REVIEW ARTICLE

A Review on Traditional Uses, Chemical Constituents and Pharmacology of *Ageratum conyzoides* L. (Asteraceae)

R Kaur¹, N K Dogra¹*

¹Ph.D. Scholar, Department of Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala-147002, Punjab, India

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**ABSTRACT**

*Ageratum conyzoides* L. (Family: Asteraceae) is a widely available plant in India. The plant has been employed in various conventional systems of medicines to cure a wide array of disorders including asthma, wounds, malaria, piles, dysentery, etc. Various chemical constituents belonging to chemical classes such as sterols, flavonoids, terpenoids, lignan, pyrrolone, chromenes and pyrrolizidine alkaloids have been found in the plant. This review compiles the available data on the traditional uses, chemical constituents, pharmacology and toxicity studies reported from *Ageratum conyzoides* in a systematic order so as to highlight the medicinal worth of the plant.

**Keywords:** *Ageratum conyzoides*, Asteraceae, Chromenes, Goat weed, Wounds.

**INTRODUCTION**

*Ageratum conyzoides* L. commonly known as Goat weed or White weed is a member of the family Asteraceae, also known as sunflower family. The plant is native of Tropical America and is found throughout India, up to an altitude of 1,800 m. [1-3] It is an annual erect, aromatic herb with 1 m height; leaves are broadly ovate or rhomboid-ovate to triangular; stem is branched and more or less hairy bearing pale blue or white malodorous flowers. Achenes are either glabrous or thinly hairy, with aristate, serrulate pappus-scales. Various parts of the plant have been conventionally used in several countries for healing wounds, boils, sores, tetanus, skin diseases, fever, eye ailments, rheumatism, stomach disorders etc. [4,5] This review focuses on the traditional uses, chemical constituents pharmacological and toxicological aspects reported from the plant so as to encourage the researchers to develop this plant into a potential herbal medicine.

**TRADITIONAL USES**

Since ages various parts of *A. conyzoides* have been used in different folkloric system of medicine to treat a variety of diseases such as, skin disorders, stomach ailments, chronic ulcer, intra-uterine problems, frontal headache, rheumatism, colic, pneumonia, sleeping sickness, wounds, boils, malaria and sore throat. [3, 6-9] The plant is also used as a purgative, febrifuge, emetic, antispasmodic and antiasthmatic. [10] The leaves of the plant are consumed as a vegetable [11] and also for preventing tetanus. [4] Traditional preparations employing various parts of the plant are described in Table 1.

**CHEMICAL CONSTITUENTS**

The secondary metabolites identified from *A. conyzoides* comprise of terpenoids (87), sterols (8), flavonoids (23), chromenes (23), pyrrolizidine alkaloids (1), coumarins (1), pyrrolone (1) and lignan (1). [16-28] Chemical constituents identified from *A. conyzoides* are briefly described below:

**Sterols:** Sterols namely β-sitosterol, stigmasterol, brassicasterol, dihydrobrassicasterol, spinasterol, dihydrosinasterol, stigmast-7-en-3β-ol and cholesterol (8) were reported from various parts of the plant. [4, 29-31]

**Flavonoids:** 5,6,7-trimethoxy-3,4-methylenedioxy flavone (ageconyflavone A), 4-hydroxy-5,6,7,3'-tetramethoxyflavone (ageconyflavone B), 4'-hydroxy-5,6,7,3',5'-pentamethoxyflavone (ageconyflavone C), 5,6,7,3',4'-pentamethoxy flavone (sinensetin), 5,6,7,8,5'-pentamethoxy-3',4'-methylene dioxy flavone (eupalesin), 5'-methoxy lucidin dimethyl ether, 5,6,7,8-

*Corresponding Author:* Nitya K. Dogra, *Email:* 24nittyakdogra@gmail.com
tetramethoxy-3',4'-methylenedioxyflavone (linderaflavone B; lucidin dimethyl ether), 5,6,7,8,3'-pentamethoxy-4',5'-methylenedioxy flavone, 5,6,7,8,3',4' hexamethoxyflavone (nobiletin), 5,6,7,8,3',4',5'-heptamethoxyflavone (5'-methylnobiletin), 5,6,7,5'-tremamethoxy-3',4' methylenedioxyflavone, 4'-hydroxy-5,6,7,8,3'-pentamethoxyflavone, 4'-hydroxy-5,6,7,8,3',5'-hexamethoxyflavone, 5,6,7,3',4'5'-hexamethoxyflavone, kaempferol 3, 7-digluicoside and kaempferol 3-rhamnoglucoside were identified from A. conyzoides. Quercetin (3,5,7,3',4'6-tetrahydroxyflavone), 5,6,7,8,3',4',5' -heptamethoxyflavone were reported from aerial parts of A. conyzoides. 1-(7-methoxy-2,2-dimethyl-2H-chromen-6-yl)ethanol (encecalol), 1-(7-hydroxy-2,2-dimethyl-2H-chromen-6-yl)ethanone, 1-(7-hydroxy-2,2-dimethylchroman-6-yl)ethanone, eupatoriochromene and a dimer of ageratocromene were isolated from aerial parts of A. conyzoides. 1-(7-methoxy-2,2-dimethyl-2H-chromen-6-yl)ethanone (encecaline; 6-acetyl-7-methoxy-2,2-dimethylchromene), androencecalinol, 6-acetyl-2,2-dimethylchromene (demethoxy-encecalin), 6-acetyl-7-hydroxy-2,2-dimethylchromene (demethylencecaline), 6-acetyl-2,2-dimethylchroman (dihydromethoxy encecaline) and 6-acetyl-7-methoxy-2,2-dimethylchroman (dihydroencecaline) were reported from the leaves. [4, 31, 32, 34, 38, 41-55] 

Table 1: Traditional uses of Ageratum conyzoides L.

<table>
<thead>
<tr>
<th>Country</th>
<th>Traditional use (s)</th>
<th>Plant part</th>
<th>Preparation (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>Hepatic disorders, antidote to poisoning, fever</td>
<td>NS</td>
<td>NS [15]</td>
</tr>
<tr>
<td></td>
<td>Wounds, cuts, bruises</td>
<td>Leaves</td>
<td>Poultice [16]</td>
</tr>
<tr>
<td></td>
<td>Diarrhoea and dysentery, boils, skin diseases, joint pain</td>
<td>Juice [17]</td>
<td></td>
</tr>
<tr>
<td>Cameroon</td>
<td>Syphilis</td>
<td>Leaves</td>
<td>Mixed with other herbs [18]</td>
</tr>
<tr>
<td>India</td>
<td>Cuts, wounds</td>
<td>Leaves</td>
<td>Mixed with other herbs [19]</td>
</tr>
<tr>
<td></td>
<td>Bleeding, antiseptic</td>
<td></td>
<td>Juice [20]</td>
</tr>
<tr>
<td></td>
<td>Piles</td>
<td></td>
<td>Paste [21]</td>
</tr>
<tr>
<td>Nepal</td>
<td>Cuts, wounds</td>
<td>Leaves</td>
<td>Juice [22]</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Diabetes</td>
<td>Whole plant, leaves</td>
<td>Juice, decoction [23]</td>
</tr>
<tr>
<td></td>
<td>Insecticide</td>
<td>Leaves</td>
<td>NS [24]</td>
</tr>
<tr>
<td></td>
<td>Wounds, sores</td>
<td></td>
<td>Poultice [25]</td>
</tr>
<tr>
<td>Tanzania</td>
<td>Eye drops</td>
<td>Leaves</td>
<td>Juice [26]</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>Prostate, female complaints</td>
<td>NS</td>
<td>NS [27]</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>Mosquitoicidal</td>
<td>Leaves</td>
<td>Smoke made by burning leaves [28]</td>
</tr>
</tbody>
</table>

NS- Not stated

Chromenes:
6-(1-methoxyethyl)-7-methoxy-2,2-dimethyl chromene, encecanesins, 6-(1-ethoxyethyl)-7-methoxy-2,2-dimethylchromene, 6-vinyl-7-methoxy-2,2-dimethylchromene, 6-(1-hydroxyethyl)-7-methoxy-2,2-dimethylchromene, encecalol methyl ether, 7-methoxy-2,2-dimethylchromene (6-demethoxy ageratocromene; precocene I), 6,7-dimethoxy-2,2'-dimethylchromene (ageratocromene; precocene II), 2,2-dimethylchroman-7-ol, encecalol angelate, 6-angeloyloxy-7-methoxy-2,2-dimethylchromene, 6,7,6'-7'-tetramethoxy-2,2',2'2'-tetramethyl-3(4')-dehydro-3'-4(S)-bichroman, (RS)-1(7-methoxy-2,2-dimethyl-2H-chromen-6-yl)ethanol (encecalol), 1-(7-hydroxy-2,2-dimethyl-2H-chromen-6-yl)ethanone, 1-(7-hydroxy-2,2-dimethylchroman-6-yl)ethanone, eupatoriochromene and a dimer of ageratocromene were isolated from aerial parts of A. conyzoides. 1-(7-methoxy-2,2-dimethyl-2H-chromen-6-yl)ethanone (encecaline; 6-acetyl-7-methoxy-2,2-dimethylchromene), androencecalinol, 6-acetyl-2,2-dimethylchromene (demethoxy-encecalin), 6-acetyl-7-hydroxy-2,2-dimethylchromene (demethylencecaline), 6-acetyl-2,2-dimethylchroman (dihydromethoxy encecaline) and 6-acetyl-7-methoxy-2,2-dimethylchroman (dihydroencecaline) were reported from the leaves. [4, 31, 32, 34, 38, 41-55] 

Terpenoids:
Terpenoids are the major phytoconstituents present in A. conyzoides. Four types of terpenoids were reported:

Monoterpenes:
So far 39 monoterpenes have been reported from the essential oil of A. conyzoides; α-phellandrene, α-thujene, (E)-β-ocimene, α- and β-pinene, δ2-carene, myrcene, thymol, thymyl acetate, limonene, nerol, p-cymene, linalool, camphene, carvacrol, carvacyl acetate, (E)-sabinene hydrate, linalool, myratenal, carvacryl acetate, (E)-copaene, farnesol, elemol, δ-cadinene, myrcene, thujene, β-farnesene, farnesol, elemol, α- and β-cubebene, α- and β-farnesene, farnesol, elemol, α- and β-selinene, α-, β-, γ- and δ-elemene, α-humulene, humulene epoxide II, (Z)-α-bisabolene, γ-bisabolene, α- and γ-muurolene, α-, γ- and δ-cadinene, 1-epi-cubenol, cadina-1,4-diene, guaiol, nerolidol, (Z)-jasmine, cedrene, germacrene D, germacrene D-4ol, bicyclogermacrene, spathulenol, α-cadinol, epi-α-cadinol, β-
caryophyllene, caryophyllene alcohol, caryophyllene oxide, caryophyllene epoxide were isolated from *A. conyzoides* [4, 31, 41-48, 51-56].

**Diterpene and triterpenes:**

Only one diterpene (phytol) [54] and two triterpenes (squalene and friedelin) [28, 54] have been identified from the plant.

**Miscellaneous compounds:**

Two pyrrolizidine alkaloids (lycopsamine and echinitine), [57] a coumarin (cumarine), [41, 43] a natural pyrrole (5-ethoxy-1H-pyrrol-2[5H]-one) [58] and a lignan (sesamin) [31] have been reported from *A. conyzoides*. Fumaric acid, gallic acid, coumaric acid, protocatechuic acid, p-hydroxybenzoic acid, p-coumaric acid, sinapic acid, ethylenedioxybenzoic acid, methanazulene and tricycoundecane were also identified from the plant. [17, 39, 46-48, 50, 53-55]

**PHARMACOLOGICAL REPORTS**


Mostly crude extracts and to a smaller extent fractions of *A. conyzoides* have been employed to demonstrate the pharmacological activities. The bioactive constituents along with their structures and pharmacological activity are described in (Table 2). A few pharmacological reports are described below:

**Antimicrobial activity:**

Mostly *in vitro* studies were carried out using disc diffusion and broth dilution method. [22, 41, 80, 81] The crude methanolic extract of the plant showed antibacterial activity against *Bacillus subtilis, Staphylococcus aureus, Escherichia coli* and *Pseudomonas aeruginosa*. [19] Various researchers have reported the antimicrobial activity exhibited by essential oil of the plant. The essential oil was found to demonstrate moderate (60%) fungitoxicity against the test fungus, *Botrytis cinerea* at 500 ppm. [82] It also showed prominent antifungal activity against toxigenic strain Saktiman 3NSt of *Aspergillus flavus* at 1µl/ml and completely inhibited aflatoxin production at 0.5 µl/ml. [83] Pure fractions of the plant have also exhibited significant *in vitro* antimicrobial activity against *Helicobacter pylori*. [84] A formulation developed using aerial parts of the plant was found to show better antimicrobial activity than the crude extracts. [54]

**Antioxidant activity:**

The antioxidant activity of crude extracts has been mostly determined using DPPH assay. [22] The crude methanolic extract of the stems showed concentration-dependent scavenging of DPPH (IC50 46.01±2.23 µM/ml) [85] whereas ethanol extract demonstrated antioxidant activity with EC50 of 15.19 µg/ml. [65, 86] The flavonoid fraction of *A. conyzoides* produced significant DPPH radical scavenging effect (52.18%) at a concentration of 100 µg/ml. [62]

**Anticancer activity:**

The antitumor activity of ethanolic leaf extract of *A. conyzoides* was analysed using carrot disc infected with *Agrobacterium tumefaciens*. The extract showed activity after 3 weeks of incubation at 1000 ppm dose. [86] Ethylacetate extract of the leaves showed highest anticancer activity against A-59 and P-388 cancer cell lines with IC50 of 0.68 and 0.0003 µg/ml respectively. [37] The crude ethanol extract and various fractions of the leaves were found to be cytotoxic against human lung cancer cells lines (SK-MES 1 cells) with IC50 ranging from 10-38.5 µg/ml. [81]

**Antidiabetic activity:**

The crude aqueous extract along with bioactive fractions of *A. conyzoides* leaves exhibited hypoglycaemic and antihyperglycaemic activities in normoglycaemic and streptozotocin-induced diabetic rats. [87, 88]

**Anti-inflammatory:**

Crude alcoholic extract of *A. conyzoides* showed a time-dependant anti-inflammatory activity in carrageenan-induced paw edema model at an oral dose of 1.0 and 1.5 g/kg. The activity was comparable to the standard (diclofenac sodium). [60] The water soluble fraction (30 and 50 mg/kg, s.c.) of hydroalcoholic leaf extract of the plant significantly reduced the carrageenan-induced neutrophil migration into peritoneal cavities and
subcutaneous 6 day old air pouches. At the same
dose the fraction inhibited carrageenan-induced
paw edema and blocked increase in cutaneous
vascular permeability. [89]

**Antifungal activity:**
Fungi isolates were exposed to aqueous and
ethanolic extracts of A. conyzoides. However, all
the concentrations of ethanolic and aqueous
each extracts showed no significant inhibitory
activity against fungi isolates. [89]

**Antinociceptive activity:**
The antinociceptive activity of aqueous and
ethanolic extracts of A. conyzoides were
evaluated using rat tail pressure method and
rat tail immersion model. The aqueous extracts
significantly decreased the paw pressure pain
threshold at doses of 100 mg/kg, i.p. or 400 mg/kg,
p.o. [90] Ethanolic extracts significantly decreased
the paw pressure pain threshold at doses of 50
mg/kg, i.p. or 300 mg/kg, p.o. [90]

**Wound healing activity:**
Methanol and aqueous extracts of A. conyzoides
leaves showed better rate of wound healing in rats
than corresponding petroleum ether and
chloroform extracts. [91] Oral administration of
ethanolic extract (5% w/w) of A. conyzoides in rats
with open excision wound showed increased
healing rate of wound with doses of 10 and 50
mg/kg, i.p. or 30 and 150 mg/kg, p.o. [90]

**Antimicrobial activity:**
The antimicrobial activity of the aqueous
extract of A. conyzoides revealed that the
extracts were effective against a wide range of
microorganisms. [92] The aqueous and
methanol extracts of A. conyzoides leaves
showed promising results in the management of
a number of bacterial pathogens such as,
*Staphylococcus aureus, Escherichia coli, Pseudomonas
aeruginosa, and Proteus vulgaris*. [93, 94] Petroleum ether
extract of the plant showed strong bactericidal
activity against *S. aureus* with IC50 ranging from 4.12 -
12.5 mg/ml. [95, 96] The hexane extract caused
94.86% mortality of *Rhyzopertha dominica* F.
while coumarin showed insecticidal activity
against all the tested insect pests; *R. dominica, S.
zeamais, Diaphania hyalinata, Musca domestica,
Periplaneta americana* and *Oryzaephilus surinamensis* L. with LD50 ranging from 2.49 -
39.72 mg/g. [33, 35] Petroleum ether extract of the
plant showed strong larvicidal activity against *M.
domestica, Cynthia carye* and *Acanthoscelides
obtecutus*. [38]

**Radioprotective activity:**
Alcoholic extract of A. conyzoides caused dose-
dependent decrease in radiation-induced mortality
upto a dose of 75 mg/kg, i.p. The extract further
demonstrated concentration-dependent scavenging
of DPPH which indicates that the radioprotective
activity may be due to scavenging of reactive
oxygen species. [107]
Table 2: Bioactive constituents identified in *Ageratum conyzoides* L. along with their structures and pharmacological activity

<table>
<thead>
<tr>
<th>Class and bioactive constituents(s)</th>
<th>Structure</th>
<th>Pharmacological activity reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavonoids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5,6,7,8,5'-penta methoxy-3',4'-methylene dioxyflavone (eupalestin)</td>
<td><img src="image1.png" alt="Structure" /></td>
<td>Antiprotozoal [32]</td>
</tr>
<tr>
<td>5,6,7,5'-tetramethoxy-3',4'-methylene dioxyflavone</td>
<td><img src="image2.png" alt="Structure" /></td>
<td>Antiprotozoal [32]</td>
</tr>
<tr>
<td>5,6,7,8,3',4',5'-heptamethoxy flavones (5'-methoxy nobiletine)</td>
<td><img src="image3.png" alt="Structure" /></td>
<td>Antiprotozoal, allelopathic, insecticidal [34]</td>
</tr>
<tr>
<td>5,6,7,3',4'5'-hexamethoxy flavone</td>
<td><img src="image4.png" alt="Structure" /></td>
<td>Antiprotozoal, allelopathic [32, 34, 47, 51, 55], anthelmintic [56]</td>
</tr>
<tr>
<td>Chromenes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precocene I</td>
<td><img src="image5.png" alt="Structure" /></td>
<td>Antiprotozoal, allelopathic, insecticidal [39, 47, 51, 55], anthelmintic [56]</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Chemical Constituents</th>
<th>Pharmacological Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Precocene II</strong></td>
<td>Allelopathic, hypoglycaemic, insecticidal [34]</td>
</tr>
<tr>
<td><strong>Encecalol angelate</strong></td>
<td>Antiprotozoal, cytotoxic [30]</td>
</tr>
<tr>
<td><strong>Monoterpenes</strong></td>
<td>Allelopathic [34]</td>
</tr>
<tr>
<td>Fenchyl acetate</td>
<td>Allelopathic [34]</td>
</tr>
<tr>
<td><strong>Sesquiterpenes</strong></td>
<td>Allelopathic, anthelmintic [36]</td>
</tr>
<tr>
<td>β-caryophyllene</td>
<td>Allelopathic, insecticidal [34, 35]</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
<td>Insecticidal [34]</td>
</tr>
<tr>
<td>Coumarin</td>
<td>Allelopathic [34]</td>
</tr>
</tbody>
</table>

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TOXICITY STUDIES

Several studies were carried by researchers to determine the toxicity of *Ageratum conyzoides*, and have generally found it to be safe.\[61, 99, 108\] Brine shrimp larvae lethality test was used to evaluate *in vitro* toxicity of crude ethanol extract. LC$_{50}$ for acute (6 h exposure) and chronic toxicity (24 h exposure) was 2005.07 and 768.72 ppm respectively.\[65\] Crude methanolic extract of *A. conyzoides* stem was found to be cytotoxic (LC$_{50}$-1.32 µg/ml).\[85\] The safety potential of ethanolic leaf extracts was determined in Sprague Dawley rats by evaluating biochemical, haematological and histological indices. Significant reduction in biochemical markers along with elevated levels of WBC count and mean platelet volume and hepatocellular necrosis was observed in groups treated with extracts (1000 and 1500 mg/kg).\[109\] Sub-chronic toxicity study of Precocene II (25 and 50 mg/kg, gastric intubation) was carried out in Sprague Dawley rats and it was observed that the compound altered some haematopoietic elements.
CONCLUSION

*Ageratum conyzoides* has been used in traditional system of medicine of various countries to manage different ailments. So far 160 compounds have been identified from this plant and the crude fractions have shown multifarious pharmacological activities and have generally found to be safe. Despite the extensive phytochemical research not many compounds have been related to the pharmacological activities and still the mechanism responsible for the activity of crude extracts/fractions have not been established. This review would hopefully encourage researchers to explore the plant with respect to its use in pharmaceutical, biotechnological and agriculture fields.

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