INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VI, June 2025

Phytochemical Screening and Antimicrobial Properties of Momordica Balsamina L. (Balsam Apple) Leaves Extracts

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DOI: https://doi.org/10.51583/IJLTEMAS.2025.140600040

Received: 18 June 2025; Accepted: 23 June 2025; Published: 08 July 2025

Abstract: The microbial treatment methods are losing potentiality as pathogens are swiftly gaining resistance to antibiotics, which poses a threat to global health communities and necessitates searching for alternatives therapeutics from plants origin with limited side effects. This study aimed to investigate the phytochemical components and antimicrobial properties of extracts from *Momordica balsamina* leaves to scientifically justify the use of this plant as remedy for treating certain ailments. The ground powdered leaves of *Momordica balsamina* were percolated with Ethanol and fractioned into n–Hexane, Chloroform and Methanol fractions which were evaluated against *Bacillus subtilis, Escherichia coli*, *Salmonella typhi* and *Staphylococcus aureus* using Agar well diffusion method. The MIC and MBC were determined. Qualitative phytochemical screening of the plant extracts using standard method revealed the presence of alkaloids, flavonoids, glycosides, steroids, saponins and tannins. The antimicrobial analysis results revealed sensitivity with highest zone of inhibition of 29.0±2.0mm, 27.0±3.0mm, 19.0±1.0mm and 15.0±2.0mm for ethanol extract against *Bacillus subtilis, Escherichia coli, Salmonella typhi* and *Staphylococcus aureus* respectively. This study revealed extracts from *Momordica balsamina* leaves contained some bioactive compounds that could be used to treat ailments caused by these bacteria tested.

Keywords: Microbial, *Mormodica balsamina*, phytochemicals, infectious diseases, bioactive compounds.

I. Introduction

Bacterial diseases have a significant effect on human health, especially in low-income countries, where antibiotic abuse, poor infection, prevention, and control techniques contribute to high mortality rates and the establishment of drug resistance, the antimicrobial resistance (AMR) is a global health concern that needs the development of new treatments (Ca'tia *et al*., 2022; Thakur *et al*., 2024). Antibacterial resistance is expected to be responsible for 4.95 million fatalities in 2019, with most of them occurring in low and middle-income nations, Pathogenic bacteria' AMR is expected to reach ten million by 2050 and WHO has identified *Pseudomonas aeruginosa*, *Escherichia coli*, and *Staphylococcus aureus* as critical antibiotic-resistant priority pathogens (Thakur *et al*., 2024).

Antibiotics are natural or manmade chemicals (synthetic) that have the potential to hinder, suppress, or stop biochemical processes in an organism's body, ultimately inhibiting that organism's growth process (Aryanti and Lamdayani, 2021). The growth in antibiotic-resistant infections, notably among the Enterobacteriaceae, highlights the need for alternate treatments, Medicinal herbs play an important role in resolving these issues (Enitan *et al*., 2023). They are the primary source of life-saving medications for the majority of the world's population. Many modern medicines are derived from plants that were traditionally used to cure illness and disease. The World Health Organization (WHO) has also identified over 20,000 medicinal plant species and described them as a potential source of new medications (Vaou *et al*., 2021). As a result, there is an increasing desire for novel antimicrobial agents capable of reducing the use of synthetic antibiotics while also combating resistance development. This has prompted researchers to isolate and identify novel bioactive compounds from plants that can combat microbial resistance, Medicinal plants provide a nearly limitless supply of bioactive chemicals, and their usage as antimicrobial agents has been explored in many methods (Vaou *et al*., 2021). The majority of herbal therapies used today are awaiting validation of their claimed effects and possibly the development of novel antimicrobial drugs from them (Bello *et al*., 2018). *Momordica balsamina* is a notable example of such plants with reported medicinal properties that displayed crucial antibacterial properties, which renders this plant interesting in the quest for novel antimicrobial substances (Ca'tia *et al*., 2022)

Description (Biological classification of *Momordica balsamina)*

Kingdom – Plantae

Superdivision – *Spermatophyta* (Seed plants)

Division – *Magnoliophyta* (Flowering plants)

Class – *Magnoliopsida* (Dicotyledons)

Order - *Cucurbitales*

Family – *Cucurbitaceae* (Cucumber family)

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Sub family - *Cucurbitoideae*

Genus – *Momordica*

Species – *balsamina Linn.* (Thabile, 2016)

A local name includes Bitter melon, Balsam apple in English, Garahuni in Hausa, Akbon-ndewe in Igbo, and is also known as Ejirin in Yoruba. Mozambians called it Cacana while South Africans called it nkaka (Abdulhamid *et al*., 2023).

Morphology of *Mormodica balsamina*

The plant has soft stems and tendrils that climb up shrubs, boundary fields and fences. The green leaves are deeply palmately 5-7 lobed, with toothed margin and about 12 cm long stalked (Bello *et al.,* 2018). Researchers and traditional healers both have expressed great interest in the plant's therapeutic potential, even though; it is considered an invasive species in some areas (Khatoon *et al.,* 2025).

Medicinal Uses of *Mormodica balsamina* (Balsam apple)

Mormodica balsamina has amazing antibacterial properties and can be used as an excellent source of antimicrobial agent for a variety of ailments. It has been used to treat HIV, fever, diabetes, diarrhea, and family planning (Abdulhmid *et al.,* 2023). The leaves are cooked as part of a green vegetable soup for lactating mothers in order to regenerate lost blood during labor and purify their breast milk. Extracts of fruits, leaves, and seeds are used as anti-helminthics in northern Nigeria and parts of Niger. Leaf extract is used to treat high fever, uterine hemorrhage, and syphilis. It is also used to treat rheumatism, hepatitis, skin conditions, and gastroenteritis. Many folkloric practices exist in Northern Nigeria; the majority of them lack a scientific basis. For example, applying moist chopped *Mormodica balsamina* leaves to newborn babies' navel wounds serves as a healing agent (Bello *et al*., 2018). In Senegal, it is used to cure hemorrhoids, uncomfortable menstruation, dermatosis, stomachaches, rheumatism, and other diseases. An aqueous extract of its leaves relieves menstruation cramps in young females. It also possesses antimalarial and antidiabetic effects. The Wolof people (Senegal) use the fruits for purgative and deworming reasons. *Mormodica balsamina* is used in Nigeria to treat asthenia and digestive problems, and the Fulani people use it as a dewormer and tranquilizer. It is even put into medications for mental health difficulties. Additionally, the maceration of the entire plant serves as a galactagogue and is employed for chest massages to ease intercostal soreness. In Niger, crushed *Mormodica balsamina* leaves are used as poultices to treat skin problems. In Syria, an infusion of fruit or leaf powder is used as an antibacterial, as well as to cure asthenia and hemostasis. In Indonesia, it is used as a laxative, fever therapy and as a stimulant for loss of appetite (Thiaw *et al*., 2023). The leaves of *Momordica balsamina* are an important source of nutrients including 17 amino acids, various minerals like Phosphorus, Zinc, Manganese, Calcium, Sodium, Magnesium, Potassium, Iron and vitamins A and C, its high potassium content is a good source for the management of hypertension and other cardiovascular conditions (Souda *et al*., 2018).

Toxicity of *Mormodica balsamina*

According to Behera *et al.,* 2011, there have been no published reports of any fatal or adverse effects of *Mormodica balsamina* in humans at regular oral doses of 50millilitre juice. Toxicity has been found in several animal investigations, *Mormodica balsamina* leaves and fruits from Nigeria have been reported to be harmful to different organs and tissues of rats at extremely high doses, *Mormodica balsamina* stem bark at extremely high dosage (LD50 3750mg/kg) produced depression, dilated pupils, urine, weakness, sleepiness, and death in rats within 24hours. Fruits are hazardous because they contain alkaloids, resins, saponin, and glycosides, however, these compounds are denatured when cooking (Thabile, 2016). Toxicity and cytotoxicity investigations were performed on crude extracts of *Mormodica balsamina*, oral administration of the methanolic extract of *Mormodica balsamina* to albino mice for one week revealed that doses of 30 and 40mg/kg did not cause toxicity. However, when the dosage ranges from 50mg/kg to 150mg/kg, mice fatalities were reported with an average death rate of 20%. An intoxication syndrome develops in mice at 50mg/kg, followed by occasional deaths, with the greatest average death rate reaching 40% (Thiaw *et al*., 2023).

II. Materials and Methodology

Sample collection and preparation

The fresh leaves of the plant *Momordica balsamina* were collected from Aliko Dangote University of Science and Technology (ADUSTECH), Wudil around the premises of Faculty of Science Complex Buiding, Wudil local government area Kano State Nigeria and the sample was identified at Biology Department, Aliko Dangote University of Science and Technology Wudil by Technologist Muhammad A. Abbas and confirmed by Prof. Lawal D. Fagwalawa and a voucher specimen number Kust/Biol/00035 was deposited there. The leaves were brought to Chemistry Mega Laboratory washed with tap water and exposed in a well-ventilated area to air dried then ground to powder using mortar and pestle. The dried sieved powdered leaves obtained were kept in a clean polyethene bag at room temperature which served as a sample for the research.

Extraction Procedure

One hundred and fifty grams (150g) of the powdered leaves was percolated in 1000millilitres of ethanol at ambient temperature for two (2) weeks with regular shaken. The mixture was decanted, filtered using Whatman filter paper and concentrated using rotary

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evaporator at 70^0C. The crude ethanolic extracts obtained was dried at ambient temperature and kept for further use (Abdulhamid *et al.,* 2023; Thakur *et al.,* 2024). Percentage yield was determined using the expression below

$$\text{Percentage (\%) yield} = \frac{weight\ of\ the\ plant\ extract\ obtained}{\text{weight of ground plant materials used}}\ X\ 100\%$$

Fractionation of Crude Extract

Six grams (6.0g) of crude ethanolic extract was fractioned into three distinct fractions using various solvents (n-Hexane, Chloroform and Methanol) based on their polarities; each fraction was allowed to dry at ambient temperature and the resulting fractions were kept in refrigerator in air tight bottles for further use. Percentage yield was determined using the expression below

$$\text{Percentage (\%) yield} = \frac{\text{weight of fraction obtained}}{\text{weight of ground plant material used}}\ X\ 100\%$$

(Thakur *et al.,* 2024)

Qualitative Phytochemical Analysis

Phytochemical screening was conducted to identify the various natural products that have some bioactivity using standard methods as described by Abubakar and Haque 2020 and Musa *et al.,* 2023.

Test for alkaloids (Dragendorff's test): To 1millilitre of the plant extract in a test tube,

1millilitre of Dragendorff's reagent (potassium bismuth iodide solution) was added and shaken. Formation of an orange red precipitates, indicates the presence of alkaloids.

Test for glycosides (Legals test): To 1millilitre of the plant extract taken in a test tube, then an equal volume of sodium nitroprusside was added followed by few quantity of sodium hydroxide solution and then shaken. Formation of pink-to-blood-red precipitates indicates the presence of cardiac glycoside.

Test for triterpenoids and steroids (Salkowski's test): To 1millilitre of the plant extract in a test tube, 2millilitre of chloroform was added, shaken, and filtered. Then few drops of concentrated sulfuric acid were added and shaken, it was allowed to stand. Formation of golden-yellow precipitates indicates the presence of triterpenes or steroids.

Test for tannins (Gelatin's test): To 1millilitre of plant extract in a test tube then 1% gelatin solution containing sodium chloride was added and shaken. Formation of white precipitates indicates the presence of tannins.

Test for flavonoids (Lead acetate test): To detect the presence of flavonoids, 1millilitre of extract was taken and placed into a test tube. Then followed by addition of few drops of lead II trioxonitrate V solution, $Pb(NO_3)_2$ and shaken. Formation of yellow precipitate indicates the presence of flavonoids

Test for Saponins: To 1millilitre of the plant extract, 2millilitre of distilled water was added to form a suspension of plant extract. The suspension was shaken in a test tube for 10minutes. Appearance of thick foam indicates the presence of Saponins.

Test for phenols: A small amount of plant extract was taken with 1millilitre of water in a test tube and 1-2 drops of ferric chloride was added. A blue, green, red, or purple coloration is a positive test and indicates the presence of phenols.

Preparation of stock solution and varying concentrations of the plant extracts

Four different concentrations of the extracts were prepared by serial dilution; 0.5grams of each extract was dissolved in 0.5millilitre of Dimethyl sulfoxide (DMSO) to yield a concentration of 1.0g/ml equivalent to 1000mg/ml (10^6µg/ml) as stock solution. From the stock solution, 0.1ml was transferred into a sterile bijou bottle containing 0.9ml of DMSO thus giving a concentration of 100mg/ml. From stock solution 0.1ml was transferred into another sterile bijou bottle containing 1.9ml of DMSO which gave a concentration of 50mg/ml and this was further diluted to 25mg/ml and 12.5mg/ml.

Antimicrobial bioassay Test

The antimicrobial test was carried out to access the antimicrobial activity of the leaves extract of *Momordica balsamina* against *Bacillus subtilis, Escherichia coli, Salmonella typhi* and S*taphylococcus aureus* using Mueller-Hinton agar & Nutrient Broth agar. Performed through the following methods:

Microorganisms collection

Bacillus subtilis, Escherichia coli, Salmonella typhi and S*taphylococcus aureus* were obtained from Microbiology Laboratory of Aliko Dangote University of Science and Technology, Wudil. These organisms were chosen because they are pathogens which cause a broader spectrum of diseases in biotic entities. The research was conducted at Microbiology Laboratory of Aliko Dangote University of Science and Technology, Wudil.

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Preparation of Mueller Hinton agar Medium

The Mueller Hinton agar was prepared by dissolving 38g of the agar powder in 1000ml of distilled water in a volumetric flask and swirled to dissolve. The solution was sterilized in an autoclave at 121°C for 15minutes and allowed to cool at 50°C before pouring to sterile Petri dishes (Bello *et al.*, 2018; Musa *et al.*, 2023), allowed to solidify and set for the analysis.

Preparation of culture medium and inoculation

The pure isolates were obtained by sub culturing unto fresh nutrient agar plates. The freshly grown microbial cultures were carefully diluted in test tubes containing sterile normal saline solution to conform to the McFarland standard as described by Kengne *et al.*, 2017. The McFarland standard was prepared by mixing 0.05ml of 1% (W/V) dehydrated barium chloride solution with 9.95ml of 1% (V/V) Tetraoxosulphate VI acid solution and was labeled as the standard inoculums and kept in a sterile closed bottle in a refrigerant before use. The standard inoculums were then evenly smeared onto the prepared nutrient agar plates. After smearing, plates were dried for 15minutes and 6mm wells were punched using sterile borer. The wells were filled with concentrations of plant extracts. Commercially available Ciprofloxacin (50.0mg/ml) was used as positive control in this study while the solvent (DMSO) was used as negative control. After a 30-minute diffusion period, all petri dishes were placed in an incubator at 37^0C for 24 hours. After a 24-hour incubation period, a clear inhibition zone was measured in millimeters around each well using a millimeter ruler. Larger zones state higher antibacterial potency, an agar well (6mm) showing no zone of inhibition was considered as no antimicrobial activity and each test was performed in duplicate.

Determination of Minimum Inhibitory Concentration (MIC)

The broth dilution method was employed in the determination of the Minimum inhibitory concentration MIC of plant extract and fractions were determined using Clinical and Laboratory Standards Institute (CLSI), 2017 guidelines with slight modifications. Stock solution of all extracts was made with Dimethyl sulphoxide (DMSO), four test tubes (for each sample) containing 2mililitres of Mueller Hinton Broth were serially diluted with the stock solution, 0.1 mililitres of a standardized inocolums of a test organism was added to each test tube and incubated for 24hours at 37^0C, the test tubes were observed for presence of growth, the minimum concentration that inhibit the growth of organism (indicated by the absence of turbidity) is the minimum inhibitory concentration (MIC) of the test extracts (Thakur *et al.*, 2024).

Determination of Minimum Bactericidal Concentration (MBC)

This was carried out according to the method described by Thabile, 2016 to determine growth of the bacteria colonies on plate after overnight incubation. Minimum Bactericidal Concentration was carried out by inoculating sample from the MIC tubes that show no viable bacterial growth, on the prepared nutrient agar plates and incubated at 37^0C for 24hours. The plates were observed for the presence or absence of growth. The least concentration of extract showing no bacterial growth was considered the MBC. Values were recorded in mg/ml

Statistical analysis

The means ± standard deviations (SD) were employed to express the data. Every test was performed in duplicate.

III. Results and Discussion

Results

Secondary metabolites (Phytochemicals) were extracted using different solvents and solutions of all the fractions obtained have a bitter taste. Table 1 below presents some physical properties, weight and percentage yield of *Mormodica balsamina* leaves ethanolic crude extract and its solvent fractions.

Table 1: Physical properties and percentage yield of the fractions obtained

Extracts	Physical Appearance/Solubility in water	Mass obtained	Percentage yield
Ethanol fraction	Dark green, sticky substance/soluble	9.08g	6.05%
n-Hexane fraction	Greenish solid and slightly soluble.	1.80g	1.20%
Chloroform fraction	Gummy Greenish solid/soluble	1.60g	1.07%
Methanol fraction	Greenish solid/soluble	2.60g	1.73%

Using different methodologies and reagents, phytochemical analysis was performed to confirm the presence of certain bioactive substances. Table 2 shows the results of a qualitative phytochemical screening of extracts from *Mormodica balsamina* leaves. Flavonoids and tannins were present in all the fractions while phenols was absent in all the fractions and alkaloid, saponins, glycosides, steroids give positive results in some of the fractions.

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Table 2: Phytochemical Constituents of *Mormodica balsamina* leaves extracts

Phytochemicals/Fractions	Ethanol	n-Hexane	Chloroform	Methanol
Alkaloid	+	+	-	-
Flavonoids	+	+	+	+
Glycosides	+	+	+	-
Polyphenols	-	-	-	-
Saponins	+	-	+	+
Steroids	+	-	-	+
Tannins	+	+	+	+

Keys: (+) = Indicate present; (-) = Indicate absent

Table 3 showed the antimicrobial activity of crude ethanolic extract and its fractions carried against the tested bacteria *Bacillus subtilis, Escherichia coli, Salmonella typhi* and S*taphylococcus aureus* using dimethyl sulphoxide (DMSO) as a solvent. The crude extract was active against all the test organisms while other fractions show selectivity for antimicrobial activities on the tested pathogens.

Table 3: Antimicrobial Activities of *Mormodica balsamina* Leaves Extracts against the tested bacteria

Extracts/Drugs	Zone of Inhibitions (ZI) in millimeter (mm)				
	Concentrations	*B. subtilis*	*E. coli*	*S. typhi*	S. *aureus*
Ethanol	100mg/ml	29.0±2.0	27.0±3.0	19.0±1.0	15.0±2.0
	50mg/ml	16.0±0.5	17.0±1.5	15.0±0.0	12.0±0.5
	25mg/ml	14.0±1.0	13.0±0 .3	13.0±0.6	11.0±1.0
	12.5mg/ml	9.0±1.0	8.0±1.5	7.0±0.5	8.0±1.5
n-Hexane	100mg/ml	18.0±0.7	18.0±1.0	12.0±0.7	11.0±1.2
	50mg/ml	10.0±0.5	9.0±0.0	10.0±1.4	10.0±0.0
	25mg/ml	7.0±0.0	8.0±0.5	8.0±0.5	8.0±1.0
	12.5mg/ml	0.00	8.0±0.0	6.0±0.0	8.0±0.5
Chloroform	100mg/ml	25.0±0.2	25.0±0.5	14.0±0.7	14.0±0.3
	50mg/ml	21.0±0.5	9.0±1.0	13.0±0.0	15.0±0.0
	25mg/ml	9.0±1.5	6.0±0.6	7.0±0.0	10.0±1.7
	12.5mg/ml	10.0±0.8	0.00	6.0±0.2	6.0±0.0
Methanol	100mg/ml	16.0±0.8	18±1.0	19.0±0.0	13.0±1.0
	50mg/ml	13.0±2.0	15±1.0	17.0±0.4	11.0±2.0
	25mg/ml	10.0±0.6	10±2.0	10.0±1.0	7.0±0.2
	12.5mg/ml	11.0±1.0	6±0.0	7.0±0.2	6.0±0.0
Ciprofloxacin	50.0mg/ml	34.0±1.0	36±0.5	34.0±1.5	38.0±1.2
	12.5mg/ml	29.0±0.0	26±1.5	30.0±1.0	31.0±2.0
DMSO	0.10ml	0.00	0.00	0.00	0.00

Values are mean ± S.D (n = 2)

Key: mm - millimeter

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In vitro activity of drugs with antibacterial potential is evaluated using two basic parameters: the Minimum Bactericidal Concentration and the Minimum Inhibitory Concentration. Table 4 shows that the lowest bactericidal concentrations for the bacterial species tested ranged from 12.5mg/ml to 50mg/ml, while the minimum inhibitory concentrations for the different pathogenic bacteria investigated in the extracts ranged from 25mg/ml to 100 mg/ml

Table 4: Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of *Momordica balsamina* Leaves Extracts against the tested bacteria

Extracts	MIC and (MBC) in mg/ml				
	Concentrations	*B. subtilis*	*E. coli*	*S. typhi*	S. *aureus*
Ethanol	100mg/ml	-	-	-	-
	50mg/ml	-	- (+)	- (+)	- (+)
	25mg/ml	- (+)	-	-	-
	12.5mg/ml	-	+	+	-
n-Hexane	100mg/ml	-	-	-	-
	50mg/ml	- (+)	-	-	+
	25mg/ml	-	- (+)	+	+
	12.5mg/ml	+	-	+	+
Chloroform	100mg/ml	-	-	-	-
	50mg/ml	- (+)	-	+	- (+)
	25mg/ml	+	+	+	+
	12.5mg/ml	+	+	+	+
Methanol	100mg/ml	-	-	-	-
	50mg/ml	- (+)	- (+)	-	-
	25mg/ml	-	-	- (+)	-
	12.5mg/ml	+	+	+	-

Keys: - = Indicate that the bacteria were dead or growth was inhibited due to the absence of turbidity in the test tubes which means the extract used is effective.

+ = Indicate that the bacteria were alive due to the presence of turbidity, which means the extract used is not effective. (+) = Indicate least concentration of extract showing no bacterial growth on the agar plates (MBC)

IV. Discussion

The study has shown that *Mormodica balsamina* leaves extracts consists of phytochemical components which include alkaloids, steroids, glycosides, saponins, tannins and flavonoids but phenols were absent. This finding coincides with earlier research by Giwa *et al.*, 2025, that assessed the phytochemical composition and antibacterial efficacy of leaves extracts in *Momordica balsamina* and discovered that the anthraquinones were absent while alkaloids, flavonoids and tannins were among the bioactive compounds present. Thakur *et al.*, 2009 reported that screening of *Mormodica balsamina* leaves, seeds, fruit and stem indicates the presence of saponins, steroids, terpenes, and cardiac glycoside. Also Abdulhamid *et al.*, 2023 identified flavonoids, tannins, coumarins, terpenoids and phenols from *Mormodica balsamina* leaves crude extract and its fractions.

Since dimethyl sulfoxide (DMSO) is a colorless, polar aprotic solvent that has no biological activity and can dissolve both polar and non-polar molecules, it was chosen as the solvent for the plant extracts (Aryanti and Lamdayani 2021). Table 3 indicates that at a concentration of 100 mg/ml, the entire fractions exhibited inhibitory diameter, with the highest zone of inhibition for ethanol extract against *Bacillus subtilis, Escherichia coli, Salmonella typhi,* and *Staphylococcus aureus* being 29.0±2.0mm, 27.0±3.0mm, 19.0±1.0mm, and 15.0±2.0mm, respectively and 0.00mm zone of inhibition for n-Hexane and Chloroform fractions against *Bacillus subtilis* and *Escherichia coli* at 12.5mg/ml. This is in accordance with research on the antibacterial activity test of Giwa *et al., 2025* who evaluated the antibacterial activities of methanol leaf extracts from *Momordica balsamina*, the extracts demonstrated significant antibacterial activity, particularly against Gram-negative bacteria (*Salmonella typhi*). Using methanol leaf extracts, Abdulhamid *et al.*, (2023) investigated the antibacterial activity of *Momordica balsamina* against *Escherichia coli and*

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Staphylococcus aureus for a 24hour period. According to their findings, *Momordica balsamina* methanol extracts demonstrated sensitivity to the tested microorganisms, suggesting that *Momordica balsamina* leaves could serve as a natural antibacterial alternative for infections caused by these bacteria. Phytochemicals play an important role in medicinal properties of plants (Thakur *et* al., 2024).

Phytochemicals are known for their medicinal significance, displaying various pharmacological, biochemical, and physiological effects, commonly employed in modern medicine (Rajani *et al*., 2024). Therefore the antimicrobial properties of this plant may be due to the presence of alkaloids tannins and flavonoids.

The MIC and MBC are the fundamental parameters used to assess the *in vitro* activity of antimicrobial drugs having antibacterial potential. The minimum inhibitory concentration (MIC) for the various pathogenic bacteria tested in the extracts ranged from 25mg/ml to 100mg/ml and for minimum bactericidal activity (MBC) for the bacterial species tested ranged from 12.5mg/ml to 50mg/ml, as presented in Table 4. All the extracts inhibit the growth of the pathogens (MIC) at 100mg/ml, while lowest MBC were observed at 25mg/ml against *Bacillus subtilis, Escherichia coli* and *Salmonella typhi*. The MBC values are more reliable than the MIC values which depends only on the visual observation of turbidity (Junaid *et al*., 2006). MIC values <1mg/mL expressed by crude plant extracts are regarded as indicators of good antimicrobial activity with potential physiological relevance *in vivo* (Souda *et al.*, 2018).

V. Conclusion

Based on findings, in phytochemical analysis the results showed that flavonoids and tannins are present in all the fractions, while phenol was absent in all the fractions, steroids, alkaloids, glycosides, saponins were found present in some fractions and absent in some fractions. Moreover the fractions where further screened for activity against *Bacillus subtilis, Escherichia coli, Salmonella typhi* and *Staphylococcus aureus* where the Antimicrobial analysis results revealed some sensitivity in a dose depending manner. Therefore leaves of *Momordica balsamina* contains some natural compounds that could be useful in the treatment of infectious diseases caused by these bacteria.

VI. Recommendation

Due to the presence of many metabolites in the leaves extract of *Mormodica balsamina*, further analysis should be carried out to isolate and identify the specific metabolite(s) that have effect against the pathogenic organisms used in this research also the extracts should be tested on other pathogenic microorganisms. Further investigations regarding the mode of action and other related pharmacological studies such as *in vivo* investigation, drug formulation and clinical trials are highly recommended.

Acknowledgments: The Authors are thankful to the Tertiary Education Trust Fund (Tetfund) being this research is fully funded by Tetfund through Institution Based Research (IBR). TeTfund Reference (No: ADUSTECH/DRI&D/IBR/DISB/BT9/2024/029). We are thankful to the Directorate of Research, Innovation and Development, Aliko Dangote University of Science and Technology (ADUSTECH).

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