



## 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](mailto:vishalkhandal133@gmail.com)

*Momordica dioica* Roxb. belongs to the family Cucurbitaceae. Plant is perennial, dioecious and 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 important and 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<sup>1</sup>. *M. dioica* is a perennial, dioecious climbing creeper belonging to the family Cucurbitaceae and it is commonly known as Parora and kakora<sup>2</sup>. Genus *Momordica* contains about 80 species<sup>3,4</sup>. Worldwide it is commonly known as a bitter melon, spine gourd or small bitter melon whereas, kakrolin Bangladesh and as kankora, kartoli, kantoli, kantola, kantroli, ban karola or jungle karela in India<sup>5,6</sup>. The

plant is about 5–7 meters in length. Its fruits, leaves and young twigs are used as vegetable in summer<sup>7,8</sup>.

The genus originated from Indo-Malayan region but now it is extensively grown in India, Bangladesh, Sri Lanka, Myanmar, China, Japan, South East Asia, Polynesia, Tropical Africa and South America<sup>9,10</sup>. It is cultivated up to an altitude of 1500 meters in Assam and Garo hills of Meghalaya<sup>11</sup>. 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<sup>12-14</sup>. All plant parts and components of the *M. dioica* are potential source of medicative substances<sup>15</sup>.

#### Systematic Position of *Momordica dioica*<sup>16</sup>

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Violales
Family	Cucurbitaceae
Genus	<i>Momordica</i>
Species	<i>dioica</i>

**Table 1: Vernacular Names of *Momordica dioica* (Spinygourd) in India<sup>17</sup>.**

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 dioica* is commonly known as 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<sup>18</sup>. 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<sup>19</sup>. The root of the male plant is used in snake bites and scorpion sting<sup>20</sup>.

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<sup>22</sup>. 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, antihemorrhoidal, hepatoprotective, antibronchitic, antipyretic, antiasthmatic and analgesic properties<sup>23,24</sup>. 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<sup>25,26</sup>.

“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<sup>27</sup>. 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<sup>28,29</sup>. 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<sup>30</sup>.

#### 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%<sup>31</sup>. 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<sup>32,33</sup>.

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)<sup>34</sup>. 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<sup>35</sup>. The protein content of leaves and dry weight of aerial plant parts reported higher in male plant as compared to female plants<sup>36</sup>. The fruit also contains good quantity of ascorbic acid and iodine<sup>37,38</sup>.

The fruit of *M. dioica* is a good source of secondary metabolites like alkaloid, steroids, triterpenoids and saponins<sup>39</sup> 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<sup>40</sup>. In addition to these, fruit

contains other phytochemicals like lectins,  $\beta$ -sitosterol, saponins glycosides, triterpenes of ursolic acid, hederagenin, oleanolic acid,  $\alpha$ -spinasterol, stearic acid, gypsogenin, momodicaursenol and 3 new compounds known as 3  $\beta$ -o-benzoyl-11-oxo-ursolic acid, 3-o-benzoyl-6-oxo-ursolic acid and 3  $\beta$ -o-D-glucuronopyranosyl gypsogenin<sup>41,42</sup>.

#### 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, antihemoroidal, antipyretic and anti-perspirant agent.

**Table 2: Phytochemical Potential of *Momordica dioica*.**

S. No.	Plant part	Class	Compounds	Extract	References
1.	Root	Steroid	$\alpha$ -spinasterol-3-O- $\beta$ -D-glucopyranoside, Oleanolic acid, Gypsogenin, Hederagenin	Methanol extract	42 36 31
		Triterpenoid	3 $\beta$ -O-benzoyl-6-oxo-ursolic acid, 3 $\beta$ -O-benzoyl-11-oxo-ursolic acid, 3-O- $\beta$ -D-glucopyranosyl hederagenin, 3-O- $\beta$ -D-glucopyranosyl gypsogenin, 3-O- $\beta$ -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 had more promising antimicrobial activity	43
		Leaf, Root	Ethyl acetate	The concentration of 200 $\mu$ g/disc was more active against <i>E. coli</i> as compared to, <i>S. paratyphi</i> , and <i>P. mirabilis</i> 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 $\alpha$ -spinasterol-3- $\beta$ -D-glucopyranoside was shown to be 50%, at the dose of 4 $\mu$ g/mL while testing on cancer cell (L1210).	46
4	Antiulcer activity	Fruit	Ethanol extract	Decreased the level of $H^+$ - $K^+$ ATPase, volume of gastric juice and acid output. Gastric wall mucus, pH and catalase enzyme were increased significantly. Antioxidant enzyme 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	Found marked 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) production.	49
7	Antioxidant activity	Root	Alcoholic extract	Inhibited the formation of oxygen derived free radicals (ODFR) <i>in vitro</i> with 4000 $\mu$ g/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 $\mu$ g/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 <i>Momordica dioica</i> in rat model was screened.	56
9	Antimalarial activity	Not specified	Alcoholic extract	Screened extract <i>in vivo</i> and <i>in vitro</i> against NK65 strain of <i>Plasmodium berghei</i> , <i>Jurineamacrocephala</i> , <i>Aegle marmelos</i> 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 CCl <sub>4</sub> 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 CCl <sub>4</sub> induced hepatic damage.	62
12	Antifertility activity	Fruit	Ethanol 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 and methanol extract gave more significant analgesic activity than ethyl acetate extract.	65
			Hexane, methanol extract	Exhibited analgesic activity when compared to standard drug.	66

## References

1. Joseph JK 2005, Studies on ecogeography and genetic diversity of the genus *Momordica* L. in India [Ph.D. thesis], Department of Botany, Mahatma Gandhi University, Kottayam, India.
2. Duthie JF 1965, Flora of the upper Gangatic plans. Botanical survey of India. Calcutta, 1 89-91.
3. Bharathi LK, Munshi AD, Chandrashekar S, Behera TK, Das AB and John KJ 2011, Cytotaxonomical analysis of *Momordica* L. (Cucurbitaceae) species of Indian occurrence. *Journal of Genetics*. 90 1 21-30.
4. Raj NM, Prasanna KP and Peter KV 1993, *Momordica* spp., in Genetic Improvement of Vegetables Crops, Kallo G and Bergh BO, Eds., Pergamon Press, Oxford, UK, pp. 239-243.
5. Trivedi RN and Roy RP 1972, Cytological studies in some species of *Momordica*. *Genetica*. 43 2 282-291.
6. Singh H 2008, Importance of local names of some useful plants in ethnobotanical study. *Indian Journal of Traditional Knowledge*. 7 2 365-370.
7. Sastri SN 1962, The Wealth of India-Raw Materials, CSIR, New Delhi, India.
8. Zuberi MI and Bishwas A 1998, Biodiversity degradation in Bangladesh: wild kakrol (*Momordica dioica* Roxb.) an endangered species. *Asia Pacific Journal of Environmental Development (Bangladesh)*. 5 1 66-74.
9. Rashid MM 1976, Bangladeshi Shabjee, Bangla academy, Dhaka, Bangladesh, 1st edition.
10. Hooker JD 1961, The Flora of British India, Reeve Co, Kent, UK.
11. Ram D, Kalloo G and Banerjee MK 2002, Popularizing kakrol and kartoli: the indigenous nutritious vegetables. *Indian Horticulture*. 6 9 11.
12. Walters TW and Decher DS 1988, Notes on economic plants, Basampear (*Momordica charantia*) Cucurbitaceae. *Econ. Bot.* 286-288.
13. Maniraj N, Prasanna KP and Petter KV 1993, Bitter guard *Momordica* Spp. In: Kalloo, G., Bergh, B-O., [Eds] . Genetic improvement of vegetable plants, Pergamon Press. 239-246.
14. Decher-Walters DS 1999, Cucurbits, Sanskrit and the Indo-Aryans. *Econ. Bot.* 98-112.
15. Shankar D and Ved DK 2003, Indian Forester. 129 275-288.
16. Plants Database, database (version 4.0.4) (1996). National Plant Data Center, NRCS, USDA. Baton Rouge, LA 70874-4490 USA.
17. Spine Gourd Farming (Kakrol/Kantola) Guide 2015.
18. Gopalkrishnan TR. Vegetable crops. PP-136.
19. Kirtikar KR and Basu BD 1999, Indian Medicinal Plants, vol. 2, International Book Distributors, Dehradun, India.
20. Kirtikar KR and Basu BD 1981, Indian Medicinal Plants, vol. 2, Lalit Mohan Basu, Allahabad, India.
21. Satyavati GV, Gupta AK and Tandon N 1987, Medicinal plants of India, vol. 2, ICMR, New Delhi, India.
22. Nadkarni AK 2007, Indian Materia Medica, vol. 1, Popular Prakashan, Mumbai, India.
23. Publication and Information Directorate, The Wealth of India. First Supplement Series, NISCIR, vol. 4, CSIR, New Delhi, India, 1962.
24. Jadeja BA, Odedra NK and Odedra KR 2006, Herbal remedies used for haemorrhoids by tribals of Saurashtra, Gujarat. *Indian Journal of Traditional Knowledge*. 5 3 348-352.

25. Oudhia P, Ankol (Alangium) based Indigenous Herbal Medicines for Bleeding Piles (Hemorrhoids): Pankaj Oudhias Medicinal Plant Database, <http://www.pankajoudhia.com/>.
26. SharmaMC and Joshi C 2004,Plants used in skin diseases of animals.*Natural Product Radianc*e. 3 4 294.
27. SatyavatiGV, RainaMK and SharmaM 1987, Medicinal Plants of India, vol. 1, ICMR, New Delhi, India.
28. AnjariaJ, Parabia M, Bhatt G andKhamar R 2002, Natural Heals: A Glossary of Selected Indigenous Medicinal Plants of India, Sristi Innovations, Ahamedabad, India, 2 edition.
29. Sharma GK 2004,Medical ethnobotany in the Shivalik Range of the Himalayas.*Journal of the Tennessee Academy of Science*. 7 12–16.
30. Ali A and Deokule SS 2008,Comparison of phenolic compounds of some edible plants of Iran and India. *Pakistan Journal of Nutrition*. 8 26–31.
31. Maharana T and Tripathy P 1996, Agrotechniques of *Momordica dioica*growing spine gourd in pots.*Indian Horticulture*. 16– 17.
32. Bharathi LK,Naik G, Singh HS,Dora DK andPeter KV 2007, Spine gourd, in Underutilized and Underexploited Horticultural Crops, K. V. Peter, Ed., New India Publishing, New Delhi, India,pp. 289–295.
33. Aberoumand A 2011,Screening of less known two food plants for comparison of nutrient contents: Iranian and Indian vegetables. *Functional Foods in Health and Disease*. 10 416– 423.
34. Singh D,Bahadur V,Singh DB and Ghosh G 2009, Spine gourd (*Momordica dioica*): an underutilized vegetable with high nutritional and medicinal values.*ISHS Acta Horticulturae*. 809 241–248.
35. Ghosh A 2005,Mechanism of monocarpic senescence of *Momordica dioica*: source-sink regulation by reproductive organs.*Pakistan Journal of Scientific and Industrial Research*. 48 1 55–56.
36. BhuiyaMRH, HabibAKMA and RashidMM 1977,Content and loss of vitamin C in vegetables during storage and cooking.*Bangladesh Horticulture*. 5 1–6.
37. RaoMK 2001, Flora of Maharashtra State, Dicotyledons, vol. 2.
38. KumaraKN and BulugahapitiyaVP 2004,A preliminary chemical study on secondary metabolites present in fruits of *Momordica dioica* (Thumbakariwila), in Proceedings of the 2nd Academic Sessions,pp. 96.
39. JianCC, MingHC, RuiLN, CordelGA and QiuzSX 2005, Cucurbitacins and cucurbitane glycosides: structures and biological activities. *Natural Product Reports*. 22 3 386–399.
40. Ali M andSrivastava V 1998,Characterization of Phytoconstituents of the Fruits of *Momordica dioica*.*Indian Journal of Pharmaceutical Sciences*. 60 5 287–289.
41. Luo L and Li Z 1997,Two new triterpenes of ursolic acids from *Momordica dioica*.*Acta Botanica Yunnanica*. 19 3 1–3.
42. Luo L, Li Z, Zhang Y and Huang R 1998,Triterpenes and steroidal compounds from *Momordica dioica*.*YaouxueXuebao*. 33 11 839–842.
43. Joshi SR, Vasantha K and Robb JS 2005,An unusual antiH lectin inhibited by milk from individuals with the Bombay phenotype.*Immunohematology*. 21 1 1–4.
44. Shrinivas B, Anil S, Parera M and Saxena M 2009, Evaluation of

- antimicrobial and antioxidant properties of *Momordica dioica* Roxb. (Ex Willd). *Journal of Pharmaceutical Research*. 2 6 1075-1078.
45. Arekar JA, Arekar AR and Paratkar GT 2013, Screening of antibacterial activity of flavonoid fractions of *Momordica dioica*, Roxb. *Global Journal of Bio-Science and Biotechnology*. 2 2 235–237.
  46. RakhMS, KhedkarAN, AghavNN and ChaudhariSR 2012, Antiallergic and analgesic activity of *Momordica dioica* Roxb. Willd fruit seed. *Asian Pacific Journal of Tropical Biomedicine*. 2 1 192–196.
  47. FernandopulleBMR, RatnasooriyaWD and KarunanayakeEH 1996, Evaluation of two cucurbits (Genus: *Momordica*) for gastroprotective and ulcer healing activity in rats. *Medical Science Research*. 24 2 85–88.
  48. Rakh MS and Chaudhari SR 2010, Evaluation of CNS depressant activity of *Momordica dioica* Roxb. willd fruit pulp. *International Journal of Pharmacy and Pharmaceutical Sciences*. 2 4 124–126.
  49. Jain A and Singhai AK 2010, Effect of *Momordica dioica* Roxb on gentamicin model of acute renal failure. *Natural Product Research*. 24 15 1379–1389.
  50. Jain A and Singhai AK 2010, Nephroprotective activity of *Momordica dioica* Roxb. in cisplatin-induced nephrotoxicity. *Natural Product Research*. 24 9 846–854.
  51. ShreedharaCS and VaidyaVP 2006, Screening of *Momordica dioica* for hepatoprotective, antioxidant, and anti-inflammatory activities. *Natural Product Sciences*. 12 3 157–161.
  52. Shreedhara CS, Aswatha Ram HN, Zanwar SB and Gajera SB 2011, In vitro antioxidant potential of ethanolic extract of *Momordica dioica* Roxb. (Cucurbitaceae). *Pharmacologyonline*. 3 622–633.
  53. Jain A, Soni M and Deb L 2008, Antioxidant and hepatoprotective activity of ethanolic and aqueous extracts of *Momordica dioica* Roxb. leaves. *Journal of Ethnopharmacology*. 115 1 61–66.
  54. Reddy GT, Kumar BR and Mohan GK 2005, Anithyperglycemic activity of *Momordica dioica* fruits in alloxan-induced diabetic rats. *Nigerian Journal of Natural Products and Medicine*. 9 33–34.
  55. Singh R, Seherawat A and Sharma P 2011, Hypoglycemic, antidiabetic and toxicological evaluation of *Momordica dioica* fruit extracts in alloxan induced diabetic rats. *Journal of Pharmacology and Toxicology*. 6 5 454–467.
  56. Gupta R, Katariya P and Mathur M 2011, Antidiabetic and renoprotective activity of *Momordica dioica* in diabetic rats. *Diabetologia Croatica*. 40 3 81–88.
  57. FernandopulleBMR, KarunanayakeEH and RatnasooriyaWD 1994, Oral hypoglycaemic effects of *Momordica dioica* in the rat. *Medical Science Research*. 22 2 137–139.
  58. Misra P, PalNL, GuruPY, Katiyar JC and TandonJS 1991, Antimalarial activity of traditional plants against erythrocytic stages of *Plasmodium berghei*. *International Journal of Pharmacognosy*. 29 1 19–23.
  59. Ilango K, Maharajan G and Narasimhan S 2003, Analgesic and Anti-inflammatory Activities of *Momordica dioica* Fruit Pulp. *Natural Product Sciences*. 9 4 210–212.
  60. Govind P 2011, Medicinal plants against liver diseases. *International Research Journal of Pharmacy*. 2 5 115–121.
  61. Kumar C, Ramesh A, Suresh Kumar JN and Mohammed IB 2011, A review on hepatoprotective activity of medicinal

- plants. *International Journal of Pharmaceutical Science and Research*. 2 3 501–515.
62. Chaudhary GD, Kamboj P, Singh I and Kalia AN 2010, Herbs as liver savers-a review. *Indian Journal of Natural Products and Resources*. 1 4 397–408.
63. Kushwaha SK, Jain A, Gupta VB and Patel JR 2005, Hepatoprotective activity of the fruits of *Momordica dioica*. *Nigerian Journal of Natural Product and Medicine*. 9 29–31.
64. Kudaravalli M 2006, Screening of antifertility activity of *Momordica dioica*, Roxb. in male and female rats [M.S. thesis], Department of Pharmacology, V.I.P.S, Bangalore, India.
65. Shreedhara CS, Pai KSR and Vaidya VP 2001, Postcoital antifertility activity of the root of *Momordica dioica* Roxb. *Indian Journal of Pharmaceutical Sciences*. 63 6 528–531.
66. Rakh MS and Chaudhari SR 2010, Evaluation of analgesic activity of *Momordica dioica* Roxb. Willd fruit pulp. *International Journal of Pharmaceutical Science and Research*. 1 9 53–56.