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RESEARCH ARTICLE

Investigation of the Phytochemical Contents and Antimicrobial Effects of *Telfairia Occidentalis* Microorganisms

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Abstract

The rise in several deadly diseases like infections by multidrug-resistant bacteria implies re-inventing the wheel on drug discovery. Perhaps, extensive research has been dedicated to identifying alternatives to mitigating the effects of antibiotics resistance. Over the years, plants have contributed significantly to traditional medicine, proven effective in human health care, and were extensively used as alternative antibiotics in certain conditions. Thus, the current study's primary purpose is to determine the phytochemical contents and the antimicrobial activity of *T. occidentalis* microorganisms, including *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*. The result of the phytochemical analysis conducted on the leaf and seed of *T. occidentalis* revealed alkaloids, tannin, steroids, flavonoids, phenol, and saponins. However, it was found that tannins and phenol were mainly deposited in the plant's seed. Also, the antimicrobial analysis conducted revealed that *S. aureus* was more vulnerable to the ethanol, acetone, and hot aqueous extracts of *T. occidentalis*. At the same time, *P. aeruginosa* and *C. Albicans* showed sensitivity to ethanol and acetone exposure but failed to react to the hot aqueous extracts. The study concludes that the observed biological reactions shown by the aqueous extracts of *T. occidentalis* corroborate the traditional application of this plant as an alternative antibiotic.

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Introduction:-

Infectious diseases are among the most common causes of human death worldwide (Guo et al., 2020). However, the growing resistance of some microorganisms to antibiotics is compromising the efficacy of the currently available pharmacotherapies (Aira et al., 2019; Akter et al., 2020; Avner et al., 2012; Carro, 2018; Dias et al., 2020; Frattari et al., 2019; Ichim et al., 2019; Oliva et al., 2020; Pabasara et al., 2021; Pérez-López et al., 2012; Ravensbergen et al., 2019; Shin et al., 2019). Multi-drug resistant microorganisms have become a severe public health problem worldwide (Dias et al., 2020). It has resulted in a high rate of mortality, disability, and diseases across the world (Al-Salami & Al-Abbasy, 2020; Calónico et al., 2018; Dahake & Kamble, 2014; Lee et al., 2004; Luna et al., 2001; Mallick et al., 2020; Nayak et al., 2014; Pal et al., 2021; Pinteus et al., 2020; Tutchenko et al., 2021). Especially in developing countries (Okwu et al., 2019). The upsurge of several deadly diseases and infections by multidrug-resistant bacteria implies re-inventing the wheel on drug discovery (Lage et al., 2018). Perhaps, extensive research has been dedicated to identifying alternatives to mitigating the effects of antibiotics resistance (De Freitas, 2017; Shrivastava et al., 2018; Tacconelli et al., 2018; WHO, 2017).

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Medicinal plants and traditional preparation with antimicrobial activities have been used extensively in almost all cultures (Jamshidi-Kia et al., 2018). Over the years, plants have contributed significantly to traditional medicine and have proven effective in human health care worldwide (Asif, 2013; Hamayun et al., 2006; Johnson et al., 2015; Kumar et al., 2013; Tripathi & Pandey, 2017). It is presumed that about 80% of people living in developing countries use traditional medicines, which are majorly prepared from medicinal plants to meet their primary healthcare needs (Oguntibeju, 2019). The efficacy of alternative medicine has attracted many people to utilize it in treating various illnesses (Albejo et al., 2015; Ali et al., 2020; Baars et al., 2019; James et al., 2018; Mordeniz, 2019). The bioactive and secondary metabolites constitute the vital components in the therapeutic potentials of plants. Perhaps, empirical knowledge relating to the underlying mechanisms of the therapeutic effect of medicinal plants remains unclear. However, the usefulness of plants in combating varying fungal, bacterial, and other related infections is implicated in the efficacy of traditional medicines in remedying various diseases (El Hajj & Holst, 2020; Kamatenesi-Mugisha et al., 2008; Kayanja, 2008; Martin & Ernst, 2003; Wang et al., 2014). Numerous researches have highlighted the use of medicinal plants in Nigeria. For example, complementary and alternative medicines from plants have been deployed in treating various sicknesses among Nigerians, including cancer (Aliyu et al., 2017; Ezeome & Anarado, 2007), diabetes, and hypertension (Ala et al., 2020; Olayemi et al., 2015), HIV infection (Oshikoya et al., 2014), acute illnesses (Duru et al., 2020), kidney diseases (Okwuonu et al., 2014), malaria (Odugbemi et al., 2007), epilepsy (Lagunju, 2013), and asthma (Adeyeye et al., 2011). Thus, plants are essential in health, and research in their bioactive components remains significant. Therefore, the present study is focused on *Telfairia occidentalis*.

Telfairia occidentalis, commonly referred to as fluted pumpkin, is a vegetable that belongs to the family Cucurbitaceae and is also a green vegetable popularly consumed among the native of Africa (Adisa et al., 2012). It is a darkish green leafy vegetable popularly used in soup and folk medicine to manage many diseases in Nigeria (Akindele et al., 2013; Saalu et al., 2010). *T. occidentalis* is widely known for its commercial importance in West Africa region. The therapeutic activities of *T. occidentalis* have been reported by many investigators. *T. occidentalis* leaves are tropical vegetables of medicinal properties (Jimoh, 2018). It possesses high antioxidant activity (Eseyin, Sattar, et al., 2018). Several medicinal uses of the *T. occidentalis* in traditional medicine have been documented (Aisida et al., 2019; Ajani & Akinyemi, 2016; Aregheore, 2011; Atabo et al., 2016; Aworunse et al., 2018; Igbeneghu & Abdu, 2014; Kayode & Kayode, 2011; Kayode et al., 2009; Nwidu & Oboma, 2019; Alia, 2012).

Research on the pharmacological potentials of *T. occidentalis* indicates that the plant possesses antibacterial properties (Noumedem et al., 2013), antioxidant (Airaodion et al., 2019; Eseyin, Benedict, et al., 2018), antimicrobial (Stanley et al., 2018), anxiolytic (Ajao & Akindele, 2013), anticancer (Eseyin et al., 2014), antidiabetic, (James et al., 2016), antimalarial (Okokon et al., 2009), and antifungal activities (Nkiru, 2018). Although *T. occidentalis* has been widely studied and its phytochemical properties and activities established. The present study intends to further assess existing evidence from the literature on the antimicrobial effects of *T. occidentalis* on bacteria. Thus, the current study's primary purpose is to determine the phytochemical contents and the antimicrobial activity of *T. occidentalis* on *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*.

Materials and Methods:-

Collection and Preparation of Plant Materials

Fresh samples of the *T. occidentalis* plant were collected from the open market in Ankpa, Kogi State, Nigeria, and were conveyed to the laboratory for proper identification and authentication. The samples were washed and prepared according to the method described by Alara et al. (2019).

Sample Extraction

Aqueous Extract

Ten grams of the ground sample of the plant stem bark and leaf of *T. occidentalis* were extracted and added to 100ml of sterile distilled. The extraction of the plant's aqueous components was done following the method adopted in Abdulmalik et al. (2016) and Ali et al. (2017).

Phytochemical Screening of *T. occidentalis*

Phytochemical screening of the *T. occidentalis* leaf and seed extracts was conducted to ascertain bioactive components such as alkaloids, tannins, saponins, steroids, phenols, and flavonoids using the standard qualitative method as previously described by Trease and Evans (1989).

Sterility Test of the Plant Extracts

The plant's aqueous extract was tested for sterility following sterilization by inoculating 1 mL of each extract on sterile nutrient agar incubated at 37°C for 24 hours. Perhaps, the plates were carefully observed for growth.

Standardization of the Bacterial Cell Suspension

McFarland standard (Washington, 2011) was adopted to test for the standardization of the bacterial suspension. Colonies of the tested organism were picked into a sterile test tube containing sterile nutrient broth and incubated for one day.

Determination of Antimicrobial Activities

The crude extracts' antimicrobial activity was conducted using the agar well diffusion method described in Chaman et al. (2013) with few modifications.

Result:-

Table 1:- Table showing the phytochemical contents of the leaf and seed of *T. occidentalis*.

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

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

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

Table 2:- Table showing the sensitivity parameter of the organisms to ethanol extract.

Organisms	Seed	%	leaf	%
<i>C. albicans</i>	8mm	36.89	2mm	12.45
<i>P. aeruginosa</i>	5mm	18.21	1mm	6.78
<i>S. aureus</i>	8mm	37.10	7mm	36.26

Table showing the observed zone of inhibition of ethanol extract on *T. occidentalis* seed and leaf against some pathogenic organisms. Exposing the microorganisms to the aqueous extract of seed for sensitivity revealed the same 8mm diameter of inhibition zone (36.89% and 37.10%), respectively, for *C. Albicans* and *S. aureus*. However, *P. aeruginosa* possessed a minimal 5mm (6.78%) diameter inhibition zone than *C. Albicans* and *S. aureus*. The test on an ethanol extract of the leaf shows that *S. aureus* produced a high diameter of inhibition zone of 7mm (36.26%) while *C. albicans* produced lower with 3mm (12.45%) diameter of inhibition zone.

Table 3:- Table showing the sensitivity parameter of the organism to an acetone extract of the plant.

Organisms	Seed	%	leaf	%
<i>C. albicans</i>	8mm	21.38	7mm	41.19
<i>P. aeruginosa</i>	15mm	31.36	3mm	8.82
<i>S. aureus</i>	15mm	36.10	5mm	26.16

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* (31.36% and 36.10%), respectively, when tested with acetone seed extract of *T. occidentalis*. However, *C. Albicans* produced a reduced diameter of inhibition zones of 8mm (21.38%). Furthermore, it was revealed that *C. Albicans* produced an increased diameter of inhibition zones of 7mm (41.19%) 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	%
<i>C. albicans</i>	r	-	r	-
<i>P.aeruginosa</i>	r	-	r	-
<i>S. aureus</i>	8mm	96.10	r	-

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

Discussion:-

The present study was conducted to assess the phytochemical constituents and antimicrobial activity of fluted pumpkins on *Candida albicans*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. The result of the phytochemical analysis conducted on the leaf and seed of *T. occidentalis* revealed the presence of alkaloids, tannin, steroids, flavonoids, phenol, and saponins. However, it was found that tannins and phenol were mainly deposited in the plant's seed. Thus, the study is consistent with previous studies (Eltayeb & Hamid, 2017; Mensah, 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 conducted revealed that *S. aureus* was more vulnerable to the ethanol, acetone, and hot aqueous extracts of *T. occidentalis*. This is indicated in the increased size of the inhibition zones' diameter, as shown in the tables. 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 ethanol and acetone extracts' antimicrobial potentials compared to 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 traditional application of this plant as an alternative antibiotic.

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