



Antibacterial and Phytochemical Screening of Crude Extracts of Leaves and Seeds of *Datura stramonium*

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Authors' contributions

This work was carried out in collaboration between all authors. Author OOJ designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors VOO and MFI managed the analyses of the study. Author OOJ managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Datura stramonium, known by the common name Jimson weed, belongs to nightshade family; its origin can be traced back to Mexico, it has also been grown in other regions including Nigeria. This plant possesses antimicrobial agents which aid in its efficacy for treatment of ailments. Hence, this study investigated the antibacterial activities and phytochemical screening of aqueous and methanol extract of leaves and seeds of *Datura stramonium*. Leaves and seeds of the plant sample were processed to obtain fractions of crude extracts which were used against bacterial isolates such as, *E. coli*, *S. aureus*, *S. typhi* and *P. aeruginosa*. Phytochemical screening of the samples was also done to detect the presence of alkaloid, saponins, flavonoids, glycosides, tannin, terpenoids, sterol and phenols. Results obtained showed the susceptibility pattern against the bacterial isolates at concentrations ranging from 0.5 – 2.5 mg/mL. The methanol extract of leaves of the plant sample showed high susceptibility pattern against *E. coli* and *S. typhi*. The study shows that crude extracts of leaves and seed of the plant sample were effective against the test organisms. The phytochemicals constituents were also present except sterol which is lacking in the seed sample due to the solvent used such as ethanol but may be present if other solvent is used. Antibacterial activity of crude extracts of *D. stramonium* leaves and seeds were as a result of presence of phytochemical constituents because they are fundamental biomedical, which are considered biologically to be active compounds.

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1. INTRODUCTION

Medicinal plants have been found to play vital roles in the effort of treating some ailments and diseases in human. The request for alternative medicine has increased overtime in developed and developing nations as a result of more recognition of important medicinal plants [1]. For the past few years, there has been a great increase in the use of medicinal plant for curative purposes. Medicinal plant is becoming well-known in some countries of the world due to its efficacy fewer side effects [2]. In the indigenous health care delivery system, numerous plant species and natural products derived from plants are to treat diseases of infectious origin [2]. Herbal medicine is an immense reservoir from which antimicrobial agents may be obtained. The significant purpose for which plants derive their medicinal efficacy is due to the combinations of phytochemical constituents found in the plant; and these include as alkaloids, steroids, tannins and phenolic compounds, flavonoids, and fatty acids which are capable of producing definite physiological action on body [3].

The most practical way to fight degenerative diseases is to increase antioxidant activity in our body and that could be achieved by consumption of vegetables, fruits or edible plants [4]. Several synthetic antioxidant agents including butylated hydroxyanisole and butylated hydroxytoluene (BHT) are commercially available, however, are reported to be toxic to animals including human beings which have stimulated the interest of many investigators to search natural antioxidant [5].

Datura stramonium (commonly called 'gegemu' in Yoruba land) is an annual plant from the Solanaceae family [6]. It is among the most popular medicinal plants utilized in many parts of the world including Nigeria. From ancient civilization it was traditionally used for religious visionary purposes throughout the world and used by witchcraft in medieval Europe [7]. Decoction made from the leaves of *D. stramonium* was found to be effective in the treatment of asthma and sinus infections [8].

Datura has been used in herbal medicine to suppress asthma symptoms and as an analgesic during surgery or bone setting. It is also a powerful hallucinogen that was utilised for the intense visions it produces. However, the

phytochemical constituent (alkaloids) that is responsible for the medicinal and hallucinogenic properties are fatally toxic in only slightly higher amounts than the medicinal dosage, and careless usage often results in hospitalisations and deaths [9].



Fig. 1. Leaves and seeds of *Datura stramonium*

The aim of this study is to investigate the antibacterial activities of aqueous and methanol extracts of seeds and leaves of *Datura stramonium* against pathogenic bacterial organisms, and also to detect the phytochemical constituents present in the plant to establish whether the phytochemicals are responsible for the antibacterial efficacy of the plant.

2. MATERIALS AND METHODS

2.1 Plant Collection

The plant sample was collected from a farmland within Ikere-Ekiti and Ado-Ekiti. The plant material was then taken to Department of Agricultural Technology for identification.

2.2 Extract Preparation

The fresh leaves and seeds of the plant were collected and shade dried to obtain 400 g dry sample which was later coarsely powdered in a mill and used for solvent extraction. For sample preparation, 200 g of dry sample was extracted twice (1,000 mL for each) with 95% methanol at 25°C for 48 h and concentrated using a rotary evaporator. 200 g of the sample was soaked into

500 mL distilled water. The water extract was filtered and evaporated to dryness at 20°C using rotary evaporator.

2.3 Reactivation of Test Bacteria

The bacteria that were used in this study include *E. coli*, *S. aureus*, *S. typhi* and *P. aeruginosa*. They were removed from stock, and inoculated into 5 mL nutrient broth and incubated at 37°C for 18 – 24 hr.

2.4 Antibacterial Susceptibility Testing

The method employed by Aiyegoro et al. [10] was adopted. Different concentrations (0.5, 1.0, 1.5, 2.0, and 2.5 g) of each extract were weighed and dissolved separately in 2 mL of methanol and distilled water. These extracts were incorporated into sterilized paper disks made from Whatman No. 1 filter paper. The medium (nutrient agar) was prepared according to the manufacturer specifications; the broth culture of each organism was serially diluted to 10^{-3} . A loopful of 10^{-3} dilution was spread onto the prepare agar plates. The disks with the different concentrations were placed on the inoculated plates, incubated at 37°C for 18-24 hr and observed for growth and the diameter of the zones of inhibition was measured in millimeter using a metre-rule.

2.5 Phytochemical Analysis

A small portion of the dried leaf extract was subjected to phytochemical analysis for the presence of alkaloids, tannins, flavonoids, steroids, saponins, terpenoids, phenols and cardiac glycoside using standard methods described by Trease and Evans [11].

3. RESULTS AND DISCUSSION

Table 1 shows the antibacterial activities of aqueous extracts of *Datura stramonium* leaves against *E. coli*, *S. typhi*, *P. aeruginosa*, and *S. aureus*. The susceptibility pattern of the extracts to *S. typhi* was found to range from 3.0 – 12.0 mm and 1.0 – 5.0 mm on methanol and aqueous reconstituting solvent respectively at concentrations of 250 – 1250 mg/mL. *E. coli*, *P. aeruginosa* and *S. aureus* were also susceptible to the extract at minimal level on the reconstituting solvents; except for aqueous solvent on *S. aureus* where no zones of inhibition

were noticed at concentrations of 250 mg/mL and 500 mg/mL.

The susceptibility pattern of activities of the aqueous seeds extracts of *D. stramonium* as shown in Table 2 reveals the highest zones of inhibition against *E. coli* and *S. typhi* on the methanol reconstituting solvent; having 10.0 – 22.0 mm and 10.0 – 17.0 mm at concentrations of 250 – 1250 mg/mL respectively. *P. aeruginosa* had zones of inhibition ranging from 9.0 – 20.0 mm, and *S. aureus* had 5.0 – 20.0 mm at concentrations 250 – 1250 mg/mL for methanol reconstituting solvent respectively. The zones of inhibition for aqueous reconstituting solvent were relatively low; no zone of inhibition was observed for *S. typhi* and *S. aureus*; this implies that reconstituting aqueous extracts of *D. stramonium* seeds with water will have minimal or no inhibitory effect against bacterial isolates.

Table 3 shows the antibacterial activity of methanol extracts of *D. stramonium* leaves on bacterial organisms. The susceptibility pattern was more pronounced against *E. coli* and *S. typhi* having zones of inhibition of 11.0 – 22.0 mm and 10.0 – 20.0 mm at concentrations of 250 – 1250 mg/mL respectively on the methanol reconstituting solvent, while the level aqueous reconstituting solvent ranged from 8.0 – 17.0 mm and 3.0 – 17.0 mm respectively. This shows that methanol extracts of *D. stramonium* leaves can only be more effective if reconstituted with methanol.

Table 4 shows the susceptibility pattern of methanol extracts of *D. stramonium* seeds against the bacterial isolates. Aqueous reconstituting solvent of the extract was observed to be high on *E. coli* and *S. aureus* having zones of inhibitions ranging from 8.0 – 16.0 mm and 8.0 – 17.00 mm at concentrations of 250 – 1250 mg/mL respectively. The zones of inhibitions of *S. typhi* and *P. aeruginosa* range 3.0 – 12.0 mm and 4.0 – 15.0 mm on methanol reconstituting solvent. These, however, are not as high as for other reconstituting solvent against other organisms, which points to the fact that methanol extracts *D. stramonium* seeds could be efficacious against some bacterial isolates if reconstituted with water.

The phytochemicals present in the crude extracts of *D. stramonium* leaves and seeds were presented in Table 5. The entire phytochemicals screened are found to be presented in both the

leaves and seeds of the plant sample, except sterol which is absent in seed.

The reason of herbal medicinal plants by an individual or group of people could be traced back to its cheapness and readily availability; therefore making herbs more acceptable and recognised globally. Medicinal plants constitute an efficient beginning for both traditional and advanced medical specialty. Approximately, 80% of people from developing countries use traditional medicine as primary health care [12]. Consequently, such plants should be investigated in a broad range to better understand their properties, safety and efficacy.

The significance of plant extracts and phytochemicals, both with known antimicrobial properties can be of great significance in therapeutic treatments. A routine of surveys has been previously conveyed in different states to

prove such efficiency [3,13]. Various plants have been employed as a result of their antimicrobial traits, which are due to compounds synthesised in the secondary metabolism of the flora.

In the present study, antibacterial activities of aqueous and methanol extracts of *D. stramonium* leaves and seeds using 2 extracts as reconstituting solvents have been conducted against the clinical isolates human pathogenic microorganisms. As per the research, there was no previous work conducted to validate *D. stramonium* leaves and seeds extract using the patterns used in this research in Nigeria. Aqueous reconstituting solvent did not show any antibacterial activity against *S. typhi* and *S. aureus* (Table 2) which are supported by previous findings that used water as an extraction solvent for finding active antibacterial components [14].

Table 1. Antibacterial activity of aqueous extracts of *Datura stramonium* leaves on selected organisms

Organism	Reconstituting solvent	Diameter of zones of inhibition (mm)				
		Concentrations (mg/mL)				
		250	500	750	1000	1250
<i>E. coli</i>	Methanol	2.0	6.0	7.0	9.0	11.0
	Distilled water	1.0	3.0	5.0	6.0	7.0
<i>S. typhi</i>	Methanol	3.0	3.0	8.0	10.0	12.0
	Distilled water	1.0	2.0	3.0	4.0	5.0
<i>P. aeruginosa</i>	Methanol	1.0	3.0	5.0	6.0	9.0
	Distilled water	-	1.0	2.0	3.0	4.0
<i>S. aureus</i>	Methanol	1.0	3.0	4.0	5.0	8.0
	Distilled water	-	-	1.0	2.0	3.0

Table 2. Antibacterial activity of aqueous extracts of *Datura stramonium* seeds on selected organisms

Organism	Reconstituting solvent	Diameter of zones of inhibition (mm)				
		Concentrations (mg/mL)				
		250	500	750	1000	1250
<i>E. coli</i>	Methanol	10.0	12.0	14.0	18.0	22.0
	Distilled water	2.0	4.0	6.0	10.0	12.0
<i>S. typhi</i>	Methanol	10.0	12.0	13.0	15.0	17.0
	Distilled water	-	-	-	-	-
<i>P. aeruginosa</i>	Methanol	9.0	12.0	14.0	16.0	20.0
	Distilled water	4.0	6.0	10.0	14.0	16.0
<i>S. aureus</i>	Methanol	5.0	13.0	15.0	17.0	20.0
	Distilled water	-	-	-	-	-

Table 3. Antibacterial activity of methanol extracts of *Datura stramonium* leaves on selected organisms

Organism	Reconstituting solvent	Diameter of zones of inhibition (mm)				
		Concentrations (mg/mL)				
		250	500	750	1000	1250
<i>E. coli</i>	Methanol	11.0	15.0	16.0	19.0	22.0
	Distilled water	-	8.0	12.0	16.0	17.0
<i>S. typhi</i>	Methanol	10.0	13.0	15.0	18.0	20.0
	Distilled water	3.0	5.0	10.0	14.0	17.0
<i>P. aeruginosa</i>	Methanol	4.0	6.0	10.0	12.0	16.0
	Distilled water	2.0	5.0	7.0	9.0	13.0
<i>S. aureus</i>	Methanol	2.0	5.0	7.0	9.0	11.0
	Distilled water	1.0	3.0	5.0	8.0	10.0

Table 4. Antibacterial activity of methanol extracts of *Datura stramonium* seeds on selected organisms

Organism	Reconstituting solvent	Diameter of zones of inhibition (mm)				
		Concentrations (mg/mL)				
		250	500	750	1000	1250
<i>E. coli</i>	Methanol	5.0	7.0	9.0	13.0	15.0
	Distilled water	8.0	10.0	12.0	14.0	16.0
<i>S. typhi</i>	Methanol	3.0	6.0	7.0	10.0	12.0
	Distilled water	3.0	5.0	7.0	9.0	12.0
<i>P. aeruginosa</i>	Methanol	4.0	6.0	10.0	12.0	15.0
	Distilled water	5.0	7.0	10.0	11.0	14.0
<i>S. aureus</i>	Methanol	2.0	5.0	8.0	11.0	14.0
	Distilled water	8.0	9.0	11.0	13.0	17.0

Table 5. Phytochemical screening results of crude extracts of *Datura stramonium* leaves and seeds

Parameters	Leaves	Seeds
Alkaloid	+	+
Saponins	+	+
Flavonoid	+	+
Glycoside	+	+
Tannin	+	+
Sterol	+	-
Phenol	+	+

+ Present; - Not present

The current study shows that leaves and seed extracts of *D. stramonium* inhibited the growth of human pathogenic bacteria *S. aureus*, *E. coli*, *P. aeruginosa* and *S. typhi* which is in line with the outcomes obtained by

Obi et al. [15]. The leaf extracts of *D. stramonium* showed antibacterial activity against *E. coli* and *S. typhi* which is in resonance with Adebayo et al. [16] who found high antimicrobial activity against those microorganisms.

Antibacterial activity of *D. stramonium* leaves and seeds extracts is due to the presence of phytochemicals that includes, flavonoids, phenols, tannins, saponins, sterols, alkaloids, terpenoids and glycosides. Because of the presence of these fundamental biomedical, *D. stramonium* is considered as treasured medicine and useful in the treatment of many diseases. Phytochemical constituents in the plant sample are known to be biologically active compounds and they are responsible for different activities such as, antimicrobial, antioxidant, antifungal and anticancer [17,18].

4. CONCLUSION

The antibacterial activities of crude extracts of *D. stramonium* were investigated against some pathogenic bacteria. Results obtained from the study indicated that *D. stramonium* plant possesses considerable antibacterial activity that supports the use of the flora in the traditional scheme of medicine for the handling of several diseases.

D. stramonium crude extracts can be used against the pathogenic microorganisms and may provide better alternatives or supplements to the conventional antibacterial and antifungal additives in foods. Therefore *D. stramonium* leaves and seeds crude extract can be recommended for use in the treatment of various human ailments.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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