COMPARATIVE ANALYSIS OF THE ANTIBACTERIAL ACTIVITIES OF DATURA STRAMONIUM FLOWER FROM DIFFERENT SOLVENTS

F.G. Obomanu, *H.A. Orlu, and C.C. Obunwo

Department of Chemistry, Rivers State University, Nkpolu-Oroworukwo Port Harcourt

* Corresponding Author (happiness_orlu@yahoo.co.uk)

Received 10 November 2017; accepted 29 December 2017, published online 29 January 2018

ABSTRACT

This study was undertaken to analyse the possible antibacterial activity of extracts of Datura stramonium flower. Solvents with varying polarities, were employed in the extraction process, since different secondary metabolites of plant species possess different functional groups with different polarities. Phytochemical and antibacterial activities were assessed using standard methods. The phytochemical analysis revealed that tannins, alkaloids, and flavonoids were present in the methanol, dichloromethane, ethyl acetate and n-hexane extracts; saponins were present in methanol and dichloromethane extracts but absent in ethyl acetate and n-hexane extracts. However, steroids were absent in all four solvent extracts. The antibacterial activities revealed that zones of inhibitions for Staphylococcus aureus and Escherichia coli were (14.0 mm, 9.5 mm) for the methanolic and (8.0 mm, 7.5 mm) for the dichloromethane extracts respectively. Higher zones of inhibition were recorded for the ethyl acetate (24.0 mm, 25.0 mm) and n-hexane (15.0 mm, 20.0 mm) extracts for S. aureus and E. coli respectively implying that they were more susceptible in less polar solvent extracts. The n-hexane and ethyl acetate extracts of the D. stramonium may thus act as broad spectrum antibacterial agents since they are active against gram positive S. aureus and gram negative E. coli.
Introduction

Herbal medicine is the study and use of medicinal properties of plants for the prevention and/or treatment of ailments. It is an expanding area in health sciences. Nearly all plants have medicinal benefits. [1]. Traditional and folklore medicine play an important role in the improvement of health services around the globe. It is believed that traditional use of plants have fewer side effects compared to the refined and processed drugs [2].

Plant secondary metabolites are also responsible for plant defense against pathogens. They have a wide variety of compounds with functional groups capable of exhibiting modulatory effects on animals at both the cellular and organ levels [3].

Traditionally, phytochemicals from plant are extracted using water or alcohol. However, they may be extracted using several organic solvents in the laboratory in order to harvest a wide variety of functional groups present. Depending on the polarity of the solvents, different classes of phytochemicals with different polarities can be extracted from the plant materials. Solvents used in this study in the order of increasing polarity are hexane, ethyl acetate, dichloromethane and methanol.

The medicinal values of *D. stramonium* have been widely explored in different parts of the world for traditional medicine. It is a plant that grows by the road side, wasteland and planted around residential areas with a trumpet shaped, white, creamy or violet coloured flower depending on the variety. Datura flower has been used over the years to cure different ailments. The poultice of the flower is used in folklore medicine as a topical pain relief and juice from the flower is used to treat bacteria- related ear infection [4]. Decoctions made from the flower and roots have been used by the Zuni Indians and other cultures in south west Mexico to relieve pain and as a sedative during the setting of fractured bones [5]. The medicinal properties result from the vast composition of phytochemicals. *Datura* plants have been found to contain tropane and atropine alkaloids [6] as well as other phytochemicals such glycoside, flavonoids, flavones, saponins and tannins.

Antibacterial activities in previous studies have been attributed to alkaloids, tannins and sometimes flavonoids. Several strains of gram positive and gram negative bacteria are found to be resistant against commercially available antibacterial agents. There is therefore need to harness the vast natural chemicals present in *D. stramonium* as well as take advantage of the synergetic effect the chemicals contribute to exhibit biological actions.

Different parts of the *D. stramonium* plants have been investigated for their antibacterial activities and are known for significant antibacterial activities. [7], [8], [9]. Uzun et al. [10] investigated the antibacterial activity of *D. stramonium* leaves and found that the petroleum ether extract was active against *E. coli* and *Trachystemon orientalis*. Okwu and Igar [11] isolated and characterized a new antibacterial agent, 5',7' dimethyl 6'-hydroxy 3', phenyl 3 α-amine β- yne sitosterol from *D. metel* leaves. The compound was found to be active against S. aureus, *P. aeruginosa*, *Proteus mirabilis*, S. typhi, *B. subtilis* and *K. pneumonia* but could not inhibit *E. coli*.

Banso and Adeyemo [12] assessed the phytochemical components and antimicrobial activity of *D. stramonium* ethanolic leaf extract against *P. aeruginosa*, *K. pneumonia* and *E. coli*. It was recorded that higher concentrations of the extracts were required to inhibit growth. Acetone extracts of *D. stramonium* leaves were active against *Vibrio cholerae* and *Vibrio parahaemolyticus* [13]. The crude plant extracts exhibited a minimum inhibitory concentration of 2.5 to 15 µg/ml.

Despite the numerous works done to assess the antibacterial activities of *Datura Stramonium* and other varieties, there has not been work reported for the assessment of antibacterial activity of *D. stramonium* flower (in four different solvent extracts). This study thus aims to assess the possible antibacterial activity of *Datura stramonium* flower extract from four different solvents of varying polarities.

METHODOLOGY

Fresh flowers of *D. stramonium*, collected from different locations in Port Harcourt metropolis and identified by a plant taxonomist were rinsed in distilled water and shade- dried at room temperature. The dried flowers were ground to powder and stored in an airtight plastic container. Methanol, dichloromethane, ethyl acetate and n-hexane, marketed by Geochemicals, Nigeria Ltd, were obtained and double distilled.

500ml each of the four solvents were poured into 4 different conical flasks. Into each flask was added 50 g of the dried powdered sample. Each mixture was kept for 72 hours with intermittent shaking and the marc was decanted and filtered. The crude extracts obtained by
concentrating the filtrates were used to test for the presence of secondary metabolites according to standard methods. [12], [14] and [15].

Gram positive *Staphylococcus aureus* (ATCC 25923) and gram negative *Escherichia coli* (ATCC 29455) were cultured in nutrient agar media. Paper discs used for this analysis, were prepared according to standard procedures. 0.5 g of each crude extract was dissolved in 100 mL of the solvents from which they were extracted to obtain a stock solution with concentration of 0.05 µg/ml. The prepared paper discs were impregnated with about 0.01 mL of the extract solutions as well as the solutions of the standard drugs and allowed to dry. The commercial antibiotics served as the positive control while the pure solvents used for extraction served as the negative control.

With the aid of a graduated wire loop, 0.2 mL of the test organisms was inoculated over the entire surface of the nutrient agar and after about 5 minutes the inoculated agar surfaces were seeded with the impregnated discs containing the solvents, solvent extracts and the commercial antibacterial agent, were placed in their respective locations with the aid of a sterile forceps. Finally, the culture plate alongside the positive and negative control plates were incubated at room temperature for 24 hours. The extent of bacterial growth was determined by measuring the diameter of zone of inhibition in millimeters.

**Results**

**Phytochemical analysis**

The qualitative phytochemical evaluation of *D. stramonium* flower (Table 1) showed that tannins, alkaloids, and flavonoids were present in the methanol, dichloromethane, ethyl acetate and n-hexane extracts; saponins were present in methanol and dichloromethane extracts but absent in ethyl acetate and n-hexane extracts. Steroids were absent in all four solvent extracts.

**Table 1: Phytochemical analysis of D. stramonium flower**

<table>
<thead>
<tr>
<th>Phytochemical</th>
<th>Methanol</th>
<th>Dichloromethane</th>
<th>Ethyl acetate</th>
<th>n-Hexane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloid</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Flavonoid</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Saponins</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Steroids</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tannins</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Key:  
+ = present  
- = absent

Antibacterial activity of *D. stramonium* flower is presented in Table 2, values of the diameter of zones of inhibition of the test drugs and control drugs.

**Table 2: Antibacterial activity of D. stramonium flower**

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>Zones of inhibition (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Methanol</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>14.0</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>9.5</td>
</tr>
</tbody>
</table>

Key:  
Gram +ve: commercial drugs for gram positive organism (gentamycin, rocephin, streptomycin and erythromycin)  
Gram –ve: commercial drug for gram negative organism (chloramphenicol, sparflaxacin and refloxacin)

**Discussion**

The phytochemical analysis of *D. stramonium* flowers showed that tannins, alkaloids, and flavonoids were present in all four solvents extracts used. This is similar to the report by [16] having these three present in both polar and nonpolar solvent extracts of the leaves. Saponins were present in polar (methanol and dichloromethane) extracts but absent in (less polar) ethyl acetate and n-hexane extracts. However, steroids were absent in all four solvent extracts. Steroids are high molecular weight organic compounds, they are usually nonpolar compounds. In contrast, previous work by Oyeleke et al [17] found steroids were present in the methanolic and acetone extracts of the seed; as well as in the chloroform extract of the leaves. Deshmukh et al [18] also found steroids in the methanolic extract of the leaves. It may be concluded that steroids are not present in *Datura stramonium* flower.

In a previous study, Eftekhari et al. [19] reported that antibacterial activity of the methanolic extracts of the leaves of *D. stramonium* and *D. innoxia* have shown
antibacterial activity against gram positive bacteria in a dose dependent way and very little or no antibacterial activity was found against E. coli. In contrast, the present study revealed that the methanolic (14.0 mm, 9.5 mm) and dichloromethane (8.0 mm, 7.5 mm) solvent extracts of Datura stramonium flower had moderate activity on both S. aureus and E. coli respectively whereas the ethyl acetate (24.0 mm, 25 mm) and n-hexane (15.0 mm, 20.0 mm) extracts had excellent activity against S. aureus and E.coli respectively. The gram positive control antibiotics (gentamycin, rocephin, streptomycin and erythromycin had 15-24 mm zones of inhibition against S. aureus while the gram negative control antibiotics (chloramphenicol, sparflaxacin and refoxacin) had 14-22 mm zones of inhibition against E. coli. Therefore the Datura stramonium flower exhibit broad spectrum antibacterial activity in less polar solvents.

CONCLUSION

Although, many phytochemicals were observed to be present in the flower extracts, it is significant to note that there were no steroids detected. Furthermore, the less polar (ethyl acetate and hexane) solvent extracts of the flower showed high broad spectrum antibacterial activities against gram positive (S. aureus) and gram negative (E. coli) bacteria. This seems to validate the traditional use of Datura stramonium flower in the treatment of some bacterial ear infection. The flower extract may thus serve as an alternative to conventional drugs.

REFERENCES