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Investigating the Nutritional and Medicinal Potential of Momordica Dioica

Saranya Balaguru

Associate Professor, KME'S, G. M. Momin Womens College, Bhiwandi
saranya@gmail.com

Abstract: ***A member of the Cucurbitaceae family, Momordica dioica is found throughout India and the Indian subcontinent. Alkaloids, steroids, triterpenoids, flavonoids, glycosides, saponins, triterpenes, and other bioactive substances are all present in the phytochemical analysis of M. dioica fruits. Significant antioxidant activity is displayed by M. dioica, which may help explain its potential for controlling and preventing disorders like diabetes that are linked to oxidative stress. dioica exhibits anti-diabetic and antioxidant properties, and its potential as a natural treatment for diabetes and other conditions linked to oxidative stress is being investigated. In light of current scientific findings as well as traditional medical plant-based treatments like ayurveda, this review attempts to assess the phytochemical, ethnobotanical, phytotherapeutical, and pharmacological qualities of kakrol. Despite having a better nutritional content than many commonly consumed vegetables and a notable presence of certain components, kakrol is regarded as an underappreciated food.***

Keywords: Momordica dioica, Antioxidant, oxidative stress, Diabetes, ethanobotany

1. Introduction

In warmer climates around the world, *momordica* species are widely grown as vegetable crops. The Cucurbitaceae family, which includes the cucumber, gourd, melon, and pumpkin families, is where they belong. Because of the phytochemicals (alkaloid) they contain, they are known to taste bitter. They have numerous medicinal applications as well. It is unclear exactly where the Momordica genus originated, but most scientists agree that bitter gourd cultivation is concentrated in eastern Asia, likely in southern China or eastern India [34,17]. Ayurvedic records by Indo-Aryan cultural members, however, claim that it originated in India between 2000 and 200 BCE. *Momordica dioica* Roxb, a perennial climber that belongs to the Cucurbitaceae family, is also referred to as Kantola in Hindi. In the genus Momordica, there are 80 species. In the latest revision of Indian Momordica, six species are recognised, including two monoecious and four dioecious species. Although this genus originated in the Indo-Malayan region, it is currently found growing in China, Japan, South East Asia, Polynesia, Tropical Africa, India, Bangladesh, Sri Lanka, and Myanmar. It has been found to grow up to 1500 meters in the Meghalayan Garo highlands and Assam.Most people call it spine gourd, teasel gourd, or small bitter gourd, however in Bangladesh it is called kakrol, and in India it is called kankro, kartoli.

This review focuses on biochemical constituents and pharmacological properties of Momordica dioica.

1.1. Folklore Uses and Phytochemicals of *Momordica dioica*

Vegetables naturally contain tannins, which are polyphenolic substances. Their historical use has been influenced by their presence in nature in a variety of ways, and their additional modification with an eye towards an industrial use has been made possible by the reworking of their customary use. Sometimes these alterations imply

Figure: Fruits of *M. dioica*

the addition of dangerous compounds like formaldehyde, which is a category B1 carcinogen [10]. The quantity of sugar chains affixed to the triterpene or steroid aglycone backbone is their distinctive feature, also known as sapogenins. However, it has been established that the primary non-food sources of saponins used in industrial and medical uses are dicotyledons similar to legumes.*Mordica dioica* contains alkaloids, steroids, triterpenoids, flavonoids, glycosides, saponins, vitamins, protein, carbohydrates, and momordicin. The gourd is also referred to as Momordica dioica Roxb. Ex. Willd (Cucurbitaceae). It has long been used as an astringent, febrifuge, antibacterial, anthelmintic, spermicidal, and for other conditions such bleeding piles and urinary infections as well as sedation. Studies show that it has hepatoprotective, analgesic, antibacterial, anti-inflammatory, anti-lipid peroxidative, and antioxidant activities [4]. The unpeeled form of *M. dioica* has 0.26 mg/kg of chromium and 11.0 mg/kg of zinc, while the peeled form had 0.27 mg/kg of chromium and 4.91 mg/kg of zinc. Male defruited and monoecious plants continued to have larger dry weights of aerial plant parts and higher protein content in their leaves than female plants [6]. The fruit has increased levels of iodine and ascorbic acid [5, 25]. Fruit secondary metabolites such as triterpenoids, alkaloids, steroids, and saponins were identified [25].

Ayurveda states that its leaves have antihelminthic, aphrodisiac, antihemorroidal, hepatoprotective, antibronchitic, antipyretic, antiasthmatic, and analgesic properties, while its fruits have diuretic, laxative, hepatoprotective, antivenomous, antihypertensive, anti-inflammatory, antiasthmatic, antipyretic, antiileprosy, antidiabetic, and antidepressant properties [19, 23]. 50 mL

of root juice should be taken orally once daily with an empty stomach to treat diabetes.

Phytochemical studies (Harborne et al., 1998) revealed the presence of flavonoids, glycosides, phenolic compounds, alkaloids, carbohydrates, proteins, saponins and amino acids in Plants. The fruit of *M. dioica* contains ashes: 9.1%, crude protein: 5.44%, crude lipid: 3.25%, crude fiber: 22.9%, and carbohydrate: 59.31%. Its fruit has high energy value (288.25 kcal/100 g) in dry weight. Its mineral ranges (mg/100 g dry weight,) are: potassium (4.63), sodium (1.62), calcium (7.37), iron (5.04), and zinc (3.83) [1,30]. In another investigation, its nutritional value of per 100 g edible fruit is reported to contain 84.1% moisture, 7.7 g carbohydrate, 3.1 g protein, 3.1 g fat, 3.0 g fiber and 1.1 g minerals and small quantities of essential vitamins like carotene, thiamin, riboflavin and niacin [31].

Table 1: Different plant parts of M. dioica and their effect

Plant Parts	Solvent for Extraction	Effect of extracted compound
Seed	Seed oil	Antiallergic effect
Leaves	Methanol Aqueous	Hepato-protective Allelopathic acivity ,good for seed germination
Fruits	Hexane Extract ethyl acetate Extract Methanol extract	Anti-diabetic, Anti-inflammatory and Neuroprotective activity. Aantidepressant Anticancer effect and hepatoprotective
Roots	Alcoholic extract	Antioxidant,Antifertility effect and anti cancer

(Source: Talukdar et al., 2014; Jha et al., 2017)

1.2 Phramacological Potential

1.2.1 Antioxidant

Recently, there has been a lot of interest in the potential of antioxidants and secondary metabolites to prevent diseases caused by oxidative stress, which degrades cell membranes and causes a variety of degenerative conditions [22]. Since oxidative stress causes cell membrane degradation and a host of other pathological diseases, antioxidants and secondary metabolites are crucial in avoiding disease [8] Furthermore, new research has demonstrated that antioxidants derived from plants that have the ability to scavenge free radicals[20] may be very important as treatment agents for diseases mediated by free radicals and the ageing process [22].The stable free radical diphenylpicrylhydrazyl (DPPH) is the basis of one such approach that is currently widely used. Examining the method's foundation and the application of the "EC50" (equivalent concentration to give 50% effect) parameter—which is currently employed in the interpretation of experimental data from the method are the goals of this paper [18] Additionally, *M. dioica* has a number of vital nutritional compounds that are necessary for the body to function properly. In the investigation by Venkateshwarlu M et.al.[20] it was found that 0.5 mg of calcium, 1.5 mg of sodium, 8.3 mg of potassium, 0.14 mg of iron, 1.34 mg of zinc, 19.38% protein, 4.7% fat, 3.7 mg of total phenolic substance, 2.8 mg of phytotic acid, 4.1 calories, and an ash value of 6.7%. The antioxidant and hepatoprotective properties of *M. dioica*ethanolic and aqueous extracts were documented by Jain et al. [12,13] It was discovered that the ethanolic extract had a stronger hepatoprotective effect than the other extract. In another work, the free radical scavenging potential of the tuberous roots was studied by different in vitro methods, namely, DPPH radical scavenging, ABTS radical scavenging, iron chelating activity, total antioxidant capacity, and haemoglobin glycosylation assay. Total antioxidant capacity of ethanolic extract was found to be 26 mg/mL which is equivalent to ascorbic acid.Sanas and Pimpliskar (2025)[26] exhibited in their work the DPPH radical scavenging in the methanolic extract had radical scavenging activity with IC50= 675.45 mg/ml and with aqueous extract IC50= 383.70.So, the *M. dioica* showed significant Antioxidant activity with IC50 which signifies that antioxidant potential of plant under study has evidanced based.

1.2.2 Antimicrobial Activity.

Shrinivas et al. [29] studied methanolic extract and aqueous extract of fruit and found that methanolic extract had more promising antimicrobial activity [29]. Arekar et al. [3] screened antibacterial activities of ethyl acetate extract. The concentration of 200 ug/disc was more active against *E. coli* compared to *S. aureus*, *S. paratyphi*, and *P. mirabilis bacteria*. Ethyl Acetate extract of in vitro shoot culture (yield: 0.26%) showed maximum inhibition zone against *S. paratyphi* and *P. mirabilis* while ethyl acetate extract of in vitro callus culture (yield: 21.5%) showed maximum inhibition zone against *S. aureus* [3]. According to the study by Sanas et.al, [26] extracts of the fruit *M. dioica* have the potential to be antimicrobial against *A. niger*, *C. albicans*, (fungi) and *S. aureus*, *S. pyogens*, *S. typhi*, and *E. coli (*Bacteria*)*. The *M. dioica* methanol crude extract demonstrated significant antibacterial activity, the dry *M. dioica* powder in methanol extract demonstrated the highest antibacterial activity against all organisms, the pure extract demonstrated the lowest activity against all organisms, and the aqueous extract exhibited no activity against any of the six organisms when tested using the agar cup method..In other investigations for gram-negative bacteria, the sequence of activity is *M. dioica* root > *M. dioica* fruit > *M. charantia* root > *M. charantia* fruit; for gram-positive bacteria, the sequence is *M. dioica* Fruit > *M. charantia* Root > *M. dioica* Root > *M. charantia* Fruit. The findings of the current study are comparable to those of the following studies: [9,11,15,32]. Number of investigation reveals the antibiotic potential of *Momordica* species worldwide.

1.2.3. Nephroprotective and Neuroprotective Activity.

Screening of the seed ethanol extract revealed significant nephroprotective and curative properties without any toxicity from nephrotoxin-like gentamicin [32]. Its fruit extract was also found to have nephroprotective and curative properties [12]. In streptozotocin-diabetic rats, Gupta et al.

assessed the renal protective effect of *Momordica dioica* extract [13]. Using neuropharmacological experimental paradigms in mice, the effects of methanol and fruit pulp aqueous extract on the central nervous system were observed. These extracts were utilised to reduce the length and commencement of a decrease in locomotor activity in a dose-dependent manner. Methanol and fruit pulp aqueous extract (100 mg/kg and 200 mg/kg) were proposed to have neuroprotective properties [7].

1.2.4 Activity that Prevents Diabetes

There is increasing interest in treating diabetes mellitus with traditional means because of the substantial financial burden that the disease places on the world's population. Diabetes has traditionally been treated with Momordica species, in addition to the bitter gourd tablets that are currently available on the market. Momordica species are used to treat both Type I and Type II diabetes. Insulin is essential for people with type 1 diabetes. Recently, several proteins from M. charantia were found to be involved in the insulin signalling system. Charantin, vicine, glycosides, karavilosides, insulin-like peptide (plant (p)-insulin), and extracts from fruits, seeds, liquids, and powders are among the identified compounds that have demonstrated promise in lowering blood sugar. [29]

In the study by Md. Mynul Hassan et al (2022) [30], *M. dioica* ethanol extract improved glycaemic and lipidemic conditions in type 2 diabetes model rats and is capable of improving the diabetic state. According to our results, the ethanolic extract from M. dioica fruit significantly decreased the fasting serum levels of glucose, cholesterol, and triglycerides. There are no comprehensive findings on the main active phyto-constituents of *M. dioica* ethanolic extract, and there is little clinical support for the fruit's traditional and regional usage in a variety of therapies. It is therefore challenging to identify which phytochemicals have anti-diabetic properties. The creation of a novel antidiabetic medication could result from more investigation into the molecular process and the identification of the substance causing this tendency. In another investigation by Sharma and Singh (2014)[31] demonstrated that aqueous extract of *Momordica dioica* possess potent antioxidant activity. Protection and regeneration of pancreatic β-cell function and enhancement in insulin secretion may be one of the reasons for its anti-diabetic activity of *M. dioica* fruits.

1.2.5 Anti Cancer Activity

Many investigator reported the anti cncer activity of M.dioica with evidence showing the anticancer potential .Drugs with antimitotic activity are screened using root meristematic cells in the *Allium cepa* root meristem model, also referred to as the Allium assay[2.14]. The cell division in the meristematic area resembles that of human cancer cells. These meristematic cells can therefore be assessed for the purpose of screening medications that may have antimitotic properties. The allium assay is regarded as a quick, extremely sensitive, and repeatable bioassay for cytotoxicity and genotoxicity detection. The antimitotic effects and reduction of root growth serve as indicators of genotoxicity. The easily studied karyotype of plant and the capacity to link test results with those of mammalian cells in the course of toxic evaluations have been credited with *Allium cepa's* good genotoxic assay performance as a plant system.

In the study by Patil et.al (2018) [21], it was observed that in Root growth inhibition and a lower mitotic index following treatment demonstrated the dose-dependent antimitotic activity of an aqueous extract of *Mordica dioica* fruits (10 mg/ml) on *Allium cepa* root meristematic cells. At a concentration of 10 mg/ml, this indicates that the aqueous extract of Mordica dioica fruits has a fair antimitotic potential. Rupchandra and his coworkers exhibited that the seed of plant Momordica charantia L. (cucurbitaceae) shows anticancer activity on ovarian cancer cell lines while alcoholic seed extract demonstrated that Momordica dioica shows good anticancer activity by causing 50% inhibition of A549 cells at IC50 value of 3.125 µg/mL and MCF-7 cells at IC50 value of 1.56 µg/mL.There are millions of plants available in the world with greater importance. The compounds isolated from various parts of plants play a vital role in treatment of various diseases and have received good attention in recent years due to their different pharmacological properties including cytotoxic,antidiabetic antimicrobial and anticancer activity.

2. Conclusion

Synthetic drug use increases the risk of cancer, diabetes, and neurological diseases, posing a threat to world health. The creation of medications with natural herbs is desperately needed as a treatment. By lessening the harmful effects of synthetic pharmaceuticals, indigenous medicines offer a favorable answer to the global health threat. The plant *Momordica dioica* is regarded as a nutrient-dense vegetable and traditional medicine. It contains a variety of substances known as phytoconstituents, which include amino acids, alkaloids, tannins, fixed oil, flavonoids, and sterol.

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