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REVIEW ARTICLE

Phytochemical and pharmacological overview on *Paerida foetida* L. and *Sphaeranthus amarnthoides* Burm.f.: A Review

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Abstract

The phytochemistry and pharmacological activities of the plants *Paerida foetida* L. and *Sphaeranthus amaranthoides* Burm.f. are the goals of this review. The current study's findings are supported by the review literature and published research on the pharmacological and phytochemical characteristics of *Sphaeranthus amaranthoides* Burm.f. and *Paerida foetida* L. These plants are useful for antibacterial, anthelmintic, antioxidant, cytotoxic, anti-diabetic, hypolipidaemic and hepatoprotective effects. The plant extracts were regarded as safe for animals according to toxicity studies. Both plants contain a variety of phytoconstituents, including tannins, terpenoids, steroids, phenols, flavonoids and saponins, each of which has a distinct pharmacological action. For many years, people have been exploring the natural world to find novel phytoconstituents that have been employed in the treatment of various illnesses. It also offers a way to discover novel semisynthetic and synthetic molecules as well as new natural entities. This review article examines the claims, traditional knowledge and phytochemical and pharmacological analyses of these plants, as well as their potential uses in the future.

Keywords

Paerida foetida L.; *Sphaeranthus amaranthoides* Burm.f.; phytochemical analysis and pharmacological study; anti-diabetic; hypolipidaemic

Introduction

Paerida foetida L. belongs to the Rubiaceae family, which is extensively used in folk medicine. It is a small herb and perennial plant used as a folk medicine to treat disorders such as rheumatism, diarrhea, inflammation, piles, dysentery, gout, calculi, stomachic and emetic (1). The majority of these plants are native to the northeast region of India, and these northeast communities of India have an understanding of how to properly prepare them and use them as food or medicine (2, 3). Some of these communities are Bhedailota and bungki-repuk missing tribe from Assam, Upu tere in Nyishi, Yepe tere in Adi & Shedra wunyee in Aka tribe from Arunachal Pradesh, Pasim in Garo tribe from Meghalaya, Stinkvine & Oinam from Manipur, Sil-zil in Ao-Naga tribe from Nagaland, Gandha bhadali in Bengal & Dukupui in Kokborok, Vawihuihhri from Mizoram and Berihara from Sikkim (4). Because of the plant's significant nutraceutical benefits, it is also utilized as a vegetable. A few evaluations have been on the plant's pharmacological, phytochemical and pharmacognostical profiles (5). The north-western part of India alone utilizes more than 80% of the 1600 plant species in traditional Indian medicine systems, indicating the region's deep

traditional knowledge systems (1). Tribal people like Nepali and Lepcha tribes of the Northeast in the Sikkim and Darjeeling Himalayan regions have historically used the plant as a natural remedy for diabetes (2). A decoction of the whole plant is used for therapeutic purposes. To treat joint illnesses like gout and rheumatism, some ethnic communities (Munda and Santala) of Odisha in the Mayurbhanj district cook the leaves with rice (3). Dry fish and *Paederia foetida* L. leaves are used by the Tripura clan to produce "Gudak" (5). In Ayurveda, Chinese and other traditional medical systems, *P. foetida* L. has been used for various illnesses, including arthritis, vesical calculi, inflammation, asthma, diarrhea, dysentery, piles, diabetes and seminal weakness (5). It has an unpleasant taste and a bitter taste. Additionally, it is reportedly used for gout, vesical calculi, diarrhoea, dysentery, piles, liver inflammation and emetic. Additionally, it is an ingredient in the preparation of Dasamularishta (6).

One of the kaya kalpa medications in the Siddha System of Medicine is *Sphaeranthus amaranthoides* Burm.f. (Asteraceae). The rejuvenation drugs known as Kalpa remove pathogenic microorganisms from our body and stop them by boosting our immune system (7). Additionally, it prevents the ageing and deterioration of bones, bone marrow, muscles, nerves and blood cells (7). In Tamil Nadu, the name Sivakarantai is well known. It is a weed in the paddy field. This plant is also reported to possess hepatoprotective properties (8). This plant is widely recognized for healing eczema, blood-related disorders, filaria, stomach worms, fever, piles, Kapha and Vata. It has also been proven to treat skin problems (9). Previous clinical research on this plant reports its curative effects, like antibacterial, antioxidant, antidiarrheal, anti-mutagenic, analgesic and anti-inflammatory properties (10-13).

It has been observed that modern medicine science has developed in many fields, such as synthetic, semisynthetic, and natural science. However, the past 50 years of contemporary medicine science have shown the utilization of transformed modern medicine derived from medicinal plants. These chemicals are similar to those originating from natural sources. The WHO guidelines have also encouraged the utilization of herbal products for their high potency and safe utility compared to synthetic medicine. Even now, several pharmaceutically active essential medications utilized to treat human ailments have been isolated from natural sources. This action is possible for phytochemical screening and pharmacological studies on natural sources. As a result, multiple novel constituents with significant therapeutic values have been isolated (14).

Taxonomical, phytochemical and pharmacological study of *Sphaeranthus amarnthoides* Burm.f. and *Paerida foetida* L.

Sphaeranthus amaranthoides Burm.F.

Classification of Sphaeranthus amarnthoides Burm.f.

Classification *of Sphaeranthus amaranthoides* Burm.f. is as follows. (15)

Kingdom: Plantae

Clade: Angiosperms

Clade: Eudicots

Clade: Asterids

Order: Asterales

Family: Asteraceae

Genus: *Sphaeranthus*

Species : *Sphaeranthus amaranthoides*

Phytochemical analysis of Sphaeranthus amarnthoides Burm.f. (9-15)

Phytochemical screening of the *Sphaeranthus amaranthoides* Burm.f. plant has shown different phytochemical constituents in different solvents, as given in Table 1

Compounds present in methanolic extract of Sphaeranthus amarnthoides Burm.f. using GC MS (16, 17)

GC-MS analysis of the metabolic extract of *Sphaeranthus amaranthoides* Burm.f. revealed 23 phytochemical constituents, as given in Table 2.

Table 1. Presence of Phytochemical constituents in different extracts of *Sphaeranthus amaranthoides* Burm.f. (9,15)

Sl.no.	Test	Methanol Extract	Ethanolic extract	Petroleum Extract	Chloroform extract	Ethyl acetate
1	Alkaloids	+	+	-	-	+
2	Amino acid	+	+	Not assessed	Not assessed	Not assessed
3	Flavonoids	+	+	-	+	+
4	Glycoside/sugar	-	+	+	+	-
5	Phenol	+	+	-	+	+
6	Quinone	-	-	Not assessed	Not assessed	Not assessed
7	Steroid	+	+	+	+	-
8	Tannin	+	+	-	+	+
9	Triterpenoid	-	+	-	+	+
10	Saponin	+	+	Not assessed	Not assessed	Not assessed

+ present; - absent.

Table 2. Identification of bioactive compounds in methanolic extract of *Sphaeranthus amaranthoides* Burm.f. by GC-MS analysis (16.17)

Sl. No.	RT	Name of Compound	MF	MW	Peak Area %	Compound Nature
1	3.10	(2RS,3aRS)-2-(3-Hydoxy-1-methoxypropyl)perhydroindan-4-one	C14H24O4	256	1.08	Ketone
2	14.34	2-Propenoic acid ,1,7,7-trimethylbicyclo(2,2,1)hept-2-yl-ester,exo-	C13H20O2	208	3.78	Ester
3	8.07	Dimethyl derivative of vtamin D3-triol	C28H48O3	432	0.92	Sterol
4	29.01	Primidone	C12H14N2O2	218	4.50	Alkaloid
5	12.61	1-propanone,2-bromo-1-phynyl-(CAS)	C9H9BrO	212	1.44	Ketone
6	13.23	1,3-Bis(4-chlorobenzyl)-5,6-dihydrobenzo(f)quinazoline	C26H20Cl2N2	430	0.72	Alkaloid
7	9.33	7,8 Bi(trimethylsilyl)benzo(5,6-g)-1H,3H-quinazoline-2,4-dione	C18H24N2O2Si2	356	1.89	Alkaloid
8	17.12	2-tert-Butyl-4-isopropyl-5-methylphenol	C14H22O	206	0.49	Phenol
9	17.71	4,7-Methano-1H-indene,3a,4,5,6,7,7a-hexahydro-5-(2-propenyloxy)-	C13H18O	190	6.27	Ester
10	20.57	Methanone,(1-hydroxycyclohexyl)phenyl-	C13H16O2	204	13.71	Ketone
11	22.99	2-Propenoic acid,2-methyl-,2[{2,3,3a.4,7,7a(or 3a,4,5,6,7,7a)-hexahydro-4,7-methano-1H-indenyl}oxy]ethyl ester	C16H22O3	262	32.73	Ester
12	25.71	Hexadecanoic acid, methyl ester	C17H34O2	270	0.75	Ester of fatty acid
13	34.53	Epoxygedunin	C28H34O8	498	0.63	Sapponin/ Steroid
14	32.72	1,2,4-Trioxolane-2-octanoic acid,5-octyle-methyl ester (CAS)	C19H36O5	344	1.80	Ester of fatty acid
15	33.40	4,4'-Isopropylidine-bis-(2-cyclohexylphenol)	C27H36O2	392	0.83	Phenol
16	33.81	4,5-Bis(p-bromophenoxy)-1,2-dicyanobenzene	C20H1oBr2N2O2	468	0.66	Aromatic
17	37.14	2,9-bis(2',6'-dimethoxyphenyl)-1.10-phenanthroline	C28H24N2O4	452	1.36	Alkaloid
18	36.00	6-(t-Butylimino)-8-(3'-trifluoromethylphenyl)-3.4-dihydro-2H.6H-pyrimidol[2.1-b]{1,3)thiazine-7-carbonitrile	C19H19F3N45	392	0.87	Alkaloid
19	36.54	7a,9c-(iminoethano)phenanthro[bcd]furan4a,a'.5-dihydro-3-methoxy-12-methyl-9(CAS)	C18H19NO2	281	0.67	Alkaloid
20	37.85	Diethyl-2-(2-furyl)-4-hydroxy-4-methyl-6-oxo-1,3-cyclohexanedicarboxylate	C23H36O7Si	452	1.00	Ester
21	17.12	2-tert-Butyl-4-isopropyl-5-methylphenol	C14H22O	206	0.49	Phenol
22	37.61	6,7-Dihydro-6,6-dimethyl-2,3-diphenylindazol-4(2H,5h)-one	C21H20N2O	316	1.03	Alkaloid
23	37.98	Di-(2-ethylhexyl)phthalate	C24H38O4	390	2.54	Ester

Pharmacological activity of Sphaeranthus amarnthoides Burm.f.

Anti-inflammatory and analgesic activities

The plant's leaves and inflorescences were used in powdered form for this study. Indomethacin drug has been taken as standard (15). The analgesic impact was estimated using the tail-flick hot water immersion method. Wistar albino rats exhibited a weak analgesic effect. The carrageenan-induced acute hind paw oedema method investigated the anti-inflammatory impact on Wistar albino rats. The second stage of acute inflammation was suppressed by 95%. This effect might result from prostaglandin synthase and cyclooxygenase enzyme inhibition (7).

Antimicrobial activity

Sphaeranthus amaranthoides Burm.f. ethanol extracts have shown a potent effect against bacteria such *as Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Proteus mirabilis and Enterococcus faecalis*. Its most significant activity was against *E. coli*. Some natural herbal sources can activate the body's defensive mechanisms; as a result, they are helpful in various therapeutic effects. The extract was exposed to antibacterial screening using the disc diffusion method (18). The extract's highest impact against *E. coli* was a 20 mm zone of inhibition with 50 mg, a 25 mm zone with 100 mg, a 26 mm zone with 200 mg and a 31 mm zone with 400 mg (7).

Antidiabetic activity

Insufficient insulin secretion is the cause of diabetes mellitus. The application of nanoscience in conjunction with herbal medicine is growing in popularity now (14). Silver nanoparticles were used as a topical ointment to treat burns and open wounds. *Sphaeranthus amaranthoides* Burm.f. silver nanoparticles were made and characterized after the plant's whole body was extracted using ethanol. By reducing the activity of the enzyme amylase, the antidiabetic effect was investigated and the result was compared with that of the common medication, acarbose. The plant's IC50 value was determined to be 0.28 g/ml (8).

Anti-diarrhoeal activity

Wistar rats that had been given castor oil to induce diarrhoea were used to test the ethanolic extract. The ethanolic extract of *S. amaranthoides* Burm.f. showed a significant dose-dependent reduction at 200 mg/kg and 400 mg/kg. The frequency of defecation and the moistness of faces showed antidiarrheal activity. Similar effects have been observed compared to standard diphenoxylate with 400 mg/kg of plant extract (15). The presence of tannins, a chemical found in plants known to lessen the diarrhoea effects by creating protein tannate, increases the intestinal mucosa's resistance and reduces secretion, which may account for the antidiarrheal impact (19). Thus, the tannins found in the extract may be partly responsible for various pharmacological properties and their medicinal antidiarrheal effect (20, 21).

Rheumatic arthritis

In arthritis, autoantigens are produced due to proteinase activity, protein denaturation and membrane lysis. Therefore, a substance that prevents protein denaturation can be considered anti-inflammatory. The inhibitory effects of *Sphaeranthus amaranthoides* Burm.f. plant extracts on bovine serum albumin have been tested. Chloroform, methanol and petroleum ether extracts all demonstrated a significant percentage inhibition of 80.43%, 75.17% and 64.9%, respectively; however, ethyl acetate extract had a more substantial percentage inhibition of 91.48%. Except for the petroleum ether extract, all extracts were shown to be more effective in the HRBC stabilization process. The extract's stabilizing effect may be caused by membrane expansion or contraction, which interacts with membrane proteins to increase the surface area-to-volume ratio of the cells. At 1000 g/ml concentration, petroleum ether's percentage protection was just 69.11% (22).

Antioxidant activity

The study demonstrates that *Sphaeranthus amaranthoides* Burm.f. extracts and flavonoid fractions accelerate wound healing and repair. The full-thickness covering of the injured area has been found (23). The methanolic extract demonstrated high anti-oxidative activity. The phenolic content of the plant's methanolic extract was high, so it may be correlated with its antioxidant properties. Antioxidants enhance healing abilities by diminishing the harm caused by oxygen radicals. Antioxidants reduce the damage oxygen radicals produce to both infected and non-infected wounds. Animal wounds from various groups were treated with *S. amaranthoides* Burm.f. extract. An ulcer in a rat's skin slice exposed to *S. amaranthoide's* methanol extract revealed significant granulation tissue beneath the blood and fibrin clots. The antioxidant properties of several plant extracts were analyzed using ferric thiocyanate (24, 25).

The methanolic extract had shown a higher level of antioxidant potential than ethanolic and aqueous extracts. Methanolic extracts have the same effects as ascorbic acid (15).

Cytotoxic studies

An *In vitro* cytotoxicity study was conducted with *Spaeranthus amaranthoides* Burm.f. chloroform extract showed a considerable rise in the percentage of inhibition with increasing concentration. A concentration of less than 3 µg chloroform extract inhibited over 50% of the cells. About 82% of the cells were inhibited when the concentration of chloroform extract was increased to 15 µg (15).

The natural herb S. amaranthoides yielded 86 unique peptides in total. Three of these peptides were described and the manual de novo method was used to determine their amino acid sequences. In its physicochemical properties it has been found that the SA923 is stable peptide and it has higher binding potential. In investigation has been predicted that it is an anticancer peptide (26).

Hepatoprotective effect

A well-known poison called D-galactosamine (-D-GalN) causes hepatitis in rats that is comparable to viral hepatitis. Numerous medicinal herbs are used in India to treat liver problems. By 95% ethanol, the plant's aerial portion was extracted. D-galactosamine caused liver damage in albino Wistar rats. The animal was administered the plant's ethanolic extract. The regeneration of liver cells in rats pretreated with *S. amaranthoides* Burm.f. provides evidence of the compound's protective properties against oxidative stress. The altered antioxidant enzymes, such as Catalase (CAT), Superoxide dismutase (SOD), Glutathione peroxide (GPx), Glutathione S-Transferase (GST), Glutathione (GSH) and Glutathione reductase (GR), were recovered and the mitochondrial and hepatic architecture returned to normal (27). Other abnormal elevated lipid peroxidation (TBA-RS) also inhibited and showed a regeneration of liver cells by the SA extract (28). These findings were correlated to silymarin, a substance with a well-known hepatoprotective effect. It clarifies the plant's hepatoprotective properties (27).

***Paerida foetida* L.**

Classification of Paerida foetida L.

Paerida foetida linn belongs to the following taxonomy (29).

Kingdom: Plantae

Clade: Angiosperms

Clade: Angiosperms

Clade: Eudicots

Clade: Asterids

Order: Gentianales

Family: Rubiaceae

Genus: *Paederia*

Species***: Paederia foetida***

Phytochemical analysis of Paerida foetida L.

Phytochemical screening of *Paerida foetida* Linn. has shown the presence of different phytochemical constituents like Alkaloids, Flavonoids, saponins and tannins, as given in Table 3 (5,30,31).

GC MS metabolomic and multivariate analysis (32)

A total of 397 presumptive compounds were detected using GC-MS metabolomics. 12 of the 397 compounds were interpreted as plant metabolites using retention

Table 3. Presence of Phytochemical constituents in different extracts of *Paerida foetida* Linn (5,30,31)

Chemical	Ethanol extract	Ethyl acetate	Aquous
Alkaloids	+	-	-
Flavonoids	-	-	+
Saponin	+	-	+
Tannin	+	+	+
Phenolic acids	Not assessed	-	+
Steroids	Not assessed	+	-

+present; -absent.

times, area percentage and similarity index (Table 4). The bioactive compounds were identified through GC-MS metabolomics utilizing.

Pharmacological study of Paerida foetida

Anti-diarrhoeal activity

Particularly in the case of young children in developing or backward nations, diarrhoea is one of the leading causes of illness and death. The World Health Organisation supports traditional medicine in treating and preventing diarrheal disorders. *Paerida foetida* Linn is a plant that is used folklorically for treating diarrhoea and dysentery in India and a few other Asian countries. An efficient response was shown by ethanolic extract of *P. foetida* L. This effect is produced by a considerable extension of the latent period of diarrhoea and a decrease in gastrointestinal motility (33); the extract may have an additive effect on the motility decrease caused by morphine at doses of 500 mg per kg body weight given twice (29).

Hepatoprotective activity

The methanolic extract of *P. foetida* L. at doses of 100 and 200 mg/kg body weight of rats has shown a significant reduction in the increased levels of GTP (Glutamate-Pyruvate aminotransferase), GOT (Glutamate-Oxaloacetate transaminase) and total Protein. This reduction may be due to the protection mechanism of the plants against oxidative damage caused by hepatotoxicity (34). Additional research reveals that it has moderate hepatoprotective activity based on its therapeutic effect against liver disorders (35-37).

Antitussive effect

The defensive reflex of coughing clears the breathing path of any foreign objects, secretions, or microbes. The primary purpose of antitussive medicines is to stop a dry cough and pain (38). In a conscious cat, stimulation of the laryngopharyngeal (LP) and tracheobronchial (TB) mucosal parts of the airways is tested for antitussive effect with ethanolic extract of *Paerida foetida* Linn. The ethanolic extract of *Paerida foetida* Linn is at 200mg/kg in body weight. It exhibited antitussive action of 25.3% and dropropizine at a dose of 100 mg/kg of body weight intravenously (28.3%); it shows a hepatoprotective effect. However, it has a lower antitussive effect than that of the narcotic codeine at a dose of 10 mg per kg body weight (38).

Anti arthritic activity

In different Clinical studies, *P. foetida* L. was a valuable medicine in rheumatoid arthritis. After a clinical course of 42 days, 65% of patients demonstrated improvement in their joint pain, oedema, stiffness and discomfort (39). The plant also lowers increased levels of acute-phase proteins, which makes it an advantageous medicine over non-steroidal anti-inflammatory drugs (NSAIDs) and a potential disease-modifying anti-rheumatic medication (DMARD). NSAIDs do not affect these proteins. Independent research supported the plant's activity on albino rats (40).

Anti-inflammatory activity:

The disease of inflammation is brought on by the release of leukocytes and a variety of other complex mediator molecules from tissues and migratory cells, including prostaglandins, leukotrienes, histamines, bradykinin, platelet -activating factor and IL-1 (41,42). The butanol fraction of a methanolic extract of *P. foetida* L. defatted leaves inhibited the formation of granulation tissue in cotton-pellet implanted rats more effectively than standard phenylbutazone, which only inhibited it by 29% at a dosage of 100 mg kg-1 intraperitoneally. Inhibition was 52% and 59% at 100 and 200 mg kg-1 body weight, respectively. Without altering serum aspartate transaminase activity, it reduced liver aspartate transaminase activity. These percentages were higher than those of acetylsalicylic acid (37.5% of anti-inflammatory activity at 50 mg kg-1) but lower than those of hydrocortisone (61.46% of anti-inflammatory at a dose of 5mg/kg) (36, 43).

Table 4. Bioactive compounds identified in chloroform extract of *Paerida foetida* Linn by GC-MS analysis (32).

Sl. No.	Peak No	RT (min)	Area of Percentage (%)	Chemical formula	Molecular Weight	Similar Index
1	1	18.158	0.96	C29H30O	430	86
2	21	13.433	0.85	C16H34O	242	85
3	95	15.838	1.35	C19H38O	282	93
4	96	19.408	20.20	C29H50O	414	77
5	233	20.233	1.92	C29H48O	412	88
6	247	19.025	10.51	C19H48O	412	95
7	379	19.417	20.20	H29H50O	414	94
8	382	19.413	20.20	C29H50O	414	78
9	384	15.883	0.75	C21H42O4	358	91
10	14, 17, 64	13.433	29.48	C16H32O2	256	97
11	26, 27, 135	19.442	0.54	C29H32O	416	81
12	372, 392	15.775	1.51	C21H44OSi	340	72

Antioxidant activity

Antioxidants are responsible for preventing free radicals production and can slow aging and postpone the onset of neurodegenerative diseases (44). In various studies, *P. foetida* L. extracts were shown to exhibit antioxidant activity. Using the 2, 2'-azinobis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS) radical cation test and carotene bleaching, good antioxidant activity was found in the methanolic extract of *P. foetida* Linn (45, 46). The carotene and ABTS assay were used to measure the antioxidant activity of fresh extract. It was found to be 78% and 75%, respectively, while the dried sample had 66% and 67% antioxidant activity, respectively. Phenolic compounds may work as free-radical scavengers to show their antioxidant action (36, 47, 48).

Gastroprotective activity

Five groups of Healthy Albino rats were taken, each with five rats. Throughout the experiment, vehicles (5 ml/kg, orally, pure water) were provided to both standard control (Group 1) and ulcer control (Group 2) groups. Three groups were administered different doses of *Paerida foetida* Linn methanol extracts for four days at 100 and 200 mg/kg body weight/day (Groups 3 and 4) and the standard drug ranitidine was administered at a dose of 10 mg/kg body weight/day (Group 5). As an ulcerogenic agent, indomethacin suspension at a dose of 25 mg/kg subcutaneously was administered to all animals except those in the control group once daily for four days. The methanol extract was administered to groups 3 and 4 at different doses, 100 and 200 mg/kg, respectively, 30 minutes later to inhibit the ulcers. The administration of methanol extracts decreased the rise in gastric secretion volume and acid production at two separate doses (100 and 200 mg/kg). However, there was also a rise in pH. The index for stomach ulcers dropped and produced 72% and 78% ulcer protection, compared to ranitidine's ulcer protection of 82% (32, 49).

Antiproliferative/anticancer activity

Reactive nitrogen species (RNS) and reactive oxygen species (ROS) are the root cause of several pathological disorders, including cancer, cardiovascular disease, liver disease, arthritis and other multifactorial environmental diseases (50). In clinical research, the anticancer study justified using 50% ethanolic extract against human nasopharyngeal epidermoid carcinoma as an anticancer medication. This activity might be a result of its anti-inflammatory or antioxidant characteristics. Anticancer action was also detected with 50% ethanolic extract of the leaf against L-1210 lymphoid leukemia (36, 51).

Analgesic activity

The acetic acid induced writhing inhibition method had shown a considerable effect at a dosage of 150 mg kg^{-1} through the oral route. Inhibition values for methanolic extract, hexane and ethyl acetate were 19%, 9% and 21%, respectively. In comparison, dosages of 300 mg kg^{-1} demonstrated respective inhibitions of 37%, 12% and 25%. In the same experiment, 50 mg/kg of aminopyrine exhibits 63% inhibition. It was assumed that prostaglandin pathway blockage was mainly caused by analgesic action (36, 52).

Antihyperlipidemic activity

The impact of PF leaf extract on lipid profile levels was assessed. The diabetic rats induced by STZ showed reduced levels of HDL (high-density cholesterol), greater levels of triglycerides and lower levels of VLDL (very-low-density cholesterol) and LDL (low-density cholesterol) than the rats in the standard control group. The lipid profile of the average rat after oral treatment of PF dosage 500 mg/kg did not alter. Three different doses of PF (100 mg/kg, 250 mg/kg, and 500 mg/kg orally) have shown good percentage reductions in LDL (26.82%, 44.18%, 65.08%), triglyceride (11.48%, 21.07%, 32.72%), cholesterol (14.80%, 22.90%, 32.82%) and VLDL (11.48%, 21.07%, 33.72%). A 500 mg/kg oral dose of PF was found to be the most effective in decreasing triglycerides, LDL cholesterol, VLDL cholesterol and cholesterol levels in rats induced with streptozotocin (STZ) while increasing HDL cholesterol levels in comparison to other doses of PF and glibenclamide (53).

Antihyperglycaemic activity

Good antidiabetic activity was observed in diabetic rats, regularly caused by streptozotocin (STZ) with an oral dose of PF extract. Three distinct dosages of PF leaf extract, i.e., 100, 250 and 500 mg/kg) significantly (P 0.001) reduced blood glucose levels in diabetes-induced rats by STZ. This activity was dose and time-dependent. On day 28, the blood glucose level dropped to its lowest point (55.74%, 61.76%, and 69.12%, respectively). Meanwhile, the standard glibenclamide showed a decreased blood sugar level of 65.27% (53).

Anti-ulcer activity

Gastrointestinal tract illnesses include diarrhoea, dysentery, carminative, piles, spasms, gastralgia, loose motion, stomach enlargement, cleansing, flatulence, gastritis and ulcers have various traditional and scientific evidence to be cured by using *Paerida foetida* Linn (54). This plant is used as a vegetable in many tribal cultures across India. However, it also treats ulcers and other stomach problems (55).

Antihelmintic activity

The anthelmintic activity of a methanolic extract of *Paederia foetida* Linn leaves was evaluated against *Tubifex* and *Pheretima Posthuma, Bunostomum sp.,* and *Monezia* sp. were eliminated by *Paederia foetida* L. At intervals of every two days for a week, at a dose ranging from 4 to 10 grams per body weight (56).

Discussion

After reviewing the current work, it was determined that the study provides an overview of the pharmacological and phytochemical properties of *Paeida foetida* Linn *and Sphaeranthus amaranthoides* Burm.f. Both plants have been used to cure various diseases, such as antibacterial, antioxidant, cytotoxic, anthelmintic, antidiabetic, hypolipidemic and analgesic. Both plants have many valuable phytoconstituents

like alkaloids, saponins, sterols and tannins. But still, no research has been done on cardiotonic activity and the isolation of chemical constituents. The subsequent investigation should concentrate on other pharmacological activities by using different specific parts of plants like root/flower/stem, which may be more effective in the medicinal field. As most research has been done on methanolic extract, other solvents may be applicable for separating and isolating other *Sphaeranthus amaranthoides* Burm.f. and *Paeida foetida* Linn constituents.

Conclusion

While the results of this review seem highly encouraging for using both plants as versatile therapeutic agents, there are currently certain limitations in the literature. More clinical trials should be carried out to support the therapeutic use of both plants, even if they have been used successfully in traditional medicine. It is necessary to recognize that extracts could show efficacy not just in isolation but also in enhancing physiological responses when administered with other herbs or pharmaceuticals.

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Authors' contributions

AJ participated in manuscript writing. NS carried out reviews of the article. DP participated in the sequence alignment and LKK provided guidance.

Compliance with ethical standards

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