



Phytochemical Screening and Atomic Absorption Spectroscopic Analysis of the Leaf and Stem Extracts of *Amaranthus Spinosus*

Anyanele, Sylvalyn Ijeoma^{a*},
Ajiwe, Vincent Ishmael Egbulefu^a,
Anyanele, Wisdom Chibuzo^b,
Umeokoli, Blessing Ogechukwu^c
and Modozie, Benjamin Uchenna^c

^a Department of Pure and Industrial Chemistry, Nnamdi Azikiwe University, Awka, Nigeria.

^b Department of Botany, Nnamdi Azikiwe University, Awka, Nigeria.

^c Department of Pharmaceutical and Medicinal Chemistry, Nnamdi Azikiwe University, Awka, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This research work was carried out to determine the phytochemicals and elemental constituents present in the leaf and stem of *Amaranthus spinosus*. The atomic absorption spectroscopic analysis was carried out using the crushed dry plant materials while the extraction of the phytochemicals

*Corresponding author: E-mail: ijanyanele@gmail.com, c.anyanele@unizik.edu.ng;

was carried out using methanol in a Soxhlet extractor. From the analysis done, the following elements were detected in the plant parts: cobalt, lead, manganese, nickel, copper, cadmium, magnesium, iron, chromium and calcium but nickel was found absent in the leaf. Some of these elements are beneficial to health. The phytochemical screening done indicated the presence of the following: alkaloids, flavonoids, saponins, tannins, steroids, volatile oils, proteins, and carbohydrates.

Keywords: *Phytochemicals; Amaranthus spinosus; spectroscopy; analysis; Elements.*

1. INTRODUCTION

“Plants or herbs have been found to have medicinal and therapeutic importance in the prevention, palliation, treatment or cure of diseases and ailment. This knowledge has been passed down from one generation to another either verbally or in writing” [1]. “Medicinal plants are well known for their role in complementing the fight against diseases in humans” [2]. “They play a significant role in providing primary health-care services to rural people and used by about 80% of the marginal communities in the world” [3,4,5].

“Medicinal plants components remain untapped reservoir for active compounds (phytochemicals) with properties that can potentially perform multiple biological activities such as anti-inflammatory, antimicrobial, antiviral, antioxidant and so on” [6].

“As at present a substantial number of drugs are developed from plants which are active against a number of ailments and diseases conditions such as hypertension, pains, fever, cancer, diabetes, arthritis, gastrointestinal diseases and so on” [7,8,9].

“Phytochemicals may also be described as non-nutritive plant chemicals that have protective or disease preventive properties. They are regarded as non-essential nutrients” [10].

“Normally, they are naturally occurring bioactive molecules produced by plants for protection from the elements of the earth and the sun’s harmful rays. These amazing phytochemicals provide food resources for the human cells. Consumption of plant foods containing these compounds have been scientifically validated to help shadow the aging process and reduce the risk factors of many diseases including cancer, heart disease, stroke, high blood pressure, cataracts, osteoporosis, diabetes and urinary tract infections” [11].

“The consumption of phytochemicals enhances reduction in the emergence of degenerating diseases” [12].

“The array of secondary metabolites produced by plants is daunting, with wide ranging chemical, physical and biological activities. These constitute a source of bioactive substances and presently scientific interest has increased due to the search for new drugs of plant origin” [13].

“*Amaranthus spinosus* is a herb which belongs to Amaranthaceae family and used by ethnic people in the treatment of various infections and ailments. *Amaranthus spinosus* has a long history usage in traditional medicine against various ailments in the world” [14].

The work was aimed at investigating the pharmaceutical constituents present in the leaf and stem of *Amaranthus spinosus*.

2. MATERIALS AND METHODS

Amaranthus spinosus whole plants were uprooted from uncultivated farm land in Awo-Omamma in Oru East local government Area in Nigeria.

Sample preparation – The leaves were detached from the whole plant and the stems were cut off from the remaining parts. These plant materials were washed and the stems were sliced into smaller pieces. They were dried under room temperature for seven days for the leaves and fourteen days for the stems. The dried materials were differently crushed into powder with grinder. The samples were kept in different air tight containers for subsequent analyses.

2.1 Extraction of Plant Materials

500g of the powdered samples were placed in a round bottom flask containing 200ml of methanol, the extracting solvent. The flask was attached to the extractor. The Soxhlet extraction lasted for

three hours. The crude methanol extracts were concentrated using water bath at 40°C, cooled and corked for phytochemical analysis.

2.2 Phytochemical Screening

Phytochemical screening was done using standard methods [15-20] (Cheesbrough, 2002).

The methanol crude extracts were reconstituted and the solutions were tested for the following compounds: saponins, tannins, steroids, flavonoids, volatile oils, alkaloids, glycosides, anthraquinones, resins, reducing sugars, protein.

2.3 Determination of Mineral Elemental Composition Using Atomic Absorption Spectroscopy

The following elements were analyzed for: Co, Pb, Mn, Ni, Cu, Cd, Mg, Fe, Cr and Ca. The analysis was conducted using Varian AA240 Atomic Absorption spectrophotometer according to the method of APHA 1995 (American Public Health Association).

Each of the dried powdered plant materials (2.0g) was collected and heated in a furnace for 2 hours at 550°C. The residue was diluted with 20ml, 20% H₂SO₄ and filter with filter paper. It was measured using FS240AA Agilent atomic absorption spectroscopy.

A series of standard metal solutions in the optimum concentration range was prepared, the reference solutions range were prepared daily by diluting the single stock element solutions with water containing 1.5ml concentrated nitric acid

liter. A calibration blank was prepared using all the reagents except for the metal stock solutions. Calibration curve for each metal was prepared by plotting the absorbance of standards versus their concentrations.

3. RESULTS AND DISCUSSION

The phytochemical screening of the leaves and stems extracts of *Amaranthus spinosus* indicated the presence of the following phytochemicals: alkaloids, flavonoids, saponins, Tannins, Steroids, volatile oil, protein and carbohydrates. The following phytochemicals were not detected; cardiac glycosides, Anthraquinones and resins.

Alkaloids were detected in the stem but not detected in the leaves. Choudhury, 2012 reported the absence of alkaloids in the leaves of *Amaranthus spinosus*. Alkaloids are very important in medicine and constitutes most of the valuable drugs. They have marked physiological effect on animals [20]. They show considerable pharmaceutical activity (Dey *et al.*, 2010).

Flavonoid was detected in both leaves and stems extracts of *Amaranthus spinosus*. Flavonoids are anticoagulants (Morrison and Boyd, 2008). They also help in healing of wounds and in the treatment of skin diseases due to their ability to neutralize the acidity of wounds and inflammatory.

Saponins were detected in the stem and not in the leaves. Ishir *et al.* [21] reported "the presence of saponins in the methanolic stem extract of *Amaranthus spinosus*". "The presence of saponins and alkaloids have been reported to be responsible for various pharmacological properties with alkaloids exerting toxic effects against cells of foreign organism" [22].

Table 1. Results of the phytochemical analysis of crude samples of Leaves and stems extracts of *Amaranthus spinosus*

Phytochemical Compounds	Amaranthus Leaf	Amaranthus Stem
Alkaloids	-	+
Flavonoids	+	+
Saponin	-	+
Tannins	+	+
Steroids	+	+
Volatile oils	+	+
Cardiac Glycosides	-	-
Anthraquinones	-	-
Resins	-	-
Protein	+	+
Carbohydrates	+	+

Note : - = not detected
+ = present

Tannins were detected in the two parts of plant tested for. Tannins have been found to form irreversible complexes with proline rich proteins [23] resulting in the inhibition of the cell protein synthesis. Medicinally, this is important for the treatment of inflamed or ulcerated tissues [23]. "Indeed, herbs that have tannins as their main component are astringent in nature and are used for treating of intestinal disorders such as diarrhoea and dysentery" [24].

"Steroids were detected in both parts of the plant. It has been found that some of these Nigeria medicinal plants contain steroidal compounds. It should be noted that steroidal compounds are of importance and interest in pharmacy due to their relationship with such compounds as sex hormones" [25].

"Carbohydrates were detected in both the leaves and stems of *Amaranthus spinosus*. The primary role of carbohydrate is to provide energy to all cells in the body and dietary fibre" [26]. The plant also contains protein. Functional food is usually derived from phytochemical and bioactive proteins from plants and animal sources.

"The presence of these secondary metabolites in plants produce some biological activity in man and animals and it is responsible for their use as herbs. These compounds also serve to protect the plant against infection by microorganisms, predation by insects and herbivores" [27]. "Some of these metabolites particularly the flavonoid might have been identified as vital in antimicrobial activity of medicinal plants" [28]. "Phytochemicals act in numerous ways to assist the body in combatting diseases and health problems. The consumption of phytochemicals enhances reduction in the emergence of degenerating diseases" [29].

The Elemental analysis result of the *Amaranthus spinosus* leaves and stems in Table 2, showed the presence of cobalt, lead, manganese, nickel, copper, cadmium, magnesium, iron, chromium and calcium. Some of these elements have some health benefits to man and animals.

"The concentration of Iron is higher in the stem than in the leaf. Iron is an essential element for almost all living organisms as it participates in a wide variety of metabolic processes, including oxygen transport, deoxyribonucleic acid (DNA) synthesis, and electron transport" (Abbaspour *et al.*, 2014). "It is the key element for our growth and development. Iron is strictly required for the survival of most forms of life, including bacteria, plants and humans" (Gozzelino, 2015).

"The result also showed that the concentration of magnesium in both the leaf and stem of *Amaranthus spinosus* is higher than the concentration of the other elements. Magnesium is an essential element for humans, animals and plants; it is required for growth, development and maintenance of health. Excessive exposure or intake may lead to a condition known as manganism" (Avilat *et al.*, 2013).

"Magnesium is an essential nutrient involved in many important processes in living organisms, inducing protein synthesis, are cellular energy production" (Castiglioni, 2021). "Magnesium has several functions in the human body. It acts as a cofactor for more than 300 enzymes, regulating a number of fundamental functions such as muscle contraction, glycemic control, myocardial contraction and blood pressure" [30]. The results assured the usefulness of these elements in the physiological administration of the crude drug since some of the elements were of health benefit and equally at low concentration.

Table 2. Result of the elemental analysis of *Amaranthus spinosus*' leaf and stem extracts in parts per million(ppm)

Metals	Leaf	Stem
Cobalt	0.179	0.192
Lead	0.599	1.081
Manganese	1.873	1.475
Nickel	0.00	0.050
Copper	0.126	0.139
Cadmium	0.023	0.064
Magnesium	24.442	22.869
Iron	4.789	10.608
Chromium	1.052	1.089
Calcium	2.490	2.715

“Calcium, present in significant concentration is a supportive element in bone and tooth structure. It is also important to good muscle tone. Research has confirmed that calcium is involved vascular contraction, vasodilation, muscle functions, nerve transmission, intracellular signaling and hormonal secretion” [31-34].

The heavy metal ions that are known to be poisonous such as lead and nickel were present in low concentration.

4. CONCLUSION

The result of the investigation carried out on the leaves and stems extracts of *Amaranthus spinosus* showed the presence of important phytochemicals which is an indication of the usefulness of the plant parts in the manufacture of drugs. The elemental composition of these parts of the plant showed that the heavy metals detected are in quantities which are not significant. The result also showed high content of iron and magnesium. These elements are useful to both human beings and animals.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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