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Ageratum conyzoides: A Tropical Source of Medicinal and Agricultural Products

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Ageratum conyzoides L., Asteraceae, is an annual herbaceous plant with a long history of traditional medicinal uses in several countries of the world and also has bioactivity with insecticidal and nematocidal acitivity. This tropical species appears to be a valuable agricultural resource.

BOTANY

Ageratum is derived from the Greek "*a geras,*" meaning non-aging, referring to the longevity of the flowers or the whole plant. The specific epithet "*conyzoides*" is derived from "*kónyz,*" the Greek name of *Inula helenium,* which it resembles (Kissmann and Groth 1993).

The synonyms of *A. conyzoides* include *A. album* Stend; *A. caeruleum* Hort. ex. Poir.; *A. coeruleum* Desf.; *A. cordifolium* Roxb.; *A. hirsutum* Lam.; *A. humile* Salisb.; *A. latifolium* Car.; *A. maritimum* H.B.K.; *A. mexicanum* Sims.; *A. obtusifolium* Lam.; *A. odoratum* Vilm. and *Cacalia mentrasto* Vell. (Jaccoud 1961). In Brazil, *A. conyzoides* has the following vernacular names: *catinga de bode, catinga de barrão, erva de são joão, maria preta, mentrasto, erva de são josé, picão roxo, erva de santa-lúcia, camará-opela, agerato, camará apeba, camará iapó, camará japê, erva de santa maria, macela de são joão, macela francesa, matruço* (Jaccoud 1961; Oliveira et al. 1993).

Ageratum ranges from Southeastern North America to Central America, but the center of origin is in Central America and the Caribbean. Most taxa are found in Mexico, Central America, the Caribbean, and Florida. *Ageratum conyzoides* now is found in several countries in tropical and sub-tropical regions, including Brazil (Baker 1965; Lorenzi 1982; Correa 1984; Cruz 1985).

Johnson (1971), classifies two subspecies, *latifolium* and *conyzoides*. Subspecies *latifolium* is found in all the Americas and subsp. *conyzoides* has a pantropical distribution. The basic chromosome number is $2n = 20$ but natural tetraploids are found. *A. conyzoides* subsp. *latifolium* is diploid and *A. conyzoides* subsp. *conyzoides* is tetraploid.

Ageratum conyzoides is an erect, herbaceous annual, 30 to 80 cm tall; stems are covered with fine white hairs, leaves are opposite, pubescent with long petioles and include glandular trichomes. The inflorescence contain 30 to 50 pink flowers arranged as a corymb and are self-incompatible (Jhansi and Ramanujam 1987; Kaul and Neelangini 1989; Ramanujam and Kalpana 1992; Kleinschimidt 1993). The fruit is an achene with an aristate pappus and is easily dispersed by wind. In some countries the species is considered a weed, and control is often difficult (Lorenzi 1982; Scheffer 1990; Kalia and Singh 1993; Lam et al. 1993, Paradkar et al. 1993; Waterhouse 1993; Kshatriya et al. 1994). Seeds are positively photoblastic, and viability is often lost within 12 months (Marlks and Nwachuku 1986; Ladeira et al. 1987). The optimum germination temperature ranges from 20 to 25°C (Sauerborn and Koch 1988). The species has great morphological variation, and appears highly adaptable to different ecological conditions.

PHYTOCHEMICAL CHARACTERISTICS

There is high variability in the secondary metabolities of *A. conzyoide* which include flavonoids, alkaloids, cumarins, essential oils, and tannins. Many of these are biologically active. Essential oil yield varies from 0.02% to 0.16% (Jaccoud 1961). Vyas and Mulchandani (1984) identified conyzorigum, a cromene. Borthakur and Baruah (1986) identified precocene I and precocene II, in a plant collected in India. These compounds have been shown to affect insect development, as antijuvenile hormones, resulting in sterile adults (Borthakur and Baruah 1987). Ekundayo et al. (1988) identified 51 terpenoid compounds, including precocene I and precocene II. Gonzales et al. (1991) found 11 cromenes in essential oils, including a new cromene, 6-angeloyloky-7-methoxy-2,2-dimethylcromen. Vera (1993), in Reunion, found ageratocromene, other cromenes, and beta cariophylene in its essential oil. Mensah et al. (1993) and Menut et al. (1993) reported similar yields of precocene I in the essential oil of plants collected in Ghana.

Vyas and Mulchandani (1986), in India, identified flavones, including some considered new such as *ageconyfavones* A, B, and C. Horrie et al. (1993) reported hexametoxyflavone. Ladeira et al. (1987) in Brazil, reported three cumarinic compounds, including 1-2 benzopirone. The species contains alkaloids, mainly the pirrolizidinic group, which suggest that it may be a good candidate for pharmacological studies. Trigo et al. (1988) found several alkaloids, including 1,2- desifropirrolizidinic and licopsamine which can have hepatotoxic activity. Alkaloids also were found by Weindenfeld and Roder (1991) in a hexane extract of *A. conyzoides* in Africa.

FOLK MEDICINAL USES AND PHARMACOLOGICAL STUDIES

A. conyzoides is widely utilized in traditional medicine by various cultures worldwide, although applications vary by region. In Central Africa it is used to treat pneumonia, but the most common use is to cure wounds and burns (Durodola 1977). Traditional communities in India use this species as a bacteriocide, antidysenteric, and antilithic (Borthakur and Baruah 1987), and in Asia, South America, and Africa, aqueous extract of this plant is used as a bacteriocide (Almagboul 1985; Ekundayo et al. 1988). In Cameroon and Congo, traditional use is to treat fever, rheumatism, headache, and colic (Menut et al. 1993; Bioka et al. 1993). In Reunion, the whole plant is used as an antidysenteric (Vera 1993). The use of this species in traditional medicine is extensive in Brazil. Aqueous extracts of leaves or whole plants have been used to treat colic, colds and fevers, diarrhea, rheumatism, spasms, or as a tonic (Penna 1921; Jaccoud 1961; Correa 1984; Cruz 1985; Marques et al. 1988; Negrelle et al. 1988; Oliveira et al. 1993). *A. conyzoides* has quick and effective action in burn wounds and is recommended by Brazilian Drugs Central as an antirheumatic (Brasil 1989).

Several pharmacological investigations have been conducted to determine efficacy. Duradola (1977) verified inhibitory activities of ether and chloroform extracts against in vitro development of *Staphylococus aureus*. Almagboul et al. (1985), using methanolic extract of the whole plant, verified inhibitory action in the development of *Staphylococus aureus*, *Bacillus subtilis*, *Eschericichia coli*, and *Pseudomonas aeruginosa*. Bioka et al. (1993) reported effective analgesic action in rats using aqueous extract of *A. conyzoides* leaves (100 to 400 mg/kg). Assays realized in Kenia, with aqueous extract of the whole plant, demonstrated muscle relaxing activities, confirming its popular use as an antispasmotic (Achola et al. 1994).

In Brazil, assays conducted by State University of Campinas and Paraiba Federal University) showed promising results. Marques Neto et al. (1988) in clinic trials with patients with arthrosis, administered aqueous extract of the whole plant, and reported analgesic effect in 66% of patients and improvement in articulation mobility in 24%, without side effect. Mattos (1988), using aqueous extract of the whole plant, verified effective clinical control of arthrosis, reporting a decrease in pain and inflammation or improvement in articulation mobility, after a week of treatment.

BIOACTIVITY

Ageratum conyzoides has bioactive activity that may have agricultural use, as shown by several research investigations in different countries. Pereira in 1929, cited by Jaccoud (1961), reported use of the leaves as an insect (moth) repellent. The insecticide activity may be the most important biological activity of this species. The terpenic compounds, mainly precocenes, with their antijuvenile hormonal activity are probably responsible for the insecticide effects.

Assays conducted in Colombia by Gonzalez et al. (1991) showed activity of this species against *Musca domestica* larvae, using whole plant hexane extract. Vyas and Mulchandani (1980) reported the action of cromenes (precocenes I and II), isolated from *Ageratum* plants, which accelerate larval metamorphosis, resulted in juvenile forms or weak and small adults.

Ekundayo et al. (1987) also demonstrated the juvenilizing hormonal action of precocene I and II in insects, the most common effect being precocious metamorphosis, producing sterile or dying adults. Raja et al (1987), using *A. conyzoides* methanolic extract from fresh leaves (250 and 500 ppm) in the fourth instar of *Chilo partellus* (Lepidoptera, Pyralidae), a sorghum pest, observed the presence of a dark stain in the insects' cuticle and immature pupae formation, both symptoms of deficiency of juvenile hormone.

A. conyzoides also induces morphogenetic abnormalities in the formation of mosquitoes larvae (*Culex quinquefasciatus, Aedes aegypt*, and *Anopheles stephensi*). This has been verified using petroleum ether ex-

tracts (5 and 10 mg/L) of the whole plants. The larvae showed intermediary stages between larvae–pupae, discolored and longer pupae, as well as incompletely developed adults (Sujatha et al. 1988). Extracts of the flowers of this species showed activity against mosquitoes (*Anopheles stephensi*), in the last instar, showing DL 50 with 138 ppm (Kamal and Mehra 1991).

Cetonic extracts of the species produced significant effects against the mosquito, *Culex quinquefasciatus*, in India, when applied to fourth instar larvae and adult females. In larvae, the extracts produced altered individuals, intermediate between larvae and pupae, unmelaninized and with inhibition of development, as well as adults with deformed wings muscles. In female adults, there was loss of fecundity, lower eggs production, and production of defective eggs (Saxena et al. 1992). Similar results were observed in larvae *of Anopheles stephensi* and *Culex quinquefasciatus* in others essays, confirming the antijuvenile potential of *A. conyzoides* (Saxena and Saxena 1992; Saxena et al. 1994).

The species also has potential use in controlling other pests. Shabana et al. (1990), using aqueous extract of the whole plant, verified reduction of larvae emergence of *Meloidogyne incognita*. Pu et al. (1990) and Liang et al. (1994), verified that plants of *A. conyzoides* in *Citrus* orchards sheltered predators of the spider *Panonychus citri*, suggesting that its development in orchards is beneficial. Other *Citrus* spiders populations, *Phyllocoptruta oleivora* and *Brevipalpus phoenicis* were decreased with maintenance of *A. conyzoides* in the orchards and a reduction of leprosy virus was noted (Gravena et al. 1993)

The presence of *A. conyzoides* can also be used as an seed inhibitor, decreasing development of several herbaceous plants. Jha and Dhakal (1990) in Nepal, reported that an aqueous extract of the aerial part or roots of this species (15 g of aerial part or 3 g of roots in 100 ml of water, during 24 h) inhibited germination of wheat and rice seeds while Prasad and Srivastava (1991) in India, reported a lower germination index in peanut seeds with aqueous extract.

CULTURAL STUDIES

Magalhaes et al. (1989) in Brazil evaluated fertilizer studies and plant density on biomass production of *A. conzyzoides*. The higher the N level, the higher the biomass production (dry weight basis). Optimum spacing was 70 cm between rows and 50 cm between plants. Biomass yields was 1.3 t (dry weight)/ha.

Correa Jr. et al. (1991) obtained biomass yields of 3.3 to 5.3 t (fresh wt)/ha. Essential oil content was 0.02% (fresh wt) and 0.16 % (dry wt) in the preflowering state. Preliminary data of Ming (1998) indicated that essential oils, higher in leaves than in flowers, peaked during early-flowering.

FUTURE POTENTIAL

There are some small pharmaceutical companies in Brazil using *A. conyzoides* as a raw material for phytochemicals. The demand is increasing year by year and this situation warrants further scientific research to develop both agricultural and medical uses. Research on medicinal plants should be focused primarily on species whose pharmaceutical activities have already been demonstrated. Positive preliminary clinical assays of *A. conyzoides* clearly demonstrate that this species may be an important economic resource in several tropical countries. The use of this species as a natural biocide or agent for pest management particularly requires further investigation.

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