



## **Phytochemical and Potential Pharmacological Properties of *Pavetta indica* Linn**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Background:** *Pavetta indica* Linn is a medicinal plant that belongs to the family of Rubiaceae. The parts of this plant are used in indigenous clinical practices, especially for treating visceral obstruction, haemorrhoidal pains, rheumatism and eye diseases, and in the preferential treatment of liver disease, pain from piles, urinary infections, and fever. Despite its usage in indigenous clinical practices, there is limited available information on comparative pharmacognostic, physicochemical, phytochemical, ethnopharmacological data and antioxidant capacity of this herb.

**Aim:** To review and summarize the medicinal properties of *Pavetta indica* Linn after critically evaluating the published studies reporting and to identify potential research areas from the existing data.

**Methodology:** In the first phase, a comprehensive literature search was carried out in several databases under the PRISMA (Preferred Reporting Project for Systematic Reviews and Meta-Analysis) guidelines.

**Results:** The plant reported various classes of bioactive compounds with the main components: carbohydrates, glycosides, alkaloids, phytosterols, saponins, tannins, proteins and amino acids, phenolic and flavonoids. Extracts of this plant possess multiple pharmacological activities such as hepatoprotective, anti-inflammatory, antioxidant, antidiabetic, neuroprotective and wound healing factors, anti-dementia, anti-cancer, antimicrobial, antihelminthic and diuretic properties.

**Conclusion:** This review gives vital information on the traditional uses and, on the other hand, modern discoveries such as phytochemistry and pharmacology of *Pavetta indica* Linn. The therapeutic value of the plant was discovered based on the information gathered during the review process. As a result, greater research on this plant should be encouraged to identify new useful drugs and therapeutic effects and test using clinical studies.

**Keywords:** *Pavetta indica* Linn; phytochemical; pharmacological; anti-cancer; antimicrobial, antioxidant; antidiabetic; hepatoprotective.

## 1. INTRODUCTION

*Pavetta indica* Linn is a member of the Rubiaceae family. It is a shrub or small tree growing to a height of 3-5 meters. The opposite branches consist of membranous leaves and vary diversity [1]. The trunk and the bark of the *Pavetta* plant are grey, smooth and irregularly scaly when mature greenish cream. The *Pavetta indica* Linn leaves are simple: planoconvex in cross-section, glabrous and variable in shape (elliptic, obovate or oblanceolate). Its flowers are of the inflorescence of corymbose cymes, with white flowers at the terminal. The fruit of the *Pavetta indica* Linn is a berry with two pyrenes and seeds, one per pyrene [2].

It is discovered in woodlands, grasslands and thickets in sub-tropical, tropical Africa and Asian Countries but widely distributed in Sri Lanka and India: and undergrowth in disturbed evergreen to semi-evergreen forests up to 900m [3]. Indian Pavetta, Pavettai, Kamatta and Pavatta are few other names used for *Pavetta indica* Linn. Unfortunately, the plant is Least Concerned about national conservation status.

The plant leaves and roots are preferably used in folk medicine, Ayurveda and Siddha medical systems, especially for treating visceral obstruction, haemorrhoidal pains, and rheumatism and eye diseases [4]. *Pavetta indica* Linn leaves are traditionally used to treat liver disease, pain from piles, urinary infections and fever. The roots are revealed to have had purgative, aperient, diuretic and tonic properties and are prescribed in visceral obstructions, jaundice, headaches, urinary diseases and dropsical affections [5]. It is also reported that Sri Lankan traditional and ayurvedic specialists use *Pavetta indica* Linn to relieve different ailments,

including Purishaja Krimi (*E. vermicularis*) infestations successfully. [6].

Despite its extensive history of use in indigenous clinical practices, there is limited information available on the herb's comparative pharmacognostic, physicochemical, phytochemical, and ethnopharmacological properties. Therefore, this comprehensive review focuses on the fundamental importance and research on the herbal plant *Pavetta indica* Linn, which has exceptional therapeutic value. Thus, the present work is intended at the phytochemical screening and pharmacological properties of *Pavetta indica* Linn to provide scientific evidence to evaluate the potential effect of the plant as an aid for forthcoming studies.

## 2. METHODOLOGY

In the first phase, a comprehensive literature search was carried out in the following databases: PubMed Central (PMC) ® (US National Library of Medicine, USA), Ovid © (Ovid Technologies, Inc.) Science Direct © (Elsevier BV), Springer Link © (Springer Nature Switzerland AG), Cochrane Library © (John Wiley & Sons, Inc.), and Google Scholar. The keyword used was: "*Pavetta indica* Linn". The results were limited to studies in English, while all the published articles regarding *Pavetta indica* Linn were included.

The inclusion criteria were used to search the databases mentioned above, and the total number of articles was limited to the sum of total hits under each search criteria. The total number of articles was then screened, and duplicates were removed. The articles were checked by reading the full text for the following information: phytochemical properties and pharmacological

properties. Studies that do not meet the inclusion criteria were excluded at these stages.

In the final step, a manual search was performed using the reference list of the included articles to obtain more data. When possible, follow up on the citations of the studies were done during the literature review and checked whether it is possible to include them. The search process was carried out independently by two reviewers, and after repeated consensus processes, the final group of articles to be included in the review was determined [7].

The literature search using the above search criteria identified the following number of articles in the respective databases; PubMed Central (n=92), Ovid (n=0), Science Direct (n=159), Springer Link (n=195), Cochrane Library (n=2), and Google Scholar (n=3240). Therefore, after removing duplicates and shortlisting the total number of articles according to inclusion criteria, the articles included in the present review are 24.

### 3. RESULTS

#### 3.1 Phytochemical Constituents

The phytochemical investigation is of utmost importance as it identifies bioactive compounds that can possess therapeutic importance. Therefore, the literature searched was based on the studies done to examine the phytoconstituents of different aerial parts of *Pavetta indica Linn* after extraction.

According to Murthy et al., in 2010, aerial parts of *Pavetta indica Linn* were extracted with petroleum ether. Then the preliminary qualitative analysis was used to identify chemical

constituents of the extract and confirmed the presence of carbohydrates, glycosides, alkaloids, phytosterols and flavonoids by thin-layer chromatography (TLC) [8]. In the same study, chloroform extract of aerial parts of *Pavetta indica Linn* was adsorbed on silica gel for column chromatography. The extract was used to isolate various compounds [8].

Leaf extracts were screened for phytochemical screening by Suresh et al. in 2015, applying the standard methods and tests. The ethanolic extract was subjected to Gas Chromatography and Mass spectrometry (GC-MS) [5].

Further, this also contains the results of the compounds from the root extract of *Pavetta indica Linn*, which were successively extracted with petroleum ether, chloroform and ethanol and partitioned with the different solvent systems by increasing their polarities. Then, the compounds were fractionated by using column chromatography & thin layer chromatography technique. The spectral analysis of the compounds has been characterized (IR, 1H sNMR and Mass spectroscopy). Based on the result, ethanolic extract of plant *Pavetta indica Linn* isolates four compounds for the first time from the root parts, namely, Fericlic acid, Chlorogenic acid, Oleic acid and Salicine [9].

In the steam distillation study carried out to establish the chemical composition of the volatile oil obtained from the leaves of *Pavetta indica Linn* using a Clevenger apparatus, 24 compounds were indicated. Among them, the major oil constituents were  $\beta$ -pinene,  $\beta$ -eudesmol and tricyclene, while oxygenated sesquiterpene hydrocarbons and monoterpenes were identified as the minor components [10-13].

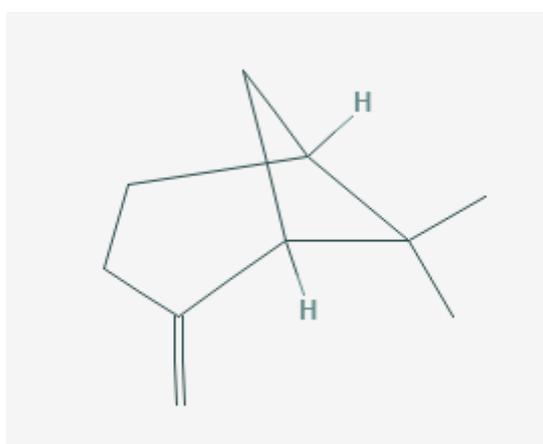


Fig. 1.  $\beta$ -pinene

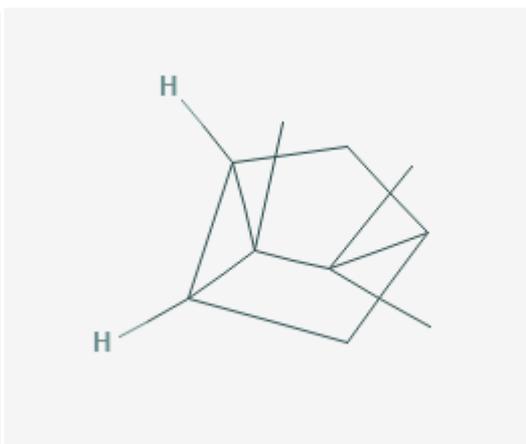
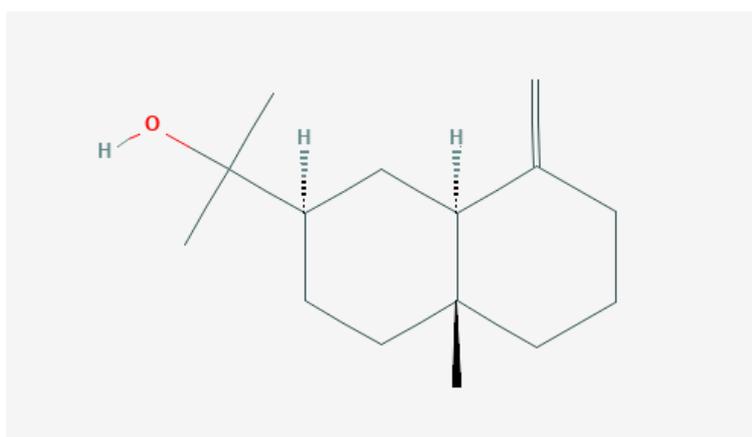


Fig. 2. Tricyclene

Fig. 3.  $\beta$ -eudesmolTable 1. Phytochemical composition of *Pavetta Indica Linn*

Phytochemical constituent	Petroleum ether extract	Methanolic extract	Chloroform Extract	Ethyl acetate extract
Carbohydrate :	+	+	+	+
Glycosides	+	+	-	-
Phytosterol	+	+		
Saponins	+	+	+	+
Fixed oil and fats	+	+		
Tannins	-	-		
Proteins and amino acids	-	-	+	-
Flavonoids	-	+	+	-
Alkaloids	-	+	-	+
Coumarins	-	-		
Phenolic	-	+	+	-

(+) positive or the presence of the constituent, (-) negative or the absence of the constituent

The Table 1 summarizes the phytochemical screening of the plant *Pavetta indica Linn* and the phytochemically active chemicals identified through qualitative analysis.

### 3.2 Pharmacological Properties

#### 3.2.1 Hepatoprotective activity

The hepatoprotective nature of the ethanolic extract of *Pavetta indica Linn* leaves was investigated against acute and chronic liver damage induced by paracetamol in albino rats. Paracetamol administered rats were treated separately with the ethanol extract of *Pavetta indica Linn* leaves. The results report that the potency of ethanolic extract of *Pavetta indica Linn* leaves reverses structural damage to hepatocytes while maintaining normal physiological functioning [14].

The effectiveness of using the aqueous leaf extract of *Pavetta indica Linn* in protecting

against  $\text{CCL}_4$  induced hepatotoxicity due to free radicals and lipid peroxidation in albino Wistar rats was observed by Singh et al. in 2012. The study results revealed hepatoprotective activity of the leaf extract due to the reduction of serum AST, ALT, ALP, bilirubin indicator levels and presence of normal serum levels of protein upon the treatment with the plant extract 10mg/kg body weight along with  $\text{CCL}_4$  hepatotoxicity induction. However, non-toxicity of the leaves was evident with the serum investigations of rats treated only with *Pavetta indica Linn* leaf extract [15].

#### 3.2.2 Anti-inflammatory activity

Methanolic extract of *Pavetta indica Linn* leaves showed significant anti-inflammatory activity when tested against carrageenan, histamine and dextran as different inflammatory models to induce rat paw oedema in male albino Wistar rats. Methanolic extract of the plant has shown granuloma reduction activity [16]. Suresh et al.

investigated the inhibitory potential on protein denaturation of ethanolic extract of *Pavetta indica* Linn using egg albumin. The results revealed the dependent variability of denaturation inhibition percentage on extract concentration, which increases proportionately with the extract's increasing concentration, indicating higher inflammatory ability in higher extract concentration [17].

### 3.2.3 Antioxidant activity

*Pavetta indica* Linn was revealed to possess high antioxidant properties in the in vitro assessment of aerial parts of the plant. Based on the results of the previous studies, three extracts of the plants (petroleum ether extract, ethyl acetate extract and methanolic extract) were tested, and the methanolic extract has shown the highest (2,2-diphenyl-1-picrylhydrazyl) DPPH scavenging activity. The highest hydroxyl radical scavenging and highest iron chelation percentages were also observed with the methanolic extract [18]. In another experiment conducted by Muthu et al. in 2016 evaluating superoxide anion scavenging activity and nitric oxide scavenging activity, it was found that the methanolic extract to be more effective in its antioxidant potential to inhibit the radicals [19].

Both of these experiments were concentration-dependent and showed optimum results in the concentration of the extracts at 1000µg/ml. Thus, low half-maximal inhibitory concentration (IC<sub>50</sub>) in methanolic extracts in each assay exhibits its effectivity in low concentrations. Also, the high phenolic content of methanolic extract of *Pavetta indica* Linn shows its potency as an antioxidant [19].

Antioxidant properties of the plant were further supported by Penumala et al. in their study using the chloroform fractions of the methanolic extract of *Pavetta indica* Linn along with *A. alnifolia* and *Ochna obtusata* plants in ABTS and DPPH assays. The effectivity order of the study was *Ochna obtusata* > *Pavetta indica* Linn > *Amelanchier alnifolia*. With DPPH free radicals against ascorbic acid as the positive control, *Pavetta indica* Linn has shown the highest value compared to the other two extracts confirming its worthiness as an antioxidant [20].

### 3.2.4 Antidiabetic activity

Remarkable reduction of blood glucose levels of diabetic Wistar rats could be observed with the

oral administration of *Pavetta indica* Linn methanol extracts in an Oral Glucose Tolerant Test. Furthermore, when Alloxan-induced diabetic rats were studied, the plant extract effectively reduced blood glucose [21].

Penumala et al. studied the antidiabetic activity of methanolic extract of *Pavetta indica* Linn and its derived CHCl<sub>3</sub>, *n*-BuOH, and H<sub>2</sub>O fractions using its alpha-glucosidase inhibitory potential against the standard drug Acarbose using in vitro enzyme assay. The results showed the inhibition of alpha-glucosidase enzyme activity of methanolic extract and the chloroform fraction, with much lower IC<sub>50</sub> values than the other two fractions [20].

### 3.2.5 Antidementia

The effect of *Pavetta indica* Linn methanol extract and its derived fractions of CHCl<sub>3</sub>, *n*-BuOH, and H<sub>2</sub>O was observed for their Acetylcholinesterase (AChE) and Butyrylcholinesterase (BuChE) inhibitory activities by Penumala et al. 90% of the methanol extract showed the highest inhibitory potential for both AChE and BuChE with its lower IC<sub>50</sub> values [20].

### 3.2.6 Neuroprotective activity

The neuroprotective factor of chloroform fraction of the *Pavetta indica* Linn methanol extract was evaluated against the H<sub>2</sub>O<sub>2</sub> induced injury in SK-N-SH cells. Observed results were dependent on the doses used in the ascending manner of 50µg < 100 µg < 200 µg < 500µg where the highest concentration of the doses exhibited the maximum neuroprotective capacity against oxidative stress [20].

### 3.2.7 Wound healing activity

The plant's wound healing potential of roots and leaves was screened by inflicting circular excision wounds and long incision wounds separately on albino rat models and testing them with Petroleum ether, chloroform & methanol extracts of *Pavetta indica* Linn. Uniform wound healing and contraction process was observed with the plant extracts in the excision wound model. In contrast, increased tensile length was observed with the extracts in incision wounds, where effective results were observed in roots extracts of the plant in comparison with leaves extract. Further, the highest tensile strength was

observed with methanolic extracts of roots and leaves [22]

### 3.2.8 Anti-cancer properties

The in vitro cytotoxicity potentials of the ethanolic extract of *Pavetta indica* Linn was assessed using the Trypan blue dye assay process. This technique is commonly used as a vital stain in anti-cancer activity studies as a dyestuff that changes the colour of dead tissues to blue.

The Anti-cancer activities of ethanolic extract of *Pavetta indica* Linn showed that the higher concentration had a higher inhibition activity against cancer cells [23].

The latest studies on *Pavetta indica* Linn's profound effect on triple-negative breast cancer (TNBC) has shown the necessity of further research on the anti-cancer properties of methanol extract of its leaves and branches. According to the methanol extract of the leaves and branches of *Pavetta indica* Linn. induced cell-cycle arrest at the sub-G1 level, indicated by the activation of caspase-8, -3, -7, and a c-PARP study reported by Yen Thi-Kim Nguyen, Jeong Yong Moon et al. [24].

Furthermore, studies used different signaling mechanisms to explain and identify the antitumor function of Traditional Chinese Medicine (TCM) and natural medicine in TNBC. Plant medicine and herbal formulas inhibited TNBC cell development, proliferation, migration, invasion, and metastasis by regulating associated gene and protein expression through pathways such as PI3K/AKT/mTOR, MAPK, and Wnt/catenin. TCM and natural medicine had an inhibitory effect on tumours at various levels and across multiple pathways, providing adequate evidence for novel drug growth [25].

### 3.2.9 Antimicrobial properties

In the study conducted to show the antimicrobial activity of organic and aqueous organic solvent extracts of the leaves of *Pavetta indica* Linn by Vinod Kumar et al., the extracts were tested against *Escherichia coli*, *Bacillus subtilis* and *Saccharomyces cerevisiae* using disc diffusion assay. The study reported the bactericidal activity against *B. subtilis* of the leaf extracts [1].

In the tests done to discover the minimum inhibitory concentration (MIC) and minimum

bactericidal concentration (MBC) of the water and methanol extracts of *Pavetta indica* Linn leaves, the bactericidal activities for both the MBC and MIC are between 1.95-7.81 mg/ml.

Furthermore, the same study tests have been conducted to discover the thermal stability of aqueous and methanolic crude extracts that exhibited antibacterial activity. The heat stability exhibited by the antibacterial activities has indicated that the plant leaf tissues can be utilized as a valuable source for extracting antimicrobial compounds [1], [26].

On the basis of the aforementioned findings, extracts of the leaves of *Pavetta indica* Linn may have demonstrable bactericidal activity on Gram-positive bacteria and are able in inhibiting the growth of Gram-negative bacteria (Table 1).

### 3.2.10 Antihelminthic properties

The antihelminthic activity of chloroform, petroleum ether, and methanol extracts of *Pavetta indica* Linn roots and leaves was investigated against adult Indian earthworms (*Pheretima posthuma*) and roundworms (*Ascaridia gali*). Using various extracts with varying concentrations (25, 50, and 100 mg/ml), parameters such as the paralysis and onset of death were evaluated. Albendazole in 5% aqueous Dimethylformamide (DMF) was used as a reference standard, with 5% aqueous DMF as a control group. At higher concentrations, more activities were observed. In all extracts, there was dose-dependent activity. With a concentration of 100 mg/ml of methanol extract of plant roots, the least amount of time required for paralysis and death were observed. According to the reports, the plant's root extract had more potent activity than the leaves extracts [27].

### 3.2.11 Diuretic properties

Petroleum ether and methanol extracts of *Pavetta indica* Linn leaves have shown diuretic activity in the studies and compared to furosemide which has been taken as a standard in a study conducted by Ramamoorthy et al. All the extracts had substantial diuretic activity, which was confirmed by elevated total volume and concentrations of urine of Na<sup>+</sup>, K<sup>+</sup>, and Cl<sup>-</sup>. The findings support the use of *Pavetta indica* Linn as a diuretic [28].

**Table 2. Zone of inhibition given by crude extract of *Pavetta indica* Linn against different organism**

Organism	Zone of Inhibition (mm) crude extracts						MIC (mg/ml) flower extract		
	Aqueous		Ethanol		Benzene		Aqueous	Ethanol	Benzene
	well	disk	well	disk	well	disk			
<i>S. aureus</i>	18±1.6	-	30±5.3	-	12±1.6	-	2.50	1.3	3.0
<i>B. subtilis</i>	-	7.5	-	-	-	6.5	1.25	0.31	0.31
<i>B. cereus</i>	14±5.31	-	32±1.0	-	31±1.4	-	3.20	0.62	0.65
<i>S. typhi</i>	6 ±0.30	-	40±7.1	-	20±3.1	-	1.25	0.72	1.05
<i>P. vulgaris</i>	-	-	-	-	-	-	2.50	0.31	1.25
<i>E. coli</i>	15±0.5	No	25±5.5	-	22±.5.3	No	2.50	0.62	1.25
<i>L. acidophilus</i>	11±0.7	-	19±2.8	-	36±3.6	-	5.10	5.15	5.05
<i>M. variance</i>	-	-	-	-	-	-	5.00	1.25	5.00
<i>K. pneumoniae</i>	12±2.67	-	18±4.0	-	13±2.2	-	2.50	0.31	2.50
<i>P. aeruginosa</i>	-	-	-	-	-	-	5.00	1.25	2.50
<i>S. cerevisiae</i>	-	No	-	-	-	No	-	-	-

**Table 3. Urine volume and urine electrolyte concentrations measured against different extract types**

S. no.	Extract type	Dose	Urine Volume (ml) 24 hr.	Electrolyte Excretion			
				Na <sup>+</sup>	K <sup>+</sup>	Cl <sup>-</sup>	Na <sup>+</sup> /K <sup>+</sup>
1	Control	25 ml/kg 1%CMC	6.9±1.02	104.2± 3.42	212.2± 9.02	65.2± 3.12	0.49± 0.37
2	Standard (Frusemide)	25 mg/kg I.P.	14.2± 2.02 bb(a)	146.4± 4.10 bb(a)	86.4± 4.02 bb(a)	98.9± 3.06 bb(a)	1.69± 1.01
3	Petroleum. Ether extract	250 mg/kg Suspension With1%CMC	7.9±1.01	118.4± 4.08	114.6± 4.26	76.4± 2.96	1.03± 0.95
4	Methanol extract	250 mg/kg Suspension With1%CMC	8.8±1.18bb(b)	129.3± 5.21 bb(b)	136.5± 5.62 bb(b)	69.3± 2.06 bb(b)	0.94± 0.92 bb(b)

Values are expressed as Mean ± SEM

According to the study done by Ramamoorthy et al., The values shown in the table are found by using ANOVA (Analysis of variance) followed by Newman level's multiple range tests.

bb(a) values were significantly different from control at ( $P < 0.01$ )

bb(b) values were significantly different from the standard at ( $P < 0.01$ )

At 250 mg/kg, both extracts mentioned above showed increased urine volume and the concentration of  $\text{Na}^+$ ,  $\text{K}^+$ , and  $\text{Cl}^-$  in urine, possibly revealing the basic ion responsible for the diuretic effect. The methanolic extract of *Pavetta indica Linn* demonstrated important diuretic activity among these extracts. The study showed that *Pavetta indica Linn* is an essential source for diuretic effects which can be utilized in modern pharmacology.

#### 4. DISCUSSION

Out of the 422,000 documented plant species, only 12.5% have been used medicinally since ancient times and not always for medicinal value. Additionally, extensive research has been conducted to ascertain the medicinal properties of plants, thus establishing their use by our ancestors [29].

*Pavetta indica Linn* plays an essential role in various disease conditions. The identified tremendous potential of the plant can be utilized to develop the new drug molecules for various serious diseases. Furthermore, *Pavetta indica Linn* is used in folk medicine, Siddha and Ayurveda medical systems to treat different conditions such as pain from piles, liver disease, urinary infections and fever, etc.

The phytochemical investigation, chemical composition, and phytochemical screening of this plant are found among the commonly discussed topics. In different extracts such as ethanolic, methanolic and various aqueous photo components have been investigated. Alkaloids, carbohydrates, tannins, steroidal glycosides, steroids, flavonoids etc., are found among the commonly studied phytocomponents. Furthermore, the Gas Chromatography and Mass spectrometry (GCMS) results of the analysis of ethanolic extracts indicate 36 phytoconstituents grouped into the following categories: acids, alkanes, amines, esters, and phenolic compounds. These phytoconstituents are significant and can be attributed to their

medicinal characteristics [5]. There is scientific evidence for reported bioactivities at the in vitro and in vivo levels. Antibacterial, anti-inflammatory, hepatoprotective, anti-cancer, antidiabetic, diuretic, antihelminthic, and hepatoprotective effects have been observed in several portions of the *Pavetta indica Linn* plant. Numerous studies have been conducted on the leaves, and they have been shown to possess antihelminthic, anti-inflammatory, diuretic, hepatoprotective, antibacterial, anti-cancer, anti-dementia, antidiabetic, and antioxidant properties.

Reactive oxygen species (ROS), including various forms of activated oxygen (free radicals) and their adverse health effects on humans, are widely considered. Thus, many researchers primarily focus on natural antioxidants, and in the plant kingdom, numerous crude extracts and purely natural compounds are tested for antioxidant activity. In vitro assays of the aerial parts of methanolic extract of *Pavetta indica Linn* exhibits significant antioxidant activity comparable to that of petroleum ether & ethyl acetate extracts of *Pavetta indica Linn*. These indicate that in preventing the progress of various oxidative stresses, this plant extract is a significant source of natural antioxidants. Furthermore, there is a necessity to assess the in-vivo antioxidant activity of this extract before clinical use. Thus, this addresses the novel research areas of further isolating and identifying the antioxidant compounds present in the plant extract [20].

Chemotherapy and radiotherapy resistance is a significant constraint on cancer treatment, and the novel research has been focused to develop new anti-cancer agents from natural sources, including plants [30]. Extract of leaves and branches of *Pavetta indica Linn* in methanol causes cell- cycle arrest at the sub- G1 phase and induces apoptotic cell death by activating caspase- 8, - 3, - 7, and c- PARP. The preclinical evidence for the effect of *Pavetta indica Linn* on the anti-cancer effects of a methanol extract of its leaves and branches that is currently available reveals its synergistic effect with both doxorubicin and radiation [24]. In addition, ethanolic extract of the plant *Pavetta indica Linn*. showed that the higher concentration (200  $\mu\text{g}/\text{ml}$ ) had a higher inhibition activity against cancer cells in the Anti-cancer activity [25].

Diabetes is likely to double in prevalence over the next decade. Diabetes is not a solitary illness; instead, it is a diverse combination group of syndromes characterized by hyperglycemia or increased blood sugar [31]. The Methanolic extract of *Pavetta indica Linn* in the dose 250mg/kg p.o and 400mg/kg p.o lower the elevated blood glucose level. This significantly reduces hyperglycaemic condition compared to the glibenclamide (600µg/kg) p.o, standard drug administering [23].

Initially, studies were made to investigate the anti-inflammatory activity of the leaves' methanol extract of *Pavetta indica Linn*. The extract exhibited its significant anti-inflammatory activity in the cotton pellet examination. The anti-inflammatory actions of steroids and triterpenoids have been already reported. In addition, *Pavetta indica Linn* leaf extract also contains steroids and triterpenoid, which gives it the ability to act similarly [18].

*Pavetta indica Linn* possesses distinguishable bactericidal activity on Gram-positive bacteria and growth inhibitory activity on Gram-negative bacteria. Antimicrobial activities of phytoconstituents such as tannins, phenol, terpenoids, alkaloids, essential oils, flavonoids and saponins have been reported, and the predominant feature is the heat stability of the antimicrobial activities [1].

Besides the bactericidal activity, the antihelmintic activity in methanol, petroleum ether, and chloroform extracts of *Pavetta indica Linn* roots and leaves can be achieved. A concentration of 100 mg/ml of methanol extract of plant roots succeeded in killing helminths within the shortest time needed for paralysis and death.

The liver is a vital organ present in vertebrates and some other animals involved in maintaining metabolic function. Moreover, liver damage is a widespread disease caused by several factors. In evaluating hepatoprotective efficacy of aqueous leaf extract of *Pavetta indica Linn* against CCl<sub>4</sub> induced liver injury, hepatoprotective effect against CCl<sub>4</sub> induced liver damage in rats was observed. This may be due to the hepatoprotective, anti-inflammatory and antioxidant properties of *Pavetta indica Linn* [17]. Furthermore, reasonably good hepatoprotective activity was observed when the hepatoprotective activity of *Pavetta indica Linn* leaves was studied in ethanol extract [16].

A wound is a type of injury that happens relatively quickly which may be opened or closed. The wound healing activity is a widely studied topic. Investigations on the ability of *Pavetta indica Linn* extracts to heal wounds in both excision and incision wound models using albino rats have shown significant results. Extracts of all types, including those of leaves and the roots, possessed wound-healing properties. However, root extracts of *Pavetta indica Linn* (petroleum ether, chloroform, and methanol) have shown significant activity compared to the extract of all leaves [22].

The wide variety of benefits of *Pavetta indica Linn* suggest satisfactory pharmacological applications of this plant.

## 5. CONCLUSION

*Pavetta indica Linn* is a medicinal plant containing various bioactive compounds such as carbohydrates, glycosides, alkaloids, phytosterols, saponins, tannins, proteins and amino acids, phenolic and flavonoids. In conclusion, *Pavetta indica Linn* possesses numerous pharmacological activities, including hepatoprotective, anti-inflammatory, antioxidant, antidiabetic, neuroprotective and wound healing activities, anti-dementia, anti-cancer, and antimicrobial, antihelmintic and diuretic properties. Previous research has been focused on carrying out in-vitro and in-vivo studies. Presently, there is a necessity to conduct novel research in clinical trials to characterize the pharmacological activities to determine whether they can be used in public health care.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## NOTE

*Pavetta indica Linn* plays an essential role in various disease conditions. The identified tremendous potential of the plant can be utilized to develop the new drug molecules for various serious diseases. Furthermore, *Pavetta indica Linn* is used in folk medicine, Siddha and Ayurveda medical systems to treat different conditions such as hemorrhoidal pains, liver disease, urinary infections, and fever, etc. The

study highlights the efficacy of pharmacological and phytochemical properties of the plant. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized to develop novel drug targets.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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