DOI: https://doi.org/10.53555/nnas.v8i1.1272 **Publication URL: https://nnpub.org/index.php/AS/article/view/1272**

EVALUATION OF ANTIMICROBIAL AND BIOACTIVE POTENTIALS OF TELFAIRIA OCCIDENTALIS ON MICROORGANISMS

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ABSTRACT

The intensification of numerous deadly diseases like infections by multidrug-resistant bacteria suggests re-inventing the wheel on drug discovery. Indeed, countless disparate studies have underscored substitutes for combating the effects of antibiotic resistance. For many decades, plants have assumed an essential alternative medicine, demonstrated to be effective in human healthcare. The use of plants as alternative antibiotics in controlling some illnesses has attracted considerable research attention. The present paper investigates the phytochemical contents and the antimicrobial action of T. occidentalis on microorganisms. In particular, the study examined its effect on Candida albicans, Staphylococcus aureus, and Pseudomonas aeruginosa. The outcome of the phytochemical analysis performed on the seed and leaf of T. occidentalis indicated the presence of tannin, alkaloids, steroids, flavonoids, saponins, and phenol. However, it was found that phenol and tannins were primarily deposited in the plant's seed. Similarly, the antimicrobial analysis showed that S. aureus was more susceptible to the acetone, ethanol, and hot aqueous extracts of T. occidentalis. Furthermore, Candida albicans and Pseudomonas aeruginosa showed sensitivity to acetone and ethanol but did not react to the hot aqueous extracts. The study's findings reveal that the biological responses elicited by T. occidentalis aqueous extracts support the plant's historical use as an alternative antibiotic.

KEYWORDS: *T. occidentalis*, phytochemical, ethanol, acetone, antimicrobial

BACKGROUND

Viral infections are one of the world's leading causes of death and morbidity (Guo et al., 2020). The efficacy of currently existing treatment modalities is undermined by the increasing resistance of certain microorganisms to antibiotics. (Aira et al., 2019; Aktar et al., 2020; Avner et al., 2012; Carro, 2018; Dias et al., 2020; Fratarri et al., 2019; Ichim et al., 2019; Oliva et al., 2020; Pabasarra et al., 2021; Perez-Lopez et al., 2012; Ravensbergen et al., 2019; Shin et al., 2019). Multidrug-resistant bacteria have become a foremost public health concern across the world (Dias et al., 2020), resulting in a high rate of mortality, disability, and disease (Al-Salami & Al-Abbasy, 2020; Calonico et al., 2018; Darhake & Kamble, 2014; Lee et al., 2004; Luna et al., 2001; Malick et al., 2020; Nayark et al., 2014; Pal et al., 2021; Pinteus et al., 2020; Tuchenko et al., 2021). Particularly in poorer nations (Okwu et al., 2019). The emergence of several lethal illnesses and infections caused by multidrug-resistant bacteria necessitates re-inventing the drug research process (Lage et al., 2018). De-Fretas, 2017; Shrivastava et al., 2018; Taconelli et al., 2018) suggest that substantial research has been focused on exploring options for minimizing the impacts of antibiotic resistance.

In practically all civilizations, medicinal herbs and traditional preparations with antibacterial properties have been employed extensively (Jamshidi-Kia et al., 2018). Plants have made major contributions to traditional medicine over time and have shown to be helpful in human health care across the universe (Assif, 2013; Hamayun et al., 2006; Johnson et al., 2015; Kurmar et al., 2013; Tripathi & Pandey, 2017). Around 80% of people in underdeveloped nations are thought to utilize traditional medicines, mostly made from medicinal plants, to address their primary healthcare requirements (Oguntibeju, 2019). The success of alternative medicine has persuaded many people to adopt it to treat a range of diseases. (Albejo and colleagues, 2015; Ali et al., 2020; Baars et al., 2019; James et al., 2018; Mordeniz, 2019). The bioactive and secondary metabolites are essential components of plants' medicinal potential. Indeed, the scientific understanding of the fundamental processes of medicinal plants' therapeutic effects is still lacking. However, the success of traditional medicines in treating various ailments is linked to the effectiveness of plants in combatting certain fungal, bacterial, and other associated disorders (El Haj & Holst, 2020; Kamatenessi-Mugisha et al., 2008; Kayanja, 2008; Martin & Ernest, 2003; Wang et al., 2014).

The usage of medicinal plants in Nigeria has been documented extensively. For example, plant-based complementary and alternative medicines have been used to treat cancer (Aliyu et al., 2017; Ezeome & Anarado, 2007), acute illnesses (Duru et al., 2020), HIV infection (Oshikoya et al., 2014), diabetes and hypertension (Ala et al., 2020; Olayemi et al., 2015), kidney diseases (Okwuonu et al., 2014; Adeyeye et al., 2011). As a result, plants are vital to human health, and study into their bioactive components continues to be necessary. As a result, the focus of this research is Telfairia occidentalis.

Telfairia occidentalis, often known as fluted pumpkin, is a vegetable that belongs to the Cucurbitaceae family and is a green vegetable frequently consumed by Africans (Adisa et al., 2012). It is a dark green leafy vegetable commonly used in soup and traditional medicine in Nigeria to treat various ailments (Akindele et al., 2013; Saalu et al., 2010). *T. occidentalis* is well-known in West Africa for its commercial significance. Many researchers have reported on the medicinal properties of T. occidentalis. The leaves of T. occidentalis are tropical vegetables with therapeutic effects (Jimoh, 2018). It has a high level of antioxidant activity (Eseyin, Sattar, et al., 2018). T. occidentalis has been used for a variety of therapeutic purposes in traditional medicine (Aisida et al., 2019; Ajanni & Akinyemi, 2016; Areghore, 2011; Atabor et al., 2016; Aworunse et al., 2018; Igbenegbu & Abudu, 2014; Kayode & Kayode, 2011; Kayode et al., 2009; Nwidu & Obioma, 2019; Alia, 2012).

Studies on the pharmacological potentials of *T. occidentalis* indicate that the plant possesses antibacterial properties (Noumedem et al., 2013), antimalarial (Okokon et al., 2009), antioxidant (Airaodion et al., 2019; Eseyin, Benedict, et al., 2018), anxiolytic (Ajao & Akindele, 2013), antimicrobial (Stanley et al., 2018), anticancer (Eseyin et al., 2014), antidiabetic, (James et al., 2016), and antifungal activities (Nkiru, 2018). Although *T. occidentalis* has been widely studied, its phytochemical properties and activities have been established. This study aims to expand on the current literature on the antibacterial activities of *T. occidentalis* on bacteria. The study's primary goal is to investigate the phytochemical composition of *T. occidentalis* and its antibacterial efficacy against *Staphylococcus aureus, Pseudomonas aeruginosa, and Candida albicans*.

Materials and Methods

Collection and Preparation of Plant Materials

Fresh *T. occidentalis* plant samples were gathered from the Ogbete market in Enugu, Nigeria, and transported to the lab for correct identification and authenticity. The samples were cleaned and processed according to Alara et al.'s procedure (2019).

Sample Extraction

Aqueous Extract

Ten grams of crushed *T. occidentalis* plant stem bark and leaf were removed and mixed with 100ml of sterile distilled water. Abdulmalik et al. (2016) and Ali et al. (2017) have used the same procedure to extract the plant's aqueous components.

Phytochemical Screening of *T. occidentalis*

Phytochemical screening of T. occidentalis leaf and seed extracts was carried out using the standard qualitative approach established by Trease and Evans (1989) to determine bioactive components such as alkaloids, tannins, saponins, and steroids, phenols, and flavonoids.

Sterility Test of the Plant Extracts

Following sterilization, the plant's aqueous extract was tested for sterility by inoculating 1 mL of each extract on sterile nutrient agar and incubating at 37°C for 24 hours. The plates were particularly scrutinized for signs of development.

Standardization of the Bacterial Cell Suspension

The McFarland standard (Washington, 2011) was used to check for bacterial suspension standardization. Colonies of the tested organism were chosen and cultured for one day in a sterile test tube with sterile nutrient broth.

Antimicrobial Activity Determination

The antimicrobial activity of the crude extracts was tested using the agar well diffusion technique reported by Chaman et al. (2013), with a few alterations.

Result

Table 1:

Table showing the phytochemical contents of *T. occidentalis* seed and leaf

Phytochemical compounds	leaf	Seed
Alkaloids	++	++
Steroid	+++	+
Saponins	++	+++
Tannin	-	+++
Phenolic	--	+++
Flavonoids	++	+

Key: Positive = +; Moderate = ++ ;High = +++; Negative = -

The above table reveals the aqueous screening conducted on the seed and leaf of *T. occidentalis*, indicating that the plant contains a significant number of alkaloids, tannin, steroids, flavonoids, phenol, and saponins. However, the screening revealed phenol and tannins in the seed and not the plant's leaf.

Table 2:

Table showing the sensitivity parameter for ethanol extract.

Organisms	Seed	%	leaf	%
C. albican	8mm	35.88	2mm	13.46
P.aeruginosa	5mm	19.22	1mm	6.78
S. aureus	8mm	38.11	7mm	37.27

The table above shows the observed zone of inhibition of ethanol extract on *T. occidentalis* seed and leaf against some pathogenic organisms. For sensitivity, exposing the microorganisms to the aqueous extract of the seed for sensitivity revealed the same 8mm diameter of inhibition zone (35.88% and 38.11%) for *S. aureus and C. Albicans.* However, *P. aeruginosa* possessed a minimal 5mm (6.78%) diameter inhibition zone than *S. aureus and C. Albicans*. The test on an ethanol extract of the leaf shows that *S. aureus* produced a high diameter of inhibition zone of 7mm (37.27%) while *C. albican*s produced lower with a 3mm (13.46%) inhibition zone diameter.

Table 3:
Table showing the sensitivity parameter of the organisms to acetone extract.

Organisms	Seed	%	leaf	%
C. albicans	8mm	22.39	7mm	42.18
P.aeruginosa	15mm	32.37	3mm	8.84
S. aureus	15mm	37.11	5mm	27.17

The table above shows the test organisms' sensitivity parameter when exposed to an acetone extract of *T. occidentalis* seed and leaf. The result indicated a high diameter of inhibition zones of 15mm for *P. aeruginosa* and *S. aureus* (32.37% and 37.11%), respectively, when tested with acetone seed extract of *T. occidentalis*. However, *C. Albican*s produced a reduced diameter of inhibition zones of 8mm (22.39%). Furthermore, it was revealed that *C. Albican*s produced an increased diameter of inhibition zones of 7mm (42.18%) when subjected to acetone leaf extract of *T. occidentalis*.

Table 4:
Table showing the sensitivity position of the test organisms to hot aqueous extract

Organisms	Seed	%	leaf	%
C. albicans	r	-	r	-
P.aeruginosa	r	-	r	-
S. aureus	8mm	96.10	r	-

Furthermore, the organisms were exposed to hot aqueous extract of the plant. Only one pathogenic organism (*S. aureus*) exhibited a reaction within the 8mm diameter of the inhibition zone. Thus, other organisms maintained a resistant position towards the extract.

Discussion

The present study examined the phytochemical constituents and antimicrobial activity of fluted pumpkins on *Candida albicans, Staphylococcus aureus, and Pseudomonas aeruginosa*. The phytochemical analysis performed on the seed and leaf of *T. occidentalis* revealed the presence of alkaloids, tannin, phenol, steroids, saponin, and flavonoids. However, it was shown that phenol and tannins were mainly deposited in the plant's seed. Thus, the study is consistent with previous studies (Eltayeb & Hamid, 2017; Mensah, SI, 2017; Oladele et al., 2020; Otitoju et al., 2016). The plant's phytochemical constituents have been implicated in the antimicrobial potentials of *T. occidentalis* (Deepika et al., 2020).

Furthermore, the antimicrobial analysis revealed that *S. aureus* was more vulnerable to the ethanol, acetone, and hot aqueous extracts of *T. occidentalis*. As shown in the tables, this is indicated in the increased size of the inhibition zones' diameter. However, *P. aeruginosa* and *C. Albicans* showed sensitivity to ethanol and acetone exposure. However, they failed to react to the hot aqueous extracts. Consistent with (Adetutu et al., 2011; Moreno et al., 2006), the findings affirmed that ethanol and acetone extracts' have antimicrobial potentials compared to the aqueous extracts.

Conclusion

The present study assessed the antimicrobial potentials of *T. occidentalis* extracts on *Candida albicans, Pseudomonas aeruginosa*, and *Staphylococcus aureus*. The result confirmed that the seed and leaf extracts of the plant possess antimicrobial tendencies. Thus, the observed biological reactions shown by the aqueous extracts of *T. occidentalis* corroborate the conventional application of *T. occidentalis* as an alternative antibiotic.

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