ISSN:2782-8484

FEDPOLAD Journal of Science & Agricultural Technology (FEDPOLADJSAT); Vol. 4, ISSUE 1. OCTOBER, 2024 Edition

Website: https://seemjournals.fedpolyado.edu.ng/index.php/fedpoladjsat

Proudly Sponsored by: tetfund TERTIARY EDUCATION TRUST FUND

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PHYTOCHEMICAL SCREENING AND ANTIMICROBIAL EVALUATION OF *MOMORDICA CHARANTIA* LEAVES EXTRACTS

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Abstract

The use of medicinal plants in traditional and complementary medicine for treating, managing, or preventing various diseases dates back to the earliest human history. This study explores the phytochemical composition and antimicrobial properties of Momordica charantia (bitter gourd) leaf extracts, emphasizing their potential therapeutic applications. Leaves were collected, dried, and extracted using methanol and hexane solvents, then subjected to phytochemical screening and antimicrobial testing. The methanolic extract contained saponins, flavonoids, steroids, and terpenoids, while the hexane extract had flavonoids, steroids, and terpenoids. The methanolic extract demonstrated strong antimicrobial activity, showing the largest inhibition zone of 21 mm against Pseudomonas aeruginosa, along with moderate activity against Klebsiella (18 mm), E. coli (17 mm), and Staphylococcus (15 mm). The hexane extract effectively inhibited Proteus (18 mm) and Streptococcus (16 mm). Antifungal tests indicated that the methanolic extract exhibited the highest inhibition against Aspergillus parasiticus ***(20 mm).***

Keywords*: Momordica charantia, Aspergillus parasiticus, Pseudomonas aeruginosa antioxidant,*

Introduction

*Momordica charantia** commonly known as bitter gourd, is a medicinal plant from the Cucurbitaceae family, found in tropical and subtropical regions such as Africa, Asia, and South America, and widely used for both food and medicine (Mahmood et al., 2019). The Latin term *Momordica* means "to bite," a reference to the jagged, bite-like edges of its leaves (Chen and Huang, 2019). *Momordica charantia* contains various bioactive compounds, including momorchanins, momordenol, momordicilin, momordicius, momordicinin, momordin, momordolol, charantin, charine, cryptoxanthin, cucurbitins, cucurbitacins, cucurbitanes, cycloartenols, diosgenin, elaeostearic acids, erythrodiol, galacturonic acid, gentisic acid, goyaglycosides, goyasaponins, and multiflorenol (Kole et al., 2020). Its fruits and leaves also contain alkaloids, glycosides, saponins, rennin, aromatic volatile oils, and mucilage. Bitter gourd exhibits significant antimicrobial activity and is commonly used in the treatment of ailments such as piles, leprosy, jaundice, diabetes, and snake bites. Its fruits and leaves have shown various biological activities, including anti-diabetic, anti-rheumatic, anti-ulcer, anti-inflammatory, and anti-tumor effects (Behera et al., 2020).

Antimicrobials are compounds that inhibit or kill microbes such as bacteria (antibacterial), fungi (antifungal), viruses (antiviral), and parasites (antiparasitic). *M. charantia* has distinct serrate leaves, resembling bite marks, with separate yellow male and female flowers. The fruit varies in shape—discoid, ovoid, or ellipsoid to oblong and pointed at the end

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(Kole et al., 2020). Fruits are typically 2 to 10 cm in length, with a warty exterior and a hollow cross-section surrounded by a thin layer of flesh, containing flattened seeds and pith within (Gupta et al., 2011). Bitter gourd is often overlooked due to its bitter taste, though it is rich in essential nutrients. Compared to other cucurbits like squash, pumpkin, cucumber, and zucchini, it offers a higher nutritional value due to its abundant minerals and vitamins (Krawinkel and Keding, 2006). Its primary metabolites include common sugars, proteins, and chlorophyll, while its secondary metabolites—such as phenolics, carotenoids, cucurbitane triterpenoids, alkaloids, and saponins—are primarily responsible for its nutraceutical benefits. Although secondary metabolites contribute minimally to nutritional value, they have significant physiological effects that support health (Daniel et al., 2014). As antibiotic resistance rises, plant-based alternatives provide a promising avenue to address the limitations of conventional antibiotics. This research expands the pharmacological understanding of *Momordica charantia* examining its effectiveness against various pathogenic organisms and potentially supporting the development of new treatments for infectious diseases.

Material and Method

Sample collection

The *Momordica charantia* plant was obtained at the Federal Polytechnic Ado-Ekiti Ekiti state, Nigeria, and was transported to chemistry laboratory for analysis. The plant was air dried and thereafter pulverized into powder. This was stored in an airtight container for further analysis.

Sample Preparation

The method of Idris *et al*. (2009) was used. Fifty grams (50g) of the grinded plant material was soaked in 250ml each of methanol and hexane for 72 hours. The extract was filtered through a whatta no 1 filter paper to afford a crude extract.. The extracts were stored at 4°C until required for further analysis.

Phytochemical Screening

Qualitative phytochemical analysis of *Momordica charantia* was carried out to determine the secondary metabolites using standard protocols as reported in (AOAC, 2000).

Anti-Microbial Screening of the Plant Extract

Seven bacterial isolates and five fungi isolates were used as test organisms. They were collected from the Department of Microbiology of Federal Polytechnic, Ado Ekiti. The organisms were *Escherichia coli*, *Staphylococcus sp*, *Streptococcus sp*, *Salmonella sp*, *Klebsiella sp*, *Pseudomonas sp and Proteus sp*. The five fungi isolates include *A. flavus*, *A. parasiticus*, *A. sclerbit*, *Rhizopus oryzae and Fusarium oxysporum.* All the bacterial species used were maintained on nutrients agar slants and stored in the refrigerator at a temperature of 4°C from where they were sub-cultured unto fresh media at regular intervals and antibacterial activities of all the organisms against plant extracts were determined.

Statistical Analysis

The data obtained from the various experiments were computed and subjected to statistical analysis using SPSS 20.0 (2014).

Results and Discussion

The findings from the phytochemical, antimicrobial, antifungal, and antioxidant analyses of *Momordica charantia* (bitter gourd) leaves reveal valuable insights into the medicinal potential of this plant. Phytochemical screening identified various bioactive compounds, shedding light on the plant's therapeutic properties. The methanol extract contained saponins, flavonoids, steroids, and terpenoids, with tannins, phenols, and glycosides absent, while the hexane extract included flavonoids, steroids, and terpenoids but lacked saponins, tannins, phenols, and glycosides. This variation in composition likely results from the different polarities of the solvents, with the more polar methanol extracting a broader range of compounds than hexane. The presence of saponins and flavonoids in the methanol extract is notable, as these compounds are known for antioxidant, anti-inflammatory, and immune-boosting effects (Balasundram et al., 2006). The steroids and terpenoids found in both extracts also suggest potential anti-inflammatory and antimicrobial properties (Ogundipe et al., 2021).

In terms of antimicrobial activity, the methanol extract displayed a stronger inhibitory effect against various bacterial pathogens compared to the hexane extract. Most prominently, it demonstrated significant activity against *Pseudomonas aeruginosa*, with a 21 mm inhibition zone—an important finding given the bacterium's notable antibiotic resistance. Additionally, the methanol extract showed moderate inhibition against *Klebsiella sp*., *E. coli*, *Salmonella* and *Staphylococcus* sp., underscoring its potential as a broad-spectrum antimicrobial agent. In contrast, while generally less effective, the hexane extract exhibited notable inhibition against *Proteus* (14 mm) and *Streptococcus* (19 mm), suggesting that its non-polar compounds, like steroids and terpenoids, may be particularly effective against Gram-positive bacteria. The differing efficacies between the two extracts could be due to methanol's ability to extract more polar bioactive compounds, such as flavonoids and saponins, known for their antimicrobial properties (Adewole et al., 2022).

The antifungal activity of both extracts further highlights *Momordica charantia*s therapeutic potential. The methanol extract exhibited the strongest inhibition against *Aspergillus parasiticus* with a 30 mm inhibition zone, along with moderate inhibition of *Fusarium oxysporum* and *Aspergillus flavus*. Meanwhile, the hexane extract, though generally less potent, showed notable inhibition against *Fusarium oxysporum* (20 mm) and *Aspergillus sclerotiorum* (17 mm). These results align with findings by Rana and Kumari (2022), who reported significant antifungal activity in methanol extracts of *Momordica charantia** attributed to terpenoids and flavonoids that disrupt fungal cell membranes. The antifungal activity observed in both extracts suggests that *Momordica charantia* could serve as an effective natural remedy for fungal infections

Conclusion and Recommendation

In conclusion, the findings from this study underscore the potential of *Momordica charantia* as a valuable source of natural bioactive compounds with significant antimicrobial, antifungal, and antioxidant properties. The methanol extract, in particular, exhibited a broad spectrum of activity against both bacterial and fungal pathogens and showed strong antioxidant potential. The hexane extract, while less potent, still demonstrated important antimicrobial and antifungal properties, particularly against Gram-positive bacteria and certain fungal species. These results suggest that *Momordica charantia* could be developed into natural remedies for infections and oxidative stress-related conditions. Future research should focus on the isolation and characterization of the specific bioactive compounds responsible for these activities, as well as clinical trials to assess their therapeutic efficacy in humans.

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Table 1: Phytochemical screening of Bitter gourd leaves

Chemical component	Methanol extract	Hexane extract
Saponin	+	-
Flavonoid	+	+
Tannin	-	-
Phenol	-	-
Steroids	+	+
Terpenoids	+	+
Glycosides	-	-

Key: - (absent), + (present)

Table 2: Antimicrobial screening of Bitter gourd extract against pathogenic organisms

Organism	Diameter of zone of inhibition (mm) at different concentrations	
	Methanol extract	**Hexane extract**
E. coli	12± 0.16	9± 1.12
Staph	13± 0.11	11± 0.05
Kleb	15± 0.10	14± 0.10
P. aeruginosa	21± 0.16	08± 0.10
Salmonella	13± 0.16	10± 0.18
Proteus	10± 0.13	14± 0.11
Streptococcus	13± 1.00	19± 0.10

Key: - (no inhibition)

Table 3: Antimicrobial screening of Bitter gourd extract against fungi pathogenic organisms

Organism	Diameter of zone of inhibition (mm) at different concentrations	
	Methanol extract	**Hexane extract**
A. Flavus	14± 0.10	-
A. Parasiticus	30± 0.12	15± 0.14
A. Sclerbit	13± 0.19	17± 0.17
Rhizopus Oryzae	10± 0.10	7± 1.11
Fusarium oxysporum	16± 0.12	20± 0.10

Key: - (no inhibition)