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REVIEW ARTICLE

Ethnobotanical Importance and Phytochemical constituents of Parthenium weed (*Parthenium hysterophorus* L.) – A Review

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Abstract

***Parthenium hysterophorus* L. is a harmful weed of family Asteraceae (Compositae). Its chemical constituents and ethnobotanical uses have been reviewed in this paper. The reported phytochemical studies revealed the presence of flavonoids, oils, phenolics, terpenoids, amino acids, alkaloids and others. Different parts of the plant have been reported to be used in traditional medicine against fever, diarrhoea, neurologic disorders, urinary tract infections, dysentery, malaria and as emmenagogue. It is also used as remedy for inflammation, eczema, skin rashes, herpes, rheumatic pain, cold, heart trouble and gynaecological ailments. Although plenty of compounds were isolated from this plant, further work needs to be carried out and explore folk recipes for the benefit of improving human health.**

Keywords: *Parthenium hysterophorus*; flavonoids; Asteraceae; biocontrol; Green manure

Introduction

The genus *Parthenium* L. of family Asteraceae (Compositae) is distributed in North Central America, Northern South America and West Indies. It consists of ca.16 species. One species, *Parthenium hysterophorus* L. is widespread weed. It is the only species, found in Pakistan (Khalid, 2000).

P. hysterophorus L. is commonly known as congress grass, congress weed, carrot grass, dog flea weed, white heads (English), parthenium matricaire (French), ragweed parthenium (USA), chatak chandani, gazar ghas (India), thandhi booti, lewanai bhang (Pakistan) (Parker and Shabbir, 2008 - 2013).

After accidental introduction of Parthenium weed (*P. hysterophorus* L.) in India in the mid-1950s through imported food grains, it has been documented as invasive weed in this continent. Then it has spread over most parts of the neighbouring countries including Pakistan (Javaid and Anjum, 2005). This weed is rapidly spreading in wastelands, degraded areas, rocky crevices, along water channels, roadsides, railway tracks, and also in cultivated lands (Shabbir, 2002) of various parts of Punjab, Khyber Pakhtoon Khawa and Kashmir (Javaid and Anjum, 2005).

P. hysterophorus L. has become a major pest plant of the wastelands and metropolitan areas of Islamabad where, many other plants have already been labelled to be the causes of the pollen allergy and hay fever. Heavy infestation of *P. hysterophorus* L., which has also been proved to be an allergy causing plant, poses a serious threat to the inhabitants of the Islamabad (Shabbir and Bajwa, 2007).

The invasive nature of Parthenium weed is due to its ability to form huge monocultural stands with no other plant in the vicinity. That is why it has rapidly substituted local weed flora. Various reports have declared it as noxious weed due to its potential to decrease the crop productivity, fodder scarcity, biodiversity depletion and health problems for livestock and human causing hay fever, skin problems and asthma (Riaz and Javaid, 2011).

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Table 1. Chemical constituents of *Parthenium hysterophorus* L.

Sl. No.	Compound	Group	Reference(s)
1.	8-ß-acetoxyhysterone C	----------	Roy and Shaik, 2013
2.	Acetylated pseudoguaianolides	Pseudoguaianolides	Saini *et al*., 2014
3.	N-acetylgalactosamine	Amino sugars	Roy and Shaik, 2013
4.	N-acetylglucosamine	Amino sugars	Roy and Shaik, 2013
5.	Alanine	Amino acids	Roy and Shaik, 2013; Saini *et al*., 2014
6.	Ambrosin	Pseudoguaianolides	Saini *et al*., 2014
7.	Anhydroparthenin	Pseudoguaianolides	Saini *et al*., 2014
8.	Anisic acid	Phenolics	Parsons and Cuthbertson, 2001; Saini *et al*.,2014
9.	Apigenin	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
10.	Artecanin	Terpenoids	Roy and Shaik, 2013
11.	Artemorin	Terpenoids	Roy and Shaik, 2013
12.	Balchanin	Terpenoids	Roy and Shaik, 2013; Saini *et al*., 2014
13.	Borneol	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
14.	Bornyl acetate	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
15.	Isobornyl 2-methyl butanoate	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
16.	Caffeic acid	Phenolics	Parsons and Cuthbertson, 2001; Saini *et al*.,2014
17.	Camphene	Oils	Roy and Shaik, 2013; Saini *et al*.,2014
18.	Camphor	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
19.	Carvacrol	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
20.	Caryophyllene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
21.	Caryophyllene oxide	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
22.	Centaureidin	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
23.	Charminarone	Pseudoguaianolides	Roy and Shaik, 2013; Saini *et al*., 2014
24.	Chlorogenic acid	Phenolics	Parsons and Cuthbertson, 2001; Saini *et al*., 2014
25.	Chrysanthemolide	Terpenoids	Roy and Shaik, 2013
26.	Chrysanthemonin	Terpenoids	Roy and Shaik, 2013
27.	Chrysanthenone	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
28.	Chrysartemin A	Terpenoids	Roy and Shaik, 2013
29.	Chrysoeriol	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
30.	Conchasin A artecanin,	Pseudoguaianolides	Saini *et al*., 2014
31.	Cornopolin	Terpenoids	Roy and Shaik, 2013
32.	Coronopilin	Pseudoguaianolides	Saini *et al*., 2014
33.	Costunolide	Terpenoids	Roy and Shaik, 2013; Saini *et al*., 2014
34.	p-coumaric acid	Phenolics	Saini *et al*., 2014
35.	p-cymene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
36.	p-cymen-8-ol	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
37.	Damsin	Pseudoguaianolides	Saini *et al*., 2014
38.	Deacetyltetraneurin A	Pseudoguaianolides	Saini *et al*., 2014
39.	Epoxyartemorin.	Terpenoids	Roy and Shaik, 2013; Saini *et al*., 2014
40.	8α-Epoxymethylacrylyloxyambrosin	-------	Roy and Shaik, 2013
41.	8α-Epoxymethylacrylyloxy-11	-------	Roy and Shaik, 2013
42.	8α-Epoxymethylacrylyloxyparthenin	-------	Roy and Shaik, 2013
43.	Farnesene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
44.	Ferulic acid	Phenolics	Parsons and Cuthbertson,2001; Saini *et al*.,2014
45.	Galactose,	Carbohydrate	Saini *et al*., 2014
46.	Germacrene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
47.	Glucose	Carbohydrate	Saini *et al*., 2014
48.	Glycine	Amino acids	Roy and Shaik, 2013; Saini *et al*., 2014
49.	Humulene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
50.	Hymanin	Pseudoguaianolides	Saini *et al*., 2014
51.	Hysterin	Pseudoguaianolides	Saini *et al*., 2014
52.	Hysterones A to E	Pseudoguaianolides	Roy and Shaik, 2013; Saini *et al*., 2014
53.	1-ß-hydroxyarbusculin	Terpenoids	Roy and Shaik, 2013; Saini *et al*., 2014
54.	P-hydroxy benzoic acid	Phenolics	Saini *et al*., 2014
55.	2ß and 8ß-hydroxycoronopilin	Pseudoguaianolides	Saini *et al*., 2014
56.	8- α-hydroxyestafiatin, artecanin	Terpenoids	Roy and Shaik, 2013; Saini *et al*., 2014
57.	2ß-Hydroxycoronopilin	----------	Roy and Shaik, 2013
58.	3-ß-hydroxycostunolide	Terpenoids	Roy and Shaik, 2013; Saini *et al*., 2014
59.	Dihydroisoparthenin	Pseudoguaianolides	Saini *et al*., 2014
60.	Dihydroxyparthenin	Pseudoguaianolides	Saini *et al*., 2014
61.	13-dihydroparthenin	----------	Roy and Shaik, 2013
62.	1α, 2ß, 4ß-Trihydroxypseudoguaian-6ß, 12-olide	----------	Roy and Shaik, 2013

The major components of toxin being 'Parthenin' and other phenolic acids such as caffeic acid, vanillic acid, anisic acid, chlorogenic acid and parahydroxy benzoic acid are lethal to human beings and animals. In addition to

Table 1. Chemical constituents of *Parthenium hysterophorus* L. – Contd.

Sl. No.	Compound	Group	Reference(s)
63.	3-ß-hydroxy- parthenolide	Terpenoids	Roy and Shaik, 2013
64.	6-hydroxykaempferol 3,6-dimethyl ether	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
65.	6-hydroxykaempferol 3,6,4'-trimethyl ether (tanetin)	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
66.	11-H,13-hydroxyparthenin	Pseudoguaianolides	Saini *et al*., 2014
67.	5-ß-hydroxyreynosin	Terpenoids	Roy and Shaik, 2013; Saini *et al*., 2014
68.	Jaceidin	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
69.	Kaempferol glucoside	Flavonoids	Saini *et al*., 2014
70.	Kaempferol glucoarabinoside	Flavonoids	Saini *et al*., 2014
71.	KCl	Salt	Saini *et al*., 2014
72.	Lignan	Flavonoids	Saini *et al*., 2014
73.	Limonene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
74.	Linalool	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
75.	Luteolin	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
76.	Lysine	Amino acids	Roy and Shaik, 2013; Saini *et al*., 2014
77.	Magnolialide	Terpenoids	Roy and Shaik, 2013
78.	Melatonin	----------	Roy and Shaik, 2013
79.	13-methoxydihydroambrosin	Pseudoguaianolides	Saini *et al*., 2014
80.	13-methoxydihydroparthenin	Pseudoguaianolides	Saini *et al*., 2014
81.	2ß,13α-dimethoxydihydroparthenin	Pseudoguaianolides	Saini *et al*., 2014
82.	Myrtenal	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
83.	Neochlorogenic acid	Phenolics	Roy and Shaik, 2013; Saini *et al*., 2014
84.	Ocimene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
85.	Parthenin	Terpenoids	Roy and Shaik, 2013
86.	Parthenolide	Terpenoids	Roy and Shaik, 2013
87.	Partholide	Terpenoids	Roy and Shaik, 2013
88.	ß-ocimene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
89.	α-phellandrene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
90.	α-pinene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
91.	Pinocarvone	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
92.	Potassium chloride	-------	Roy and Shaik, 2013
93.	ß-terpene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
94.	Proline	Amino acids	Roy and Shaik, 2013; Saini *et al*., 2014
95.	Protein	--------	Roy and Shaik, 2013
96.	Protocatechuic acid	Phenolics	Saini *et al*., 2014
97.	Pyrethrin	--------	Roy and Shaik, 2013
98.	Quercetagetin 3,6-dimethyl ether	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
99.	Quercetagetin 3,6,3'-trimethyl ether (along with isomeric 3,6,4'-trimethyl ether)	Flavonoids	Roy and Shaik, 2013
100.	Quercetin	Flavonoids	Roy and Shaik, 2013
101.	Quercetin glucoside	Flavonoids	Saini *et al*., 2014
102.	Reynosin	Terpenoids	Roy and Shaik, 2013
103.	Sabinene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
104.	Santin	Flavonoids	Roy and Shaik, 2013; Saini *et al*., 2014
105.	Santamarin	Terpenoids	Roy and Shaik, 2013
106.	Saponins	along with Flavonoids	Saini *et al*., 2014
107.	Scopoletin	Pseudoguaianolides	Saini *et al*., 2014
108.	Syringaresinol	Flavonoids	Saini *et al*., 2014
109.	ß-myrcene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
110.	Tannins (type unspecified)	--------	Roy and Shaik, 2013
111.	ß-terpene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
112.	Tetraneurin-A	Pseudoguaianolides	Saini *et al*., 2014
113.	Tetraneurin-E	Pseudoguaianolides	Saini *et al*., 2014
114.	α-terpinene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
115.	γ-terpinene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
116.	α-terpineol	Oils	Roy and Shaik,2013,Saini *et al*., 2014
117.	Terpinene-4-ol	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
118.	α-thujene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
119.	Trans-myrtenol acetate	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
120.	Tricylene	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
121.	Vanillic acid	Phenolics	Parsons and Cuthbertson, 2001; Saini *et al*., 2014
122.	Ugenol	Oils	Roy and Shaik, 2013; Saini *et al*., 2014
123.	α-unsaturated γ-lactones	Terpenoids	Roy and Shaik, 2013

health hazards lot of available data also highlights its impact on agriculture as well as natural ecosystems (Javaid and Anjum, 2005). Although plenty of compounds were isolated from this plant (Table 1), further work needs to be

carried out and explore folk recipes for the benefit of improving human health.

Taxonomy and Nomenclature

Domain:	Eukaryota
Kingdom:	Plantae
Phylum:	Spermatophyta
Subphylum:	Angiospermae
Class:	Dicotyledonae
Order:	Asterales
Family:	Asteraceae
Genus:	*Parthenium*
Species:	*hysterophorus* L. (Anonymous, 2014).

Description

Parthenium hysterophorus L. is an annual herb with a deep tap root and an erect stem that becomes woody with age. As it matures, the plant develops many branches in its top half and may eventually reach height of two metres. Leaves are pale green, deeply lobed and covered with fine soft hairs. Flowers small creamy white lowers occur on the tips of the numerous stems. Each flower develops 4-5 black seeds that are wedge-shaped, two mm long with two thin, white scales (DEEDI, 2011).

Parthenium weed normally germinates in spring and early summer, produces flowers and seeds throughout its life and dies around late autumn. However, with suitable conditions (rain, available moisture, mild temperatures), it can grow and produce flowers at any time of the year. In summer, plants can flower and set seed within four weeks of germination, particularly if stressed (DEEDI, 2011). An individual plant may produce 15,000-25,000 seeds (Javaid and Anjum, 2005).

Habitat

P. hysterophorus L. occurs in humid and subhumid tropics, typically favouring heavier fertile soils, such as black, alkaline clay loams, but is able to grow on a wide variety of soil types from sea level up to 2400 m. Areas receiving less than 500 mm of rainfall annually are probably unsuitable, although the weed has strong adaptive methods to tolerate both moisture stress and saline conditions (Parker and Shabbir, 2008-2013).

Uses

The decoction of *P. hysterophorus* L. has been used in traditional medicine to treat fever, diarrhoea, neurologic disorders, urinary tract infections, dysentery, malaria and as emmenagogue. Ethnobotanically, it is used as remedy for inflammation, eczema, skin rashes, herpes, rheumatic pain, cold, heart trouble and gynaecological ailments. *P. hysterophorus* L. has been found to be pharmacologically active as analgesic in muscular rheumatism, therapeutic for neuralgia and as vermifuge. This weed is also reported as promising remedy against hepatic amoebiasis. Parthenin, the major constituent of the plant, exhibits significant medicinal attributes including anticancer property (Patel, 2011). Decoction of roots is used in dysentery and helpful in skin disorders. Plant used as tonic, febrifuge, emmenagogue and analgesic (Ravinder and Vashistha, 2014). Parthenium weed is used as a herbal remedy for various intestinal and skin disorders using a decoction of boiled roots. It has potential medicinal properties due to antitumor and antiamoebic activities (Anonymous. 2014). The whole plant is bitter and strong-scented, reckoned tonic, stimulating and anti-hysteric. It was once a popular remedy in ague. Its odour is said to be peculiarly disagree to bees and that insects may be easily kept at a distance by carrying a handful of the flower heads (Oudhia, 2014).

The application of parthenium weed compost and green leaf manure was reported to lower weed populations in rice. This was due to the role of allelopathic compounds present in it, an increase in soil moisture due to the build-up of soil organic carbon, increased soil N, P and K content, and a reduced incidence of pests in rice such as stem borers and leaf rollers. Parthenium weed is also potentially a rich source of potash. Parthenium weed stem is boiled in water and used to remove the toothache and strong the gums. Ground root in water is used to remove boils and pimples. Its leaves extraction is used insomnia by pouring its drops in eyes (Noor and Kalsoom, 2011). It is carminative, leaves juice gives strength to the stomach and relief from constipation. Some people use it in fever also (Mahmood *et al*., 2011).

Competing interests

The authors declare that they have no competing interests.

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