



Analysis of *Amaranthus spinosus* minerals by close-range spectrometry

¹Shivraj Singh and ²Dr. Sachin Singh

¹Research Scholar, Shri Krishna University, Chhatarpur, Madhya Pradesh, India

²Professor, Shri Krishna University, Chhatarpur, Madhya Pradesh, India

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Corresponding Author: Shivraj Singh

Abstract

The nutritional value of *Amaranthus spinosus* was the driving force for this research. The medical plant known as *Amaranthus spinosus* Linn., sometimes known as "Spiny pigweed," "Prickly amaranth," or "Spiny amaranth," is abundant in India and other parts of the globe. We utilized a variety of fertilizers at a rate of 500 kg h⁻¹. The elements that were measured and investigated were soil temperature (29.50 °C), moisture (3.5%), water holding capacity (74%), pH (8.17), organic carbon % (1.90), and organic matter % (3.28). Others were also included. Cancer patients often undergo one of three treatment modalities: surgery, chemo, or radiation. One seedling of *Amaranthus spinosus* was grown in each of the 10 by 20 cm and 3 cm deep holes during the first season. When the seedlings were two days old, they were watered. Past the twentieth day, I watered the seedlings as needed. The effects of organic and inorganic fertilizers on *A. spinosus* phytochemical, proximate, mineral, antioxidant, and vitamin C and A content, among other characteristics, were examined in the first season to determine the proximate composition of the plant.

Keywords: *Amaranthus spinosus*, organic, plant, fertilizers and cancer

1. Introduction

A relatively new specialty of medicine, integrative oncology seeks to supplement standard cancer therapy with complementary approaches in order to mitigate some of the negative consequences of conventional medicine. Surgery, chemo, and radiation are some examples of conventional cancer therapies. Oncologists all throughout the globe are coming to terms with the fact that patients undergoing these therapies are at increased risk of experiencing harmful side effects. Oncologists have begun to use herbal antioxidants into cancer treatment plans as a means to stave against oxidative cell damage caused by dangerous free radicals like reactive oxygen species (ROS). Therefore, it is theoretically possible to preserve the anticarcinogenic characteristics of the mainstream medicine while preventing oxidative cell damage to healthy body cells by combining physiological antioxidants with external herbal remedies. Because these approaches work in tandem with current treatments, they would do away with the need for complementary and alternative medicine. Researchers are always looking for new ways to improve the administration of cancer medications, so it's clear that there's a lot of room for growth in this area. An amateur herbal extract from the *Amaranthus*

spinosus (AS) plant will be tested for its antioxidant capabilities in this article. We used the results of the preliminary phytochemical investigation to determine which plant sections had the greatest concentrations of the target phytochemicals, and then we blended those extracts to make this herbal formulation. A crude extract that accurately represents the potency of the whole *Amaranthus spinosus* (AS) plant is prepared and described in this research.

A therapeutic plant abundant in India and other parts of the globe, the *Amaranthus spinosus* Linn. Plant goes by many names, including "Spiny amaranth," "Prickly amaranth," and "Spiny pigweed". In rice fields, this plant is often seen as an invasive weed. Ayurveda, India's ancient folk medicine, has a long history of using this plant to cure a wide range of conditions, including diabetes, jaundice, and others. The anti-inflammatory, anti-diabetic, anti-diarrheal, anti-bacterial, anti-microbial, and anti-malarial effects of this plant have been documented in earlier research. Therefore, the scientific community is very interested in this plant's medical potential. Previous phytochemical research has focused on certain plant components, such leaves, but scientists still don't know much about the plant as a whole,

and there have been few efforts to extract medicinal medications from it.

Isolating a particular phytocomponent is the standard procedure for preparing a medicinal medication. Because making a crude herbal extract was our aim, we counted the amount of the target secondary metabolites in the plant's various parts (leaves, root, stem, and inflorescence). Radiation therapy, chemotherapy, or surgery are the standard methods for treating cancer. Radiation and pharmacological cancer treatments are effective in killing cancer cells, but they come with a price: cell stress, which in turn increases levels of reactive oxygen species (ROS) and other free radicals. These ROS then react with different parts of cells, including DNA, amino acids, and the phospholipid bilayer, causing oxidative damage to all of these parts. Moreover, anti-cancer medications limit the action of natural antioxidant enzymes such as superoxide dismutase. So, to augment current treatments and prevent adverse effects on healthy somatic cells, an exogenous antioxidant dose is required. As byproducts of their metabolic processes, plants mainly create secondary metabolites, which are organic molecules.

2. Literature Review

Refatul *et al.* (2025) ^[16], this study used BARI Tomato-7, also known as "Apurba," a well-known tomato variety developed by the Bangladesh Agriculture study Institute (BARI), to examine the impact of organic and inorganic fertilizers on the emergence rate and early growth of this tomato variety. At Gopalganj's Bangabandhu Sheikh Mujibur Rahman Science and Technology University, researchers used three plots measuring 152 by 122 cm. Each plot was assigned to one of three treatment groups: one that received organic fertilizer, one that received inorganic fertilizer, and a control group that did not receive any fertilizer. According to the findings, seeds treated with organic fertilizer grew an average of seven days after administration, while seeds treated with inorganic fertilizer grew an average of five days later. Eighty percent of the inorganic fertilizer group emerged. On average, it took 6 days for seeds in the control group to germinate, and their emergence rate was 75%. In terms of short-term growth rate, soil health, and microbial activity, the inorganic fertilizer group surpassed the organic fertilizer group. In terms of long-term growth rate, however, the organic fertilizer group outgrew both groups.

Ehsan *et al.* (2023) ^[17], when applied consistently over time, chemical fertilizers pose a number of health risks. An excess of chemical fertilizers may harm food safety and lead to low-quality vegetables in more ways than one, including nitrate accumulation in plants. Organic fertilizers have made it simpler than ever to achieve sustainable agricultural development. In contrast to organic fertilizers, which release their nutrients more slowly, chemical fertilizers release their nutrients at a rate that is only faster than what plants can absorb. In the 2020-2021 harvest season, researchers from Iran's Ferdowsi University of Mashhad's Faculty of Agriculture used a randomized complete blocks design with three replications in their experimental study. The goal of this field experiment was to examine the effects of chemical and organic fertilizers on the quantitative and qualitative characteristics of tomato plants. The experimental

treatments included the following: 1- biochar (8 t.ha⁻¹), 2- animal manure (30 t.ha⁻¹), 3- vermicompost (25 t.ha⁻¹), 4- NPK chemical fertilizer (225 kg.ha⁻¹ urea, 150 kg.ha⁻¹ phosphorus fertilizer and 150 kg.ha⁻¹ potassium sulfate), 5- a mixture of 50% biochar and 50% animal manure, 6- a mixture of 50% biochar and vermicompost, 7-50% animal manure + 50% vermicompost, -50% biochar + 50% NPK, -50% animal manure + 50% NPK, -50% biochar + 50% NPK, -50% animal manure + 50% NPK, -50% biochar + 25% animal manure + 25% vermicompost + 25% NPK, - and 12- a control. Two cuts were made to complete the harvesting process. Fruit length, diameter, and size were among the characteristics measured from five plants chosen at random in each plot. Lycopene, vitamin C, total yield, Brix index, and both cuttings were also measured. The first cutting yielded the most fruit volume when treated with NPK chemical fertilizer (80.5 cm³), whereas the second cutting yielded the most when treated with a combination of NPK chemical and animal manure (131 cm³).

Tusar *et al.* (2024) ^[18], the term "organic farming" has just entered the vernacular, gaining traction and rapid endorsement from both farmers and shoppers. Vegetables, which have an extremely short withholding period before consumption after harvest, as a way to address the increasing number of health issues caused by the overuse of different agricultural chemicals and the residues they leave behind. Organic farming techniques have lately seen a spike in popularity, and these crops are a perfect illustration of that. Not only are vegetables an important part of any balanced diet, but they also keep for quite a while. Despite the numerous advantages of organic farming, such as better vegetable nutrition and edible quality, reduced human disease risk, and preservation of soil biology in terms of diversity, population, activity levels, and overall health, the ongoing concern of sustainable crop management in the field without inorganic fertilizers or pesticides with no effect on yields remains. Contemplating the existing state, difficulties, methods, certification, and potential of organic vegetable crop production is vital in light of the ongoing issue of feeding a rapidly expanding human population.

Hosseini *et al.* (2022) ^[19], one of the most crucial concerns in organic farming is the optimal supply of minerals, especially nitrogen (N), from approved sources. One potential ecological function that forage legumes may provide by intercropping with cereal crops is biological nitrogen fixation, which benefits both the companion crop and the ones grown after it. Over the course of two growing seasons, researchers tested 10 distinct wheat cultivars with varying levels of biological, chemical, and organic fertilizer to see how each affected yield and quality. For the first trial, we used Persian clover (*Trifolium resupinatum* L.) as a cover crop (F1: biological N fixing; we used organic cow dung (F3: 40 t ha⁻¹) for the third, and 100 kg ha⁻¹ of urea for the second. Treatments F1 and F2 were beneficial in respect to vegetative growth parameters. With a higher number of spikelets per spike and a higher 1000-grain weight, F2 produced more seeds and spikelets than F1. Almost every reproductive metric was better satisfied by the cv. "Kabul-13" compared to the other cultivars that were evaluated. Seed yields of 8.02 t ha⁻¹ were achieved by F2 'Kabul-13,' whereas F1 'Kabul-13' yielded 7.26 t ha⁻¹. When it came to seed output, 'Chont-1' and 'Kabul-13' were the best

candidates for clover intercropping. Potassium and phosphorus levels in seeds were unaffected by the experimental variables,

Maize is a significant crop that may help alleviate hunger and provide food security in Nigeria. Due to factors pertaining to accessibility and ease of use, farmers have started using organic fertilizers. However, there is little data on how effective different organic manures are in increasing crop yields. As a result, researchers looked at how different organic fertilizers affected maize growth. Approach and Procedures Roughly four thousand grams of dirt with consistent characteristics was packed into twenty-four (24) bags. Each group received six bags of excrement: cows, goats, and poultry. A control group received six bags of dung. The experimental design called for the sowing of two maize varieties the local variety and Sammaz 15 into the soil. The outcomes are: While the local variety had a larger stem diameter and leaf area (4.66 vs. 378.00) and a bigger number of leaves (11.88 vs. 65.24), Sammaz 15 had a much higher height and leaf number (11.33 vs. 60.61). In terms of both height and quantity of leaves produced, goat dung differed significantly. (12.21 vs. 59.31), cow dung (11.60

vs. 68.26), and control (10.58 vs. 55.50). Poultry droppings had a much larger stem diameter and leaf area (5.08 and 406.63) in comparison to goat dung (4.73 and 370.66), cow dung (4.19 and 360.80), and the control (3.75 and 311.76 correspondingly). The number of leaves generated by the interaction between Sammaz 15 and chicken droppings was much more than that of the other interactions.

3. Research Methodology

During the first season, seedlings of *Amaranthus spinosus* were cultivated in holes that were 10 cm by 20 cm in size and 3 cm deep, with one seedling in each hole. The seedlings were watered on the second day of their life cycle. I irrigated the seedlings as required after the twentieth day. Approximately 20 fully grown plants were harvested to analyze the plants in all three plots (T-1, T-2, and T-3) on average of three months. Proximate composition and psychophysiological characteristics were studied with fresh leaves. Following the drying of the rest of the leaves in a dryer at 70 °C, they were ground into a powder. Minerals, proximate composition, and phytochemicals will be determined using 100 grammes of powdered samples.



Fig 1: *Amaranthus spinosus* L. (Chaulai) experimental plant

4. Data Analysis

The following data pertain to the immediate plant

components measured in the experiment: water content, ash, protein, carbohydrates, fiber, and total fat.

Table 1: Approximate fertilizer composition of *A. spinosus* in the first harvest season as affected by various treatments

S. No.	Parameters	T-1	T-2	T-3
1.	Moisture content, %	85.72 ±0.07	80.22±0.17	82.78±0.52
2.	Ash %	7.78± 0.09	5.43±0.2	7.10±0.31
3.	Protein (gm/100gm)	9±0.64	7.6± 0.05	8.02±0.16
4.	Carbohydrate (gm/100 gm)	11.10±0.25	10.41±0.28	10.90±0.34
5.	Total fat (gm/100 gm)	0.49±0.04	0.27±0.02	0.38±0.08
6.	Crude fiber (gm/100 gm)	3.06±0.37	2.31±0.32	2.89±0.28

Values are mean ± SE

We provide data that we gathered on how chemical and organic fertilizers affected the proximate makeup. For T-1 therapy, the highest proximal composition was seen, while for T-2 treatment, it was the lowest. The first season's

optimum values for moisture content (85.72 ± 0.07%), ash (7.78 ± 0.09%), protein (9±0.64 gm/100 gm), carbohydrate (11.10 ± 0.25 gm/100 gm), crude fiber (3.06 ± 0.37 gm/100 gm), and total fat (0.49 ± 0.04 gm/100 gm) were achieved

when treated with organic fertilizer. A reasonable level of moisture content ($82.78 \pm 0.52\%$), ash ($7.10 \pm 0.31\%$), protein (8.02 ± 0.16 gm/100 gm), carbs (10.90 ± 0.34 gm/100 gm), crude fiber (2.89 ± 0.28 gm/100 gm), and total fat (0.38 ± 0.08 gm/100 gm) were reported when the combination was subjected to both chemical and organic fertilizers. Results

for moisture content ($80.22 \pm 0.17\%$), ash ($5.43 \pm 0.2\%$), protein (7.6 ± 0.05 gm/100 gm), carbs (10.41 ± 0.28 gm/100 gm), crude fiber (2.31 ± 0.32 gm/100 gm), and total fat (0.27 ± 0.02 gm/100 gm) were lowest in the treatment with chemical fertilizers.

Table 2: Analysis of variance (ANOVA) of *A. spinosus* proximate composition in crop season-1 treated with different fertilizers

ANOVA						
Source of Variation	SS	DF	MS	F	P-value	F crit
Rows	15081.55	5	3016.31	3091.484	1.32E-15	3.325835
Columns	9.934633	2	4.967317	5.091116	0.029864	4.102821
Error	9.756833	10	0.975683			
Total	15101.24	17				

To see how different fertilizer treatments affected the proximate composition of *Amaranthus spinosus* in the first season, we did an ANOVA, the results may be seen in Table

2. We may deduce that the target means are statistically different from one another since the F-value is bigger than the P-value.

Table 3: *A. spinosus* proximate composition in response to different fertilizer treatments during the second harvest

S. No.	Parameters	T-1	T-2	T-3
1.	Moisture content %	88.6 ± 0.52	83.2 ± 0.43	85.4 ± 0.19
2.	Ash %	7.99 ± 0.29	5.08 ± 0.32	6.25 ± 0.55
3.	Protein (gm/100 gm)	9.8 ± 0.46	7.9 ± 0.36	8.4 ± 0.32
4.	Carbohydrate (gm/100 gm)	12.73 ± 0.21	9.01 ± 0.08	11.56 ± 0.05
5.	Total fat (gm/100 gm)	0.42 ± 0.06	0.22 ± 0.08	0.31 ± 0.05
6.	Crude fiber (gm/100 gm)	3.25 ± 0.09	2.12 ± 0.31	2.91 ± 0.04

Values are mean \pm SE

Table 3 finds that in the second season of the investigation; proximate composition was also changed by the application of chemical and organic fertilizers. The T-1 treatment had the highest moisture content ($87.6 \pm 0.52\%$), ash ($7.75 \pm 0.29\%$), protein (9.8 ± 0.46 gm/100 gm), carbohydrates (12.73 ± 0.21 gm/100 gm), total fat (0.42 ± 0.06 gm/100 gm), and crude fiber (3.25 ± 0.09 gm/100 gm), and the lowest moisture content ($83.2 \pm 0.43\%$), ash ($5.08 \pm 0.32\%$), protein (7.9 ± 0.36 gm/100 gm), carbohydrates (9.01 ± 0.08 gm/100 gm), and total fat (0.22 ± 0.08 gm/100 gm) and crude fiber (2.12 ± 0.31 gm/100 gm) were observed in the T-2 treatment. The use of

fertilizers in combination revealed the following amounts: moisture content ($85.4 \pm 0.19\%$), ash ($6.25 \pm 0.55\%$), protein (8.48 ± 0.32 gm/100 gm), carbohydrates ($11.50.05$ gm/100 gm), total fat (0.31 ± 0.05 gm/100 gm), and crude fiber (2.91 ± 0.04 gm/100 gm).

A. spinosus proximate composition study findings from an analysis of variance (ANOVA) Table 4 displays the results from the second growing season under various fertilizer treatments. We may deduce that the target means are statistically different from one another since the F-value is bigger than the P-value.

Table 4: ANOVA study of *A. spinosus* proximate composition in crop season-2 treated with different fertilizers

ANOVA						
Source of Variation	SS	DF	MS	F	P-value	F crit
Rows	16064.6	5	3212.921	4533.271	1.96E-16	3.325835
Columns	14.83071	2	7.415356	10.4627	0.003535	4.102821
Error	7.087422	10	0.708742			
Total	16086.52	17				

All of *Amaranthus spinosus*'s minerals were more effectively used by plants that had been treated with T-1.

Fertilizer levels were lowest in the chemically treated plant samples.

Table 5: *A. spinosus* plant minerals studied throughout the first growing season with various fertilizer treatments

S. No.	Parameters	T-1	T-2	T-3
1.	Calcium (mg/100 gm)	113 ± 0.6	85.40 ± 0.3	97.57 ± 0.8
2.	Magnesium (mg/100 gm)	93 ± 0.42	62.10 ± 0.25	91.18 ± 0.8
3.	Iron (mg/100 gm)	5.4 ± 0.027	4.4 ± 0.05	4.9 ± 0.047
4.	Copper (mg/100 gm)	0.1 ± 0.004	0.08 ± 0.004	0.09 ± 0.01
5.	Zinc (mg/100 gm)	0.8 ± 0.008	0.6 ± 0.002	0.73 ± 0.01

Values are mean \pm SE

The highest concentrations of Ca (113 ± 0.6 mg/100 gm), Mg (93 ± 0.42 mg/100 gm), Fe (5.4 ± 0.027 mg/100 gm), Cu (0.1 ± 0.004 mg/100 gm), and Zn (0.8 ± 0.008 mg/100 gm) were found in the T-1 therapy, as indicated in Table 5. T-3 treatment also had a favorable effect on the quantities of Calcium (97.57 ± 0.8 mg/100 gm), Magnesium (91.18 ± 0.8 mg/100 gm), Iron (4.9 ± 0.047 mg/100 gm), Copper

(0.09 ± 0.01 mg/100 gm), and Zinc (0.73 ± 0.01 mg/100 gm). The T-2 treatment showed the least quantity of mineral content. In the treatment of chemical fertilizers, the following elements were found: calcium (85.40 ± 0.3 mg/100 gm), magnesium (62.10 ± 0.25 mg/100 gm), the concentration of iron, copper, and zinc in grams is 4.4 ± 0.05 , 0.08 ± 0.004 , and 0.6 ± 0.002 , respectively.

Table 6: Mineral content of *A. spinosus* plants during the first growing season as a function of fertilizer treatments: an analysis of variance

ANOVA						
Source of Variation	SS	DF	MS	F	P-value	F crit
Rows	28632.76	4	7158.191	94.11175	9.22E-07	3.837853
Columns	375.944	2	187.972	2.471347	0.145969	4.45897
Error	608.4844	8	76.06055			
Total	29617.19	14				

In the second growing season, *Amarantus spinosus* was analyzed for its proximate composition under various fertilizer treatments. Table 6 displays the findings of the

analysis of variance test. With a higher F-value than a lower P-value, we may infer that the goal means are statistically distinct.

Table 7: Various fertilizer treatments in the second crop season and their effects on *A. spinosus* plant minerals

S. No.	Parameters	T-1	T-2	T-3
1.	Calcium (mg/100 gm)	137.81 ± 0.9	71.08 ± 0.09	119.44 ± 0.04
2.	Magnesium (mg/100 gm)	88.48 ± 0.04	57.05 ± 0.02	83.98 ± 0.6
3.	Iron (mg/100 gm)	5.1 ± 0.041	4.06 ± 0.06	4.8 ± 0.04
4.	Copper (mg/100 gm)	0.119 ± 0.007	0.079 ± 0.003	0.088 ± 0.01
5.	Zinc (mg/100 gm)	0.62 ± 0.009	0.36 ± 0.001	0.52 ± 0.003

Values are mean \pm SE

Mineral analysis of the plant sample from the second season of the research was shown in Table 7. Treatments T-1 and T-3, which used organic manure in addition to chemical fertilizers, showed encouraging results when compared to treatments that utilized chemical fertilizers alone. The highest amounts of calcium (137 ± 0.9 mg/100 gm), magnesium (88.48 ± 0.04 mg/100 gm), iron (5.1 ± 0.041 mg/100 gm), copper (0.119 ± 0.007 mg/100 gm), and zinc (0.62 ± 0.009 mg/100 gm) were detected in the organic fertilizers treated with T-1.

The iron (4.8 ± 0.04 mg/100 gm), copper (0.088 ± 0.01 mg/100 gm), zinc (0.52 ± 0.003 mg/100 gm), magnesium (83.98 ± 0.6 mg/100 gm), and calcium (119 ± 0.04 mg/100

gm) levels in the T-3 treatments that employed both chemical and organic fertilizers were likewise positive. Calcium (71.08 ± 0.09 mg/100 gm), magnesium (57.05 ± 0.02 mg/100 gm), iron (4.06 ± 0.06 mg/100 gm), copper (0.079 ± 0.003 mg/100 gm), and zinc (0.36 ± 0.001 mg/100 gm) were found to be the lowest in the chemical fertilizers that were treated with T-2.

Table 8 displays the results of the analysis of variance (ANOVA) test, which was conducted on the minerals analysis of *A. spinosus* during the second season, for various fertilizer treatments. Since the P-value is greater than the F-value, it is clear from the table that the target means are significantly different.

Table 8: Mineral content of *A. spinosus* plants in the second growing season as a function of fertilizer treatments: An analysis of variance

ANOVA						
Source of Variation	SS	DF	MS	F	P-value	F crit
Rows	31503.3	4	7875.825	34.26964	4.42E-05	3.837853
Columns	1069.837	2	534.9185	2.327562	0.159696	4.45897
Error	1838.554	8	229.8193			
Total	34411.69	14				

5. Conclusion

The effects of organic and inorganic fertilizers on *A. spinosus* phytochemical, proximate, mineral, antioxidant, and vitamin C and A content, among other aspects. Mineralization and breakdown are processes that make the nutrients in organic materials difficult to acquire. Surgery, chemo, and radiation therapy are the standard cancer treatment modalities. In the first growing season, one seedling of *Amaranthus spinosus* was placed in each of ten by twenty centimeter-sized holes that were three centimeters

deep. While some portions of this plant, like its leaves, have been the subject of phytochemical research in the past, scientists still know very little about the plant as a whole and have made few attempts to extract medicinal medications from it. Here we provide the results of our investigation into the effects of chemical and organic fertilizers on the close-proximate composition. Compared to T-2 treatment, which had the lowest proximal composition, T-1 therapy had the greatest.

6. References

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