potential. Methanolic leaf extract of *T. purpurea* (200 and 400 mg/kg, p.o.) significantly reduced total cholesterol, triglycerides, and LDL-C while increasing HDL-C in high-fat diet-induced hyperlipidemic rats, showing comparable efficacy to fenofibrate (5 mg/kg) (Table 4) [97].

Antioxidant activity

The ethanolic extract of *T. purpurea* significantly inhibited carbon tetrachloride-induced lipid peroxidation and superoxide generation *in vivo*. Its ethyl acetate fraction exhibited stronger free radical scavenging and anti-lipid peroxidation activities, with lower IC_{50} values than the ethanolic extract [98]. Methanolic extracts of *T. purpurea* leaves, roots, stems, and seeds were evaluated for antioxidant and cytotoxic activities. The leaf extract showed the strongest antioxidant activity (DPPH: 186.3 µg/mL; FRAP: 754.2 µmol Fe (II)/mg) and the highest phenolic (90.5 µg GAE/mg) and flavonoid (21.8 µg QE/mg) contents. It also exhibited significant cytotoxicity against SW620 colorectal cancer cells ($IC_{50:}$ 95.73 µg/mL), indicating its potential as a rich source of antioxidant and anticancer agents (Table 4) [99].

Cardiovascular protection and cataract prevention

Aqueous extract of *T. purpurea* (300 and 500 mg/kg/day, p.o. for 8 weeks) significantly prevented streptozotocin-induced hyperglycemia, hyperlipidemia, hypertension, cardiac dysfunction, and lens biochemical alterations in rats, indicating its cardioprotective and anticataract potential (Table 4) [100].

DISCUSSION

The use of traditional medicines in treating various ailments is steadily increasing. With the growing reliance on ethnomedicine, WHO and research-focused industries have intensified their investment in the study of herbal remedies [102,103].

The traditional use of *T. purpurea*, known in Ayurveda and folk medicine for liver disorders, diabetes, inflammation, and skin ailments, receives growing scientific support through phytochemical and pharmacological studies. For example, the hepatoprotective claim is backed by research showing that ethanolic and hydro-alcoholic extracts of *T. purpurea* reduce serum ALT, AST, ALP, and bilirubin levels and attenuate oxidative stress in rat models of thioacetamide- or arsenic-induced liver damage [81]. These effects are likely mediated by flavonoids such as rutin and quercetin, which enhance antioxidant enzymes and stabilize cellular membranes [104]. Similarly, the antidiabetic activity aligns with findings where aqueous seed extracts improved glycemic indices and antioxidant enzyme levels in streptozotocin-induced diabetic rats [105]. The plant's anti-inflammatory and wound-healing applications also find a mechanistic basis through polyphenols that suppress pro-inflammatory mediators such as tumor necrosis factor-alpha, interleukin-6, and COX-2, and promote collagen synthesis and fibroblast proliferation. The isolation of newer flavonoid derivatives from *T. purpurea* further supports its multi-target action.

The quality and robustness of existing evidence vary considerably. While many studies document positive outcomes, most rely on crude extracts or fractions without full chemical standardization or dose-response optimization. For instance, high-performance liquid chromatography-PDA analyses revealed high chemo-diversity among samples, with flavonoid marker compounds such as rutin and deguelin showing significant variability across locations [106]. A large number of the pharmacological investigations remain *in vitro* or *in vivo*, with limited toxicity, pharmacokinetic, or human clinical data. Thus, reproducibility and translational potential are constrained.

Importantly, *T. purpurea* exhibits a multi-target and synergistic phytochemical profile that warrants deeper investigation. The concurrent presence of flavonoids, rotenoids, alkaloids, and glycosides indicates potential additive or synergistic effects across diverse biological pathways, including antioxidant defense, enzyme regulation, and anti-inflammatory mechanisms. This pharmacology aligns with traditional uses and may underpin its broad therapeutic potential, but it also complicates standardization and drug-development efforts. Advanced approaches such as network pharmacology, metabolomics, and molecular docking (such as a recent *in silico* screening of *T. purpurea* phytochemicals against different targets) are promising ways to map compound target networks [107,108].

Moreover, the paucity of pharmacokinetic, bioavailability, and long-term safety data restricts translation to clinical applications. Future research should emphasize standardized extraction and characterization of bioactive compounds, rigorous structure-activity relationship analyses, deeper mechanistic *in vivo* studies, and ultimately controlled human trials.

CONCLUSION

The present review consolidates strong evidence that *T. purpurea* possesses a diverse pharmacological spectrum, supporting its traditional use. Among its bioactive constituents, flavonoids and rotenoids emerge as the most pharmacologically significant compounds, contributing to hepatoprotective, antidiabetic, and anticancer activities through antioxidant activity. Future research should prioritize the clinical evaluation of standardized extracts, particularly for diabetic complications and liver disorders, alongside isolation and structural characterization of minor rotenoids and flavonoids for targeted anticancer and anti-inflammatory studies. Moreover, integrating metabolomics, network pharmacology, and *in silico* approaches will be crucial to elucidate synergistic interactions and compound target relationships. Rigorous pharmacokinetic, toxicological, and dose response studies are essential to translate these findings into safe, evidence-based herbal formulations with defined therapeutic applications.

CONSENT FOR PUBLICATION

Not applicable.

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CONFLICTS OF INTEREST

The author declares that they have no conflicts of interest.

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REFERENCES

1. Olasunkanmi AM, Ogunyemi O. Phytochemical constituents and antioxidant activity of *Persea americana* leave. Int J Chem Res. 2023;7(3):1-4. doi: 10.22159/ijcr.2023v7i3.219
2. Gaidashev IA, Syroeshkin AV. Development of a reference sample for rapid analysis of an elemental composition of medicinal plant raw materials. Int J Appl Pharm. 2024;16(2):174-81. doi: 10.22159/ijap.2024v16i2.49870

3. Woo S, Marquez L, Crandall WJ, Risener CJ, Quave CL. Recent advances in the discovery of plant-derived antimicrobial natural products to combat antimicrobial resistant pathogens: Insights from 2018-2022. Nat Prod Rep. 2023;40(7):1271-90. doi: 10.1039/D2NP00090C, PMID 37439502
4. Maroyi A. Medicinal uses of the Fabaceae Family in Zimbabwe: A review. Plants (Basel). 2023;12(6):1255. doi: 10.3390/plants12061255, PMID 36986943
5. Jadhavar P, Deshpande S. Recent updates on medicinal potentiality of Fabaceae Family: Critical review. Int J Pharm Bio Sci. 2022 Jul Sep;13(3):32-41. doi: 10.22376/Ijpbs.2022.13.3.b32-41
6. Palbag S, Dey B Kr., Singh NK. Ethnopharmacology, phytochemistry and pharmacology of *Tephrosia purpurea*. Chin J Nat Med. 2014;12(1):1-7. doi: 10.1016/S1875-5364(14)60001-7, PMID 24484589
7. Rao AS, Yadav SS, Singh P, Nandal A, Singh N, Ganaie SA, *et al*. A comprehensive review on ethnomedicine, phytochemistry, pharmacology, and toxicity of *Tephrosia purpurea* (L.) Pers. Phytother Res. 2020;34(8):1902-25. doi: 10.1002/ptr.6657, PMID 32147928
8. Youssef AM, Maaty DA, Al-Saraireh YM. Phytochemical Analysis and Profiling of Antioxidants and Anticancer compounds from *Tephrosia purpurea* (L.) subsp. Apollinea Family Fabaceae. Molecules. 2023;28(9):3939. doi: 10.3390/molecules28093939, PMID 37175349
9. Kumar Aneshwari RK, Vyas A, Jain V. Conspectus on *Tephrosia purpurea*: An introduction. Res J Pharmacogn Phytochem. 2022;14(4):281-7. doi: 10.52711/0975-4385.2022.00049
10. Devprakash BV, Srinivasan KK, Savitha. *Tephrosia purpurea* (linn.) Pers. A comprehensive review. Res J Pharmacogn Phytochemistr. 2012;4(2):134-43.
11. Sen SK, Behera LM. Ethnomedicinal uses of *Tephrosia purpurea* (l.) Pers. by the tribals of Bargarh district, Odisha. Int J Bot Stud. 2024;9(7):25-7.
12. Ivanescu B, Miron A, Corciova A. Sesquiterpene lactones from Artemisia Genus: Biological activities and methods of analysis. J Anal Methods Chem. 2015;2015:247685. doi: 10.1155/2015/247685, PMID 26495156
13. Sunarwidhi AL, Rahmaniar W, Prasedya ES, Padmi H, Widyastuti S, Pangestu KW, *et al*. *In vitro* anti-oxidant, *in vivo* anti-hyperglycemic, and untargeted metabolomics-aided-*in silico* screening of macroalgae lipophilic extracts for anti-diabetes mellitus and anti-COVID-19 potential metabolites. Metabolites. 2023;13(12):1177. doi: 10.3390/metabo13121177, PMID 38132859
14. Kullappan M, Anbarasu A, Ramaiah S. Ethyl Iso-allocholate from a medicinal rice Karungkavuni inhibits dihydropteroate synthase in *Escherichia coli*: A molecular docking and dynamics study. Indian J Pharm Sci. 2016;78(6):780-8.
15. Dash S, Nanda N, Bhanja M, Sao RB, Roy A, Dash R. GC-MS and molecular docking analyses of phytoconstituents from the plant *Tephrosia purpurea*. J Chem Health Risks. 2024;14(5):196-211.
16. Shi XQ, Zhu DH, Chen JL, Qin YY, Li XW, Qin S, *et al*. Growth promotion and biological control of fungal diseases in tomato by a versatile rhizobacterium, *Pseudomonas chlororaphis* subsp. *Aureofaciens* SPS-41. Physiol Mol Plant Pathol. 2024;131:102274. doi: 10.1016/j.pmpp.2024.102274
17. Fincheira P, Espinoza J, Vera J, Berrios D, Nahuelcura J, Ruiz A, *et al*. The impact of 2-ketones released from solid lipid nanoparticles on growth modulation and antioxidant system of *Lactuca sativa*. Plants (Basel). 2023;12(17):3094. doi: 10.3390/plants12173094, PMID 37687341
18. Alqurashi AS, Al Masoudi LM, Hamdi H, Abu Zaid A. Chemical composition and antioxidant, antiviral, antifungal, antibacterial and anticancer potentials of *Opuntia ficus-indica* seed oil. Molecules. 2022;27(17):5453. doi: 10.3390/molecules27175453, PMID 36080220
19. Ganesan T, Subban M, Christopher Leslee DB, Kuppannan SB, Seedevi P. Structural characterization of n-hexadecanoic acid from the leaves of *Ipomoea eriocarpa* and its antioxidant and antibacterial activities. Biomass Convers Biorefin. 2024;14(13):14547-58. doi: 10.1007/s13399-022-03576-w
20. Dash S, Bohidar J, Das C, Mohanty A, Meher A, Hota R. Evaluation of anthelmintic activity and GC-MS characterization of *Urochloa distachya* (L.). Int J Pharm Investigation. 2023;13(2):248-54. doi: 10.5530/ijpi.13.2.034
21. Mathkoor MM, Alkhfaji EN, Abd-Ulamer ON. Using GC-MS technology to identify the compounds resulting from mixing of alcoholic extracts of some medicinal plants. J Med Chem Sci. 2023;6(3):486-99.
22. Hossen SM, Eva TA, Karim MS, Mamurat H, Rahat MH, Nipun TS. Antimicrobial potential, GCMS analysis and molecular docking studies of *Coelogyne suaveolens* extracts: Identification of bioactive compounds with mechanism of action. Biochem Biophys Rep. 2024;37:101648. doi: 10.1016/j.bbrep.2024.101648, PMID 38314145
23. Sujatha S, Sara SC, Gayathiri M, Roselin IR, Gnana R, Ruby D. Analysis of bioactive compounds present in methanolic extract of *Phymatosorus scolopendria* (Burm. f.) Pic. Serm. Through gas chromatography and mass spectroscopy,". Int J Pharm Sci Res. 2020;11(7):3294-9.
24. Hebbar DR, Nalini MS. GC-MS characterization of antioxidative compounds from the stem bark and flower extracts of *Schefflera* Species, from Western Ghats. Pharm Lett. 2020;12(7):51-60.
25. Chopra I, Roberts M. Tetracycline antibiotics: Mode of action, applications, molecular biology, and epidemiology of bacterial resistance. Microbiol Mol Biol Rev. 2001;65(2):232-60. doi: 10.1128/MMBR.65.2.232-260.2001, PMID 11381101
26. National Institute of Diabetes and Digestive and Kidney Diseases. LiverTox: Clinical and Research Information on drug-induced liver injury. Bethesda: National Institute of Diabetes and Digestive and Kidney Diseases; 2012. p. NBK547852.
27. Zheng X, Chen T, Jiang R, Zhao A, Wu Q, Kuang J, *et al*. Hyocholic acid species improve glucose homeostasis through a distinct TGR5 and FXR signaling mechanism. Cell Metab. 2021;33(4):791-803.e7. doi: 10.1016/j.cmet.2020.11.017, PMID 33338411
28. Kotake-Nara E, Nagao A. Absorption and metabolism of xanthophylls. Mar Drugs. 2011;9(6):1024-37. doi: 10.3390/md9061024, PMID 21747746
29. Thomas SE, Johnson EJ. Xanthophylls. Adv Nutr. 2018;9(2):160-2. doi: 10.1093/advances/nmx005, PMID 29659682
30. Salim RM, Chiang LK, Sundang M, Rusdi NA, Maid M, Bakansing SM, *et al*. GC-MS analysis of bioactive compounds in ethanolic extract on different parts of *Ziziphus mauritiana*. Pauloi L. Biodiversitas. 2024;25(10):3442-53.
31. Fatimawali MRR, Maulana RR, Windah AL, Wahongan IF, Tumilaar SG, Adam AA, *et al*. Data on the docking of phytoconstituents of betel plant and matcha green tea on SARS-CoV-2. Data Brief. 2021;36:107049. doi: 10.1016/j.dib.2021.107049, PMID 33869690
32. Hmidouche O, Bouftini K, Chafik A, Khouri S, Rchid H, Rahimi A, *et al*. Ethnomedicinal use, phytochemistry, pharmacology, and toxicology of *Euphorbia resinifera* O. Berg. (B): A review. J Zool Bot Gard. 2023;4(2):364-95.
33. Patel K, Jain A, Patel DK. Medicinal significance, pharmacological activities, and analytical aspects of anthocyanidins 'delphinidin': A concise report. J Acute Dis. 2013;2(3):169-78. doi: 10.1016/S2221-6189(13)60123-7
34. Lee DY, Yun SM, Song MY, Jung K, Kim EH. Cyanidin chloride induces apoptosis by inhibiting NF-κB signaling through activation of Nrf2 in colorectal cancer cells. Antioxidants (Basel). 2020;9(4):285. doi: 10.3390/antiox9040285, PMID 32230772
35. Ganeshpurkar A, Saluja AK. The pharmacological potential of Rutin. Saudi Pharm J. 2017;25(2):149-64. doi: 10.1016/j.jsps.2016.04.025, PMID 28344465
36. Dehelean CA, Coricovac D, Pinzaru I, Marcovici I, Macasoi IG, Semenescu A, *et al*. Rutin bioconjugates as potential nutraceutical prodrugs: An *in vitro* and *in ovo* toxicological screening. Front Pharmacol. 2022;13:1000608. doi: 10.3389/fphar.2022.1000608, PMID 36210849
37. Qin Y, Li K, Zhang Q, Liu J, Xie Y, Zhang T, *et al*. Linoleic acid inhibits lipopolysaccharide-induced inflammation by promoting TLR4 regulated autophagy in murine RAW264.7 macrophages. J Appl Biomed. 2024;22(4):185-96. doi: 10.32725/jab.2024.023, PMID 40033806
38. Khan Z, Nath N, Rauf A, Emran TB, Mitra S, Islam F, *et al*. Multifunctional roles and pharmacological potential of β-sitosterol: Emerging evidence toward clinical applications. Chem Biol Interact. 2022;365:110117. doi: 10.1016/j.cbi.2022.110117, PMID 35995256
39. Vitamin P: Overview, Benefits, and More; 2020. Healthline. Available from: https://www.healthline.com/nutrition/vitamin-p
40. Liu K, Zhang X, Xie L, Deng M, Chen H, Song J, *et al*. Lupeol and its derivatives as anticancer and anti-inflammatory agents: Molecular mechanisms and therapeutic efficacy. Pharmacol Res. 2021;164:105373. doi: 10.1016/j.phrs.2020.105373, PMID 33316380
41. Sharma N, Palia P, Chaudhary A, Shalini VK, Verma K, Kumar I. A review on pharmacological activities of lupeol and its triterpene derivatives. J Drug Deliv Ther. 2020;10(5):325-32. doi: 10.22270/jddt.v10i5.4280
42. Farajzadeh-Dehkordi M, Darzi S, Rahmani B, Farhadian S. A novel insight into the cytotoxic effects of Tephrosin with calf thymus DNA: Experimental and *in silico* approaches. J Mol Liq. 2021;324:114728. doi: 10.1016/j.molliq.2020.114728
43. Espíndola KM, Ferreira RG, Narvaez LE, Silva Rosario AC,

Da Silva AH, Silva AG, *et al*. Chemical and pharmacological aspects of caffeic acid and its activity in hepatocarcinoma. Front Oncol. 2019;9:541. doi: 10.3389/fonc.2019.00541, PMID 31293975
44. Carrillo C, Cavia MD, Alonso-Torre SR. Antitumor effect of oleic acid; Mechanisms of action: A review. Nutr Hosp. 2012;27(6):1860-5. doi: 10.3305/nh.2012.27.6.6010, PMID 23588432
45. Hashem EZ, Khodadadi M, Asadi F, Koohi MK, Eslami M, Hasani-Dizaj S, *et al*. The antioxidant activity of palmitoleic acid on the oxidative stress parameters of palmitic acid in adult rat cardiomyocytes. Ann Mil Health Sci Res. 2016;14(3):e11467.
46. Mahapatra MK, Karuppasamy M, Sahoo BM. Semaglutide, a glucagon like peptide-1 receptor agonist with cardiovascular benefits for management of type 2 diabetes. Rev Endocr Metab Disord. 2022;23(3):521-39. doi: 10.1007/s11154-021-09699-1, PMID 34993760
47. Guo M, Zeng J, Wang Z, Shen Y. Advances in the chemical constituents, pharmacological activity, and clinical application of *Smilacis glabrae* Rhizoma: A review and predictive analysis of quality markers (Q-markers). Heliyon. 2024;10(8):e29557. doi: 10.1016/j.heliyon.2024.e29557, PMID 38644901
48. Dhaliwal JS, Moshawih S, Goh KW, Loy MJ, Hossain MS, Hermansyah A, *et al*. Pharmacotherapeutics applications and chemistry of chalcone derivatives. Molecules. 2022;27(20):7062. doi: 10.3390/molecules27207062, PMID 36296655
49. Wang X, Zhang C, Bao N. Molecular mechanism of palmitic acid and its derivatives in tumor progression. Front Oncol. 2023;13:1224125. doi: 10.3389/fonc.2023.1224125, PMID 37637038
50. Singh J, Hussain Y, Luqman S, Meena A. Purpurin: A natural anthraquinone with multifaceted pharmacological activities. Phytother Res. 2021 May;35(5):2418-28. doi: 10.1002/ptr.6965, PMID 33254282
51. Sharma N, Khurana N, Muthuraman A, Utreja P. Pharmacological evaluation of vanillic acid in rotenone-induced Parkinson's disease rat model. Eur J Pharmacol. 2021 July 15;903:174112. doi: 10.1016/j.ejphar.2021.174112, PMID 33901458
52. Mo X, Rao DP, Kaur K, Hassan R, Abdel-Samea AS, Farhan SM, *et al*. Indole derivatives: A versatile scaffold in modern drug discovery-an updated review on their multifaceted therapeutic applications (2020-2024). Molecules. 2024;29(19):4770.
53. Zhang MZ, Chen Q, Yang GF. A review on recent developments of indole-containing antiviral agents. Eur J Med Chem. 2015;89:421-41. doi: 10.1016/j.ejmech.2014.10.065, PMID 25462257
54. Ahmed Hassan LE, Khadeer Ahamed MB, Abdul Majid AS, Iqbal MA, Al Suede FS, Haque RA, *et al*. Crystal structure elucidation and anticancer studies of (-)-Pseudosemiglabrin: A flavanone Isolated from the aerial parts of *Tephrosia apollinea*. PLOS One. 2014;9(6):e90806. doi: 10.1371/journal.pone.0090806, PMID 24608571
55. Wu B, Wang Y, Zeng L, Li W, An L, Li J, *et al*. Comparative analysis of the metabolites and biological activity of cultivated and wild *Lignosus rhinocerotis*. Biomed Res Int. 2022;2022:5752575. doi: 10.1155/2022/5752575, PMID 36164453
56. Salehi B, Quispe C, Chamkhi I, El Omari N, Balahbib A, Sharifi-Rad J, *et al*. Pharmacological properties of chalcones: A review of preclinical including molecular mechanisms and clinical evidence. Front Pharmacol. 2021;11:592654. doi: 10.3389/fphar.2020.592654, PMID 33536909
57. Prashar H, Chawla A, Sharma AK, Kharb R. Chalcone as a versatile moiety for diverse pharmacological activities. Int J Pharm Sci Res. 2012;3(7):1913-27.
58. He YR, Shen YH, Shan L, Yang X, Wen B, Ye J, *et al*. Diterpenoid lanceolatins A-G from *Cephalotaxus lanceolata* and their anti-inflammatory and anti-tumor activities. RSC Adv. 2015;5(6):4126-34. doi: 10.1039/C4RA10665B
59. Lin YH, Llanos A, Mena P, Uauy R, Salem N, Pawlosky RJ. Compartmental analyses of 2H5-alpha-linolenic acid and C-U-eicosapentaenoic acid toward synthesis of plasma labeled 22:6n-3 in newborn term infants. Am J Clin Nutr. 2010;92(2):284-93. doi: 10.3945/ajcn.2009.28779, PMID 20534748
60. Yang D, Wang T, Long M, Li P. Quercetin: Its main pharmacological activity and potential application in clinical medicine. Oxid Med Cell Longev. 2020;2020(1):8825387. doi: 10.1155/2020/8825387, PMID 33488935
61. Yang SE, Lien JC, Tsai CW, Wu CR. Therapeutic potential and mechanisms of novel simple O-substituted isoflavones against cerebral ischemia reperfusion. Int J Mol Sci. 2022;23(18):10394. doi: 10.3390/ijms231810394, PMID 36142301
62. Arora SK, Verma PR, Itankar PR, Prasad SK, Nakhate KT. Evaluation of pancreatic regeneration activity of *Tephrosia purpurea* leaves in rats with streptozotocin-induced diabetes. J Tradit Complement Med. 2021;11(5):435-45. doi: 10.1016/j.jtcme.2021.03.001, PMID 34522638
63. Rao BG, Reddy SJ, Ramadevi D, Heera B. Phytochemical and pharmacological studies on *Pongamia pinnata*. Indian J Res. 2018;7(2):68-71.
64. Rusu A, Moga IM, Uncu L, Hancu G. The role of five-membered heterocycles in the molecular structure of antibacterial drugs used in therapy. Pharmaceutics. 2023;15(11):2554. doi: 10.3390/pharmaceutics15112554, PMID 38004534
65. Gupta S, Park SE, Mozaffari S, El-Aarag B, Parang K, Tiwari RK. Design, synthesis, and antiproliferative activity of Benzopyran-4-One-Isoxazole hybrid compounds. Molecules. 2023;28(10):4220. doi: 10.3390/molecules28104220, PMID 37241960
66. Patel A, Patel A, Patel A, Patel NM. Determination of polyphenols and free radical scavenging activity of *Tephrosia purpurea* linn leaves (Leguminosae). Pharmacogn Res. 2010;2(3):152-8. doi: 10.4103/0974-8490.65509, PMID 21808558
67. Singh A, Bhatt G, Gujre N, Mitra S, Swaminathan R, Limaye AM, *et al*. Karanjin. Phytochemistry. 2021;183:112641. doi: 10.1016/j.phytochem.2020.112641, PMID 33421890
68. Patel DK, Patel K. Therapeutic importance and pharmacological activities of karanjin in the medicine for the treatment of human disorders: A review through scientific data analysis. Curr Drug Ther. 2022;17(2):71-8. doi: 10.2174/1574885517666220307113724
69. Lin ZY, Yun QZ, Wu L, Zhang TW, Yao TZ. Pharmacological basis and new insights of deguelin concerning its anticancer effects. Pharmacol Res. 2021;174:105935. doi: 10.1016/j.phrs.2021.105935, PMID 34644595
70. Kusumaningtyas VA, Supratman U, Aryanti PT, Melina M, Juliawaty LD. Tephrosin and obovatachalcone with antibacterial activity from *Tephrosia vogelii* Hook.f. Nat Prod Res. 2024:1-6.
71. Chen Y, Yan T, Gao C, Cao W, Huang R. Natural products from the genus *Tephrosia*. Molecules. 2014;19(2):1432-58. doi: 10.3390/molecules19021432, PMID 24473207
72. Devi AP, Dhingra N, Bhardwaj U, Chundawat RS, Joshi CK, Singh S, *et al*. 2-(phenyl)-4H-chromen-4-ones: Green synthesis, characterization, *in vitro* antifungal evaluation and molecular docking approach toward *Aspergillus fumigatus*. Curr Res Green Sustain Chem. 2022;5:100234. doi: 10.1016/j.crgsc.2021.100234
73. Haider W, Pan W, Wang D, Niaz W, Zaman MK, Ullah R, *et al*. Maackiain: A comprehensive review of its pharmacology, synthesis, pharmacokinetics and toxicity. Chem Biol Interact. 2025;405:111294. doi: 10.1016/j.cbi.2024.111294, PMID 39477181
74. Vir DK, Pandey A, Takarkhede S, Pal R, Navik K. *Tephrosia purpurea*: A potential healer plant. IJPPR Hum. 2020;20(1):431-43.
75. Song X, Luo X, Sheng J, Li J, Zhu Z, Du Z, *et al*. Copper-catalyzed intramolecular cross dehydrogenative coupling approach to coumestans from 2'-hydroxyl-3-arylcoumarins. RSC Adv. 2019;9(30):17391-8. doi: 10.1039/C9RA01909J, PMID 35519854
76. Shiao YJ, Wang CN, Wang WY, Lin YL. Neuroprotective flavonoids from *Flemingia macrophylla*. Planta Med. 2005;71(9):835-40. doi: 10.1055/s-2005-871297, PMID 16206038
77. Jahan S, Mahmud MH, Khan Z, Alam A, Khalil AA, Rauf A, *et al*. Health promoting benefits of pongamol: An overview. Biomed Pharmacother. 2021;142:112109. doi: 10.1016/j.biopha.2021.112109, PMID 34470730
78. Sindhu G, Reddy TU, Chandini R, Swamy AV, Rajeswari P, Sumiya N, *et al*. A review on the pharmacological profile of *Tephrosia calophylla*. IAJPS. 2017;4(5):1361-5.
79. Mittraphab Y, Ngamrojanavanich N, Shimizu K, Matsubara K, Pudhom K. Anti-angiogenic activity of rotenoids from the stems of *Derris trifoliata*. Planta Med. 2018 18 Jan;84(11):779-85. doi: 10.1055/s-0044-100797, PMID 29346807
80. Lou H, Li H, Zhang S, Lu H, Chen Q. A review on preparation of betulinic acid and its biological activities. Molecules. 2021;26(18):5583. doi: 10.3390/molecules26185583, PMID 34577056
81. Khatri A, Garg A, Agrawal SS. Evaluation of hepatoprotective activity of aerial parts of *Tephrosia purpurea* L. And stem bark of *Tecomella undulata*. J Ethnopharmacol. 2009;122(1):1-5. doi: 10.1016/j.jep.2008.10.043, PMID 19059328
82. Gora RH, Baxla SL, Kerketta P, Patnaik S, Roy BK. Hepatoprotective activity of *Tephrosia purpurea* against arsenic induced toxicity in rats. Indian J Pharmacol. 2014;46(2):197-200. doi: 10.4103/0253-7613.129317, PMID 24741193
83. Samuel VJ, Mahesh AR, Murugan V. Phytochemical and pharmacological aspects of *Tephrosia* genus: A brief review. J Appl Pharm Sci. 2019;9(3):117-25. doi: 10.7324/JAPS.2019.90317
84. Verma N, Bainsal N, Singh J. Evaluation of hepatoprotective activity of *Tephrosia purpurea* linn. Stem. Int Educ Appl Sci Res J. 2017;2(7):5-6.

85. Bhadada SV, GoyaL RK. Effect of flavonoid rich fraction of *Tephrosia purpurea* (Linn.) Pers. On complications associated with streptozotocin-induced type I diabetes mellitus. Indian J Exp Biol. 2016;54(7):457-66. PMID 29466624
86. Gulecha V, Sivakuma T. Anticancer activity of *Tephrosia purpurea* and *Ficus religiosa* using MCF 7 cell lines. Asian Pac J Trop Med. 2011;4(7):526-9. doi: 10.1016/S1995-7645(11)60139-9, PMID 21803302
87. Lodhi S, Pawar RS, Jain AP, Singhai AK. Wound healing potential of *Tephrosia purpurea* (Linn.) Pers. in rats. J Ethnopharmacol. 2006;108(2):204-10. doi: 10.1016/j.jep.2006.05.011, PMID 16806763
88. Lodhi S, Jain A, Jain AP, Pawar RS, Singhai AK. Effects of flavonoids from *Martynia annua* and *Tephrosia purpurea* on cutaneous wound healing. Avicenna J Phytomed. 2016;6(5):578-91. PMID 27761428
89. Deshpande SS, Shah GB, Parmar NS. Antiulcer activity of *Tephrosia purpurea* in rats. Indian J Pharmacol. 2003;35:168-72.
90. Praveena R, Amarnath S, Jegadeesan M. Anti-inflammatory activity of *Tephrosia purpurea*. Root Int J Pharmcogn Phytochem Res. 2012;3(4):93-4.
91. Touqeer S, Saeed MA, Ajaib M. A review on the phytochemistry and pharmacology of genus *Tephrosia*. Phytopharmacology. 2013;4(3): 598-637.
92. Abayasekara CL, Rangama BN, Panagoda GJ, Senanayake MR. Antimicrobial activity of *Tephrosia purpurea* (Linn.) Pers. And *Mimusops elengi* (Linn.) against some clinical bacterial isolates. J Natl Sci Found Sri Lanka. 2009;37(2):139-45. doi: 10.4038/jnsfsr.v37i2.1071
93. Luo ZP, Lin HY, Ding WB, He HL, Li YZ. Phylogenetic diversity and antifungal activity of endophytic fungi associated with *Tephrosia purpurea*. Mycobiology. 2015;43(4):435-43. doi: 10.5941/MYCO.2015.43.4.435, PMID 26839503
94. Manjula RR, Spandana U, Joshi T, Sudheer M. *In vitro* anthelmintic activity of aqueous and methanolic leaf extract of *Tephrosia purpurea* Linn. IJRPC. 2013;3(1):12-14.
95. Kumar D. Larvicidal activity of *Tephrosia purpurea*, (L) against the larvae of *Culex quinquefasiciatus*. J Appl Pharm Sci. 2012;2(7):219-21. doi: 10.7324/JAPS.2012.2735
96. Soni K, Kumar P, Saraf M. Antioxidant activity of fraction of *Tephrosia purpurea*. Indian J Pharm Sci. 2006;64(4):456-460.
97. Dalwadi PP, Patani PV. Anti hyperlipidemic activity of *Tephrosia purpurea* plant extracts in poloxomer 407 induced hyperlipidemic rats. Int J Pharmacol Res. 2014;4(4):186-93.
98. Padmapriya R, Ashwini S, Raveendran R. *In vitro* antioxidant and cytotoxic potential of different parts of *Tephrosia purpurea*. Res Pharm Sci. 2017;12(1):31-7. doi: 10.4103/1735-5362.199044, PMID 28255311
99. Shill MC, Das AK, Itou T, Karmakar S, Mukherjee PK, Mizuguchi H, *et al*. The isolation and synthesis of a novel benzofuran compound from *Tephrosia purpurea*, and the synthesis of several related derivatives, which suppress histamine H1 receptor gene expression. Bioorg Med Chem. 2015;23(21):6869-74. doi: 10.1016/j.bmc.2015.09.049, PMID 26476665
100. Bhadada SV, Goyal RK. Effect of aqueous extract of *Tephrosia purpurea* on cardiovascular complications and cataract associated with streptozotocin-induced diabetes in rats. Indian J Pharm Sci. 2015;77(5):522-9. doi: 10.4103/0250-474X.169037, PMID 26798165
101. Nile SH, Park SW. HPTLC Analysis, antioxidant and antigout activity of Indian plants. Iran J Pharm Res. 2014;13(2):531-9. PMID 25237348
102. Malhotra M, Rana H, Tandon S. Exploring the therapeutic potential of *Catharanthus roseus*: Unveiling its diverse phytochemicals and mechanisms of action for chronic and infectious diseases. Int J Curr Pharm Res. 2024;16:1-8. doi: 10.22159/ijcpr.2024v16i5.5023
103. Gupta N, Sharma D, Rani R. *Bombax ceiba* linn: A critical review on phytochemistry, traditional uses, pharmacology, and toxicity from phytopharmaceutical perspective. Int J Pharm Pharm Sci. 2023;15(1): 8-15. doi: 10.22159/ijpps.2023v15i1.46533
104. Jain A, Nahata A, Singhai AK. Effect of *Tephrosia purpurea* (L.) Pers. Leaves on gentamicin-induced nephrotoxicity in rats. Sci Pharm. 2013;81(4):1071-87. doi: 10.3797/scipharm.1302-09, PMID 24482774
105. Pavana P, Sethupathy S, Santha K, Manoharan S. Effects of *Tephrosia purpurea* aqueous seed extract on blood glucose and antioxidant enzyme activities in streptozotocin induced diabetic rats. Afr J Tradit Complement Altern Med. 2008;6(1):78-86. doi: 10.4314/ajtcam.v6i1.57077, PMID 20162045
106. Katakam S, Rathod R, Sharma P, Kachhadiya D, Anandjiwala S, Sharma S, *et al*. HPLC Coupled with chemometric analysis and LC-MS studies of three flavonoids in *Tephrosia purpurea* (L.) Pers. Revealed impact of chemodiversity on the quest for the chemical markers. J Chromatogr Sci. 2019;57(9):821-7. doi: 10.1093/chromsci/bmz058, PMID 31504284
107. Jayasurya BR, Swathy JS, Susha D, Sameer S. Molecular docking and investigation of *Boswellia serrata* phytocompounds as cancer therapeutics to target growth factor receptors: An *in silico* approach. Int J Appl Pharm. 2023;15(4):173-83.
108. Kashyap H, Sekhon G, Varshney A, Khatri M. *In silico* screening of potential antidiabetic phytochemicals from *Tephrosia purpurea*: A polypharmacology approach. Biomed Ther Lett. 2024 September 16;11(2):911. doi: 10.62110/sciencein.btl.2024.v11.911