

Amaranthus spinosus Linn. : A common culinary herb with potential medicinal value

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Abstract:

Amaranthus spinosus Linn., a well distributed common herb found in many tropical and subtropical countries. The plant is highly nutritious and rich in minerals, vitamins and amino acids. It is very popular as a vegetable due to its great health benefits, availability, and less high price on the market. Apart from the dietary values, these plants were used in traditional ethnomedicine to cure various types of health issues in many countries, including India. Phytochemicals present in plants are effective against a number of medical implications. This literature study represents information on traditional uses, therapeutic potential, ethnopharmacology, and nutritional aspects of *Amaranthus spinosus*.

Introduction:

Amaranthus spinosus Linn. (Family: Amaranthaceae), commonly known as spiny pigweed (in English), kantanote/ kantanotya (in Bengali), is a widespread plant in India. It is a straight, perennial, spiny, herbaceous plant with a green or purple stem (Holm et al. 1997). The plant can be found on roadsides, wastelands, gardens and fields. However, the plant is also cultivated in several tropical and subtropical nations. It is very popular as a vegetable among native people. The herb has a high amount of dietary fibre and essential amino acids (Baral et al., 2011; Das et al., 2014). In addition to its nutritional benefits, this plant has been used in traditional Indian Ayurveda. Phytochemical studies have confirmed its relevance as a beneficial therapeutic herb. It is a well-known resource of lipid, saponin, betalain, beta-sitosterol, stigmasterol, linoleic acid, and tannin in addition to alkaloid, flavonoid, carotenoids, glycosides, steroids, and carotenoids (Agbaire, 2011; Guria et al. 2014). A broad range of its pharmacological effects, including anti-diabetic, anti-tumour, analgesic, anti-microbial, anti-inflammatory, spasmolytic, bronchodilator, hepato-protective, antifertility, anti-malarial, antioxidant qualities, etc. has been investigated various by many researchers (Sarker & Oba, 2019).

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Traditional usage as ethnomedicine:

India has gained access to a valuable herbal heritage (Sarkar et al., 2016; Sarkar, 2017). Along with homoeopathy and folk medicine, the traditional medical system in India continues to be essential to the nation's total healthcare system (Sanyal et al., 2018; Kundu, 2022). Humans have employed medicinal plants as necessary components in diets, beverages, and remedies since the dawn of time. There are numerous industrial uses for medicinal plants' nutritional, pharmacological, biological, and toxicological traits (Erfani, 2021; Kar et al., 2022).

Natural products are routinely used in the discovery of novel therapeutic medicines. The most sensible and economical type of treatment has historically been traditional medicine. Plants have been utilised as a kind of therapy since the beginning of time (Maiti et al., 2013; Sanyal, 2016). New therapeutic compounds are frequently discovered thanks to the medicinal plant (Banerjee et al., 2014; Bhattacharjee and Manna, 2016). Alkaloids, flavonoids, tannins, and phenols are only a few of the phytochemicals that help medicinal plants function as medicines. Herbal medicine has a long history in Indian culture (Sarkar, 2016; Maiti et al., 2010). The country's overall healthcare system for the general public still heavily relies on traditional medical methods and homoeopathy and folklore medicine, both of which are practised in India (Bhattacharjee, 2021; Acharya et al., 2021; Acharya et al., 2022).

Amaranthus spinosus has been associated with various ethanopharmacological claims in many pieces of literature, and it has long been used to treat several diseases. Traditional preparations of the plant include boiling, steaming, or frying the leaves and tender stems before eating. Due to its bitter flavour, it is generally substituted for other vegetables and consumed in modest amounts. Some cultures also utilise the plant's ash as salt. *A. spinosus* is also used as feed for livestock animals (Kritikar & Basu, 2005). Since a very long time, this plant has been traditionally used for medicine in India and around the world. Some tribes in India and Nepal utilise this herb to cause abortions. Tribal communities of Kerala, India apply the juice of whole plants to cure stomach bloating and the leaves, when cooked without salt for a couple of days, can be used to treat jaundice. It is well-known in Africa for treating various illnesses and conditions associated with nutritional deficiencies. It is historically used to cure diabetes in China, however, in South-East Asian nations, the root extract is used to treat gonorrhoea by externally applying it. In Malaysia, it is used as a broncho-expectorant, easing the symptoms of acute bronchitis (Grubben & Denton, 2004). Topical and oral application of the root paste has many positive benefits. Root extract is given to kids to induce bowel movements and also has effective diuretic properties. To treat skin conditions such abscesses, burns, bruises, eczema, inflammation and wounds, a fine paste made of leaves and roots are applied as a bandage. In Sikkim, rural residents who practise ethnomedicine utilise this plant for stomach disorders, particularly indigestion and peptic ulcers, by infusing the leaves. Plant sap administered as an eye wash can treat ophthalmia in kids (Nawaz et al., 2009). The root paste also reduces vomiting when combined with an equal volume of honey. Administration of root paste combined with black pepper in a 1:3 (1 part of black pepper to 3 parts of root paste) in a daily manner can help treat rabies. The crushed leaves are used as an external emollient in several nations, especially those in Africa. They are said to be effective in conditions of earaches, haemorrhoids, burns, sores, boils, and ulcerated lips. To wash sores, a solution containing plant ash is utilised (Ganjare & Raut, 2019). In Ayurveda *Amaranthus spinosus* has a long history. Charaka, Sushruta, Vagbhata, and others have recommended it for the remedy of pradar, sarva visha, and raktapitta. It has also been recommended for the treatment of arsha and mushika visha (Chandrashekhar, 2018).

Phytoconstituents having pharmacological potential:

Amaranthus spinosus has a variety of active phytoconstituents that belongs to several groups of carotenoids, alkaloids, glycosides, phenolics, steroids, terpenoids, and saponins. These phytoconstituents, along with their potential pharmacological action and extract preparation, are demonstrated in Figure 1 (Kumar et al., 2010; Hussain et al., 2009; Olumayokun et al., 2004; Zeashan et al., 2009; Potlilapalli et al., 2017; Chaudhary et al., 2012; Bulbul et al., 2011; Olumayokun et al., 2004; Panda et al., 2017; Olufemi et al., 2003; Lin et al., 2005; Sangameswaran et al., 2010; Hilou et al., 2006; Barku et al., 2013).

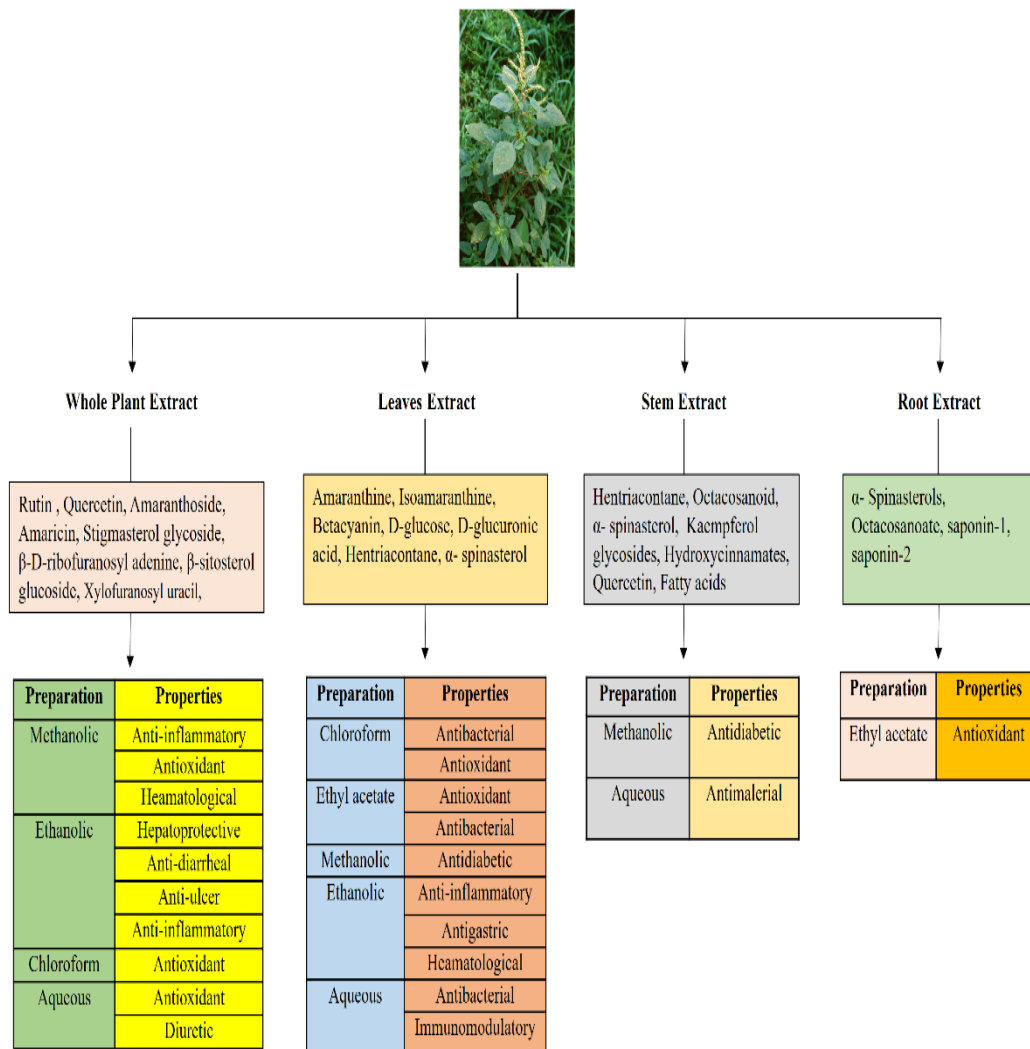


Figure 1. Pharmacological potential of the phytoconstituents present in plant extracts

Analgesic and Antipyretic Activity:

Numerous studies worldwide have scientifically supported traditional claims about the plant's ability to cure different sorts of pain. Methanol extracts of the plant were tested for antipyretic properties at dosages of 200 and 400 mg/kg in mice with yeast-induced pyrexia showed a significant reduction in body temperature (Kumar et al., 2011). Mice treated with an increased dosage of methanolic extract of *Amaranthus spinosus* had more pronounced central and peripheral analgesic action. Oral administration

of 500 mg/kg of body weight methanol extract has been proven to have a considerable antinociceptive effect against the acetic acid exposed visceral discomfort and radiant heat tail-flick test model of mice (Taiab et al., 2011)

Antioxidant activity:

This plant has been found to have antioxidant activity against DPPH free radicals, superoxide radicals, ABTS-radicals, -NO radicals, and free -OH radicals (Kumar et al., 2010). 50% ethanolic extract of *Amaranthus spinosus* (whole plant) showed significant antioxidant activity in the in-vitro assay by DPPH, superoxide, hydroxyl radicals, hydrogen peroxide and nitric oxide scavenging methods. Complete plant material extract of the plant with petroleum ether, chloroform, methanol, and water exposed to an oxidation process (in vitro non-enzymatic hemo-glycosylation) revealed the antioxidant activity of methanol extract much higher than others (Kumar et al., 2010).

Hepatoprotective activity:

50% ethanolic extract of entire plants clearly suggest that *A. spinosus* possess high hepatoprotective action against CCl₃ induced liver damage in experimental rats. Dose-dependent recovery of increased blood enzymatic levels of serum glutamate oxaloacetate transaminase (SGOT), and serum glutamate pyruvate transaminase (SGPT) in considerable levels suggest the normality of liver function. The presence of flavonoids and phenolic compounds in the extract might be responsible for the hepatoprotective effect (Zeashan et al., 2008).

Antifertility activity:

Pregnant rats were treated with oral consumption of aqueous and ethanolic root extracts of the *Amaranthus spinosus* plant and showed significant antifertility effect. Female rats that were given alcoholic plant extracts at doses of 125, 150, and 175 mg/kg of body-weight between day one and day five of pregnancy had substantial pregnancy interception. On the contrary, from 11 days to 15, receiving 125mg/kg of aqueous and alcoholic plant extracts did not significantly lead to pregnancy interception. However, alcoholic extracts of plant medications at doses of 150 mg/kg and 175 mg/kg of body weight efficiently interfered with the pregnancy (Satyanarayana et al., 2008).

Haematological activity:

Aqueous extract from *Amaranthus spinosus* leaf revealed insignificant changes in haematological parameters. In contrast, ethanol extracts showed while the alcoholic extract was found to alter several haematological indicators such as PCV, RBC count, WBC count, and haemoglobin (HB) in pigs and rats. Alcoholic extract significantly decreases serum biochemical indicators like glucose and cholesterol when monitored in rats (Akinloye & Olorede, 2000; Olufemi et al., 2003). The entire plant extract was found to significantly reduce RBC, haemoglobin (Hb), PCV, and average concentration of haemoglobin (MCHC) while dramatically increasing WBC and the average volume of red corpuscles (MCV). All the toxic effect was proved dependent on the dose, but normal blood parameters were restored upon discontinuation of the treatment (Bhande & Wasu, 2016).

Antihyperglycemic effect:

Methanolic extracts of *Amaranthus spinosus* were shown to be effective in diabetic rats (caused by streptozotocin) and significant regulation of blood sugar balance was observed on a 15-day model

(Sangameswaran & Jayakar, 2008). Alloxan monohydrate induced Male Wister albino diabetic rats were used to test the antihyperglycemic effect revealed daily dose of methanolic extract of this plant stem restored the blood glucose level as much as was tested with the impact of a conventional anti-diabetic drug (Balakrishnan & Pandhare, 2010).

Antiulcer activity:

Several researchers utilising various animal models have found that *Amaranthus spinosus* has antiulcer activity. Whole plant extract demonstrated considerable dose-dependent protection against ulcers brought on by ethanol and aspirin. However, inhibition by the greatest dose (400 mg/kg) was less than that of the standard medication (Hussain et al., 2009). The level of gastric pepsin significantly increases during the development of gastric ulcers and is likely a factor in the process of gastric ulceration. This level decreased following the administration of a suspension of *A. spinosus* leaves. The crushed leaves of the plant in a water solution showed antiulcer efficacy against aspirin-induced stomach ulcers. Immersion of leaves is thought to have an antisecretory effect by reducing the acidic condition of the stomach (Mitra et al., 2014). A study showed that the plant's roots, stem, and leaves were as effective as omeprazole in protecting albino rats from hydrochloric acid, ethanol, and other substances that might cause ulcers (Mitra, 2013).

Diuretic activity:

It has been claimed that an aqueous extract of the entire *A. spinosus* plant has diuretic properties by elevating the urinary electrolyte concentration, including Na⁺, K⁺, and Cl⁻ in mice. 500 mg/kg of body-weight dose of the aqueous extract had diuretic effects. Treatment considerably increased urine volume, and an increase in electrolyte content in urine produced alkalization of urine, which inhibited the action of saluretic and carbonic anhydrase (Potllapalli et al., 2017).

Antimalarial activity:

Aqueous extract of the bark collected from mature plant stems been tested for antimalarial properties in mice infected with RBCs parasitized by *Plasmodium berghei* showed positive response. The bark extract demonstrated dose-dependent antimalarial action in a 4-day suppressive antimalarial experiment with chloroquine as the standard antimalarial medication. The aqueous extract showed an ED₅₀ value of 789.4 mg/kg for its antimalarial activity, while chloroquine was 14.6 mg/kg (Hilou et al., 2006).

Conclusion:

It is evident from the above discussion that *Amaranthus spinosus* has a wide range of nutritional and therapeutic benefits. The use of *Amaranthus spinosus* in traditional ethnomedicine has demonstrated its effective potential. Aqueous and alcoholic extracts of the different parts or whole plant are not only limited to jaundice, stomach problems or wound healing. Numerous pieces of literature support their anti-inflammatory, antioxidant, anti-malarial, analgesic, haematological, anti-diabetic and anti-fertility activity. Maintaining a balanced diet and including this plant as a functional food ingredient has both medical and nutritional benefits, which will undoubtedly keep people in good health.

Conflict of interest:

None

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