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 complaints. 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, calotropagin, 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, calotropagin, 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 Ipecacuanha, Cottonbush, Madagascar Cottonbush, Milky Cottonbush, Red-Cotton, Red Head, Wallflower Cotton Bush, West Indian Ipecacuanha, Wild Ipecac, Wild oleander; Brazil: Algodao-de-seda, Algodãozinho-do-campo, camará-bravo, Capitao-de-sala, Capitão-de-sala, Cega-olho, Erva-de-pain, 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-flow, 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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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, asclepin CI, asclepin CII, asclepine (asclepiadin), uscharidin, uzarin, uzarigenin, corotoxigenin, asclepogenin, curassavogenin, calotropside, 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, tanin, 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 alcolic 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, cardenolides extracted from the aerial parts and roots of Asclepias curassavica showed pronounced cytotoxicity (IC50 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-hydroxycaletropin (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-phenanthroline, 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 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 iodoacetic acid [19, 36-37]. Cysteine proteases from Asclepias curassavica latex inhibited 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 antifungal activity [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].
CONCLUSION
The paper reviewed Asclepias curassavica as a 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


