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AN ETHNOMEDICINAL, PHYTOCHEMICAL AND PHARMACOLOGICAL STUDIES OF *MOMORDICA DIOICA* ROXB. EX. WILLD.A COMPREHENSIVE REVIEW

G S DEORA, VISHAL SHARMA*, MONIKA K SHEKHAWAT, SARSWATI and MANISHA NEHRA.

Department of Botany, University College of Science, Mohanlal Sukhadia University, Udaipur-313001(India).
***Corresponding author:** E-mail: vishalkhandal133@gmail.com

Momordica dioica Roxb. belongs to the family Cucurbitaceae. Plant is perennial, dioeciousand climbing creeper. It is a native to Asia and extensively distributed in India. Traditionally it is used as vegetable with a significant nutritional value and each part of the plant such as leaves, root, fruits and seeds are traditionally used as preventive and curative agents. Due to the galore of bioactive compounds, pharmacologically it is very importantand act as anti-diabetic, anti-inflammatory, anti-septic, anti-ulcerant, anti-hemorrhoidal, antipyretic and anti-perspirant agent. This plant is considered as an underutilized vegetable but it shows the presence of significant bioactive compounds with high medicinal and nutritional value than any other vegetables of this family therefore, this plant is still phytochemically potent. The object of the present review is to evaluate ethnomedicinal, phytochemicals and pharmacological properties of *M. dioica*as traditional medicinal plant along with recent scientific observations. Further this study will be helpful to the researchers to explore the role of phytochemicals in detail.

Keywords: Ethnomedicinal, Phytochemical, Pharmacological, Therapeutical, *Momordica dioica.*

Introduction

Indian *Momordica,* having six species out of which four are dioecious and two are monoecious[1].*M.dioica*.is a perennial, dioecious climbing creeper belonging to the family Cucurbitaceae and It iscommonly known as Parora and kakora[2].Genus *Momordica* contains about 80 species[3,4]. Worldwide it is commonly known asteasel gourd, spine gourd or small bitter gourd whereas, kakrolin Bangladesh and as kankora, kartoli, kantoli, kantola, kantroli, ban karola or junglee karela in India[5,6]. The plant is about 5–7 meters in length. Its fruits, leaves and young twigs are used as vegetable in summer[7,8].

The genus originated from Indo-Malayan region but nowit is extensively grown in India, Bangladesh, Sri Lanka, Myanmar, China, Japan, South East Asia, Polynesia, Tropical Africa and South America[9,10].It is cultivated up to an altitude of 1500 meters in Assam and Garo hills of Meghalaya[11]. The plants of Cucurbitaceae are well known for its bitter taste due to the presence of alkaloids and have a wide range of

medicinal value[12-14]. All plant parts and components of the *M. dioica* are potential source of medicative substances[15].

Systematic Position of *Momordica dioica*[16]

Kingdom	Plantae
Division	Magnoliphyta
Class	Magnoliopsida
Order	Violales
Family	Cucurbitaceae
Genus	*Momordica*
Species	*dioica*

Table 1: Vernacular Names of *Momordica dioica* (Spinygourd) in India[17].

S. No.	Language	Vernacular Names
1.	Hindi	Kakora, Parora, Kantola
2.	English	Small bitter gourd, Spine gourd, Teasel gourd
3.	Sanskrit	Vahisi
4.	Punjabi	Bharkarela
5.	Gujarati	Katwal
6.	Assam	Batkarila
7.	Telugu	Agakara, Karkotaki

Botanical Characteristics

*Momordica diocia*is commonly knownas Kantola or Spiny gourd and in India it is extensively found in Rajasthan, particularly in rainy season. It is also popular as teasel gourd (*Momordica dioica*) and it is climbing herb with tuberous roots and simple tendrils. Leaves are small, broadly ovate, deeply lobed, base cordate, margins denticulate, apex acute. Flowers are dioecious and solitary axillary. Fruits are ovoid, softly echinate and dark green in colour when immature and they change from green to yellow when mature. Seeds are ovoid, emarginated and pale yellow[18]. It is largely cultivated within the mountain regions of India.

Ethnobotanical Potential

Ethnobotanically every part of *M.dioica* such as fruits, leaves and roots are important for ethnic uses. Fresh fruit juice and grilled fruit with little amount of oil are given to high blood pressure and diabetic patients. 50 mL of root juice on an empty stomach is orally suggested to cure diabetes. Root juice of this plant is a domestic remedy for the inflammation caused by contact with the urine of the house lizard. The juice of fresh leaves is mixed with coconut, pepper and red sandalwood to create an ointment and applied it on the head to relieve pain. Dried fruit powder is applied into the nostrils which produces a powerful errhine impact and causes a copious discharge from the schneiderian tissue layer[19].The root of the male plant is used in snake bites and scorpion sting[20].

Root juice has stimulant, astringent, antiseptic, antidiabetic, anti-inflammatory drug and anti-ulcerant properties whereas the mucilaginous tubers act as an antihelminthic, spermicidal and anti-fertility abortifacient agent[22]. Fruits of this plant have diuretic, laxative, hepatoprotective, antivenomous, antihypertensive, anti-inflammatory, anti-asthmatic, antipyretic, anti-leprosy, antidiabetic and antidepressant properties. Leaves also have antihelminthic, aphrodisiac, antihemorroidal, hepatoprotective, antibronchitic, antipyretic, antiasthmatic and analgesic properties[23,24]. Mucilaginous tuber of female plant and toasted root are employed in bleeding piles and internal organ infections. The traditional use of *M. dioica* against bleeding piles (hemorrhoids) is also reported[25,26].

"Panchatiktaghrita" is prepared by mixing 800 g each of neem bark, *M. dioica* leaves, *Solanum surattense*, *Tinospora cordifolia* and bark of *Adhatoda vasica*, in five to six liters of water and boiled up to its reduction to 1/4 and then added 3.5 kg butter, 3 kg myrobalans. One teaspoonful is given orally twice a day with very lukewarm milk to cure chronic skin diseases[27]. Root powder is additionally applied for softening of skin and to reduce perspiration. The superficial use of root paste over the complete body act as a sedative in high fever with delirium[28,29]. In addition to these tender fruits are rubbed

on the skin for pimples and acne, roasted seeds are used for eczema and other skin disorders[30].

Phytochemical and Nutrient Potential

Fruit of *M. dioica* is rich store house of various types of micronutrients and secondary metabolites such as calcium: 0.5 mg/g, sodium: 1.5 mg/g, potassium: 8.3 mg/g, iron: 0.14 mg/g, zinc: 1.34 mg/g, protein: 19.38%, fat: 4.7%, total phenolic compound: 3.7 mg/g, phytic acid: 2.8 mg/g and ash value: 6.7% [31]. Its fruit is usually recommended as nutritionally abundant source of protein, lipid, crude fiber, carbohydrate, iron, calcium and phosphorous. The fruit of this plant also contains the highest amount of carotene (162 mg/100 g of edible portion) as compared to the other cucurbitaceous vegetables[32,33].

Its fruit has high energy worth (288.25 kcal/100 g) in dry weight. The mineral contents are metallic elements such as potassium(4.63), sodium(1.62), calcium(7.37), iron(5.04) and zinc(3.83)[34]. In another investigation, nutritional value of per 100 g edible fruit has 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 tiny quantities of essential vitamins like carotene, thiamin, riboflavin and niacin[35].The protein content of leaves and dry weight of aerial plant parts reported higher in male plant as compared to female plants[36]. The fruit also contains good quantity of ascorbic acid and iodine[37,38].

The fruit of *M.dioica* is a good source of secondary metabolites like alkaloid, steroids, triterpenoids and saponins[39]among them, 4 compounds were isolated from ester(ethyl acetate) extract and 5 compounds from methyl alcohol extract consisting of alkaloids and flavonoids with NH and C=O functional groups, respectively.The main alkaloid present in seed and root is momordicin[40]. In addition to these, fruit contains other phytochemicals like lectins, *β*-sitosterol, saponins glycosides, triterpenes of ursolic acid, hederagenin, oleanolic acid, *α*-spinasterol, stearic acid, gypsogenin, momodicaursenol and 3 new componunds known as 3 *β*-o-benzoyl-11-oxo-ursolic acid, 3-o-benzoyl-6-oxo-ursolic acid and 3 *β* -o-D-glucuronopyranosyl gypsogenin[41,42].

Pharmacological Potential:

Leaves, fruits, roots and seeds of *M. dioica* showed different types of pharmacological activities due to the presence of various types of bioactive phytoconstituents and showed different types of pharmacological activities such as antimicrobial, antiallergic, anticancerous, antiulcerant, neuroprotective, nephroprotective, antioxidant, antidiabetic, antimalarial, anti-inflammatory, hepatoprotective, antihepatotoxic and antifertility. The detail pharmacological study of *M. dioica* including activity, preparation of extract, tested against a particular disease and action showed in table 3.

Conclusion

Momordica dioica is an important medicinal plant of family Cucurbitaceae. Plant is perennial dioecious and climbing creeper having wide range of nutraceutical, ethnomedicinal and pharmacological properties. Fruit is rich in minerals, proteins, lipid, carbohydrates and carotene therefore, it traditionally used as vegetable. Root, fruit and seeds of this plant having wide range of different types of phytoconstituents such as steroids, alkaloids, stearic acid, triterpenoids, flavonoids and saponins in good amount therefore, it act as antimicrobial, antiallergic, anticancerous, antiulcerant, neuroprotective, nephroprotective, antioxidant, antidiabetic, antimalarial, anti-inflammatory, hepatoprotective, antihepto-toxic, antifertility, analgesic, anti-septic, antihemorroidal, antipyretic and anti-perspirant agent.

Table 2: Phytochemical Potential of *Momordica dioica.*

S. No.	Plant part	Class	Compounds	Extract	References
1.	Root	Steroid	α-spinasterol-3-O-β-D-glucopyranoside, Oleanolic acid, Gypsogenin, Hederagenin	Methanol extract	42 36 31
		Triterpenoid	3β-O-benzoyl-6-oxo-ursolic acid, 3β-O-benzoyl-11-oxo-ursolic acid, 3-O-β-D-glucopyranosyl hederagenin, 3-O-β-D-glucopyranosyl gypsogenin, 3-O-β-D-glucuronopyranosylgypsogenin.		
2.	Seed	Alkaloid	Momordicin	Seed oil	31
3.	Fruit	Alkaloid	-	Ethyl acetate, methanol	37
		Flavonoid	-	Methanol, hexane	
		Steroids	-	Ethyl acetate, methanol, aqueous	
		Saponins	-	Methanol, aqueous	
		Triterpenoids	-	Ethyl acetate, methanol, and aqueous	

Table 3: Pharmacological study of *Momordica dioica.*

S.No.	Pharmacological activity	Plant Parts	Extract	Detail effect	References
1	Antimicrobial activity	Fruit	Methanol, aqueous	Methanolic extract hadmore promising antimicrobialactivity	43
		Leaf,Root	Ethyl acetate	The concentration of 200 μg/disc was more active against E. coli as compared to, *S.paratyphi*, and *P. mirabilis* bacteria.	44
2	Antiallergic activities	Seed	Alcoholic extract	The antiallergic activity of extract in mice was observed.	45

3	Anticancer activity	Root	Methanol extract	The growth inhibitory index (%)of α-spinasterol-3-o-β-D-glucopyranoside was shown to be 50%, at the doseof 4 μg/mL while testing on cancer cell (L1210).	46
4	Antiulcer activity	Fruit	Ethanol extract	Decreased the level ofH^+-K^+ATPase, volume of gastric juice and acid output. Gastric wall mucus, pH and catalase enzyme were increased significantly. Antioxidantenzyme levels of superoxide dismutase were decreased.	42
5	Neuroprotective activity	Fruit	Methanol and aqueous extract	Methanol and aqueous extract of fruit pulp (100 mg/kg and 200 mg/kg) had neuroprotective activities.	47
6	Nephroprotective activity	Seed	Ethanol extract	Foundmarked nephroprotective and curative activities without any toxicity caused by nephrotoxin-like gentamicin.	48
		Fruit	Ethanol extract	Observed significant reduction in GSH and an increase in malondialdehyde(MDA)productio n.	49
7	Antioxidant activity	Root	Alcoholic extract	Inhibited the formation of oxygen derived free radicals (ODFR) *in vitro* with 4000 μg/mL ascorbic system.	50
		Root	Ethanol extract	DPPH radical scavenging, ABTS radical scavenging, iron chelating activity, total antioxidant capacity and haemoglobin glycosylation assay were studied. Total antioxidant capacity was 26 μg/mL equivalents to ascorbic acid.	51
		Fruit	Methanol, aqueous extract	Found the presence of phenolic compound, flavonoids, sterol, alkaloids and amino acids	43
		Leaf	Ethanol, aqueous extracts	The presence of flavonoids was reported as a potent antioxidant	52
8	Antidiabetic activity	Fruit	Chloroform, ethyl acetate, and alcohol extract	Ethyl acetate and ethanol showed significant antidiabetic activity at a dose of 200 mg/kg.	53

		Fruit	Aqueous, hexane, chloroform, and ethanol extract	Aqueous extract showed maximum fall (52.8%) in 0 to 1 h fasting blood glucose in glucose tolerance test compared to hexane (39%), chloroform (37.2%), and ethanol (37.7%) extract in normal healthy rats.	54
		Fruit	Methanol extract	Markedly reduced serum glucose and increased serum insulin and urea levels.	55
		Fruit	Aqueous extract	Oral hypoglycemic effect of *Momordica dioica* in rat model was screened.	56
9	Antimalarial activity	Not specified	Alcoholic extract	Screened extract *in vivo* and *in vitro* against NK65 strain of *Plasmodium berghei*, *Jurineamacrocephala*, *Aegle marmelos* and found to possess schizontocidal activity	57
10	Anti-inflammatory activity	Root	Alcoholic extract	Significantly reduced carrageenan-induced paw edema when administered orally (200 mg/kg) and the activity was comparable with ibuprofen (200 mg/kg, p.o.)	50
		Fruit	Hexane, methanol extract.	Both extracts exhibited anti-inflammatory activities when compared to standard drug	58
11	Hepatoprotective and antihepatotoxic activity	Leaf	Aqueous, methanol extract	Reported hepatoprotective and antihepatotoxicity effect of leaf.	59, 60
		Root	Ethanol extract	Prevented CCl4 induced hepatotoxicity at a dose of 200 mg/kg	61
		Fruit	Ethanol extract	Evaluated hepatoprotective activity in wistar strain of albino rats of either sex against CCl4 induced hepatic damage.	62
12	Antifertility activity	Fruit	Ethanolic extract	Found in female rats but not in male rats at the dose of 250 mg/kg	63
		Root	Ethanol, aqueous extract	Found moderate estrogenic activity including significant increase in uterine weight and abortifacient activity.	64
13	Analgesic activity	Fruit	Petroleum ether, methanol, ethyl acetate extract	Petroleum ether andmethanol extract gave more significant analgesic activity than ethyl acetate extract.	65
			Hexane, methanol extract	Exhibited analgesic activity when compared to standard drug.	66

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