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Preliminary phytochemical evaluation of methanol extracts of momordica dioica roxb

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Abstract

Momordica dioica, commonly known as spiny gourd, teasle gourd, or kakrol, is a perennial, dioecious climbing plant belonging to the Cucurbitaceae family. This versatile plant is not only used as a food source but also plays a role in preventing and treating various illnesses. The current study focuses on the phytochemical analysis of Momordica dioica, investigating its potential medicinal properties. The fruit is extracted in stages using methanol, after which the presence of key phytochemicals—such as flavonoids, phenolic compounds, tannins, saponins, phytosterols, triterpenoids, and quinones—is screened. The results indicate that this plant is a rich source of diverse phytochemicals. This experimental investigation has identified several biologically active secondary metabolites, which may contribute to the development of new drugs. Overall, Momordica dioica shows promise for future research in pharmacology and nutrition, highlighting its significance in both traditional and modern medicine.

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INTRODUCTION

Despite recent advances in modern medicine, traditional medicinal plants are still employed by many different tribes around the world for their fundamental healthcare needs. The use of medicinal plants as a method of therapy has long been prevalent in many traditional medical systems due to their effectiveness, low cost, and simplicity of availability. Unfortunately, the absence of true drug standards leaves unrefined drugs of natural origin open to adulteration and

replacement. As a result, this affects the potency, quality, and purity of the medications. To confirm the efficacy of herbal medicine, a pharmacognostic examination must be conducted [1].For many years, various illnesses have been treated with herbal medications. Herbs, which are widely available and have a lower risk of side effects, have been used to treat a variety of human ailments [19], [12]. The use of therapeutic plants is expanding in several countries, where 35% of medicines contain natural ingredients [15]. The World Health Organization (WHO) has set forth rules for standardizing herbs, herbal products, and other types of healthcare, as well as specific standards for the assurance of safety and rigorous quality control profiles [5],[2].

Diaspora Momordica Roxb is a member of the Cucurbitaceae family of the Momordica genus, which includes roughly 80 species of annual or perennial climbers [13]. A small, oval to ovoid vegetable known as teasle gourd or little bitter gourd, Momordica dioica, also called spiny gourd in India, has been listed in **Table 1**[1]. It is frequently grown for its edible fruits or vegetables [17]. The fruit of this plant has a beak that is 1-4 inches long and is densely coated in soft spines. This climbing creeper is typically found in Ceylon, Bangladesh, the Himalayas, and India. It has been reported up to a height of 1,500 meters in Assam and the Meghalayan Garo hills [16]. A cucurbitaceous plant called kakrol has been developed in Indo-Malaya. For the phytochemical screening of cucurbitaceous plants, Momordica dioica is used. A sizable number of crops, including cucumbers and melons, that are essential for medicine are members of the Cucurbitaceae family. Cucurbits refers to the family of plants as a whole. Without any immediate family members, it is a distinct family. This family of plants offers a wide range of therapeutic and dietary advantages. Therefore, it is crucial to identify the active ingredients with pharmacological activity in plants belonging to the same family. Hence, the current experimental study was chosen to determine whether phytoconstituents were present in different extracts of the chosen plant drug [14].

Materials and Methods

Collection of Plant Material:

The fruits of *Momordica dioica* Roxb. were obtained from the local market in Kadapa District, Andhra Pradesh. They were verified and authorized by a botanist at Yogi Vemana University. To utilize as experimental material, *Momordica dioica* fruits were harvested, shade-dried, cleaned, and transported in sterile plastic bags to avoid moisture loss during the trip to the lab.

Table 1 Vernacular Names of Spiny Gourd in India

English	Small bitter gourd, Spine gourd, Teasel gourd.
Hindi	Kakora, Parora, Kantola
Sanskrit	Vahisi
Tamil	Paluppakkay
Malayalam	Venpaval
Kannada	Madahagala-Kaya
Telugu	Agakara, Karkotaki
Bengoli	Kartoli
Punjabi	Bharkarela
Assam	Batkarila
Gujarat	Katwal

Macroscopic Examinations:

Macroscopic analysis is a method used to assess the scientific classification **Table 2** [3]and morphology of the fruit components that can be viewed with the unaided eye or a magnifying glass. Macroscopic analysis is important for accurately identifying crude medications and their characteristics. The fruit is densely covered in soft spines and has a small, snub beak. Young fruits are green, and as they age, they turn yellow. The red pulp that encircles the seeds is irregularly corrugated, somewhat compressed, and spherical. The fruit is roughly ovoid or ellipsoid in shape and measures 1 to 4 inches long, containing dark brown, many oval, smooth seeds. The fruits emit a bad odor and have a bitter flavor.

Microscopic Evaluation:

The transversely cut surface of the fruit features numerous outer longitudinal rugose folds and a spherical form. The pericarp is composed of an outer, middle, inner, and endocarp. The iso-diametrically tangentially elongated epidermal cells have glandular and multicellular trichomes on them. The exterior mesocarp tissue consists of eight to ten layers (8–10 layers) and contains large, isodiametric or radially elongated cells that appear to be devoid of cell sap. The middle mesocarp tissue is polygonal in shape, with four to five layers

of thick-walled cells containing lignin. The internal mesocarp consists of several layers of thin-walled cells with a significantly higher starch content than the outer layers. Tiny, floppy bundles of bicollateral vascular tissue arranged in a ring cover the core mesocarp. Endocarp tissue is composed of microscopic, thin-walled, and tangentially elongated cells, which are transparent and thin. The cotyledon tissue, oil globules, and aleurone grains surround the polygonal parenchyma that makes up the endosperm [18].

Table 2 Scientific Classification of Spiny Gourd

Kingdom	Plantae
Subkingdom	Tracheobionata
Superdivision	Spermatophyta
Division	Magnoliphyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Violales
Family	Cucurbitaceae
Genus	Momordica
Species	Dioica

Preparation of Plant Extract:

The fruit of the gathered plant material was properly washed with tap water, dried separately in the shade, and ground into a relatively coarse powder. These powdered medicines were sequentially extracted using methanol. In natural remedies, the concentrations of the active components are almost never very high. The bottleneck in the use of natural products in medication research has been the labor-intensive and time-consuming extraction and isolation process. For the extraction and separation of bioactive natural compounds, efficient and specialized technologies are being developed. This review aims to present an in-depth analysis of the various techniques employed in the extraction and separation of natural products.

Extraction:

The maceration procedure entails separating the parts of the crude medicines that are medicinally effective. Most small-scale extraction methods, such as maceration, are sluggish and time-consuming, resulting in ineffective extraction of crude medicines. To extract materials at a laboratory scale more quickly and efficiently, these procedures are typically adjusted. While small-scale instructions are inappropriate, large-scale industrial batch operations necessitate additional adjustments to the extraction process.

The most widely used extraction process is maceration, based on submerging the raw medicines in a significant amount of solvent or menstruum fluid. A stoppered container containing solid medicinal material is filled with around 2500 ml of menstruum fluid and left to stand for at least three to seven days in a warm environment with frequent shaking. The crude drug and solvent mixture are filtered until the majority of the liquid drips off. After standing, the mixed liquids are purified by filtration. Following extraction preparation, store at room temperature (15°C–25°C) while avoiding moisture and sunlight.

Triple Stage Extraction:

to maximize the yield of the active components in the extracts, the maceration method is upgraded to a multiple-step extraction. The extractor is charged with the raw drug material and is connected to several tanks, a circulatory pump, and a spray distributor to receive the extraction solution. As a result of the solvent being added and circulated in the extractor while the drug was being extracted, the process is referred to as multiple-stage extraction. This operation is performed three times. The stored solution is once more circulated through fresh drug material when the crude drug is charged in the extractor, after which it is withdrawn as an extract. The drug is also removed from the extractor after three extractions and then recharged with new drug material.

RESULTS

Phytochemical Screening of Prepared Plant Extracts:

All the plant extracts of *Momordica dioica* were screened for the presence of various secondary metabolites such as alkaloids, carbohydrates, glycosides, flavonoids, proteins, resins, steroids, and tannins according to the standard phytochemical test methods shown in **Table 3**.

DISCUSSION

Fruit extracts were subjected to phytochemical analysis, which identified components known to have physiological and therapeutic effects. This screening reveals a variety of significant chemicals that could serve as the foundation for

Table 3 Phytochemical Qualitative screening test

Test		Procedure	Observations (Indicating Positive Test)
Test for Alakloids			
1	Dragendroff's Test	Few mL sample+ 1-2 mL *Dragendorff's reagents*	A reddish-brown precipitate
2	Picric acid test	Few mL sample+ 3-4 drops of 2% picric acid solution	A orange colour
Test for Carbohydrates			
1	Fehling's test	1mL each of *Fehling's solution A &B* + 1mL filtrate[b]+ boiled in water bath	A red precipitate
Test for Glycosides			
1	Modified Borntrager's test	Plant extract + ferric chloride solution + boil for 5min. +cooled + equal volume of benzene + benzene layer is separated + Ammonia solution	A rose-pink to blood red coloured solution
Detection of Cardiac Glycosides			
1	Keller-Killani test	1mL filtrate + 1.5mL glacial acetic acid + 1 drop of 5% ferric chloride + conc. H2SO4 (along the side of test tube)	A blue coloured solution (in acetic acid layer)
Detection of Proteins and Amino acids			
1	Biuret test	2mL filtrate + 1 drop of 2% copper sulphate sol. + 1mL of 95% ethanol + KOH pellets	A of pink coloured sol. (in ethanolic layer)
2	Millon's test	2mL filtrate + few drops of *Millon's reagent*	Absence of white precipitate
Detection of Flavonoids			
1	Shinoda's test/ Mg-hydrochloride reduction test	Plant extract is dissolved in 5mL alcohol + Fragments of magnesium ribbon + few drops of conc. HCl	A pink to crimson coloured solution Presence of flavonal glycosides
Detection of Phenolic compounds			
1	Ferric chloride test	Extract aqueous solution + few drops 5% ferric chloride sol.	A Dark green/bluish black colour
Detection of Tannins			
1	Lead sub acetate test	1mL filtrate[e]+ 3 drops of lead sub acetate solution	A creamy gelatinous precipitate
Detection of Saponins			
1	NaHCO3 test	Plant extract + few mL sodium bicarbonate solution + distilled water (vigorously shaken)	A Stable honeycomb like froth
Detection of Phytosterols			
1	Salkowski's test	Filtrate[f]+ few drops of conc. H2SO4 (Shaken well and allowed to stand)	A Red colour (in lower layer)

Table 4 Phytochemical Qualitative screening test (continued)

Test	Procedure	Observations (Indicating Positive Test)
Detection of Triterpinoides		
Salkowski's test	Filtrate[f]+ few drops of conc. H2SO4 (Shaken well and allowed to stand)	A Golden yellow layer (at the bottom)
Detection of Quinones		
Alcoholic KOH test	1mL plant extract + few mL alcoholic potassium hydroxide	Colour change from Red to blue colour (Presence)
Detection of Anthraquinones		
Borntrager's test	10mL 10% ammonia sol. + few ml filtrate (shaken vigorously for 30 sec.)	A pink, violet, or red coloured solution
Detection of Coumarins		
NaOH test	Plant extract + 10% NaOH + Chloroform	A yellow colour
Detection of Fixed Oils and Fat		
Spot test/ Stain test	Little quantity of plant extract is pressed in between to filter papers	No Oil stain on the paper (Absence)

Table 4 Preliminary phytochemical screening results of methanolic extracts of Momordica dioica

S.No	Phytochemicals	Test	Results
1	Alakloids	Dragendroff's test	(-ve)
		Picric acid test	(-ve)
2	Glycosides	Modified Borntrager's test	(-ve)
3	Cardiac Glycosides	Keller-Killani test	(-ve)
4	Carbohydrates	Fehling's test	(-ve)
5	Proteins and Amino acids	Biuret test	(-ve)
		Millon's test	(-ve)
6	Flavonoids	Shinoda's test/ Mg-hydrochloride reduction test	(+ve)
7	Phenolic compounds	Ferric chloride test	(+ve)
8	Saponins	NaHCO3 test	(+ve)
9	Phytosterols	Salkowski's test	(+ve)
10	Tannins	Lead sub acetate test	(+ve)
11	Triterpinoides	Salkowski's test	(+ve)
12	Quinones	Alcoholic KOH test	(+ve)
13	Anthraquinones	Borntrager's test	(-ve)
14	Coumarins	NaOH test	(-ve)

contemporary medications to treat a range of ailments. According to reports, many plant chemicals, such as flavonoids, polyphenolic compounds, tannins, saponins, phytosterols, triterpenoids, and quinones, exhibit a variety of biological effects.

Preliminary phytochemical studies indicated that the extract included some phytochemicals while others were absent. The experiments were carried out using methanolic solvents, and phytochemical analysis found that triterpenes, saponins, flavonoids, steroids, and tannins are present, as shown in **Table 4**.

Flavonoids have been demonstrated to manifest their functions through impacts on membrane permeability, as well as by inhibiting membrane-bound enzymes such as ATPase and phospholipase A2 [6]. The anion radicals in flavonoids make them a substance that promotes health [4]. These findings indicate the effectiveness of this plant as a folkloric remedy for stress-related illnesses and as a dressing for wounds commonly associated with

circumcision rituals, such as bruises, cuts, and sores [8].

Plant compounds called triterpenoid saponins have been proposed as potential anti-carcinogens. Due to the amphiphilic nature of their chemical structure, they possess surface-active properties. The regulation of carcinogen-induced cell growth, direct cytotoxicity, immune-modulatory effects, and bile acid binding are some of the hypothesized mechanisms of saponins' anticarcinogenic actions.

However, the anticarcinogenic properties of saponins from frequently consumed plant foods have not been extensively investigated. One of the most significant sources of dietary saponins is soybeans, which serve as a primary source of protein in many vegetarian diets [7].Similar reports have been documented by previous researchers [11]; tannins are known to be helpful in the treatment of inflamed or ulcerated tissues and exhibit remarkable activity in cancer prevention and anticancer properties.

Natural steroid molecules called phytosterols are important compounds due to their interactions with other substances, such as sex hormones [10]. These phenolic chemicals contribute to the anti-oxidative characteristics of the plant and its efficacy as a herbal remedy.

It has been discovered that phenols can be used to create several antimicrobial agents, such as Dettol and cresol. Quinones are widely used as anticancer, antioxidant, antimalarial, antimicrobial, and anti-inflammatory agents.Many African tribes regularly utilize this herb to treat a variety of illnesses. In this plant investigation, alkaloids were not found. Since alkaloids have long been used medicinally and one of their typical biological characteristics is cytotoxicity [9], their absence in this plant tends to reduce the risk of plant poisoning

CONCLUSION

The use of herbal medicine in traditional practices dates back many years. Both ancient peoples and our ancestors relied heavily on plants for their therapeutic needs. The current movement away from synthetic drugs toward natural sources for illness prevention is concerning, particularly due to persistent reports of adverse drug reactions from synthetic medications and the global rise in antibiotic resistance, which indicate a health emergency.

The increasing global incidence of diabetes, cancer, obesity, hypertension, and neurological disorders is alarming. Extensive research is being conducted to identify their causes and remedies. Consequently, scientists are investigating which plant extracts possess the highest medicinal potential to develop safe drugs for various ailments. Efforts should primarily focus on utilizing the biomedical applications of these selected plants, as they contain specific classes of phytochemicals essential for their full potential.In the fight against these health issues, herbal treatments may serve as a valuable tool. This study has primarily concentrated on the phytotherapeutic and pharmacological potential of *Momordica dioica* Roxb. Its high vitamin content, presence of secondary metabolites, antioxidants, and other essential elements may help prevent neurological disorders, diabetes, and cancer, among other diseases.

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Ethical Approval

No ethical approval was necessary for this study.

Author Contribution

All authors made substantial contributions to the conception, design, acquisition, analysis, or interpretation of data for the work. They were involved in drafting the manuscript or revising it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring its accuracy and integrity.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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