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**Research Article**

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# Qualitative and Quantitative Phytochemical Analysis and Antimicrobial Screening of Solvent Extracts of *Amaranthus hybridus* (Stem and Leaves)

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**Abstract** Qualitative and quantitative phytochemical screening of *Amaranthus hybridus* showed the presence of these phytocompounds. Alkaloids 4.00% tannins 3.40%, saponins 18.00%, flavonoids 19.20 %, terpenoids 3.03 % and steroid 7.98 %. Ethanolic, n-hexane and aqueous extracts of *Amaranthus hybridus* were found to inhibit six test micro-organisms. They are *Pseudomonas aeroginosa, Salmonella typhi, Escherichia coli, Apsergillus flavus, Aspergillus niger* and *Candida albican.* The minimum inhibitory concentration (MIC), maximum bactericidal concentration (MBC)/MFC for the three solvent extracts were found for each bacterium and fungus.

**Keywords** *Amaranthus hybridus*, Phytochemical screening, Microorganisms, Minimum inhibitory concentration (MIC), Maximum bactericidal concentration (MBC), maximum fungicidal concentration, Bacteria and Fungi

## 1. Introduction

*Amaranthus* is a common name for any flowering plant with blossom that do not readily fade when picked. Most of the *Amaranthus* are found in tropics. They are herbs of shrubs with simple leaves and flowers in heads or spikes. *Amaranthus* belong to the family Amaranthaccea. *Amaranthus* locally called Terere is cultivated in several areas of the world including south America, Africa, India, China and United State [1]. In Kenya their leaves are eaten as green vegetables. In Nigeria, *Amaranthus* leaves combined with condiments are used to prepare soap [2-3]. These leaves boiled and mixed with a groundnut sauce are eaten as salard in Mozambiaue. It is poured into a sauce and served over farinaceous vegetables in West Africa [4]. A*maranthus hybridus* is an annual plant growing to 0.6 m in height. The flowers are monoecious with individual flower being either male or female, but both sexes can be found on the same plant. The edible part is used in the treatment of intestinal bleeding, diarrhea and excessive menstruation [3]. *Amaranthus hybridus* is of uncertain origin it grows wild in cultivated fields and wasted place [5].

Phytochemicals are important medicinal compound (also known as phytonutrients) that occur naturally in plants, shrubs or herbs. They are specific category of non-nutrient substance in plant which are necessary for human body to function. They are found in almost all fruits, vegetables, grains, legumes, seeds etc. Some of these chemicals have been shown to slow down the ageing process by maintaining the vigor of our body, even some herbs or plants contain fungicides used in treatment of Candida [6]. Many of the spices used by humans to season food yield useful medicinal compounds [7-8]. Plant clean and oxygenate the environment, remove $CO_2$, bind the soil and prevent erosion and drought [6].

*Amaranthus hybridus* is commonly known as green Amaranthus. The plant was used for food and medicine by several native American group and in traditional African medicine [9]. In Nigeria, this plant is used as, food. The authors wondered that since *A. hybridus* is a nutritional herbs, it must posses some medicinal properties. The objectives of this work is to (i) find out the qualitative and quantitative phytochemical components of *A. hybridus*

(ii) Find out if the solvent extracts of *A. hybridus* can inhibit the growth of some pathogenic microorganisms and (iii) to determine the elemental constituents of *A. hybridus*.

## Methodology

*A. hybridus* was bought at Afor Nnobi market in Idemili L.G.A. of Anambra State, Nigeria. After washing the fresh leaves and stem of *A. hybridus*, it was air dried at room temperature. It was ground with an electric grinder and stored in an air tight polythene bag until needed for analysis. Qualitative and quantitative phytochemical analysis were carried out on *A. hybridus* using the method outlined by Harbone [10]. Some elemental analysis was done using flame photometer, titrimetric method and colorimetric methods. After the extraction of the plant materials preparation of various concentrations was done. 1, 2, 3, 4 and 5mg of the concentrated extract was dissolved in 10ml of distilled water to obtain 5-serial dilution of each of the extracts separately, corresponding, to 0.1, 0.2, 0.3, 0.4 and 0.5mg/ml. These various concentrations of the extract were used for anti-bacterial and antifungal tests.

## Result and Discussion

**Table 1:** Qualitative and quantitative phytochemical analysis of *Amaranthus hybridus* (stem and leaves)

| Parameters tested | Qualitative | Quantitative % |
|---|---|---|
| Alkaloids | + | 4.00 |
| Flavonoids | + | 19.2 |
| Tannins | + | 3.4 |
| Saponins | + | 18.4 |
| Terpenoids | + | 3.03 |
| Steroids | + | 7.98 |
| Glycosides (cardiac) | - | - |

**Key** % = Means percentage + = Means present - = Mean absent

**Table 2: Mineral or elemental analysis of *Amaranthus hybridus***

| Elemental content | mg/l |
|---|---|
| Potassium | 14.59 |
| Zinc | 1.92 |
| Iron | 8.81 |
| Sodium | 36.85 |
| Magnesium | 24.36 |
| Calcium | 43.38 |

**Key**: ppm mean part per million

**Table 3:** Antimicrobial screening of stem and leaves of *Amaranthus hybridus* in three solvent extracts

| Microorganism | Conc. mg/l used | Ethanolic extract | n-hexane extract | Aqueous extract | +ve control | -ve control |
|---|---|---|---|---|---|---|
| ***P. aeroginosa*** | 0.1 | NA | NA | NA | 24.0±0.06 | NA |
| | 0.2 | 0.6±0.3 | NA | NA | | |
| | 0.3 | 2.0±0.06 | NA | 1.4±0.4 | | |
| | 0.4 | 3.8±0.1 | 1.2±0.3 | 3.8±0.1 | | |
| | 0.5 | 5.7±0.01 | 3.8±0.2 | 6.2±0.3 | | |
| ***S. typhi*** | 0.1 | NA | NA | NA | 28.0±0.01 | NA |
| | 0.2 | NA | NA | 2.3±0.24 | | |
| | 0.3 | 0.4±0.32 | 1.0±0.01 | 5.8±0.52 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 0.4 | 1.3±0.01 | 2.6±0.51 | 7.2±0.02 | | |
| | 0.5 | 3.1±0.23 | 3.9±0.03 | 10.0±0.02 | | |
| ***E. coli*** | 0.1 | NA | NA | NA | 32.6±0.26 | NA |
| | 0.2 | NA | NA | NA | | |
| | 0.3 | 1.6±0.01 | NA | 1.6±0.31 | | |
| | 0.4 | 3.7±0.4 | 0.7±0.01 | 3.3±0.13 | | |
| | 0.5 | 5.2±0.03 | 1.8±0.4 | 5.4±0.4 | | |
| ***C. albican*** | 0.1 | NA | NA | NA | 18.12±0.16 | NA |
| | 0.2 | NA | NA | NA | | |
| | 0.3 | NA | NA | NA | | |
| | 0.4 | NA | NA | NA | | |
| | 0.5 | 1.2±0.3 | NA | 2.4±0.06 | | |
| ***A. niger*** | 0.1 | NA | NA | NA | 22.0±0.05 | NA |
| | 0.2 | NA | NA | NA | | |
| | 0.3 | NA | NA | NA | | |
| | 0.4 | NA | NA | NA | | |
| | 0.5 | 0.5±0.01 | 0.3±0.1 | 1.0±0.1 | | |
| ***A. flavus*** | 0.1 | NA | NA | NA | 26.4±0.01 | NA |
| | 0.2 | NA | NA | NA | | |
| | 0.3 | NA | NA | 0.5±0.03 | | |
| | 0.4 | 0.3±0.13 | NA | 1.1±0.1 | | |
| | 0.5 | 0.8±0.03 | 0.2±0.01 | 1.9±0.02 | | |

**Key**: NA means no action

**Table 4:** Result of MIC, MBC and MFC

| **Test organisms** | **Ethanolic extract** | | **n-hexane extract** | | **Aqueous extract** | |
|---|---|---|---|---|---|---|
| | **MIC** | **MBC/MFC** | **MIC** | **MBC/MFC** | **MIC** | **MBC/MFC** |
| ***P. aeroginosa*** | 0.20 | 1.0 | 0.35 | 1.0 | 0.25 | 1.5 |
| ***S. typhi*** | 0.20 | 2.0 | 0.20 | 1.5 | 0.15 | 1.5 |
| ***E. coli*** | 0.25 | 1.0 | 0.35 | 2.0 | 0.30 | 1.5 |
| ***A. flavus*** | 0.40 | 3.5 | 0.50 | 4.0 | 0.30 | 3.5 |
| ***A. niger*** | 0.50 | 3.5 | 0.50 | 4.0 | 0.35 | 2.5 |
| ***C. albican*** | 0.45 | 3.5 | NA | NA | 0.45 | 3.0 |

Table 1 shows the qualitative and quantitative estimates of phytocompound present in *Amaranthus hybridus*. The phytochemical constituents present in *A. hybridus* are as follows: Alkaloids – 4.00 %, tannins – 3.4 %, flavonoids – 19.2 %, saponins – 18.00 %, terpenoids – 3.03 % and steroid – 7.98 %. This shows that the extract of *A. hybridus* can be used effectively as oral drugs in herbal medicines. *A. hybridus* contains some quality of alkaloids. It can be used to remedy some diseases. Table 2 signified that *A. hybridus* contains necessary micro-constituent elements needed by the human body for maintenance of osmotic pressure of the body. The elemental content of *A. hybridus* is as follows: k- 14.59 mg/l, Zn – 1.92 mg/l, Fe – 8.81 mg/l, Na – 36.85 mg/l, Mg – 24.36 and Ca = 43.38 mg/l. The leave and stem of *A. hybridus* is very good for the building of strong bones and teeth because of the high calcium content. Table 3 portrays the antimicrobial screening of solvent extracts of stem and leaves of *A. hybridus*. Five different concentrations of the extracts were used. At 0.1 mg/ml concentration, the three solvent extracts could not inhibit the growth of six test microorganisms. These are *P. aeroginosa, S. typhi, E. coli, A. flavus, A. niger* and *C. albican*. At 0.2 mg/ml n-hexane and aqueous extracts cannot inhibit the growth of *S. typhi* unlike the aqueous extract.

But at the same concentration, the three solvent extracts of *A. hybridus* cannot inhibit the growth of these microorganisms. *E. coli, C. albican, A. niger* and *A. flavus*. At 0.3 to 0.4 mg/ml the three solvent extracts of *A. hybridus* cannot inhibit the growth of these microorganisms *C. albican* and *A. niger.* At 0.5 mg/ml, the three solvent extracts of *A. hybridus* inhibited the six test microorganism. These are: *P. aeroginosa, S. typhi, E. coli, A flavus, A. niger* and *C. albican*. It was observed that as the concentration of the extract (drug) increases, the drug becomes more active and exhibits greater zones of inhibition. These solvent extracts of *A. hybridus* are therefore antibiotic in nature. At 0.5mg/ml concentration, the aqueous extract showed maximum action. Positive control against the six test organisms using standard antibiotic, inhibited their growth but the negative control showed no effect on the growth of the six test organism. Table 4 potrayed at a glance the result of the minimum inhibitory concentration (MIC) of the three solvent extracts of *A. hybridus* on six test organisms. The highest MIC of ethanolic extracts of *A. hyvbridus* (0.5 mg/ml) was shown on *A. niger*, while the least MIC (0.2 mg/ml) was shown on *P. aeroginosa* and *S. typhi.* The highest MIC of n-hexane extract (0. 5 mg/ml) was shown on *A. flavus* and *A. niger*, while the least (0.25 mg/ml) was shown on *S. typhi*. The highest MIC of aqueous extracts was shown against *C. albican* (0.45 mg/ml), while the least was against *S. typhi* (0.15 mg/ml).

## Conclusion

These conclusions were drawn from this study:

- The stem and leaves of *A. hybridus* contain many phytochemicals of interests. These include alkaloids, flavonoids, tannin, saponins and others.
- The stem and leaves of *A. hybridus* contains many micro-constituent elements required for body growth. These include K, Zn, Na, Mg and calcium.
- The solvent extracts of *A .hybridus* are antibiotic in nature since at 0.5 mg/ml concentration, the extracts inhibited the growth of all the six test micro-organisms.

It is then recommended that the used of solvent extracts of *A. hybridus* should be encouraged among the traditional medicine practitioners since the extracts are antibiotic in nature. Further research on this work should be carried out. This is to increase the concentration of these three solvent extracts in order to obtain greater zones of inhibition. Again the alkaloids and flavonoids extracts of this herb (plant) should be characterized in order to find out the type of alkaloids and flavonoids present in the herb.

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