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Ethnomedicinal and Phytochemical Studies of *Eclipta alba* (A-Review)

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ABSTRACT

Traditional plants have tremendous benefits for many ailments and illnesses that are typically inexpensive and side-effect-free. We highlight in this review comparatively extensive data on the ethnomedicinal applications, phytochemistry, pharmacology, and toxicity of *Eclipta alba*. The scientific data was gathered from books and online bibliographic sources like PubMed, Google Scholar, SciFinder, and Scopus. The phytochemical analysis of this plant has afforded an important category of natural products such as coumestans, terpenoids, alkaloids, volatile oils, flavonoids, and thiopenes. According to reports, coumestans are the most often used components among them. Potential pharmacological effects, including wound healing, diabetes, obesity, antioxidants, cancer, hair growth, and neuroprotective properties, have been reported for the extracted crude extract and independent component. Subsequent research ought to concentrate on in-depth mechanism-based investigations using clinical trials and animal models.

Keywords: *Eclipta alba*, Ethnomedicinal, Phytochemicals studies, Pharmacological activity, Toxicology.

INTRODUCTION

Natural-origin drugs have a significant role in the healthcare system. The oldest system of traditional medicine is Ayurveda. Ayurvedic practices use formulations made from around 600 different medicinal herbs to address a variety of diseases[1]. *Eclipta alba*, syn. *Eclipta prostrata* is a kind of small perennial herbaceous plant grown in tropical areas worldwide. Other than this it's also evenly distributed in China, India, Brazil, Thailand, Sri Lanka, Malaysia, and Nepal with moist soil, watercourse, and hilly areas[2,3].

As it is known for its traditional use in various ailments. It's commonly known as bhringraj, false daisy. *Eclipta alba* is mainly of three in variety i.e., the white flowering, the black fruiting, and the yellow flowering and all are grown all over India on the sides of rivers, lakes, and foothills of mountains[4,5,6]. In Traditional Chinese Medicine the dried aerial portion of the plant is known as yin-nourishing herb. They are frequently used to treat

associated conditions like hemorrhage, greying hair, tinnitus, and dizziness[7].

Botanical characterization of *Eclipta alba*

Eclipta alba is an annual herb growing up to 30-40 cm tall, erect, or sometimes rooting at the nodes[8]. The stem has fine hairs on its surface, making it rough and either flat or cylindrical, with branched nodes blackish-green in color. Roots are cylindrical and gray in color. The leaves are sessile to sub-sessile, opposite 1.2-2.3 cm wide and 2.2-8.5 cm long oblong, lanceolate, strigose with fine hairs on both sides of the surface[9,10,11]. The flowers are white, small, and arranged in a tiny bundle. The leaf axis gives rise to the flowering stalk, the inflorescence is racemose, and the bloom can be actinomorphic, zygomorphic, pentamerous, or unisexual. Androecium with 5 stamens, an epipetalous filament, a free anther, and an obtuse base, gynoecium with two carpels fused formed the fruit, Ovary inferior, unilocular with 1 basal ovule. Fruit is achenes cuneate, pappus, one seeded with slight wing and brown in appearance. Seeds are dark brown, hairy outer layer, height 0.2-0.25 cm and width 0.1 cm, non-endospermic dicotyledon[12].

Fig. 1. Picture of the plant *Eclipta alba*

Taxonomy of *Eclipta alba*[13]

Kingdom	Plantae
Sub-kingdom	Viridaeplantae
Division	Tracheophyta
Sub-division	Spermatophytina
Class	Magnoliopsida
Order	Asterales
Family	*Asteraceae*
Genus	*Eclipta*
Species	*alba*

Various vernacular names of *Eclipta alba* in distinct language, common name is Bhringraj, False Daisy; in Hindi bhangara, bhangaraiya; in Sanskrit keshraj, markava, bhrunga; in Bengali kesuriya, kesari; in Gujrati bhangaro; in Urdu bhangra; in Tamil *karisalai*; in Marathi maka; in Telegu guntagalagara; in Kannada garujalu, soppu, gurugada; in Malayalam kayyonni, knnunni; in Oriya kesara, kesarda; in Punjabi bhangra; in Assamese bhringraja; in Arabic kadimulabit[14,15].

Ethnomedicinal uses of *Eclipta alba*

In several parts of India, the plant *Eclipta alba* is used to treat conditions like respiratory illnesses, gastrointestinal problems, along skin diseases. The leaves of plants are used in the cure of hair fall, hair drying, alopecia[16], gingivitis, diabetes, baldness, headache[17], elephantiasis, hair dye and stem used as a blood tonic, anemia, any other blood-related problems[18], chickenpox[19] as well as its roots are having great result with constipation & irregular bowels[20]. The whole plant is used in the prevention of symptoms like burns, sores, asthma, cuts and wounds[22], ulcers, fever, normal weakness, jaundice, liver-related, snake bite[21], edema, swelling, high BP, diabetes, indigestion, hepatitis[25], spleen enlargement, anticatarrhal, febrifuge fetal development & childbirth facilitates[23,24]. The aerial portion of *Eclipta alba* is taken as a hepatic cleanser, and hair tonic[26], allergic, inflammation, burns, skin disorder, anemia, headache[27], mental disorder, astringent, antiseptic, anticancer[28,29]. There are numerous Ayurvedic formulations present from the old times, a few of them are; for hair fall (Khalitya) Bhringrajtaila, Gujadi oil[30,34], tonic for hair growth, graying or complexation of hair Bhringrajadichurana[31], Bhringrajghrit[32], Bhringrajasasv[33], and for improving the density Bhringrajchurna is used[35,36].

Pharmacological activities

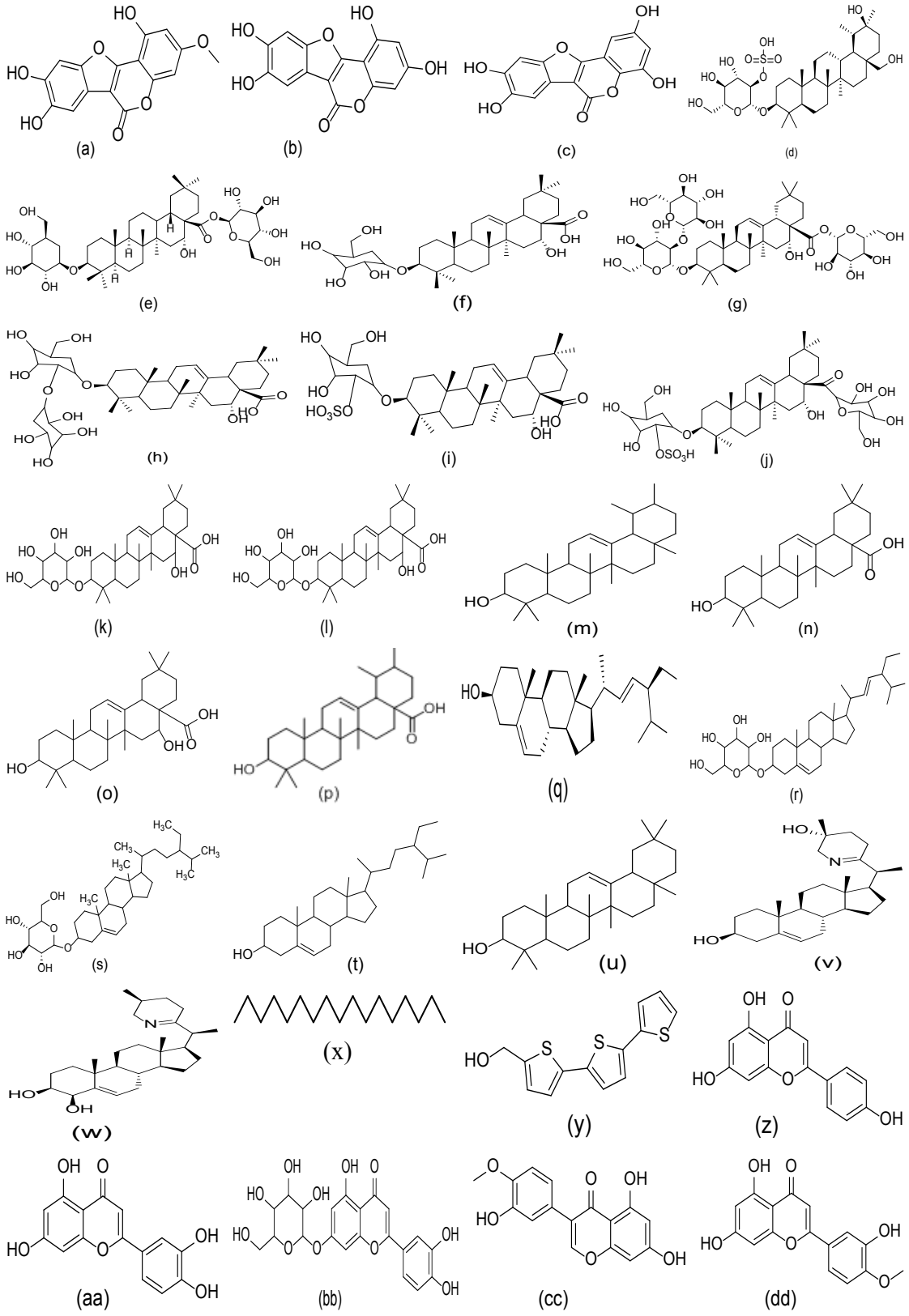
Wound healing activity: According to this investigated study they created a foam dressing with gelatin and leaf extract from *Eclipta prostrata*. Utilizing scanning electron microscopy (SEM), the pore structure was discovered and to verify the chemical arrangement, Fourier-transform infrared spectroscopy (FTIR) was utilized. As for the conclusion, it was determined that the *Eclipta prostrata* dressings had the proper pore size. In the first hour, the weight rise percentage for the *Eclipta prostrata* B dressings was higher, and in the first four hours, the rate of dehydration was higher[62]. In another study of wound healing activity with an aqueous extract of *Eclipta alba* leaves tends

to lower the glycemic action in streptozotocin-induced rats. Also, in comparison to cicatryl (J16) and vaselin (J18) Ointment A (aqueous) and B (hydroethanolic) completely healed in J14 wound in animals. The aqueous extract reduces the glycemic action as well as in streptozotocin rats and ointment of aqueous and hydroethanolic extracts was used to treat incision wounds[63]. *Eclipta alba* hydroalcoholic and methanolic extract gel induced in diabetes alloxan rats, and gel applied on wounds for 15 days that tended to result in hydroalcoholic extract gel is a more potent action than methanolic & it is non-toxic when taken orally in LD50 rats. Hydroalcoholic gel extract of *Eclipta alba* has shown the diabetic wound healing action better than methanolic extract[64].

Table 1: Phytocompounds derived from *Eclipta alba*

No	Compounds	Part	References
Coumestans			
1	Wedelolactone[a]	Aerial	37,38,39
2	Demethylwedelolactone-7-glucoside[b]	Aerial	39,40
3	Iso-demethylewedelolactone[c]	Whole Plant	40
4	Strychnolactone	Aerial	40
Terpenoids, their glycosides (taraxastane triterpene glycoside)			
5	Eclabasaponins	Whole Plant	41
6	Eclabasaponins	Whole Plant	41
7	Eclabasaponins	Whole Plant	41
8	Eclabasaponins[d]	Whole Plant	41
(Oleanane triterpene glycosides)			
9	Eclabasaponins[e]	Whole Plant	41,42,43
10	Eclabasaponins[f]	Whole Plant	41,42,43
11	Eclabasaponins[g]	Whole Plant	41,42,43
12	Eclabasaponins[h]	Whole Plant	42,43
13	Eclabasaponins[i]	Whole Plant	41,42,43
14	Eclabasaponins[j]	Whole Plant	42,43
15	Ecliptasaponin A[k]	Whole Plant	41
16	Ecliptasaponin B	Whole Plant	41
17	Ecliptasaponin C	Whole Plant	41
18	Ecliptasaponin D[l]	Whole Plant	41
19	Eclalbatin	Whole Plant	45,46
20	α-amyrin[m]	Aerial	46
21	Oleanolic acid[n]	Whole Plant	46
22	Echinocystic acid[o]	Whole Plant	41
23	Ursolic acid[p]	Whole Plant	46
24	Stigmasterol[q]	Leaves/Stem	44
25	Stigmasterol-3-O-glucoside[r]	Aerial/ stem	42,44,47
26	Daucosterol[s]	Leaves/stem	44
27	Silphioside C	Whole Plant	48
28	Silphioside B	Aerial	49
29	Silphioside E	Aerial	49
30	β-Sitosterol[t]	Aerial	39
31	Machaeroceric acid	Aerial	42
32	β-amyrin[u]	Aerial	46
33	Echinocystic acid-28-O-β-D-	Aerial	50
34	glucopyranoside		
Alkaloids			
35	Ecliptine	Whole Plant	41
36	(20S) (25S)-22,26-imino-cholesta-5	Aerial	51
37	22(N)-dien-3β-ol (verazine)	Leaves	51
38	25b-hydroxyverazine[v]	Leaves	51
39	4b-hydroxyverazine[w]	Leaves	51
40	(20R)- 4b-hydroxyverazine	Whole Plant	51
	Ecliptalbine [(20R)-2-pyridyl-cholesta 5-ene-3P, 23-diol]	Leaves	51
41	(20R)-25β-hydroxyverazine		
42	(20-epi-3-dehydroxy-3-oxo-	Leaves	51

Volatile Oils	5,6-dihydro-4,5-dehydroverazine)		
43	Heptadecane[x]	Aerial	46
44	n-hexadecenoic acid	Aerial	46
45	pentadecane, eudesma-4(14)	Aerial	46
46	6,10,14-trimethyl-2-pentadecanone	Aerial	47
47	1,2-benzenedicarboxylic acid diisooctyl ester	Aerial	46
48	(Z)-7,11-dimethyl 3-methylene-1,6,10-dodecatriene	Aerial	47
49	(Z, Z, Z)-1,5,9,9-tetramethyl-1,4,7-cycloundecatriene	Aerial	46,47
50	Phytol, octadic-9-enoic acid	Aerial	45
51	D-dithienyl acetylene ester	Aerial	51
52	α-terthienyl-methanoly	Aerial	51,52,53
53	α-formylterthienyl	Aerial	51,52,53
54	ecliptal or α-terthienyl aldehyde	Aerial	51,52,53
Flavonoids			
55	Protocatechuic acid	Leaves/Whole	39.42,44,46
56	4-hydroxybenzoic acid	Plant	39,44,46
57	Apigeni[n]	Leaves/Stem	39,44,46
58	Luteolinaa	Aerial	55
59	Luteolin-7-O-glucosidebb	Aerial	56
60	Pratenseincc	Aerial	48,57,58
61	Diosmetindd	Aerial	58
62	Buddleoside	Aerial	58
		Aerial	
63	Quercetinee	Aerial	59,60
64	Skullcapflavone[ff]	Whole Plant	60
65	Kaempferol[gg]	Whole Plant	60
66	Eriodictyol[hh]	Whole Plant	48
67	Orobol[ii]	Whole Plant	42
68	Acacetin[jj]	Whole Plant	60
69	Vanillic acid[kk]	Aerial	42
70	Syringic acid[ll]	Aerial	42
71	Chlorogenic acid[mm]	Aerial	42
72	Leonuriside A[nn]	Whole Plant	48
73	Caffeic acid[oo]	Whole Plant	48
74	Coniferyladehyde	Whole Plant	48
75	Oroboside	Whole Plant	59
76	Orobol-5-O-β-D-glucopyranoside	Whole Plant	48
77	3'-O-methylorobol[pp]	Aerial	42,59
78	3'-Hydroxybiochanin A	Aerial	57,58
79	Tricetin[qq]	Aerial	42
Thiophene			
80	Ecliprostin A, B, C	Aerial	60
81	a-Formylterthienyl	Whole Plant	53
82	Arctinol B[rr]	Aerial	63
83	6-Methoxy-arctinol-b	Aerial	63
84	α- Terthienyl	Aerial	52
85	α-Terthienyl methanol	Whole Plant	52,53,54
86	2,2',5"-terthiophene-5-carboxylic acid	Leaves	62
87	5-aldehyde-5'-(3-butene-1-ynyl)-2,2'-dithiophene	Whole Plant	53,54
Miscellaneous			
88	Heptacosanol[ss]	Roots/Leaves	52,54
89	Hentriacontanoltt (Fatty Alcohol)	Roots	52,54
90	Ecliptal	Roots	52,54
91	5-hydroxymethyl-(2,2':5',2")-terthienyltiglate	Roots/Leaves	52,54
92	5-hydroxymethyl-(2,2':5',2")-terthienylagelate	Whole Plant	52,54
93	5-hydroxymethyl-(2,2':5',2")-terthienyl acetate	Whole Plant	52,54
94	Polyacetylenes (Polyacetylinic)	Roots	44,46
95	Polyacetylene-substituted thiophenes	Leaves/Whole Plant	44,46
96	4-hydroxy benzoic acid (Phenolic acids)	Leaves/Stem	44,46
97	Protocatechuic acid (Phenolic acids)	Whole Plant	47
98	Euodionoside A	Whole Plant	48
99	Junipeionoloside	Whole Plant	48
100	Calaliuiuenside		48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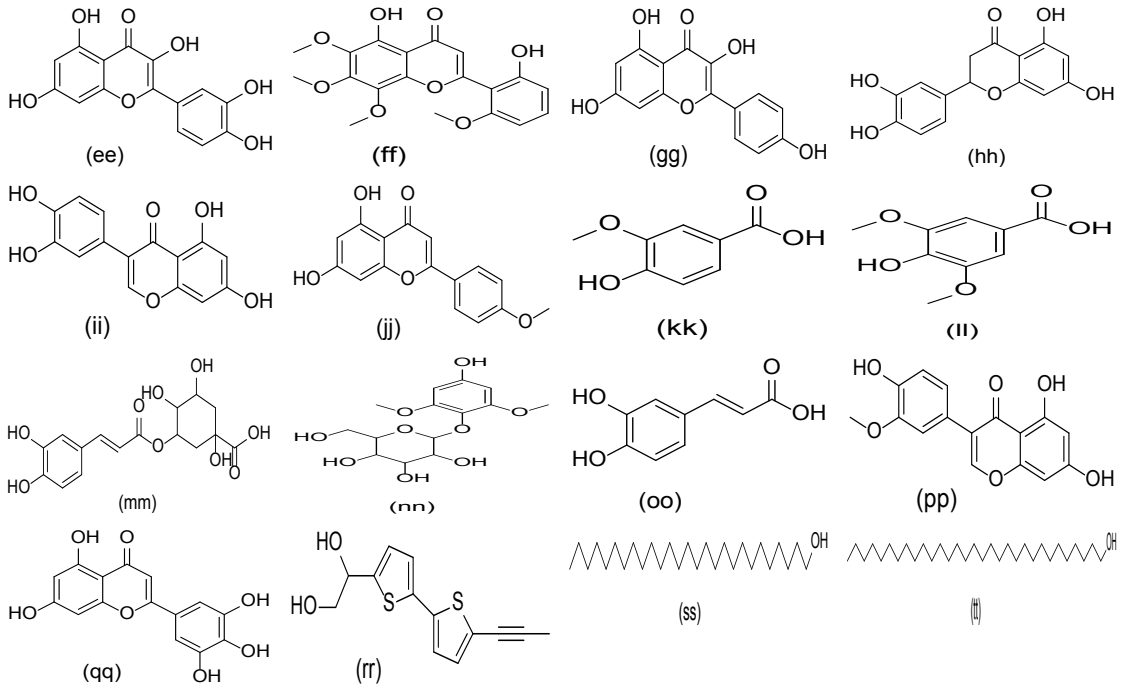

Fig. 2. Chemical structures of some phytocompounds of *Eclipta alba*

Anti-diabetic activity: As per the reported study, antidiabetic activity of *Eclipta prostrata* hydro extract in Streptozotocin-induced diabetic rat, oral treatment of *Eclipta prostrata* and glibenclamide results in efficient in diabetes, improving carbohydrate metabolizing enzymes, also enhance serum high-density lipoprotein cholesterol range[65] Diabetes is linked to insulin regulation and pancreatic beta-cell progression. Phytonanotherapy uses metal nanoparticles and plants to treat diabetes. This study focuses on the eco-friendly, *Eclipta alba* (EA-AuNPs) is used in the manufacture of gold nanoparticles, and their pharmacological effectiveness against pathogenic bacteria and streptozotocin-induced apoptosis in the RIN-5F cell line assessed. The synthesized EA-AuNPs showed anti-apoptotic potential and free radical scavenging potential, making them promising for biomedical applications in nanomedicine[66].

Anti-Cancer activity: The MTT assay experiment in the cancer cell investigation demonstrated a significant (p 0.005) selection against HCT-116 cells by the methanolic extract of *Eclipta alba*. Additionally, this extract had a negligible or harmless effect on WI-38 cells. Clonogenic and migration assays both supported the effectiveness of the extract's antitumor activity against HCT-116 cells. The outcomes showed that *Eclipta alba* methanolic extract has optimal properties, such as little toxicity against normal cells WI-38, and possesses high action against colorectal cancer cells HCT-11667.

Anti-Fungal activity: Boregowda *et al.,* 2019 reported the antifungal activity against the sorghum fungal pathogens *Fusarium thapsinum*, *Epicoccum sotghinum*, *Alternaria alternata*, and *Curvilaria lunata*. Methanolic extract of *Eclipta alba* tested on all pathogenic fungi. The existence of their plant analogs is shown by the chemical characterization of the metabolites, for example, wedelolactone, and eclalbasaponin II are available in huge amounts. To detect the phytochemicals, present in methanolic extract obtained from the plant are determined by Ultra-performance liquid chromatography and mass chromatography[68].

Anti-Obesity activity: On anti-obesity rats with high-fat diets including cholesterol and cholic acids to induce non-alcoholic fatty liver, the effects of *Eclipta prostrata* methanol extract on this condition were assessed. The lipid profile and liver function significantly improved after increased dose treatment with *Eclipta prostrata* (200mg/ and 300mg/kg), as per the outcome of biochemical and histological study[69].

Anti-inflammatory activity: *Eclipta prostrata* improved atopic dermatitis symptoms progression, reduced the layer thickness of the epidermis and dermis, infiltrated defense cells, and healed skin barrier malfunction. Additionally, by restoring the skin barrier and balancing the defense system, it reduces allergic irritation. In HaCat keratinocytes, *Eclipta prostrata* suppressed nuclear factor- B translocation, phosphorylation, and cytokine expression, indicating promising therapeutic use as an anti-atopic drug[70].

Immunomodulatory Effect: A study on heteropneustes fossilis fingerlings found that *Eclipta alba* extract, at a concentration between 50-100ppm, protects them against *A. invadans* infection. The extract induces anti-stress and antioxidative responses, reducing cortisol levels and increasing superoxide dismutase and catalase levels. The protective effect is linked to its immunomodulatory effect, enhancing fingerling survival. *Eclipta alba* extract could be a potential holistic strategy for controlling EUS in fish Species[71].

Antioxidant activity: The study looked into the antiproliferative effects, antioxidant ability, and chemistry of extracts from *Eclipta prostrata*. Two flavonoids were extracted from the ethyl acetate extract: 3-O-methylorobol and apigenin 7-sulfate. Compared to other extracts, the ethyl acetate extract exhibited larger phenol and flavonoid levels as well as stronger antioxidant activity. It decreased AGS cell viability and proliferation *in vitro* by changing gene expression to cause apoptosis[72]. Research on *Eclipta alba* found that exposure to multispectral lights significantly enhanced the growth and development of the plant. Red light led to maximum dry weight and increased phenolics and flavonoid content in callus cultures. HPLC analysis the highest accumulation of major compounds in red light-treated cultures, while blue light led to the optimal accumulation of stigmasterol. These findings suggest that multispectral lights can be an effective strategy for enhancing phytochemical production in *Eclipta alba*[73].

Nephroprotective activity: Dacus carota and *Eclipta prostrata* extract nephroprotective properties on Wistar albino rats' nephrotoxicity produced by cisplatin. Four groups of rats were created, and samples of their urine and blood were taken. The findings of cisplatin-induced nephrotoxicity in rats showed that Cis+DC/Cis+ EP (600mg/kg) markedly raised body weight and decreased kidney weight. It also raised the amount of Na, and K, creatinine in the urine and plasmin[74].

Toxicology

The 70% ethanol fraction lethal dose (LD50) in a mouse trail of acute toxicity was found to be undetectable, as no animals died even after being given a dose of 10.4 g/kg for 14 days[61]. Bone marrow stromal cells were cytotoxically affected by high doses of wedelolactone (10 mol/L) and ethyl acetate extract (20 g/mL). Additionally, a dose greater than 40 mol/L of wedelolactone inhibited human renal mesangial cell proliferation. The incongruous result differing solvents extract, ingredients, an experimental model's studies may be the reason, indicating that extra care is still required for the dosage to ensure safety[75].

CONCLUSION

The plant *Eclipta alba* is widely used in traditional medicine worldwide, especially for conditions pertaining to the stomach, liver, and skin. It is also used to promote hair development. It has a variety of phytochemical components, including coumestans, saponins, alkaloids, polyacetyl, wedelolactone, eclalbasaponins, α-amyrin, ursolic acid, oleanolic acid, luteolin, and apigenin are among the substances found in flavonoids, which have biological effects on the body, including hepatoprotective, anti-depressant, anti-inflammatory, antibacterial, and antidiabetic effects. *Eclipta alba* extract may prove to be a valuable source for the pharmaceutical and nutraceutical industries in the future if establishing standards and stability studies are conducted on it. By gathering information from pharmaceutical and clinical studies, the lead bioactive compounds could be further developed as therapeutic molecules.

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Conflict of Interest

The authors declare no conflict of interest.

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