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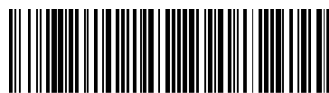
Review Article

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Amaranthus spinosus Linn - A Systemic Review on Pharmacological Aspects

	
<p>S. Jayashree*, P. Muralidharan</p> <p><i>Department of Pharmacology, C.L.Baid Metha College of Pharmacy, Thuraipakkam, Kanchipuram district, Chennai-97, TamilNadu. India.</i></p> <p>Submitted: 05 December 2020 Revised: 26 December 2020 Accepted: 16 January 2021</p>	



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ABSTRACT

Amaranthus spinosus it belongs to the family Amaranthaceae, is an annual or perennial herb which grows annually as an erect, monoecious herb with greenish or purplish stem color widely distribution throughout the United States of America, and all tropical and subtropical regions of Africa, Southeast Asia and India. The plant is used as a traditional medicine to treat various diseases. Various Pharmacological activity of the plant includes anti-inflammatory, antioxidant, anti-pepticulcer, hepatoprotective, anti-malarial, anti-tumour, anti-nociceptive, anti-bacterial, anthelmintic, anti-diabetic, anti-depressant, anti-spasmodic and other activities. The active constituents present in the plant plays a vital role as a medicinal drug. Hence due to its nutritional properties and therapeutic potential, the plant can be used as a food supplement.

INTRODUCTION

Amaranthus spinosus (Family Amaranthaceae), is an annual or perennial herb, thought to be originated from the low and tropical south and Central America and it was introduced into warmer parts of the world. This wild plant has a extensive distribution among tropical and subtropical regions of Africa, America, Southeast Asia and India. *Amaranthus spinosus* grows annually as an erect, monoecious herb, up to 100- 300 cm tall, much branched. The stems of the plant are hard, obtusely angular, glabrous, often greenish to purple in colour with a simple and alternate leaves without stipules. The leaf blade is about 3.5–11cm x 1-4.5 cm long. The leaves have a peculiar odour with bitter taste. The flowering season of this plant happens all over the year. The flowers of the plant are numerous, sessile, axillary. Male flowers are perianth, 2.5 – 3 mm long, 5 sepals, ovate, acute, bristle - pointed. Female flowers are perianth, 1.5 mm long, 5 sepals. The ripe fruit is ovoid with a compressed, shiny, tiny, dark red to black coloured seeds. The plant is used as a traditional medicine and to treat various diseases in the world¹. The plant can also be used as a vegetable and it is cultivated throughout various parts of the world^{2,3}.

PLANT PROFILE



Figure No. 1: *Amaranthus Spinosus* Linn

TAXONOMIC CLASSIFICATION

Kingdom : Plantae

Subkingdom : Viridiaeplantae

Phylum : Magnoliophyta

Subphylum : Euphyllophytina

Division : Magnoliophyta

Class : Magnoliopsida

Subclass : Caryophyllidae

Order : Caryophyllales

Suborder : Chenopodiineae

Family : Amaranthaceae

Genus : Amaranthus

Species : spinosus L.

Botanical name: *Amaranthus spinosus* L

VERNACULAR NAMES

English : Spiny amaranth, Pig weed, Thorny amaranth, Prickly Amaranth.

Sanskrit : Meghanada, Alpamarisha, Tandula, Tanduliuyah

Kannada : Mulla-dantu, Mulla harave soppu

Hindi : Kantamiris, Kantabhaji, Kataili-chaulai, Kantanatia

Gujarati : Kantalodhimdo, Kantanu dant, Tandaljo

Tamil : Mud-kerrai, Mullukeerai

Malayalam : Kattumullenkeera, Mullan-cheera

CHEMICAL CONSTITUENTS

Amaranthus spinosus contains phytoconstituents like 7-p-coumaroyl apigenin, 4-o-beta-D-glucopyranoside, a new coumaroyl flavone glycoside called spinoside, xylofuranosyl uracil, beta – D-ribofuranosyl adenine, beta-sitosterol glucoside, hydroxycinnamates, quercetin and kemferol glycoside⁴, betalins, betaxanthin, betacyanin, amaranthine and isomaranthine,

gomphrenin, betanin, stigmasterol, linoleic acid, 0.15% rutin and beta- carotene⁵⁻⁷.

TRADITIONAL USES

In Africa leaves of the plant *A. spinous* is used to treat gall bladder inflammation, gastroenteritis, ulcerated mouths, burns, wounds, abscesses, arthritis, eczema, boils, earache, hemorrhoids, colic menorrhagia and for snakebites. The Solution of plant ash is used to clean sores. The plant sap is used to treat ophthalmia and convulsion in children. In many parts of Africa, the plant plays a vital role to treat nutritional deficiency disorders and in various other diseases⁸.

In Malaysia, *A. spinosus* is used to treat patients with acute bronchitis. In South-East Asia, the plant is acts as an antidote to snake poison, and as a galactagogue⁹.

In China, *A. spinosus* is used for the treatment of diabetes. The Seeds and root of the plant plays an essential role in the treatment of broken bones. *A. spinosus* also has a diuretic action.

In Nepal, juice of the plant *A. spinosus* is used to induce abortion¹⁰.

In India, tribals of Kerala use leaves of *A. spinous* to cure stomach problem, rheumatic pain, jaundice and to prevent malaria. The leaves of the plant acts as diuretic and as well for stomach trouble specially in indigestion and peptic ulcer. The plant leaf is also used to treat piles and leprosy. The leaf poultice is useful to cure burn-wound and abscess to discharge the pus. Root of the plant is used in the treatment of eczema, gonorrhoea and in menorrhoea¹¹⁻¹³.

PHARMACOLOGICAL ACTIVITY

Hepatoprotective activity

Zeashen.H *et al.*,¹⁴ considered hepatoprotective and antioxidant activity of ethanolic extract of whole plant of *Amaranthus spinosus linn* against carbon tetrachloride (CCl₄) induce liver injury in rats. The outcome of this study specifies that whole plants of *Amaranthus spinosus* contain effective hepatoprotective activity. This may be owing to the occurrence of antioxidant defense factors such as flavonoids and phenolics compound present in the *Amaranthus spinosus*. Moreover, 50% ethanolic extract of *Amaranthus spinosus* shows antioxidant and hepatoprotective action in *in vitro*.

Zeashen. H *et al.*,¹⁵ studied the hepatoprotective activity of *Amaranthus spinosus* Linn,

against d-galactosamine/lipopolysaccharide (d-GalN/LPS)–induced liver damage in rats. The outcome of this study discovered that *Amaranthus spinosus linn* extract showed a considerable protection against (d-GalN/LPS) – induced hepatocellular damage in rats.

Srinivasa and his co-workers¹⁶ studied the methanolic extract of whole plant of *Amaranthus spinosus linn* for hepatoprotective activity against paracetamol (PCM) (3gm/kg o.p) induced liver injury in wistar rats. Existence of compounds such as amino acids, flavonoids and phenolic compounds in the methanolic extract was accountable for its chemoprotective and antioxidant activities against paracetamol induced liver injury in wistar rats.

Antioxidant activity

The antioxidant activity of *Amaranthus spinosus* by non-enzymatic haemoglycosylation was studied by Ashok Kumar et al.,¹⁷. The result of the study revealed that rutin and quercetin showed the inhibition of haemoglycosylation as maximum as 42% and 52% respectively at two different concentrations; 0.5 and 1 mg/ml. The α -tocopheral (Vitamin E) acts as a standard.

Antioxidant and antipyretic activity

The methanolic extract of *Amaranthus spinosus linn* leaves indicated the antioxidant and antipyretic property was demonstrated by Ashok Kumar *et al.*,¹⁸. 1,1-diphenyl-2-picrylhydrazil (DPPH) free radical scavenging, superoxide anion radical scavenging, hydroxyl free radical scavenging, nitric oxide radical scavenging and ABTS radical scavenging assay were considered to find out the antioxidant activity. Total phenolic content was also considered. Antipyretic activities were reported by yeast induced pyrexia method. 200 and 400 mg/kg of methanolic extract of *Amaranthus spinosus linn* serve as a treatment dose. Paracetamol was used as a standard drug for this experiment.

Anti-diabetic activity

The *in vitro* study of an alpha amylase and antioxidant potential of methanol extract of *Amaranthus spinosus linn* exhibited alpha amylase enzyme inhibition by CNPG₃ (2-chloro - 4- nitrophenol a- D- maltotrioxide) was reported by Ashok Kumar *et al.*,¹⁹. The extract of the AS has an *in vivo* antioxidant potential on malondialdehyde (MDA), glutathione (GSH), catalase (CAT) and total thiols (TT) in alloxan induced diabetic rats. The study revealed that the methanolic extract of *Amaranthus spinosus* has an effective inhibition on alpha amylase,

anti-diabetic and antioxidant activities.

Sangameswaran *et al.*,²⁰ investigated the Anti-diabetic, anti-hyperlipidemic and spermatogenic effects in streptomycin (STZ) induced diabetic rats. Both standard drug (Glibenclamide) and methanolic extract of *Amaranthus spinosus* linn extensively decreased the blood glucose level on the 15th day treatment. Additionally in streptomycin (STZ)-induced diabetic rats, the methanolic extract has a considerable anti-hyperlipidemic and spermatogenic effects. The spermatogenic effect was studied by rising the sperm count and accessory sex organ weight.

Sangameswaran and Jayakar,²¹ discovered that the *Amaranthus spinosus* linn has anti-diabetic, anti-hyperglycemic, anti-hyperlipidaemic, spermatogenic effects on alloxan induced diabetic rats. Thus, the plant is used traditionally as an anti-diabetic agent.

Anti-inflammatory activity

The methanol extract of *Amaranthus spinosus* linn showed anti-inflammatory activity in different animal models were investigated by Olumayokun *et al.*,²². The outcome of the plant extract was also studied on castor oil-induced diarrhoea and gastric mucosal integrity. These outcomes revealed the anti-inflammatory activity of the leaf extract of *Amaranthus spinosus* linn. This action of the plant extract might be due to the inhibition of prostaglandin biosynthesis.

Analgesic activity

The analgesic activity of *Amaranthus spinosus* Linn leaves in mice were demonstrated by Senthil Kumar *et al.*,²³. The methanol extract of the plant *Amaranthus spinosus* linn exhibited potent, dose dependent peripheral analgesic activity on experimental animals. The extract of the plant considerably decreased the acetic acid induced abdominal contractions.

Anti-helmintic activity

Baral and his co-workers,²⁴ conducted experiment using the water extract of *Amaranthus spinosus* Linn leaves in mice model. Adult Indian earthworms (*Pheritima posthuma*) and *Tubifex tubifex* were required for this study. Piperazine citrate was used as a reference standard. At 50 mg/ml dose, aqueous extract gave a short time of paralysis (P) and death (D) to both worms *Tubifex tubifex* and *Pheritima posthuma*. The aqueous extract has a significant

activity at a concentration of 15mg/ml against *Tubifex tubifex* when compared to *Pheritima posthuma*.

Anti-malarial activity

Hilouet *al.*,²⁵ reported prickly amaranth, *Amaranthus spinosus* Linn plant extracts possessed anti-malarial activity in mice. The extract was inoculated with parasitized red blood cells (*Plasmodium berghei*) in a 4-day suppressive anti-malarial assay. The corresponding ED₅₀ values for *Amaranthus spinosus* linn extracts is 789mg/kg.

Anti-nociceptive activity

According to Hussain Zeashana *et al.*,²⁶ the 50% of ethanolic extract of *Amaranthus spinosus* linn, whole plant showed a potent dose dependent antinociceptive and anti-inflammatory activity.

Haematological activity

The effect of aqueous extract of *A. spinosus* leaves on hematological parameters along with blood coagulation time was demonstrated by Akinloye and his co-workers (2000)²⁷ using rat model. The study revealed inconsiderable changes in the levels of several enzymes such as serum glutamate pyruvate transaminase (SGPT), serum glutamate oxaloacetate transaminase (SGOT), alkaline phosphatase (ALP) and in haematological parameters. Even though, there was a considerable decline in serum biochemical parameters such as glucose and cholesterol were noticed in rats²⁸. The effect of aqueous extract of whole plant of *A. spinosus* on hematological parameters was studied by Bhande and his co-workers. The extract of plant *A. spinosus* considerably elevated the WBC and means corpuscular volume (MCV) and decreased the hemoglobin, RBC, PCV and mean corpuscular hemoglobin concentration (MCHC)²⁸.

Anti-pepticulcer activity

Ghost *et al.*, reported the anti peptic ulcer activity of *Amaranthus spinosus* Linn in peptic ulcer models in rats. Gastric and duodenal ulcers, were induced by using Ethanol and cysteamine respectively. Omeprazole a standard anti gastric ulcer drug serve as a positive control. On comparing with standard drug, the leaves of *Amaranthus spinosus* Linn possessed anti peptic ulcer activity against ethanol and cysteamine induced peptic ulcer. The activity of

plant extract was found to be decreased when compared with that of omeprazole²⁹.

Mitra *et al.* (2013) evaluated the efficacy of leaves, stem and roots of *A. spinosus* linn against ethanol, indomethacin, hydrochloric acid, stress and pyloric ligation induced ulceration in albino rats and compared it to omeprazole an anti-gastric ulcer drug³⁰.

Immunomodulatory activity

The immunomodulatory effect of *Amaranthus spinosus* linn water extract on spleen cells from female mice was demonstrated by Lina and his co-workers³¹. The result of the test experiment indicated that the immune-modulatory effects of ethanolic extract of *Amaranthus spinosus* linn might be due to stimulatory proliferation action on B lymphocyte activation and subsequent T-cell proliferation *in vitro*.

Jin-yuarn Li *et al.*,³² carried out the immune-modulatory effects of *Amaranthus spinosus* linn water extract on spontaneous and Dexamethasone (DEX)-induced apoptosis in murine primary splenocytes. The results exhibited that the ethanolic extract inhibited the spontaneous and DEX-induced apoptosis of splenocytes.

The phytochemical investigation and immunodilator activity of *Amaranthus spinosus* Linn was carried out by Tatiya *et al.*,³³. The immunomodulatory activity was done by cell-mediated immune response (CMIR) measured by delayed type of hypersensitivity reaction to SRBC and humoral immune response (HIR) measured by hemagglutination antibody titre. Among all the various extracts, the ethanolic and alcoholic extracts showed a potent increase in cell mediated immune response and humoral immune response while the petroleum ether extract significantly reduced cell-mediated response as well as humoral response.

Gastrointestinal activity

The ethanolic extract of *Amaranthus spinosus* linn was studied for gastrointestinal activity in mice was demonstrated by Ashok Kumar *et al.*,³⁴ using a charcoal meal method. Three different doses of *Amaranthus spinosus* ethanolic extract at 100, 200 and 400 mg/kg were compared to control group. The outcome exhibited a potent gastrointestinal motility at 100 mg/kg dosage.

Antigenic and allergenic activity

Amaranthus spinosus five pollen samples work as an essential aeroallergen in India and other different parts of the country was studied by Singh *et al.*,³⁵. These study information would be helpful in standardizing pollen antigens for diagnosis and immunotherapy in India.

Antimicrobial activity

Maiyo *et al.*,³⁶ conducted experiment using different solvents like hexane, ethyl acetate, dichloromethane and methanol leave extracts of three plant species *Amaranthus hybridus*, *Amaranthus spinosus* and *Amaranthus caudatus* for studying antimicrobial activity. At various concentrations the leaves extract of plant species and extraction fraction exhibited antimicrobial activity.

The whole plant extract of *Amaranthus spinosus linn* was investigated for preliminary qualitative analysis and anti-microbial activity against some bacterial and fungal strains (*Staphylococcus*, *Escherichia coli*, *Klebsiella*, *Paracoccus*, *Fusarium*, *Aspergillus* and *Alternaria*). The plant extracts (stem and flower) possessed significant zone of inhibition on *E. Coli* (14mm), *Pseudomonas* (13mm), *Staphylococcus* (10mm), *Paracoccus* (9mm), and *Klebsiella* (15mm) in 4.7mg/disc (distilled water) and 3.8 mg/disc (methanol), respectively³⁷.

Antibacterial activity

Harsha Vardhana S and his co-workers³⁸ studied both ethanol and aqueous extract of *Amaranthus spinosus linn* root which possessed antibacterial activity against ten bacterial strains including Gram-positive and Gram-negative bacteria using agar-well diffusion method. The ethanol extract gave superior outcome when compared to the methanol extract of *Amaranthus spinosus linn*.

Diuretic activity

The extract of *Amaranthus spinosus linn* possessed a strong saluretic effect and carbonic anhydrase inhibition activity. The extract elevated the levels of Na⁺, K⁺, Cl⁻ excretion in urine and also caused alkalisation of urine as like thiazide, a standard drug. The effects of this extract were seen mostly at 500 mg/kg dose. The result showed no dose response relationship. Hence, *Amaranthus spinosus linn* acts as a diuretic, which confirms the claim as a diuretic herb in Siddha medicine³⁹.

Bronchodilator and Spasmolytic activity

Using aqueous–methanol extract of whole plant of *Amaranthus spinosus* Linn *in vivo* bronchodilator and laxative activities were carried out by Chaudhary *et al.*, (2012). *In-vitro* studies were carried out to assess the spasmolytic effect using isolated tissue preparations mounted on a tissue bath assembly embedded in a physiological salt solutions, maintained at 37°C and carbogen aerated condition to find the underlying mechanism behind it. The outcome revealed that *Amaranthus spinosu linn* possessed laxative activity and spasmolytic effect mediated through cholinergic action and calcium channel blockage. While, the bronchodilator activity was mediated through a combination of β -adrenergic and CCB pathways⁴⁰.

Antidepressant activity

Kumar *et al.*, studied the Antidepressant activity of *A. spinosus* extracts (2014) [48] using Forced Swimming Test (FST) and Tail Suspension Test (TST). The outcome of the *A. spinosus* extract exhibited potential ($p < 0.01$) antidepressant activity when compared to Escitalopram and Imipramine⁴¹.

Analgesic and Antipyretic Activity

Taiab *et al.* (2011)⁴² reported the analgesic activity of petroleum ether, ethyl acetate and methanol extracts of using acetic acid induced writhing and radiant heat tail-flick models in mice. When methanol extract were administered orally to mice (500 mg/kg of body weight) possessed significant antinociceptive activity against chemical (acetic acid-induced visceral pain) and thermal (radiant heat tail-flick test) models of nociception. Moreover, the methanolic extract of leaves of *A. spinosus* exhibited potential ($P < 0.01$) antipyretic activity by yeast induced pyrexia method at concentration of 200 and 400 mg/kg using paracetamol as standard drug⁴³.

Antifertility activity

Satyanarayan *et al.*, (2008)⁴⁴ investigated the anti-fertility activity of alcoholic extracts of *A. spinosus* Linn to interrupt pregnancy in rats. The Alcoholic extract of *A. spinosus* at dose of 150 and 175 mg/kg body weight produced considerably intercepted pregnancy in rats. Whereas, Jhade *et al.* (2011)⁴⁵ reported weak antifertility effect in aqueous and alcoholic extracts of root of *A. spinosus* in rats.

CONCLUSION

In this modern era, medicinal plants have involved significant global interest in the exploration of traditional medicine. It is used by rural and tribal communities with conventional illness and also traditional medicine plays a very essential role. The wide survey literature on *Amaranthus spinosus* Linn validated its effectiveness as an essential medicinal plant in traditional usage with various pharmacological spectrum. In the traditional medicine system of India, the plant has been proved to possess some pharmacological properties like anti-inflammatory, antioxidant, antidiabetic, antipyretic, hepatoprotective, antimalarial, antibacterial, antimicrobial, antidiuretic, antiviral and in hepatic disorders. The wide properties of this plant is chiefly due to the existence of medicinally active constituents in whole plant parts of *Amaranthus spinosus* Linn. Owing to the presence of numerous traditional uses in various treatments, it is suggested to survey this plant for the discovery of safe drugs in future.

CONFLICT OF INTEREST STATEMENT

Authors declare no conflict of interest.

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