

AMARANTHUS SPINOSUS LINN. – PAST, PRESENT AND FUTURE**Samayita Basu¹, Tanaya Ghosh¹, Prasenjit Mitra² and Prasanta Kumar Mitra^{1*}**¹Department of Medical Biotechnology, Sikkim Manipal University, SMIMS, Sikkim, India.²Department of Biochemistry, All India Institute of Medical Sciences (AIIMS), Jodhpur, Rajasthan, India.Article Received on
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Amaranthus spinosus Linn. (Family Amaranthaceae) commonly known as 'spiny amaranth' or 'pig weed', is a plant known for its medicinal properties since long. In past in the traditional system of medicine (Ayurveda, Unani, Siddha, Homeopathy, Naturopathy, Folk medicine etc.) various parts of the plant were used for treatment of different diseases. The tradition, however, is still continuing. In present day research phytochemical investigations were carried out which confirmed presence of bioactive molecules like linoleic acid, rutin, catechuic acid, tannins, alkaloids, flavonoids, glycosides, saponin, betalain, b-sitosterol, carotenoids, stigmasterol, phenolic acids, steroids, amino acids, terpenoids etc. in different parts of the plant.

Pharmacological studies were also conducted. Different parts of the plants showed analgesic, antimicrobial, antioxidant, antidiabetic, antitumor, spermatogenic, antifertility, anti-inflammatory, hepato-protective, spasmolytic, bronchodilator, antimalarial properties. In spite of all these studied there are many more work to be done in near future. Other phytochemicals present in the plant are to be isolated. Isolated phytochemicals need thorough experimental studies to confirm their medicinal values. More clinical trials will have to be undertaken to prove efficacy of the isolated phytochemicals as drug. The aim of the present work was, therefore, to make a comprehensive review on past and present studies on the plant and the possibilities of future work for its maximum medicinal use in near future. Further, *Amaranthus spinosus* Linn. is an excellent food due to its high nutrient content. Research is also needed for its maximum yield for greater interest of mankind.

KEYWORDS: *Amaranthus spinosus* Linn., ancient time, modern era, further research.

1. INTRODUCTION

For many centuries and even today plants have provided mankind with remedies for many diseases. In India there are 47000 plant species of which 15000 are reported to have medicinal properties. These plants play a major role in primary healthcare as therapeutic remedies in India. It is further claimed that these plants have been the bases of treatment and cure for various diseases in India.^[1]

Amaranthus spinosus Linn. (*A. spinosus* L.) is one such medicinal plant of India. Belongs to the family of Amaranthaceae, the plant is believed to originate from South and Central America and then introduced into various regions of Africa specially south tropical African countries such as Zimbabwe, Botswana, Malawi, Zambia and Namibia. The plant is also widely distributed in waste places, roadsides and fields in Bangladesh, Ghana, Cambodia, Philippines Maldives, Japan, Sri Lanka, Myanmar, Indonesia, Australia and India.^[2] *A. spinosus* L. grows annually as an erect perennial herb with many branches. Stems are hard, terete or obtusely angular and greenish to purple in colour. Leaves are alternate, have bitter taste with a characteristic odour. Flowers are numerous, appear throughout the year. Fruit is ovoid shaped. Seed is shiny, black or brownish-black in colour.^[3,4]

Under taxonomic classification *A. spinosus* L falls as under:

Kingdom – Plantae, Subkingdom - Viridiaeplantae, Phylum - Magnoliophyta, Subphylum - Euphyllophytina, Division - Magnoliophyta, Class - Magnoliopsida, Subclass - Caryophyllidae, Order - Caryophyllales, Suborder – Chenopodiineae, Family - Amaranthaceae, Genus – *Amaranthus*, Species - *spinosus*.^[5]

A. spinosus L. is known by different names. It is called ‘prickly amaranthus’ in English and ‘ban lure’ or ‘dhuti ghans’ in Nepali. In Bengali, Hindi, Oriya, Gujarati, Tamil, Telegu, Marathi, Sanskrit, Malayalam and Manipuri the plant is known as kantantoty, kanta chaulai, kantaneutia, kantalo dhimdo, mullukkeerai, mullatotakura, kante bhaji, tanduliuyah, kattumullenkeera and chengkruk respectively.^[6,7,2]

Amaranthus spinosus Linn and different parts



A. spinosus L. (Plant) *A. spinosus* L. (Root)

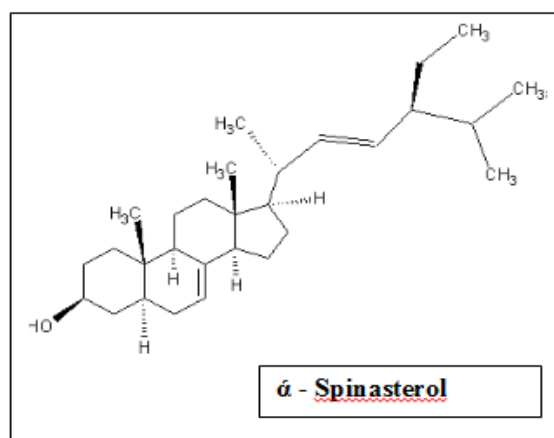
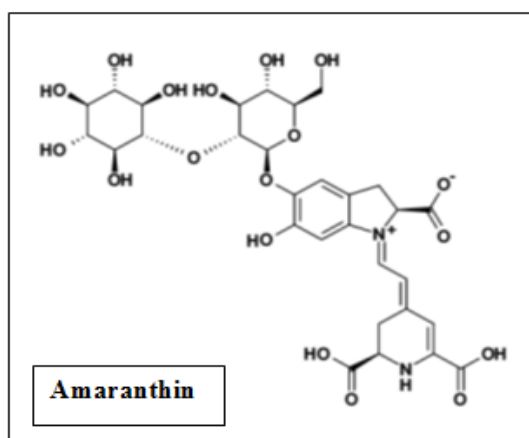
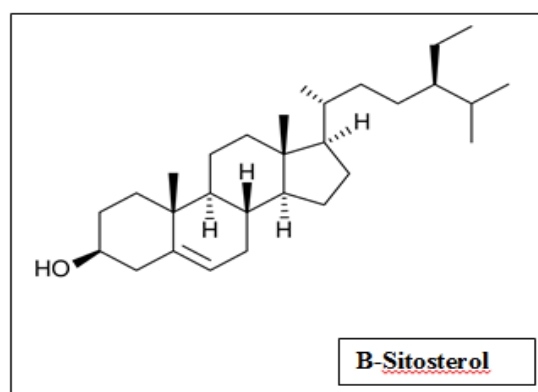
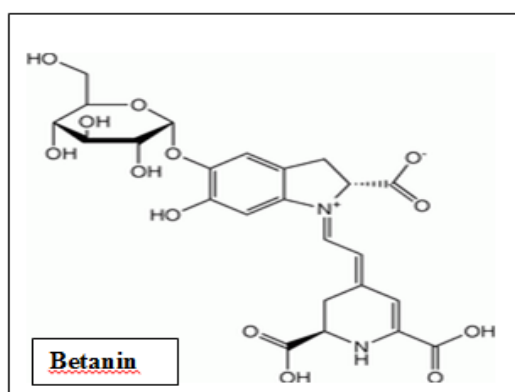
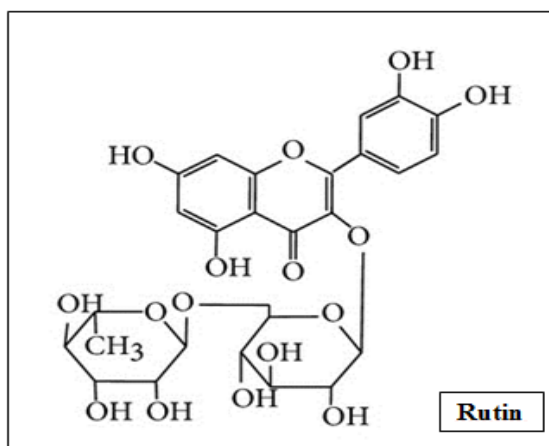
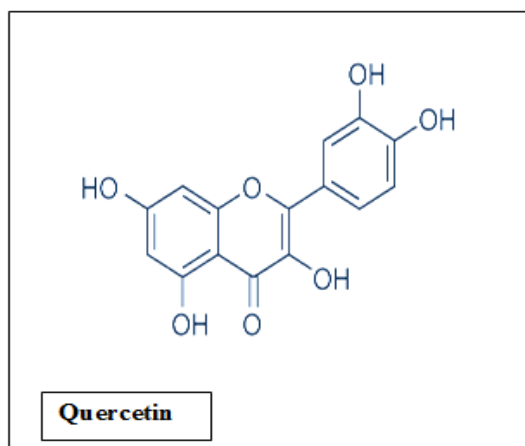


A. spinosus L. (Leaves) *A. spinosus* L. (Flower)



A. spinosus L. (Stem)

A. spinosus L. (seeds)

Few phytochemicals isolated from *Amaranthus spinosus* Linn.

Phytochemical investigations revealed that *A. spinosus* L. is a rich source of saponin, betalain, phenolic acids, steroids, amino acids, rutin, catechuic acid, alkaloids, flavonoids, glycosides, b-sitosterol, stigmasterol, linoleic acid, terpenoids, lipids, tannins and carotenoids. The plant also contains 7-p-coumaroyl apigenin 4-o-beta-D-glucopyranoside, beta - D-

ribofuranosyl adenine, amaranthine and isomaranthine, quercetin and kemferol glycoside, betaxanthin, betacyanin, betanin, stigmasterol, xylofuranosyl uracil, beta-sitosterol glucoside, hydroxycinnamates etc.^[8-11]

Due to presence of high amount of nutrients *A. spinosus* L. is used as green vegetables. 100g of plant leaves contain about 4g protein, 1.16g carbohydrate, 0.6g fat, 2.48g fibre, 2.76g ash, 91g moisture giving rise to 27 kcal of energy. 100 g dry weight of the plant contain 968.7 mg calcium, 912.4 mg magnesium, 38.4 mg iron, 1.2 mg copper, 6.8 mg manganese, 6.8 mg zinc, 816.3 mg phosphorus etc.^[12,13]

2. *Amaranthus spinosus* – PAST

A. spinosus has a long history of usage in medicine against various ailments.

As traditional medicine

In Thai traditional medicine, *A. spinosus* is used to treat diarrhea.^[14] Root of the plant is used for toothaches.^[15]

In African traditional medicine leaves of *A. spinosus* are used in gastroenteritis, gall bladder inflammation, ulcerated mouths, colic menorrhagia, burns, wounds, abscesses, arthritis, eczema, boils, earache and hemorrhoids and for the treatment of snakebites. Solution of plant ash is used to wash sores. To treat ophthalmia and convulsion in children the plant sap is used. In many parts of Africa, the plant is used in nutritional deficiency disorders and in various other diseases.^[16]

In Malaysian traditional medicine, *A. spinosus* is used to give relief to the patients in acute bronchitis. In South-East Asia, the plant is used as an antidote to snake poison, and asagalactagogue.^[17]

In Chinese traditional medicine *A. spinosus* is used to treat diabetes. Seed and root of the plant are considered effective in treatment of broken bones and as a diuretic.^[18]

In Nepalese traditional medicine juice of *A. spinosus* is used to induce abortion.^[18]

In Indian traditional medicine, tribals of Kerala use leaves of *A. spinosus* to cure jaundice, stomach problem, rheumatic pain and to prevent malaria. Tribals of Sikkim use the plant leaf as diuretic and in anemia as well as in stomach trouble specially in indigestion and peptic

ulcer. Leaf is also used in curing piles and leprosy. It is their belief that leaf poultice is helpful in burn-wound and abscess to discharge the pus. Root of the plant is used by them in eczema, gonorrhoea and in menorrhoea.^[19-21] In Manipur, cooked *A. spinous* is eaten by patients suffering from diabetes and high blood pressure.^[22]

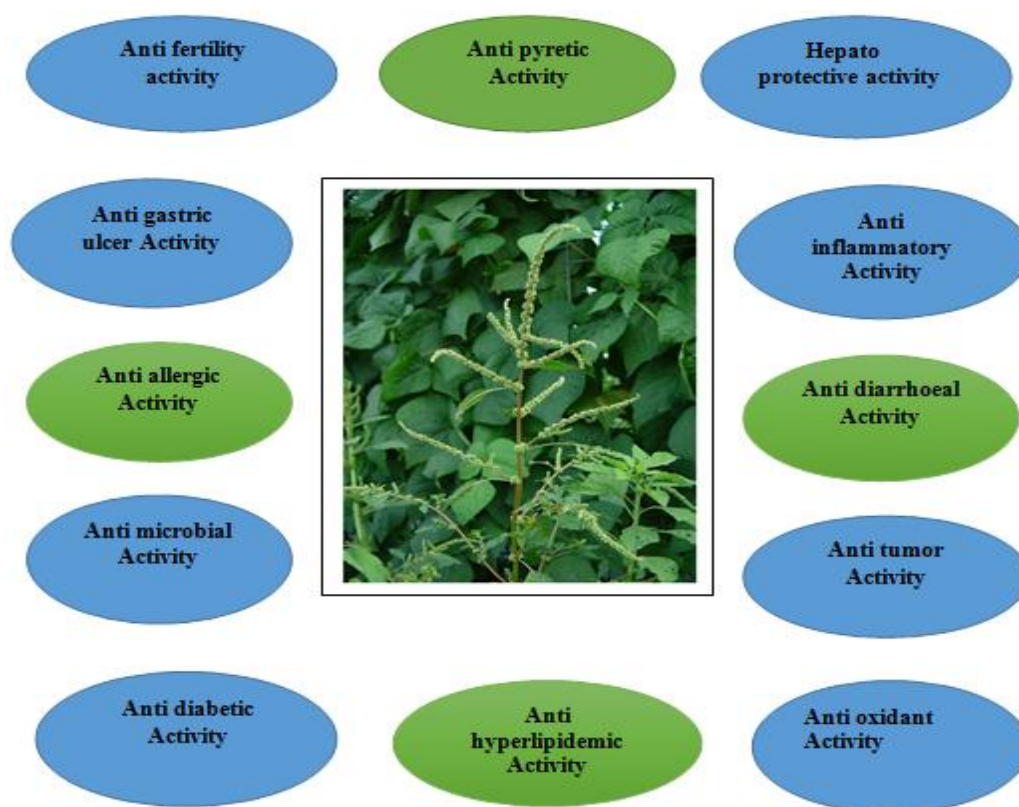
As Ayurvedic medicine

In Ayurveda *A. spinous* is regarded as emmenagogue and galactagogue. The plant is used as refrigerant, antipyretic, diuretic, stomachic, against cholera, laxative and digestive. The plant is also used to improve piles, kidney complaints, burning sensation, appetite, rat bite, biliousness, blood diseases, leprosy, bronchitis and leucorrhoea. The plant is further used in the treatment of vomiting, abdominal pain, hysteria, tonsillitis, malaria, dysentery, dysurea, chicken pox, fever, and mania.^[23,24]

A. spinous prevents vomiting, is used as mouth wash for toothache and in treatment of snake-bite. Decoction of the plant is used to arrest miscarriage. Leaves of the plant are used to treat colic menorrhagia, boils, eczema, abscesses, stomach-ache, gastroenteritis, gallbladder inflammation, rheumatic pain and arthritis. Boiled leaves and root are given to children as a laxative. Root paste in equal proportion with honey is used to control vomiting.^[25]

3. *Amaranthus spinosus* – PRESENT

In present time pharmacological actions of *A. spinosus* have been investigated by various researchers. The plant is found having several pharmacological activities which include anti-hyperlipidemic^[26], antidiabetic^[27-32], antitumor^[33,34], Immuno-modulatory properties.^[35-37]

Pharmacological activities of *Syzygium cumini* Linn.Table 1: Pharmacological properties of *Amaranthus spinous*.

Pharmacological properties	Parts used	Extract	Reference
Anti-hyperlipidemic	Whole plant	Methanol	[26]
Antidiabetic	Whole plant	Methanol	[27-32]
Antitumor	Leaf	Ethanol	[33,34]
Immuno-modulatory properties	Whole plant	Water	[35-37]
Antimicrobial	Leaf	Water	[38,39]
Antibacterial	Root	Water	[40]
Anti-peptic ulcer	Root, stem, leaf	Water	[41,42]
Anti-inflammatory	Leaf	Water	[43,44]
Analgesic	Leaf	Water	[45]
Bronchodilator and spasmolytic activity	Whole plant	Acetone	[46]
Hepato-protective	Whole plant	Water	[47-50]
Antifertility	Whole plant, root	Water, ethanol	[51,52]
Anti-nociceptive,	Whole plant	Methanol	[53]
Anti-helminthic	Whole plant	Ethanol	[54,55]
Haematological activity	Leaf	Methanol	[56-58]
Antimalarial	Whole plant	Acetone	[59]
Antidiarrhoeal	Whole plant	Ethanol	[60]
Gastrointestinal activity	Whole plant	Water	[61]
Antigenic and allergenic activity	Whole plant	Water	[62]
Antipyretic	Leaf	Methanol	[63]
Diuretic	Leaf	Water	[64]
Antioxidant	Leaf	Methanol	[65-67]

antimicrobial^[38,39], antibacterial^[40], anti-peptic ulcer^[41,42], anti-inflammatory^[43,44], analgesic^[45], bronchodilator and spasmolytic^[46], hepato-protective^[47-50], antifertility^[51,52], anti-nociceptive^[53], anti-helminthic^[54,55], Haematological activity^[56-58], antimalarial^[59], antidiarrhoeal^[60], gastrointestinal activity^[61], antigenic and allergenic activity^[62], antipyretic^[63], diuretic^[64], antioxidant properties.^[65-67] Pharmacological properties of different parts of *A. spinosus* are written in table – 1.

4. *Amaranthus spinosus* – FUTURE

Despite several studies conducted on *A. spinosus*, there are still many more opportunities for further research on this plant. These include,

1. Though pharmacological activities of *A. spinosus* are known in literature, further research is needed to explore other pharmacological properties, if any, of different parts of the plant.
2. Pharmacological activities of *A. spinosus* will have to be confirmed in different species of animals. More experiments are required in this direction.
3. During extraction process different solvent systems should be used to identify the solvent or mixture of solvents having maximum pharmacological activity.
4. Comparative study of the pharmacological activities of different parts of *A. spinosus* will have to be undertaken to identify the part having maximum activity.
5. Seasonal variation studies on the pharmacological activities of different parts of *A. spinosus* must be carried out to know season wise maximum activity.
6. Many phytochemicals have been isolated from *A. spinosus*. Many more phytochemicals may be present in different parts (stem, root, leaf, flower, seed etc.) of the plant. Attempt should be made to isolate these phytochemicals.
7. Phytochemicals, responsible for pharmacological activities, are the secondary metabolites of plants. Lot of studies had confirmed that concentration of phytochemicals varies with season. So seasonal variation in the concentration of phytochemicals of *A. spinosus* should be explored. This will also help in isolation of active compound(s) from *A. spinosus* in future.
8. Phytochemicals which are already isolated from different parts of *A. spinosus* are not properly evaluated experimentally. Work in this direction is needed.
9. Mechanism of action of the isolated phytochemicals from *A. spinosus* in treatment / prevention of disease should be explored.

10. Isolated phytochemicals and phytochemicals to be isolated from *A. spinosus* must have a thorough clinical trial for its standardization as drug.
11. Due to presence of high amount of nutrients *A. spinosus* has excellent nutritional value and is used as green vegetables. Effect of environment and cultivation practices on yield and nutrient composition should have to studied thoroughly. Further, more work on processing of the plant is required as processing has an effect on contents and bioavailability of the nutrient.
12. There is a dearth of scientific work related to nutraceutical properties of *A. spinosus*. Studies in this direction are needed

Addressing these issues will contribute to develop new drug(s) from *A. spinosus* and confirm health benefits of the plant as food.

5. CONCLUSION

Since long *A. spinosus* is being used for treatment of different diseases. In traditional and other system of medicines uses of *A. spinosus* helped patients to get rid of ailments. Modern researchers evaluated pharmacological activities of the plant. They also isolated phytochemicals from the plant responsible for medicinal values. Still, the plant has not yet been developed as a drug. Therefore, there are opportunities for further research on this plant. There may be more phytochemicals present in *A. spinosus* which need isolation. Mechanisms of pharmacological actions of the plant through the isolated phytochemicals should have to be explored. Studies must be undertaken for thorough clinical trial of the isolated phytochemicals for the discovery of safer and more affordable drugs. At the same time due to its high nutrient value, *A. spinosus* is a wonderful food. Further research is, therefore, needed to increase its production to solve the problem of malnutrition especially for developing countries.

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