CHENOPODIUM AMBROSIOIDES: AN ETHNOPHARMACOLOGICAL REVIEW

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Summary

Chenopodium ambrosioides is a herbaceous shrub that has been used for centuries by native people as dietary condiments and as traditional medicine *Chenopodium ambrosioides L*. belonging to family *Chenopodiaceae grow* wild in Central and South America. *Chenopodium ambrosioides* has been used as anthelmintic,as anti-inflammatory, as anti-tumoral, as healer and as anti leishmanial which is due to presence of Ascaridole. Ascaridole is formed in highest concentration in the seeds. Other components are limonene, transpinocarveol, ascaridole-glycol, aritasone, α-pinene, myrcene, phellandrene and α-terpineol . This review pretends to contribute to the knowledge of the pharmacology, the photochemistry and the pharmacognostical aspects of the plant.

Key words: *Chenopodium ambrosioides,* pharmacology,Characterisation,review

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Introduction

The folk medicine of Argentina employs many herbs to counteract diverse diseases such as catarrh, bronchitis, pneumonia, ulcer and diarrhea (1,2,3,4) , Chenopodium *ambrosioides* belonging to family *Chenopodiaceae is* widely used in popular medicine as vermifuge, emmenagogue and abortifacient (5,6).Beginning in the 18th century,*Chenopodium ambrosioides* was taken to the rest of the world being widely adopted as an anthelmintic remedy (7,8) .*Chenopodium ambrosioides L.*belongs to family Chenopodiaceae is used by the native people in the treatment of cutaneous ulcers caused by different species of *Leishmania*.Later in the 19th century,*Chenopodium ambrosioides* was steam distilled to produce *Chenopodium* oil, a potent anthelmintic was widely used to rid patients of worms.(7)Anthelmintic properties of *Chenopodium* oil were due to the compound *ascaridole,(7,10)* which constituted more than 50% of the weight of the oil. (7,11,12,13). Chenopodium *ambrosioides* is also called as Epazote. The common Spanish name, **epazote** is derived from the Nahuatl *epazōtl* , a compound word formed from *epatl* and *tzotl* meaning roughly "skunk smell."(14,15)

Taxonomy (14)

Kingdom: Plantae
Division: Tracheobionta
Class: Magnoliopsida
Order: Caryophyllales
Family: Chenopodiaceae
Genus: *Dysphania*
Species: *D. ambrosioides*

Synonyms

Chenopodium ambrosioides commonly known in Brazil as ‘mastruz’ or ‘erva-de-Santa-Maria’and as American wormseed, goosefoot, ‘epazote’ and ‘paico’in other American countries.(16,17)

Geographical source

The plant chenopodium is very common in Eastern & Central U.S.A.It is indigenous to Carribbean islands.It is extensively cultivated in Europe Maryland,Mexico and Canada.In India ,the other species is found in West Bengal,Tamil Nadu,Assam and Karnataka.The plants are cultivated in Eastern America. (18)

Morphology

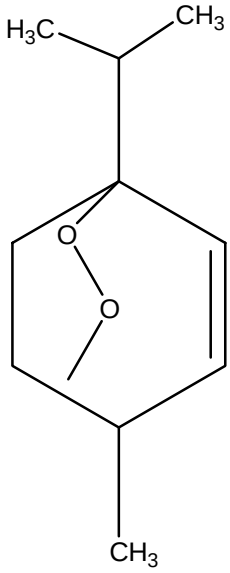
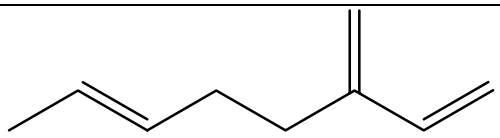
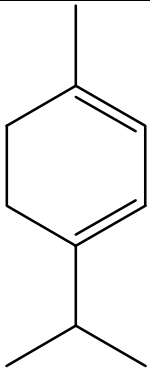
Chenopodium ambrosioides is a perennial, aromatic plant, more or less pubescent, with its branched stem often postrated. The leaves are oblong-lanceolated and serrated with small green flowers in dense terminal panicles of glomerules, each with five sepals. The persistent calyx encloses the fruit and the seeds are black and horizontal (5) .The aromatic species of *Chenopodium* are annual or perennial herbs, sometimes ligneous at the base; from pilose to glabrous, with glandular and non-glandulartrichomes. Stems aristate. Leaves from narrowly elliptical to elliptical, pinnatifid topinnatisect. Sepals three–five free or partly or totally united; stamens five–three(1), free or rarely with adnate filaments. Ovary spherical compressed; style short. The persistent calyx encloses the fruit and the seeds a black and horizontal (less than 0.8mm long).In cross-section, the leaf outline shows straight to slightly revolute margins *C.ambrosioides. C. ambrosioides* is organized as in the nonsinuate model which depends upon epidermal cell wall. (19)

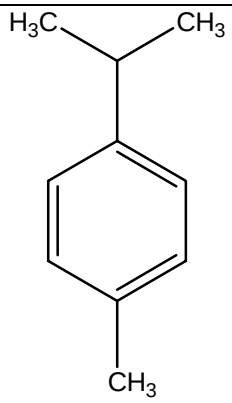
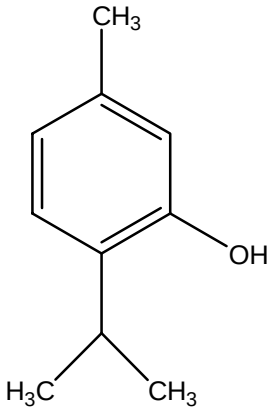
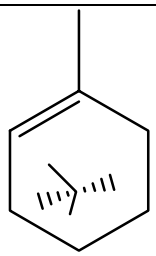
Photo of *Chenopodium ambrosioides* (14)

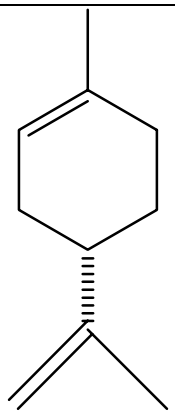
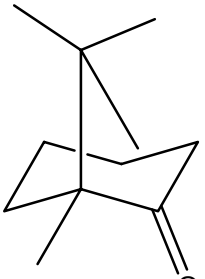
Phytochemistry

The main chemicals found in epazote include alpha-pinene, aritasone, ascaridole, butyric-acid, d-camphor, essential oils, ferulic-acid, geraniol, l-pinocarvone, limonene, malic-acid, menthadiene, menthadiene hydroperoxides, methyl-salicylate, myrcene, p-cymene, p-cymol, safrole, saponins, spinasterol, tartaric-acid, terpinene, terpinyl-acetate, terpinyl-salicylate, triacontyl-alcohol, trimethylamine, urease, and vanillic-acid (20). *Chenopodium ambrosioides* contained between 16 and 61% ascaridole, 22–77% hydrocarbons, 2–10% *p*-cymene,7–53% α-terpinene, 0.3–0.7% α -terpinene, 5–48% limonene,1–8% *iso*-ascaridole, 0.2-1%*trans*-diol and 0.1–0.4% *cis*-diol derived from ascaridole. (7,13). *Ascaridole* is very poorly soluble in water (7,21) and can be extracted out of an aqueous solution and into the hexane layer by shaking it with hexane. Ascaridole, synthesised from α-terpinene contained between 7 and 14 LC90 units of nematocidal activity per microlitre and was 95% pure, was judged by the NMR spectrum.(7,22) Ascaridole at nematocidal concentrations reduces basal tone, and decreases phasic contractions as well as carbachol-induced contractions of rat gastrointestinal tissue in vitro.(7) Ascaridole (1,4-peroxido-p-menth-2-ene) is rather an uncommon constituent of spices; another plant owing much of its character to this monoterpene peroxide is boldo. Ascaridole is toxic and has a pungent, not very pleasant flavor; in pure form, it is an explosive sensitive to shock. Allegedly, ascaridole content is lower in epazote from México than in epazote grown in Europe or Asia.(20)

Chemical constituents of *Chenopodium ambrosioides*

Sr.No	Refrence	Structure	IUPAC NAME
1.	23	 ASCARIDOLE	1-methyl-4-(1-methylethyl)-2,3-dioxabicyclo(2,2,2)oct-5-ene
2.	24	 MYCRENE	1-methyl-3-methylene,-1,6-octdiene
3.	25	 TERPINENE	4-methyl-1-(1-methylethyl)-1,3-cyclohexadiene

4.	26	 CYMENE	1-methyl-4-(1-methylethyl)benzene
5.	27	 THYMOL	5-methyl-2-isopropyl phenol
6.	28	 α-PINENE	

7.	29	 LIMONENE	1-Methyl-4-prop-1-en-2-yl-cyclohexene
8.	30	 CAMPHOR	

Pharmacological action

Chenopodium ambrosioides is rich in flavonoids and terpenoids compounds that have diverse pharmacological properties such as antioxidant and cancer chemopreventive effects (16,31,32). It was previously shown that the crude extract from *Chenopodium ambrosioides* is a strong stimulator of the murine lymphocytes (16,33). In fact, group has demonstrated that *Chenopodium ambrosioides* has a significant anti-tumor activity (16,34) and also has an effect on macrophage activation, inducing both nitric oxide (NO) and hydrogen peroxide production and increasing the macrophage spreading ability (9,35). It was showed that an essential oil from *Chenopodium ambrosioides* inhibits the progression of leishmanial Infection both *in vitro* and *in vivo*.(9,36)

According to literature, a decoction prepared with leaves and occasionally with flowers of *Chenopodium ambrosioides* and taken orally is used for dysmenorrhea and menses regulationand disorders. The leaves and flowers of *Chenopodium ambrosioides* are also used as a poultice to help 'dissolve' fibroids and to treat uterine hemorrhaging (16,17).*Chenopodium ambrosioides* has also been used to treat colds, as hemostatic, vermifuge and anthelmintic (Filipov, 1994).

In Brazil, the leaves of *Chenopodium ambrosioides* have been used to treat skin ulcerations caused by the *Leishmania* species (16,37,38).

Anthelmintic activity of *Chenopodium ambrosiodes*

Pollack et al. (1990) observed that ascaridole inhibited the growth of *Plasmodium falciparum* in vitro, and that cineol, which is a very similar compound lacking the internal 1,4 peroxide was inactive. Artemisinin, on the other hand, which like ascaridole contains a 1,4 endoperoxide, was active against *Plasmodium falciparum*. These observations prompted to conclude that the endoperoxide in ascaridole was essential for its anthelmintic activity. It was demonstrated that, ascaridole, at a concentration that immobilised or killed *Caenorhabditis elegans*, had a profound effect on rat gastrointestinal smooth muscle contractions, infusions of *Chenopodium ambrosioides* and ascaridole-free infusions of the weed had no such effect on the above smooth muscle preparations, at concentrations that effectively immobilized and killed *Caenorhabditis elegans* in vitro. (7,39)

Vermifuge activity of *Chenopodium ambrosioides*: The seed and fruit contain a large amount of essential oil which has a main active chemical in it called ascaridole. This chemical was first isolated in 1895 by a German pharmacist living in Brazil and it has been attributed with most of the vermifuge (worm-expelling) actions of the plant. (20)

Analgesic , anti-fungal activity, anti-malarial activity of *Chenopodium ambrosioides*:Ascaridole has been also documented with sedative and pain-relieving properties as well as antifungal effects.Anti-fungal activity is due to dried aerial parts which consist of monoterpenes (40,41). Application of the oil topically was reported to effectively treat ringworm within 7-12 days in a clinical study with guinea pigs. In other *in vitro* clinical studies, ascaridole was documented with activity against a tropical parasite called *Trypanosoma cruzi* as well as strong anti-malarial and insecticidal actions.(20)

Anti-cancer activity (40): Uncontrolled proliferation of cells has been linked to induction of the telomerase enzyme found in cancer cells and inhibition of this enzyme has been used to demonstrate the anticancer effects of various plants.*Chenopodium ambrosioides* was the most active in inhibiting polymerization of the human chromosomes and hence has the highest potential in inhibiting cancer cell formation.

Tribal Uses of *Chenopodium ambrosiodes* (20)

Sr.no	TRIBAL	Uses of chenopodium ambrosiodes
1.	Yucactan	intestinal parasites, asthma, excessive mucus, chorea
2.	Tikuna Indians in the Amazon	To expel intestinal worms and as a mild laxative.
3.	Kofán Indians in South America	perfume-tying it to their arm for an 'aromatic' bracelet
4	Creoles	Worm remedy for children and a cold medicine for adults
5.	Wayãpi	plant decoction for stomach upsets and internal hemorrhages caused by falls.
6	Piura	leaf decoction is used to expel intestinal gas, as a mild laxative, as an insecticide, and as a natural remedy for cramps, gout, hemorrhoids, intestinal worms and parasites and nervous disorders.
7	indigenous tribes	Bathe in a decoction of epazote to reduce fever

Herbal use of Chenopodium ambrosiodes (20)

Sr.no	Countries	Uses of chenopodium ambrosiodes
1.	Latin America	to rid children and adults of intestinal parasites, worms and amebas.
2.	Central and South America	vermifuge (to expel intestinal worms).
3.	Brazil	worms (especially hookworms, round worms and tape worms) ,oughs, asthma, bronchitis and other upper respiratory complaints; for angina, to relieve intestinal gas, to promote sweating and as a general digestive aid
4.	Peru	Same as above and soak the plant in water for several days and use it as a topical arthritis remedy
5	South America	asthma, bronchitis, diarrhea, dysentery, and menstrual disorders. Externally it has been used as a wash for hemorrhoids, bruises, wounds, contusions and fractures.

Worldwide Ethnomedical Uses (20)

Sr.no	Countries	Uses of chenopodium ambrosiodes
1.	Belize	digestive problems, hangovers, intestinal gas, intestinal parasites, and as a sedative
2.	Brazil	for abortions, angina, bacterial infections, bronchitis, bruises, circulation problems, colds, coughs, contusions, digestive sluggishness, dyspepsia, falls, flu, fractures, gastric disorders, hemorrhoids, hemorrhages, increasing perspiration, insomnia, intestinal gas, intestinal parasites, laryngitis, menstrual difficulties, palpitations, sinusitis, skin parasites, skin inflammation, skin ulceration, spasms, throat inflammation, tuberculosis, worms, wounds, and as an insect repellent and sedative
3.	Ecuador	for indigestion, intestinal gas, intestinal worms, slow digestion
4.	Haiti	for parasites, skin sores, stomachache, worms, and as an antiseptic
5.	Mexico	for colic, increasing perspiration, menstrual disorders, nerves, parasites, toothache, tumors, water retention, worms
6.	Panama	for asthma, dysentery, worms
7.	Peru	for abscesses, arthritis, birth control, blood cleansing, cholera, colic, contusions, cough, cramps, diabetes, diarrhea, digestive problems, dysentery, edema, excessive mucous, fractures, gastritis, gout, hemorrhoids, hysteria, increasing perspiration, intestinal gas, liver support, lung problems, memory, menstrual disorders, nervousness, numbness, pain, paralysis, parasites, pleurisy, rheumatism, skin disorders, spasms, stomach pain, tumors, urinary tract inflammation, urinary infections, vaginal discharge, vomiting, water retention, worms, wounds, and as an antacid and antiseptic, insect repellent, and

		sedative
8.	Trinidad	for amebic infections, asthma, childbirth, dysentery, dyspepsia, fatigue, fungal infections, lung problems, palpitations, sores, worms
9.	Turkey	for asthma, digestive problems, menstrual difficulties, nervous disorders, worms
10.	United States	for childbirth, increasing milk flow, menstrual disorders, nerves, pain, parasites, worms

Toxicity (5)

The essential oil of *Chenopodium ambrosioides* is an irritant to the mucous membrane of the gastrointestinal tract, kidney and liver. Overdoses of this oil have caused death in men and rats (42). The primary symptoms during an acute intoxication are gastrointestinal, such as gastroenteritis with diffuse hyperemia at first, followed by alterations in the CNS, such as headache, facial flushing, impaired vision, vertigo, incoordination and paresthesis. Intake of 10 mg of the oil has been known to cause cardiac disturbances, convulsions, respiratory disturbances, sleepiness, vomiting and weakness and even death

Contraindication (20)

The plant and essential oil should not be used during pregnancy and lactation. Not only does the plant have toxic activity, it has also been traditionally used to induce abortions. While epazote has been used by indigenous tribes as a contraceptive, this use is not verified by clinical research (nor should it be relied on for such). However, the use of the plant is probably contraindicated for couples trying to get pregnant. The oil of epazote is considered extremely toxic and should not be taken internally.

Drug Interactions: Not Reported (20)

Phytochemical Analysis(1)

Thin layer chromatography

Preliminary analysis of the infusion and decoction by thin layer chromatography on silicagel GF254 were performed. The chromatograms were developed in three different mobile phases benzene, chloroform and *N*-hexane-diethyl ether (80:20), respectively, using ascaridole as reference. Anisaldehyde/sulfuric acid was used as reagent (43)

Gas chromatographic–mass spectrometric analysis (GC–MS)

In order to obtain comparative results, all the aqueous samples were injected directly in the gaseous apparatus. The infusion and decoction of both herbs were analyzed by GC using a capillary column (JandW Scientific DB- 1, 40m×0.25mm i.d.×0.25_m film), temperature program ranging from 75 ◦C (4 min) to 235 ◦C (3◦C/min), using nitrogen as carrier gas (0.8 mL/min). The injector was split/splitless injector (split ratio 1:90) and its temperature was 250 ◦C. The detector was FID adjusted to air 250 ◦C. In the TLC chromatographic assay, the identification of active compounds with a Rf similar to ascaridole was not possible, neither in *Chenopodium ambrosioides* nor in *Chenopodium multifidum* extracts, in the three different solvent systems assayed (data not shown). In theGC–MSanalysis, the extracts (decoction and infusion) of both medicinal herbs had the similar volatile pattern. Ascaridole was absent in all of them (detection limit 1 ppm), although compounds with a similar mass fragmentation pattern could be detected

Discussion

There are lack phyto-chemical and phyto-analytical studies of this plant. With the availability of primary information, further studies can be carried out like phyto-pharmacology of different extracts, standardization of the extracts, identification and isolation of active principles and pharmacological studies of isolated compound. Alternative systems of medicine viz. Ayurveda, Siddha, and Chinese Medicine have become more popular in recent years (44).As the global scenario is now changing towards the use of nontoxic plant products having traditional medicinal use, development of modern drugs from *Chenopodium ambrosioides* should be emphasized for the control of various diseases. In the present review we have made an attempt to congregate the botanical, phytochemical, ethnopharmacological, pharmacological and toxicological information on *Chenopodium ambrosioides*, a medicinal herb used in the Indian system of medicine.

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