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CHEMICAL CONSTITUENTS AND PHARMACOLOGICAL EFFECTS OF *ASCLEPIAS CURASSAVICA* – A REVIEW

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ABSTRACT

Asclepias curassavica was used traditionally in different populations for many medical complains. It contained a wide range of chemical constituents including flavonols, flavonol glycosides, amino acids, carbohydrates, triterpenes, cardenolides and many other biologically active compounds. The cardenolides isolated from the plant included calactin, calotropin, calotropagenin, coroglaucigenin, asclepin, asclepain CI, asclepain CII, asclepine (asclepiadin), uscharidin, uzarin, uzarigenin, corotoxigenin, asclepogenin, curassavogenin, calotroposide, clepogenin, desglucouzarin, kidjolanin, and uscharidin. The previous studies showed that the plant exerted many pharmacological activities including antimicrobial, anticancer, cardiovascular, analgesic and antipyretic and many other pharmacological activities. This paper is a step ahead to open a new insight for the therapeutic efficacy of *Asclepias curassavica*.

Key words: *Asclepias curassavica*, Pharmacology, Constituents.

INTRODUCTION

Asclepias curassavica contained a wide range of chemical constituents including flavonols, flavonol glycosides, amino acids, carbohydrates, triterpenes, cardenolides and many other biologically active compounds. The cardenolides isolated from the plant included calactin, calotropin, calotropagenin, coroglaucigenin, asclepin, asclepain CI, asclepain CII, asclepine (asclepiadin), uscharidin, uzarin, uzarigenin, corotoxigenin, asclepogenin, curassavogenin, calotroposide, clepogenin, desglucouzarin, kidjolanin, and uscharidin. The previous studies showed that the plant exerted many pharmacological activities including antimicrobial, anticancer, cardiovascular, analgesic and antipyretic and many other pharmacological activities.

Synonym: *Asclepias nivea* [1-2].
Taxonomical classification
Kingdom: Plantae
Subkingdom: Viridaeplantae
Infrakingdom: Streptophyta
Division: Tracheophyta
Subdivision: Spermatophytina
Infradivision: Angiospermae
Class: Magnoliopsida
Superorder: Asteranae
Order: Gentianales
Family: Apocynaceae
Genus: Asclepias
Species: *Asclepias curassavica* L[3].

Common names

Arabic: Marjan, Zahrat el Dam; Australia: Bastard Ipecacuana, Cottonbush, Madagascar Cottonbush, Milky Cottonbush, Red-Cotton, Red Head, Wallflower Cotton Bush, West Indian Ipecacuana, Wild Ipecac, Wild oleander; Brazil: Algodao-de-seda, Algodãozinho-do-campo, camará-bravo, Capitao-de-sala, Capitão-de-sala, Cega-olho, Erva-de-paina, Erva-de-rato, Erva-de-rato (falso), Margaridinha, Oficial-de-sala, Paina-de-sapo, Paininha, Paira-de-sapo; China : Ma Li Chin; English: False Ipecac, Blood Flower, Bastard Ipecacuanha, Redhead Cottonbush, Blood-flower, Kittie McWanie, Milkweed, Oficial-de-sala, Red cotton, Redtop; Scarlet Milkweed; Silkweed; Germany: Curacao-seidenpflanze, Indianer- Seidenpflanze, Indianer-seidenpflanze; French: Ipeca sauvsage; Hawaii: laulele, pua

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anuhe; India: Kakatundi, Kaura-dodi; Indonesia: Kapas Cinde (Sunda); Mas Sekar (Java); Malaysia: Bunga emas; Italy: Ipecauana delle Antille, Pianta della seta a fiori rossi ; Nepal: Khursani kose phool; Netherlands: Frederiksbloem ; Philipines: Bulac-bulacan, Bulac-castila, Bulac-damo, Buquit-quit, Calalauan, Capol-capol; Portuguese: Oficail-da-sala; South Africa: Frederiksblom; Spanish: Algondocillo, Corcalito, Flor de sangre, Yuquillo; Sweden: Röd sidenört ; Thailand: Fai duean haa, Mai cheen, Thian daeng; Tonga: fisi puna, lou pepe, tulanga pepe, tuula pepe, vavae kona; Venezuela: Vuquillo and Vietnam: Bong tai, Ngo thi [4-7].

Description

Asclepias curassavica is a perennial herb, an erect, glabrous, perennial herb that grows up to 1.2m tall. It has a milky exudate throughout. The stem is smooth, round, dull green or suffused with dull red. The leaves are simple, opposite, shortly petioled, lanceolate to oblong-lanceolate, acuminate and measures 7-13cm long and 6-25cm wide. The base is narrowed. Inflorescence in the form of an umbel with 6–15 flowers on terminal or axillary peduncle. The flowers are perfect, radially symmetrical or irregularly shaped, bright red or orange with yellow centers. There are 5 sepals, deeply divided, reflexed, green. Five petals which are linear with base united into a fused corolla. The corolla lobes are red, reflexed, oblong and approximately 8mm long. The corona scale is orange in colour, 5-lobed and measures 3.5-4.0mm long. The corona is hood-shaped with inwardly curved horns; stamens 5 in number; anthers with two pollen sacs; pollen aggregates into masses called pollinia or pollen sacs. The style filaments are united with pistils 2-carpelled. The fruit is a pair of dry dehiscent, spindle-shaped follicels, measuring 5-15cm long, many seeded, splitting lengthwise on one side at maturity. The seeds are ovate, flat, winged, measures 4-6mm long and 2.2-4.0mm wide, brown in colour, minutely ridged, with a pappus of fine white silky hairs at the apex, measures 2-3cm long (8).

Distribution

The plant is native to South America but has become a naturalized weed in tropical and subtropical areas, and disturbed throughout the world [9-10].

Traditional use

The roots were used as a cheaper alternative to ipecacuanha as an emetic. It also used as purgative, haemostatic in bleeding wounds and haemorrhoids, for treatment of gonorrhoea, inflamed spleen, pneumonia, mastitis, warts, cancer, caries, fever and pyoderma. *Asclepias curassavica* is used in China to disperse fever (clears heat), improve blood circulation and to control bleeding. Entire plant is dried and decocted as a cardiac tonic, for tonsillitis, pneumonia, bronchitis, urethritis and external and internal bleeding [11-15].

Part used: Whole plant

Physicochemical properties

Total ash value was 6.8%, water soluble ash 6.87%, alkalinity of water soluble ash 2.89%, acid insoluble ash 1.98%, alcohol soluble materials 5.75% and water soluble materials 7.72% [16].

Chemical constituents

Flavonols, flavonol glycosides, amino acids, carbohydrates and triterpenes were isolated from the plant. The cardenolides included calactin, calotropin, calotropagenin, coroglaucigenin, asclepin, asclepain CI, asclepain CII, asclepine (asclepiadin), uscharidin, uzarin, uzarigenin, corotoxigenin, asclepogenin, curassavogenin, calotroposide, clepogenin, desglucouzarin, kidjolanin, and uscharidin were also isolated from the plant. The polyphenols isolated from the plant included quercetin, kaempferol, rutin and isorhametin. Carbohydrates of the plant consisted of glucose, fructose and sucrose. More than twenty-six acylated-oxypregnane glycosides were isolated from the root of the plant [11-12 , 17-25].

The leaf and stem of *Asclepias curassavica* contained fixed oils, flavonoids, phenols, quinines, tannin, terpenoid, sugars, xanthoprotein, saponin, and steroids. The leaf and root of *Asclepias curassavica* contained carboxylic acids, fixed oils, flavonoids, phenols, quinines, resins, steroids, glycosides and coumarins [16,26-28].

Asclepias curassavica was evaluated as potential renewable sources of chemicals for use as fuel and/or chemical feedstock. Calorimetric methods performed on *Asclepias curassavica* showed that leaves gave 4,590 cal/g; stems gave 4,219 cal/g; and latex gave 4,663 cal/g. Organic carbon in *Asclepias curassavica* leaves was 41.20%; in stems 41.18%; and in latex 48.03% [29].

PHARMACOLOGICAL EFFECTS

Cytotoxic effects

The alcololic extract of *Asclepias curassavica* showed cytotoxic activity against nasopharynx human carcinoma cells. It was proved that calotropin (a cardiac glycoside) isolated from the plant, exerted cytotoxic activity. In addition, cardenoliedes extracted from the aerial parts and roots of *Asclepias curassavica* showed pronounced cytotoxicity (IC_{50} of 0.01 to 0.20 microgM/ml) against four cancer cells. Asclepin from the aerial part of *Asclepias curassavica* showed the strongest cytotoxic activity (IC50 of 0.02 microM). However, 12 beta-hydroxycalotropin (a cardenolide) exerted significant cytotoxic activity (IC50 of 0.69 microM/ml) against HepG2 and (1.46 microM/ml) against Raji cell lines [30-32].

Cardiovascular effects

Previous studies recorded a positive inotropic activity for asclepin extracted from *Asclepias curassavica*; it was more potent, and safer than other cardiac glycosides (including digoxin). It showed longer duration of action than digoxin (96 h in cat, as opposed to the 72 h of digoxin) (18). In a 3 month toxicity study in rats, asclepin was found

safe in doses of 0.8, 8, and 20 mg/kg. Cat studies showed that, it was less cumulative compared to digoxin. Extracts of *Asclepias curassavica* stimulated mammalian CNS, increasing noradrenaline and serotonin. LD50 of cardenolide was = <50 mg/kg ip in mice [33-34].

Proteolytic effects

Asclepain C-II was the minor proteolytic component in the latex, but showed higher specific activity than asclepain C-I. Both enzymes showed proteolytic activity at pH 9.4-10.2, and showed poor thermostability. The activity of asclepain C-II is inhibited by cysteine proteases inhibitors like E-64, but not by any other protease inhibitors such as 1, 10-phenantroline, phenyl methane sulfonyl fluoride, and pepstatine [35].

The latex enzyme fraction exhibited strong proteolytic activity when compared to trypsin and exerted pro-coagulant action by reducing plasma clotting time from 195 to 58s whereas trypsin reduced clotting time marginally from 195 to 155s. The pro-coagulant activity of this enzyme fraction was exerted by selectively hydrolyzing alpha and beta subunits of fibrinogen to form fibrin clot when pure fibrinogen was used as substrate as assessed by fibrinogen-agarose plate method and fibrinogen polymerization assay. The electrophoretic pattern of latex enzyme fraction-induced fibrin clot was very much similar to that of thrombin-induced fibrin clot and mimic thrombin like action. The proteolytic activity including thrombin like activity of *Asclepias curassavica* latex enzyme fraction was completely inhibited by iodoaceticacid [19, 36-37]. Cysteine proteases from *Asclepias curassavica* latex exhibited strong pro-coagulant action [38].

Anti-inflammatory, analgesic and antipyretic effects

Hydroalcoholic extract of the aerial part (95%) of plant showed anti-inflammatory activity [39]. The analgesic (flick method on mice) and antipyretic (Brewer's yeast induced pyrexia in rats) effects of the alcoholic and aqueous extracts of the stem of the plant were also studied. The aqueous and alcoholic extracts of stem of *Asclepias curassavica* showed significant anti-pyretic and analgesic activity [40].

Antimicrobial effects

The antibacterial activity of *Asclepias curassavica* was examined against *Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Escherichia coli* and *Klebsiella pneumoniae.* Methanol extract was found to exhibit growth inhibition on all tested microorganisms, except *P. vulgaris*. Petroleum spirit extract showed activity against three out of five tested organisms, but comparatively, it showed less activity than methanolic extract. A poor response was obtained by ethyl acetate extract which showed activity against only two microorganisms, *S. aureus* and *B. subtilis*. There was no antibacterial activity for chloroform and hexane extracts. Among all the tested organisms, *P. vulgaris* was found to be resistant and remained unaffected by all extracts. *K. pneumoniae* showed moderate inhibitory zone with three extracts. The effect of petroleum spirit root extract against *E. coli* was so prominent. Among the various solvent extracts of leaf and root tested against different bacteria, the root extracts showed better inhibitory effects than leaf extracts [40].

The crude extracts of petroleum ether, chloroform and methanol and two pure fractions obtained from methanol extract were tested for their antimicrobial property. The crude extract of chloroform was effective against *Pseudomonas solanacearum* and *Escherichia coli* than other extracts. The crude extract of methanol was effective against *Clavibacter michiganense* than other extracts. The chloroform extract showed inhibition zone of 13mm, 19mm and 13mm against *Helminthosporium oryzae, Aspergillus niger* and *Fusarium oxysporum* respectively, whereas petroleum ether extract and methanol extract did not show any inhibition zone [41].

The *in vitro* bioassay of the root extracts of *Asclepias curassavica* Linn. was done by cold percolation and Soxhlet method against four bacterial species, *Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa* and *Proteus vulgaris* and two fungal species *Candida albicans* and *Aspergillus niger*. The MIC value for root extract of *Asclepias curassavica* was 3.06 mg/ml and the bactericidal concentration was found to be 100 mg/ml. Ethanol and acetone extracts showed good anticandidal effect [42]. The latex sap terpens, cardenolids and glucanases also exerted antifungal activity. Fungi were deformed and emptied the cytoplasm. The sap exerted its effects on cell wall [43]. The plant showed antiviral activity against Adeno virus, Coxsackie b2, Herpes type-1, Measles, Poliovirus-1 and Semlicki forest virus [44]. The MIC value of the hydroalcoholic extract (95%) of dried sap of plant, was found to be >250 µg/ml against *Entamoeba histolytica* (45). The plant showed no insecticidal effect [46].

Antifertility effect

The ethanol, water and petroleum ether extracts did not show any significant antifertility activity [47].

Contraindications and adverse effects

A case of corneal oedema in a 60 year old male patient was reported. He had hazy vision in the left eye after working in his garden the previous day. His hands had come in contact with the white, milky latex of *Asclepias curassavica,* and he had rubbed his left eye immediately afterwards [48]**.**The LD50 of the aqueous and alcoholic extracts of stem of *Asclepias curassavica* administered orally in mice was found to be 2000 mg/kg [40].The plant is toxic in nature and contains a number of potent cardiac glycosides. The signs of toxicities included vertigo, headache, vomiting, diarrhoea, stomach cramps, pallor, chills and arrhythmia. The traditional remedy for toxicity is by inducing emesis with egg white [11,49].

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CONCLUSION

The paper reviewed *Asclepias curassavica* as promising medicinal plant with a wide range of pharmacological activities which could be utilized in several medical applications because of its effectiveness and safety.

REFERENCES

1. Sydenhan E. The Botanical register: consisting of coloured figures of exotic plants. James Ridgway, London 1, 1815, 81.
2. Germplasm Resources Information Network, 2010, http://www.ars-grin.gov/cgi-bin/ npgs/html/taxon.pl?, 4469.
3. http://www.itis.gov/servlet/SingleRpt/SingleRpt?
4. Al-Snafi AE. Encyclopedia of the constituents and pharmacological effects of Iraqi medicinal plants. Thi qar University, 2013.
5. Bendre A and Kumar A. A Text book of practical botany. Rastogi Publications, New Delhi, 2009, 156.
6. Wagstaff DJ. International poisonous plants checklist: an evidence-based reference. CRC Press LLC., Boca Raton, 2008, 35
7. Merrill ED. A Dictionary of the Plant Names of the Philippine Islands. Biblio Life LLC., Manila, 1903, 37- 47.
8. LeRoy G. Holm World weeds: natural histories and distribution John Wiley & Sons Inc. New York, 1997, 82.
9. Plants Profile for *Asclepias curassavica* (Bloodflower). Plants Database. USDA Natural Resources Conservation Service. 2014, http://plants.usda.gov/ core/ profile?symbol=ASCU
10. Floridata,2012.Floridata.com LC, Tallahassee, Florida USA, *Asclepias curassavica*, www.floridata.com/ref/a/ascl_cur.cfm,
11. Oliver-Bever B. Medicinal plants in tropical West Africa. Cambridge University Press, Cambridge, London, New York, New Rochelle, Melbourne Sydney, 1986, 23.
12. Hembing W. Ensiklopedia milenium: Bunga-bungaan PT. Prestasi Insan, Indonesia, Jakarta, 2000, 81-86.
13. Hamilton W, MB Art. V. On the properties of the *Asclepias curassavica*, or Bastard Ipecacuanha. Cited from: Daydon JB. Vegetable Technology. Forgotten Books, London, 2013, 78-79.
14. Timothy Johnson CRC. Ethnobotany desk reference CRC Press LLC. Boca Raton 1998, 81.
15. Nadkarni KM. Nadkarni's Indian materia medica. Popular Prakashan Pvt. Ltd., Mumbai, 1, 1976, 151.
16. Kalidass C, Amish Abragam D and Mohan VR. Pharmacognostic studies of the whole plant of *Asclepias curassavica* Linn. *Journal of Pharmacy Research*, 2(7), 2009, 1214-1217.
17. Groeneveld HW, Berg BVD and Elings JC. Cardenolide biosynthesis from malonate in *Asclepias curassavica. Phytochemistry*, 29(11), 1990, 3479-3486.
18. Khare CP. Indian medicinal plants – An illustrated dictionary. Springer Science and Business Media, LLC 2007, 67.
19. Liggieri C, Arribére MC, Trejo SA, Canals F, Avilés FX and Priolo NS. Purification and biochemical characterization of asclepain CI from the latex of *Asclepias curassavica* L. *Protein J*, 23(6), 2004, 403-411.
20. Li JZ, Liu HY, Lin YJ, Hao XJ, Ni W, Chen CX. Six new C21 steroidal glycosides from *Asclepias curassavica* L. *Steroids*, 73(6), 2008, 594-600.
21. Warashina T and Noro T. Steroidal glycosides from the roots of *Asclepias curassavica*. *Chem Pharm Bull* (Tokyo), 56(3), 2008, 315-322.
22. Bate-Smith EC. Phenolic constituents of plants. *Journal of the Linnean Society of London*, 58, 1952, 95-173.
23. Tschesche R, Forstman D and Mohan Roa VK. Aglykone und Kardenolide von *Asclepias curassavica* L. *Chemische Berichte*, 91, 1958, 1204-1211.
24. Patel MB and Rowson JM. Investigations of certain Nigerian medicinal plants, Part I. Preliminary pharmacological and phytochemical screenings for cardiac activity. *Planta Medica*, 12, 1964, 34-42.
25. Singh B and Rastogi RP. Chemical investigation of *Asclepias curassavica* L. *Indian Journal of Chemistry*, 7, 1969, 1105.
26. Hocking GM. *Asclepias curassavica* Herba et Radix. *Quarterly Journal of Crude Drug Research*, 1976*;* 14:61-63.
27. Patnaik GK and Dhawan BN. Asclepine, a new cardioactive glycoside from *Asclepias curassavica. Indian Journal of Pharmacy*, 3, 1971, 18.
28. Reddy HS, Chakravarthi M, Chandrashekara KN and Naidu CV. Phytochemical screening and antibacterial studies on leaf and root extracts of *Asclepias curassavica* (L). *Journal of Pharmacy and Biological Sciences* (IOSRJPBS), 2(1), 2012, 39-44.
29. Emon J and Seiber J. Chemical constituents and energy content of two milkweeds, *Asclepias speciosa* and *A. curassavica*. *Economic Botany*, 39(1), 1985, 47-55.
30. Kupchan SM, Knox JR, Kelsey JE, and Saenz JA. Renauld Calotropin, a cytotoxic principle isolated from *Asclepias curassavica* L. *Science*, 146(3652), 1964, 1685-1686.
31. Roy MC, Chang FR, Huang HC, Chiang MY and Wu YC. Cytotoxic principles from the Formosan Milkweed, *Asclepias curassavica. J Nat Prod*, 68(10), 2005, 1494-1499.
32. Li JZ, Qing C, Chen CX, Hao XJ, Liu HY. Cytotoxicity of cardenolides and cardenolide glycosides from *Asclepias curassavica*. *Bioorg Med Chem Lett*, 19(7), 2009, 1956-1959.

33. Duke JA, Bogenschutz-Godwin MJ, du collier J and Duke PA. Textbook of medicinal herbs. 2nd ed. CRC Press, Boca Raton, London, New York, Washington, DC, 2002, 577.
34. Patnaik GK, Köhler E. Pharmacological investigation on asclepin- a new cardenolide from *Asclepias curassavica*. Part II. Comparative studies on the inotropic and toxic effects of asclepin, g-strophantin, digoxin and digitoxin. *Arzneimittelforschung* 1978; 28(8): 1368-1372.
35. Liggieri C, Obregon W, Trejo S and Priolo N. Biochemical analysis of a papain-like protease isolated from the latex of *Asclepias curassavica* L. *Acta Biochim Biophys Sin* (Shanghai), 41(2), 2009, 154-162.
36. Shivaprasad HV, Rajesh R, Nanda B L, Dharmappa KK and Vishwanath BS. Thrombin like activity of *Asclepias curassavica* L. latex: action of cysteine proteases. *J Ethnopharmacol*, 2009; 123(1): 106-109.
37. Shivaprasad HV, Riyaz M, Venkatesh Kumar R, Dharmappa KK, Tarannum S, Siddesha JM, Rajesh R and Vishwanath BS. Cysteine proteases from the Asclepiadaceae plants latex exhibited thrombin and plasmin like activities. *J Thromb Thrombolysis*, 28(3), 2009, 304-308.
38. Shivaprasad HV, Rajesh R, Nanda BL, Dharmappa KK and Vishwanath BS. Thrombin like activity of *Asclepias curassavica* L. latex: Action of cysteine proteases. *Journal of Ethnopharmacology*, 123, 2009, 106–109.
39. Bork PM, Schmitz ML, Kuhnt M, Escher C and Heinrich M. Squiterpene lactone containig Mexican Indian medicinal plants and pure sesquiterpene lactones as potent inhibitors of transcription factor. *FEBS Letters*, 402(1), 1997, 85-90.
40. Kumar R and Mishra R. Analgesic and antipyretic activity of extracts of *Asclepias currasavica* Linn. *International Journal of PharmTech Research*, 4(1), 2012, 306-308.
41. Hemavani C and Thippeswamy B. Evaluation of antimicrobial activity of root extract of *Asclepias curassavica*. *Recent Research in Science and Technology*, 4(1), 2012, 40-43.
42. Kurdekar RR, Hegde GR and Hebbar SS. Antimicrobial efficacy of *Bridelia retusa* (Linn.) Spreng. and *Asclepias curassavica* Linn. *Indian Journal of Natural Products and Resources*, 3(4), 2012, 589-593.
43. Moulin-Traffort J, Giordani R and Régli P. Antifungal action of latex saps from *Lactuca sativa* L. and *Asclepias curassavica* L. *Mycoses*, 33(7-8), 1990, 383-392.
44. Vandenberghe DA, Ieven M, Mertens F, Vlietinck AJ, Lammens E. Screening of higher plants for biological activities. II. Antiviral activity. *Journal of Natural Products*, 41(4), 1978, 463-467.
45. Heinrich M, Kuhnt M, Wright CW, Rimpler H, Phillipson JD, Schandelmaier A and Warhurst DC. Parasitological and microbiological evaluation of mixe Indian medicinal plants (Mexico). *J Ethnopharmacology*, 36(1), 1992, 81-85.
46. Schmeda-Hirschmann G, Rojas De Arias AA. Screening method for natural products on triatomine bugs. *Phytotheraphy Research*, 6(2), 1992, 68-73.
47. Barnes CS, Price JR and Hughes RL. An examination of some reputed antifertility plants. *Lloydia*, 38(2), 1975, 135.
48. Chakraborty S, Siegenthaler J and Büchi ER. Corneal edema due to *Asclepias curassavica*. *Archives of Ophthalmology*, 113, 1995, 8.
49. Zheng YC. Taiwan Toxic Plants. Holiday Pub. Co. Ltd., Taipei, Taiwan, 2000.