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A Review: Pharmacological potential of *Amaranthus spinosus*

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Abstract:- *Amaranthus spinosus* is a medicinal plant that has been traditionally used in various cultures to treat different ailments. The plant is rich in phytochemicals such as alkaloids, flavanoids, saponins and tannins, which has been reported to possess several pharmacological activities. Studies have shown that the plant exhibit potent antioxidant, antimicrobial, anti-inflammatory, antidiabetic, hepatoprotective, and antitumor activities. It also possesss analgesics and antipyretic properties making it useful in the treatment of pain and fever. Additionally *Amaranthus spinosus* has been found to have immunomodulatory effects and can help to boost the immune system. The pharmacological activities of *Amaranthus spinosus* have been attributed to its various bioactive compounds and further research is needed to fully elucidate the mechanism of action of these compounds. The main phytoconstitutents is 7-p coumaroyl apigenin, 4-O-beta-D-glucopyranoside, spinosidexylofuranosyl uracil, beta-D-ribofuranosyl uracil, beta–D-ribofuranosyladenine, beta sistosterol glucoside, hydroxycinnamates, quercetin and kaempferol glycosides, betalains, betaxanthin, betacyanine and isoamaranthine gomphrenin, betanin, b-sistosterol, stigmasteron, linolic acid, 0.15% rutin and beta carotene. Apart from these important phytoconstituents it contains carbohydrates, proteins, fats, fibres, minerals such as iron, calcium, manganese, copper and zinc revealing its nutritional potential. As the plant possess such nutritional values and therapeutic potential it should be included as food supplement. *Amaranthus spinosus* is a promising medicinal plant with a wide range of pharmacological activities and holds great potential for the development of new drug.

Keywords:- *Amaranthus spinosus*, Phytochemicals, Pharmacological activities antioxidant, antimicrobial, anti-inflammatory, antidiabetic, hepatoprotective, and antitumor activities.

INTRODUCTION:-

Amaranthus spinosus Family: Amaranthaceae, also called "spiny amaranth" or "pig weed," is a plant that has long been valued for its therapeutic benefits. Previously, many plant parts were used in ancient medical systems like Ayurveda, Unani, Siddha, homoeopathy, naturopathy, and folk medicine were applied to treat a variety of disorders. *Amaranthus spinosus* a member of the Amaranthaceae family of plants, is one such medicinal plant used in India. It is thought to have originated in South and Central America before being introduced to other parts of Africa, particularly southern tropical nations like Zimbabwe, Botswana, Malawi, Zambia, and Namibia. Along highways and in fields in Bangladesh, Ghana, Cambodia, the Philippines, the Maldives, Japan, Sri Lanka, Myanmar, Indonesia, Australia, and India, the plant is also widely distributed in those countries. *Amaranthus spinosus* is an annual herb that is upright and has many branches. Hard, erect or acutely angular stems that range in colour from green to purple. The bitter-tasting, alternating leaves have a distinctive scent. There are many flowers, and they bloom all year round. The shape of fruit is ovoid. Black or brownish-black seed is lustrous and has a smooth appearance.

Under taxonomic classification *Amaranthus spinosus* falls as under:
Kingdom:- Plantae,
Subkingdom:- Viridaeplantae,
Phylum:- Magnoliophyta,
Subphylum:- Euphyllophytina,
Division:- Magnoliophyta,
Class:- Magnoliopsida,
Subclass:- Caryophyllidae,
Order:- Caryophyllales,
Suborder:- Chenopodiineae,
Family:- Amaranthaceae,
Genus:- *Amaranthus*,
Species:- *spinous*.

In recent years the pharmacological actions of *Amaranthus spinosus* have been investigated by various researchers. The plant is has found various pharmacological activities which include antihyperlipidemic, antidiabetic, antitumor, Immuno-modulatory properties, antimicrobial, antibacterial, anti-peptic ulcer, anti-inflammatory, analgesic, bronchodilator and spasmolytic, hepato-protective, antifertility, anti-nociceptive, anti-helmintic, Haematological activity, antimalarial, antidiarrhoeal, gastrointestinal activity, antigenic and allergenic activity, antipyretic, diuretic, antioxidant properties.[1]

Fig:- Photos of *Amaranths Spinosus*

Pharmacological potential of *Amaranthus spinosus*:-

1.Hepatoprotective and Antioxidant activity:- Rats livers were protected against carbon tetrachloride (CCl4)-induced hepatic damage by an ethanol extract of the Amaranthus spinosus entire plant. According to this study, flavonoids and phenolic chemicals in it may have hepatoprotective properties that are mediated by antioxidant defence mechanisms. **Antioxidant activity:-** *Amaranthus spinosus* antioxidant capacity was assessed using a non-enzymatic haemoglycosylation test. According to the results, quercetin and rutin, two secondary metabolites, effectively inhibited haemoglycosylation by up to 42% and 52%, respectively. Roadside plants that were hypothesised to be continuously exposed to high levels of pollutants like nitrogen oxides and sulphur dioxides from vehicular emissions were examined for *Amaranthus spinosus* antioxidant activity. By examining the activity of the enzymes superoxide dismutase, catalase, ascorbate peroxidase, glutathione reductase, and phenolic peroxidase. *Amaranthus spinosus* has a very effective free radical scavenging system for battling air pollution. This plant has a pigment called betalain that, in several tests, exhibits anti-oxidant activity.They have EC50 values between 3.4 and 8.4µ.[2, 3]

2.Immunological effects:- *Amaranthus spinosus* leaf aqueous extract significantly increased the proliferation of splenocytes in female mouse primary splenocytes, demonstrating immuno-modulatory properties. Bulk splenocytes responded to the water extract (1250 g/mL) with a substantially faster rate of proliferation than separate, purified B and T cells, indicating some type of interaction between these cells.

3.Antidepressant activity:- *Amaranthus spinosus* methanolic extract (MEAS) was tested for antidepressant activity utilising the Forced Swimming Test (FST) and Tail Suspension Test (TST) models, and it exhibited antidepressant action.[4]

4.Antitumor activity:- The ethanol extract was used directly in the test after being dissolved in isotonic saline (0.9% NaCl w/v) solution. The donor mice's tumour cells were isolated and suspended in sterile isotonic saline solution. Under a microscope, the trypan blue indicator was used to count the live tumour cells, which were then fixed at 106 cells/mL. The first day, complete animals were intraperitoneally injected with 0.1 mL of tumour cells per 10g of body weight. The growth of cancer cells was permitted. For 16 days, the extract was taken orally. Team IV The common medication 5-Fluorouracil (20 mg/kg body weight) was delivered intravenously into tumour mice for 16th days. On the 21st day six animals in each cage were killed and the rest of the animals were kept to observe the life span of the hosts.[5]

5.Antidiarrhoeal activity:- Three different doses of the ethanol extract (50%) from the entire plant of *Amaranthus spinosus* (Amaranthaceae) (ASE) significantly decreased the rate at which a charcoal meal moved through the intestine. However, when 400 mg/kg of ASE was administered again in the presence of yohimbine, the rate of intestinal propulsive inhibition decreased, whereas morphine reversed the activity. At doses of 100, 200, and 400 mg/kg of ASE, the percentages relating to controls for the beginning of diarrhoea were 16.58, 83.42, and 116.18%, while this number was 123.93% with morphine compared to controls. With morphine plus three different dosages of ASE, the percentage purging frequency compared to controls was 41.09, 64.38, 71.23, and 86.30%, respectively. At doses of 100, 200, and 400 mg/kg of ASE, the intestinal accumulation was inhibited by 8.9, 48.16, and 68.06%, respectively, as compared to the control, while yohimbine had a 50.78% inhibitory effect. The antidiarraheal indices of ASE were 23.55, 49.16, and 76.53 for the three different ASE doses, whereas the greatest antidiarraheal index of morphine was 88.45. At doses of 100, 200, and 400 mg/kg of ASE and when combined with cimetidine, protection against ethanol-induced ulcer was 51.07, 55.91, 77.95, and 60.75%, whereas it was 41.33, 61.77, 80.88, and 74.66%. While protection was 56.96, 63.29, 81.01, and 52.32% at three different ASE dosages and with cimetidine in cold restraint-induced ulcer, lipid peroxidation was additionally related with a concurrent decrease in ulcer index.[6]

6.Antiulcer activity:- When powdered leaves of *Amaranthus spinosus* are fed to albino rats with stomach and duodenal ulcers, the effect on the ulcers is known as anti-peptic action. The findings indicate that the leaves of *Amaranthus spinosus* can significantly protect against the peptic and gastric ulcers (duodenal ulcers) that ethanol and cysteamine cause. Even though omeprazole, a medication used to treat peptic ulcers,

had a stronger anti-ulcer impact *Amarathus spinosus* still plays a significant role in treating ulcers because it has no known long-term negative effects.[7]

7.Antibacterial activity:- For in vitro antibacterial testing against gram positive and gram negative human pathogenic bacteria, the disc diffusion technique was employed. Against both gram positive and gram negative bacteria *Amaranthus spinosus* demonstrated good antibacterial activity with an average zone of inhibition of 8 to 15 mm. The ethanolic extracts of *Amaranthus spinosus* root were tested using the agar-well diffusion method against ten bacterial strains, including Gram-positive and Gram-negative bacteria. The plant extract that inhibits microbial growth in aqueous form produced better results.[8]

8.Antifungal activity:- By using various extracts in the media used for fungal cultures, three different fungal strains—Fusarium sp., Aspergillus sp., and Alternaria sp.—were resistant to the growth of the fungi. On the Sabouraud dextrose agar medium, the test was run by adding crude extracts. SAD (65 g/L) and agar (10 g/L) were dissolved in distilled water, heated to 121 C in an autoclave, and then cooled to form SAD slants. A known volume of the crude extracts was added to the media (4-5 mL), which was then thoroughly mixed in the test tubes before being allowed to set into slants. Under aseptic conditions, loop inoculations of pure cultures of various fungal strains were made.[9]

9.Anti-malarial activity:- *Amaranthus spinosus* aqueous extract was provided twice daily, at regular intervals of every 12 hours, from the first day (D1) to the fourth day (D4), to infected mice for Plasmodium berghei berghei. The parasitemia was measured on the fourth day of the experiment by counting the parasitized red blood cells on at least 9000 red blood cells, which had to be present. Tail blood smears were obtained and stained with Grunwald-Giemsa.[10]

10. Anti-inflammatory activity:- All chronic diseases share a major physiological trait in which inflammation-induced oxidative stress and damage to macromolecules occur. In a mouse model, the systemic anaphylactic shock caused by the compound 48/80 secretagogue was totally prevented by the ethyl acetate fraction of *Amaranthus spinosus* leaves. Additionally, it preserved the integrity of the lipid bilayer membrane of the mast cell, preventing disruption of the membrane, histamine release, and mast cell degranulation in vitro in rat peritoneal mast cells, suggesting a function in the prevention and control of anaphylactic events.[11]

11. Anti-diabetic activity:- Through the inhibition of the alpha amylase enzyme in vitro by 2-chloro-4-nitrophenol d-maltotrioside and the in vivo antioxidant potential of malondialdehyde, glutathione, catalase, and total thiols in alloxan-induced diabetic rats, the antioxidant potential of the methanol extract of *Amaranthus spinosus* was established. This study demonstrated the strong amylase, anti-diabetic, and antioxidant properties of *Amaranthus spinosus* methanolic extraction.[12]

12. Anti-cholesterolemic activity:- Using normal and streptozotocin (STZ)-induced diabetic rats every day for 21 days, the anti-cholesterolemic efficacy of methanolic extraction of the leaves of *Amaranthus spinosus* was investigated. Rat pancreas histology was performed to check for anti-cholesteremic activity.[13]

13. Antigenic and allergenic activity:- *Amaranthus spinosus* is a common plant that grows throughout India and is a significant aeroallergen, especially in Type I hypersensitivity disorders (asthma, rhinitis, conjunctivitis, and dermatitis) and allergic diseases (anaphylaxis, urticaria, angioedema, food, and drug allergies), which are immune reactions to foreign allergens.[14]

14.Antimicrobial activity:- The agar well diffusion method was used to test the methanol and ethanol plant extracts for antifungal activity. The fungal cultures that were produced for 72 hours were cultured on potato glucose agar. Each Petri dish received 20 mL of potato glucose agar. A sterile cork borer with a diameter of 6.0 mm was used to create the wells after the 0.1 mL inoculums of the fungal strains (1-2 x 104 CFU/mL) had been put on the surface of the agar plate after solidification. The wells were filled with 0.1 mL each of methanol and ethanol plant extracts. For the purpose of studying the antifungal activity of plant extracts, an incubation period of 3–7 days at 23°C was maintained. As negative solvent controls, methanol and ethanol were utilised. By measuring the zones of microbial growth inhibition around the plant extracts in the wells,

the antimicrobial activity was assessed. Millimetres were used to measure the zones of inhibition. A growth inhibition zone of less than 7 mm was taken to indicate antimicrobial efficacy. To assess the results repeatability the tests were run in triplicate. Under very aseptic circumstances the entire antimicrobial analysis was performed.[15]

15. Antiprotozoal activity:- A common human protozoan called Blastocystis hominis was only mildly suppressed by the dichloromethane extract of *Amaranthus spinosus* (2 mg/mL). All protozoan samples were suppressed at doses of 1.25–40 g/mL by the reference antiprotozoan drug metronidazole, which also killed 97% of the protozoa.[16]

16.Bronchodilator and spasmolytic activity:- Aqueous-methanol extract of the entire plant of *Amaranthus spinosus* was used to study the in vivo bronchodilator and laxative actions. To determine the mechanism underlying the spasmolytic action, isolated tissue preparations mounted on a tissue bath assembly imbedded in physiological salt solutions, maintained at 37°C, were used to test the effect in vitro. The findings showed that the laxative and spasmolytic effects of Amaranthus spinosus were mediated through cholinergic action and calcium channel blockade. While the bronchodilator activity was mediated by a mix of CCB and -adrenergic pathways.[17]

Table:- Pharmacological activity, Phyto-constituents, extracts and different parts of the plant *Amaranthus spinosus*.

S.No.	Plant Part	Extract	Pharmacological activity	Phytoconstituents
1	Whole Plant	Ethanol	Hepato-protective activity, Anti-diarrheal activity, Anti-ulcer activity, Anti-inflammatory activity	7-p-coumaroyl apigenin 4-O-β-D-glucopyranoside, α-xylofuranosyl uracil, β-D-ribofuranosyl adenine and β-sitosterol glucoside Rutin and quercetin Amaranthoside- α-lignan glycoside, Amaricin- α-coumaroyl adenosine stigmasterol glycoside
		Methanol	Anti-oxidant activity, Hematological activity, Anti-inflammatory activity	
		Chloroform	Anti-oxidant activity	
		Petroleum ether	Anti-oxidant activity, Anti-inflammatory activity	
		Aqueous extract	Anti-oxidant activity, Anthelmenthic activity, Diuretic activity	
		Aqueous methanolic extract	Laxative, spasmolytic and bronchodilator	
2	Leaves	n-hexane	Anti-oxidant activity, Anti-bacterial activity	α-spinasterol, hectriacontane, oleanolic acid, D-glucose, D-glucuronic acid
		Chloroform	Anti-oxidant activity, Anti-bacterial activity	
		Ethyl acetate extract	Anti-oxidant activity, Anti-bacterial activity	
		Methanol	Anti-diabetic activity, Antitumor activity, Anti-bacterial Activity, Anti-inflammatory activity	
		Ethanol	Hematological activity, Anti-inflammatory activity, Anti-tumor activity, Anti-bacterial activity, Anti-gastric ulcer activity	

		Aqueous extract	Anti-bacterial activity, Immunomodulatory activity	
3	Stem	Methanol	Anti-diabetic activity	Isoamaranthine, Amaranthine, quercetin, kaempferol glycosides, and hydroxycinnamates
		Aqueous extract	Anti-malarial activity	
4	Root	Ethyl acetate	Anti-bacterial activity	aliphatic ester-α-spin sterol octacosanoate saponin-β-D-glucopyranosyl-(1-4)-β-D glucopyranosyl –(1-4)-β-D-glucuronopyranosyl-(1-3)-oleonolic acid [86] Saponin I- β-D-glucopyranosyl-(1-2)-β-D-glucopyranosyl –(1-2)-β-D-glucupyranosyl-(1-3)-α-spin sterol, Saponin-II- β-D-glucopyranosyl-(1-4)-β-D-glucopyranosyl-(1-3)-α-spin sterol
		Hexane	Anti-bacterial activity	

Phytochemistry of Amaranthus spinosus:- *Amaranthus spinosus* have several active constituents like alkaloids, flavonoids, glycosides, phenolic acids, steroids, amino acids, terpenoids, lipids, saponins, betalains, β-sitosterol, stigmasterol, linoleic acid, rutin, catechuic tannins and carotenoids.

***Amaranthus spinosus* contains:-**

- 7-p-coumaroyl apigenin 4-O-beta-D-glucopyranoside
- spinoside
- xylofuranosyl uracil
- β-D-ribofuranosyl adenine
- β-sitosterol glucoside
- betaxanthin
- betacyanin
- gomphrenin
- betanin and
- β-carotene

Leaves and stem of *Amaranthus spinosus* contains:-

- hentriacontane
- octaconsanoid

- α-spinasterol
- Saponin and
- Fatty acids

Root contains:-

- α-spinasterols
- octacosanoate, and
- saponin.[18]

CONCLUSION:- Literature review suggested that not much work has been done regarding the formulation from plant extract of *Amaranths spinosus*. This review focuses primarily in the formulation and scopes that can be drawn from the plant and also due to its wide availability and applicability on different types of pharmacological activity. An evaluation for various formulations can be performed and extensively which indicates its further scope of research on *Amaranthus spinosus*.

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