

Phyto-pharmacology of *Momordica dioica* Roxb. ex. Willd: A Review

Bhavana Bawara¹, Mukesh Dixit², N. S Chauhan³, V. K. Dixit³, D.K .Saraf^{1*}

*Corresponding author:

Prof. D. K. Saraf

¹Department of Zoology,
Dr. H. S. Gour University Sagar
MP, 470003

India
Email: drdksaraf@gmail.com

²Lake Conservation Board,
Environment Campus, Arera
Colony, Bhopal, India

³Department of Pharmaceutical
Science,
Dr H. S. Gour Vishwavidyalya
Sagar (M.P) India

Abstract

Momordica dioica Roxb. ex. Willd (Cucurbitaceae) is commonly known as a bitter gourd. It is traditionally used as astringent, febrifuge, antiseptic, anthelmintic, spermicidal. Also Used in bleeding piles, urinary infection and as a sedative. Studies indicate that it possesses antioxidant, hepatoprotective, antibacterial, anti-inflammatory, anti-lipid peroxidative, hypoglycemic and analgesic properties.

This review aims to highlight the ethnobotany, pharmacognostic and pharmacological uses of *Momordica dioica*

Keywords: *Momordica dioica*, Cucurbitaceae, phytochemical constituents, pharmacological actions, Parora, kakora

Introduction

Momordica dioica Roxb. ex. Willd is a perennial, dioecious climbing creeper belonging to family Cucurbitaceae. Its common name is Parora, kakora. Flowering occurs during June to July and fruiting during September to November. Leaves of plant are simple membranous, broadly ovate in outline, variable in length 3.8-10cm by 3.2-8 cm, cordate at the base, deeply lobed in 3-5 triangular lobes, punctated, entire but distantly denticulate, petiole 1.3-4.5 cm. long channelled above, pubescent and glandular. Male flower is solitary, up to 2.8 cm long and yellow coloured. Petals 1.3- 2.5 cm long, oblong lanceolate. Calyx five lobed, linear lanceolate. Corolla five partite, stamen three. Female flower is solitary, small bract below the middle of the peduncle, calyx and corolla as in male without staminodes or in form

of gland three united, ovary clothed with long soft papillae and many ovuled, ellipsoid. Yellow coloured. Fruit is shortly beaked, obtuse with inner red kernel, densely echinate with soft spines, green and yellow at maturity. Seeds are rounded broadly ellipsoid, slightly compressed, slightly and irregularly corrugated enclosed in red pulp. Stem slender, branched, furrowed, glabrous and shining. Tendrils is elongated, simple, striate and glabrous [1-6]. This is climbing creeper generally found throughout India, Pakistan, Bangladesh, Himalayas to Ceylon. Reported up to an altitude of 1500 m in Assam and Garo hills of Meghalaya[7]. Kakrol is a Cucurbitaceous crop originated in the Indo -Malayan region [8-9].

Synonyms

Bengoli	- Kartoli
English	- Small bittergourd, spine gourd
Hindi	- Kakora, Parora, Golbandra
Malyalam	- Venpaval, Erima pasel
Marathi	- Kartoli
Tamil-	Aegaravalli, Tholloopavai, Paluppakkay
Telagu	- Karkotaki, Agakara
Cannad	- Madahagala –Kayi
Sanskrit	- Vahisi
Panjabi	- Dharkarela
Assam	- Batkarila

Plant parts –

Fruits - Fruit of plant are green and generally used as vegetable. It possesses many medicinal properties. Fruit are diuretic, alexiteric stomachic laxative, hepatoprotective, and have antivenum property. It is also used to cure asthma, leprosy, excessive salivation, prevent the inflammation caused by lizard, snake bite, elephantiasis, fever, mental disorders, digestive disorders and troubles of heart and to treat discharge from mucous membrane [3,10]. Fresh fruit juice is prescribed for hypertension. The fruit is cooked in a small amount of oil and consumed for treating diabetes. Tender fruits are rubbed on skin for pimples and acne. Seeds are roasted and taken for eczema and other skin problems [11]. The powder or infusion of the dried fruits, when introduced into the nostrils produces a powerful errhine effect and provokes a copious discharge from the schneiderian mucous membrane [3].

Leaves - Leaves of the plant are antihelminthic, aphrodisiac. It is also used to cure tridosha, fever and alters pitta, jaundice, asthma, bronchitis, piles, hepatic damages, mental digestive disorders, bleeding piles bowel affection and urinary complaints. The juice of the leaves mixed with coconut, pepper, red sandalwood etc in order to

form an ointment and applied to the head to relieve pain in the head. Leaf paste applied externally to skin and orally two or three times daily for skin disease [12].

Roots – Roots of the *Momordica dioica* is full of medicinal values .Juice of root is stimulant, astringent, antiseptic .The mucilaginous tubers are antihelminthic, spermicidal, antifertility abortificant, used in case of bleeding piles, similar bowel afflictions and urinary complaints [13]. Powder of root is applied to skin to make it soft and to reduce perspiration.

Mucilaginous tubers of female plants used in bleeding piles & bowel infections; the dose is two drachmas or more twice daily. Tuberous root is ground in hot water and 50ml of juice is taken orally once a day on empty stomach for to days to beat diabetes. The toasted root is used to stop bleeding from piles and also in bowel complaints. In the Konkan region, the juice of the root is a domestic remedy for the inflammation caused by contact with the urine of the house lizard. The root of the male creeper is used in ulcers, especially those caused by snake –bites.

The roots of the plant are also recommended for scorpion sting [3]. The root ground into a paste and smeared over the whole body is believed to act as a sedative in high fever with delirium [14,15].

Classification

The PLANTS Database, [16].

Kingdom	Plantae
Subkingdom	Tracheobionata
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Violales
Family	Cucurbitaceae
Genus	<i>Momordica</i>
Species	<i>dioica</i>

Taxonomic Hierarchy -

Kingdom	-Plantae Planta, plantes, plants, Vegetal
Subkingdom	-Tracheobionta -- vascular plants
Division-	Magnoliophyta -- angiospermes, angiosperms, flowering plants, phanérogames,
Class-	Magnoliopsida -- dicots, dicotylédones, dicotyledons
Subclass-	Dilleniidae
Order-	Violales
Family-	Cucurbitaceae -- citrouilles, gourdes, gourds, squashes
Species-	<i>Momordica dioica</i> Roxb. ex Willd. -- balsampear

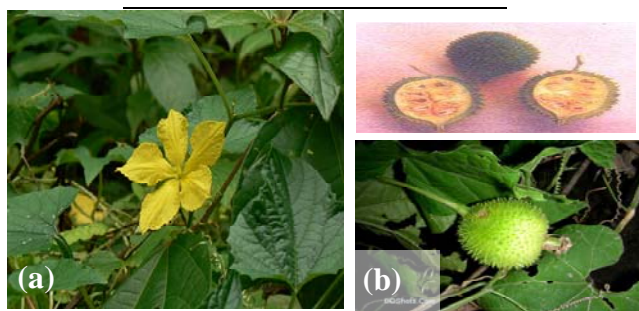


Fig 1 Photograph of *Momordica dioica* (a) Flower (b) Fruit

Pharmacological activities

Many researchers evaluated various types of activities with the extracts of different parts of the plant. These studies were based on the use by the people for various ailments and on the variation in the chemical composition of the various parts of the plant. The pharmacological studies are summarised below.

Mishra et al screened the alcoholic extracts of *Momordica dioica* for antimalarial activity against the NK 65 strain of *Plasmodium berghei*. It was found that plant possesses schizontocidal

activity (50% and above) *in vivo* as well as *in vitro* at a dose of 1 gm/kg \times 4 days [17].

Gupta et al evaluated the alcoholic extract of *Momordica dioica* for its antiallergic activity and found that it is effective to inhibit passive cutaneous anaphylaxis in mouse and rat [18].

Shreedhara et al reported the antifertility activity of aqueous and ethanolic extract of root of *Momordica dioica* Roxb. ex. wild in female rat. The extracts showed moderate estrogenic activity and caused significant increase in uterine weight. This activity was evaluated at 200mg/kg, where aqueous extract showed 83% and ethanolic extract 100% abortifacient activity [19].

Ilango et al observed the analgesic and anti-inflammatory activities in *Momordica dioica* fruit pulp hexane and methanol extracts. *Momordica dioica* fruit pulp was successively extracted with hexane and methanol. To the concentrated methanolic extract ethyl acetate was added and ethyl acetate soluble portion was separated. Both hexane extract (HE) and ethyl acetate soluble portion (EASP) of methanolic extract was vacuum dried to yield the respective HE and EASP. HE and EASP were evaluated for its analgesic and anti-inflammatory activities in a dose of 50 and 100 mg/kg in mice and rats. Both HE and EASP exhibited significant analgesic and anti-inflammatory activities when compared to standard drug [20].

Narsimhan et al reported the antifeedent activity of fruit pulp of *Momordica dioica* in hexane extract and ethyl acetate soluble fraction of methanolic extract and exhibited moderate and concentration dependent antifeedent activity against *Spodoptera litura* [21].

Kushwaha et al reported the hepatoprotective activity of the fruits of *Momordica dioica*. The flavonoidal fraction collected from column chromatography from ethanolic extract of fruits of *Momordica dioica* Roxb. was evaluated for hepatoprotective activity in wistar strain of albino rats of either sex against carbon tetrachloride induced hepatic damage. The fraction caused

decrease in serum level of enzymes serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase, alkaline phosphate and total bilirubin in treated rats as compared to control. This study showed that this fraction from *Momordica dioica* fruits could afford a good protection against carbon tetrachloride induced hepatocellular damage [22].

Thirupathi et al reported the antidiabetic activity of fruits of *Momordica dioica* Roxb. Ex. willd by preparing the various organic extract. From these three chloroform, ethyl acetate and alcoholic extracts only ethyl acetate and alcoholic extracts showed antidiabetic activity at a dose of 200mg/kg p.o. This activity of plant may be due to enhancement of peripheral metabolism of glucose [23].

Mishra et al studied *Momordica dioica* as an insecticide against mustard aphid, *lipaphis erysimi* kalt in farm of mustard crop. They concluded that seed oil of small bitter gourd was found to be satisfactory natural insecticide giving 100% mortality at 4% conc. in 24 hrs. Its lower concentration up to 2% was also found effective but require longer time to give 100% mortality. The activity of plant may be due to presence of alkaloid momordicin in the oil [24].

Mishra et al reported that the solvent extracted from vegetable seed oil of Small bitter gourd (*Momordica dioica*), evaluated as grain protectant against *Callosobruchus chinensis* on the stored legume-pulse grains. It provided negligible weight loss at the oil-application rate of 6-8 mL/kg in legume-pulse grain after 60 days storage at laboratory conditions. The milling yield and degree of dehusking gets improved after the oil application. The use of solvent extracted Small bitter gourd seed oil at the level of 6-8 mL/kg of legume-pulse grain sample resulted in the improved apparent degree of dehusking from 40.0 to 72.59, 59.88 to 92.44, 63.39 to 87.50 and 57.0 to 79.43 for pigeonpea (*Canjanus cajan*), Chickpea (*Cicer arietinum*), Urdbean (*Phaseolus mungo*) and Mungbean (*Phaseolus radiatus*), respectively [25].

Thirupathi et al reported the hepatoprotective activity of *Momordica dioica* in methanolic extract at the dose of 300mg /kg in albino rats of wistar strain and the liver was damaged by using carbon tetrachloride. The hepatoprotective activity of *Momordica dioica* may be due to presence of its phytoconstituents like steroids and triterpenoids. Increase in the total antioxidant levels causes the inhibition of lipid peroxide formation. The methanolic extract of the plant significantly reduced the AST, ALT, Lipid peroxide levels and total serum bilirubin level [26].

Jain et al reported the antioxidant and hepatoprotective activity of ethanolic and aqueous extracts of *Momordica dioica*. From both the extracts, ethanolic extract was found to be more potent hepatoprotective. The antioxidant and free radical scavenging activities were positive for both ethanolic and aqueous extract. This activity may be due to free radical scavenging and antioxidant activities which may be due to presence of flavonoids in extracts [27].

Phytochemical Studies

Momordica dioica is as dioeciously climbing herb belonging to family Cucurbitaceae. It contains many phytoconstituents. Phytoconstituents of *Momordica dioica* are traces of alkaloids, steroids, triterpenoids [28], flavonoids, glycosides, saponins [29], triterpenes of urisolic acid dark brown semidrying oil and saturated fatty acids, ascorbic acids, vitamin A, thiamine, ribnoflavins, niacin, protein carbohydrates, lectins [30], ascorbic acids, carotenes, bitter principles, oleoic acid, stearic acid, gypsogenin, alpha-spiranosterol hederagenin, momordicaursenol [31]. The alkaloid present in seed called momordicin and present in root called momordicafoetida.

Cucurbitacins and cucurbitane glycosides: structures [32] Sadyojatha et al examined the chemical constituents of the rhizome of *Momordica dioica* revealed the presence of β -sitosterol saponin glycosides and alkaloids. The

isolated principles of rhizome was tested against bacteria & concluded that the compound exhibits a moderate antibacterial activity [33].

Luo, et al isolated three triterpenes and two steroidal compounds from dry roots of *Momordica dioica*. Their structures were elucidated by spectral analysis (NMR, IR, MS, ¹HNMR, ¹³CNMR and DEPT) and chemical methods. These compounds are alpha-spinasterol octadecanolate(I), alpha-spinasterol-3-O-beta-D-glucopyranoside(II), 3-O-beta-D-glucuronopyranosyl gypsogenin(III), 3-O-beta-D-glucopyranosyl gypsogenin(IV) and 3-O-beta-D-glucopyranosyl hederagenin(V). Constituent III is a new compound. The CHCl₃ extract of *Momordica dioica* roots and five isolated constituents showed anticancer activity in pharmacologic testing on cancer cell (L1210). The growth inhibitory index (%) of compound II was shown to be 50%, at the dose of 4 micrograms.ml⁻¹. [34]

Ali *et al* have isolated the two new aliphatic constituents characterized as 6-methyl tritriacont-5-on-28 ol and 8 -methyl hentriacont -3-ene from fruit rind of *Momordica dioica* along with the known sterol pleuchiol. An unknown pentacyclic triterpene Momordicaursenol, isolated from seed has been identified as usr-12, 18(19) diene -3β -ol on the basis of spectral data analysis and chemical means [31].

Sinha *et al* soluble proteins from the specialised reproductive structure, the tuberous roots of *Momordica dioica* through which it propagates, were analysed by SDS-PAGE to compare the protein profiles of the sex forms. Twenty eight bands with molecular masses ranging from -15kD protein to more than 94kD proteins were found to be common in both sexes. The difference in their protein profiles was marked by the presence of a 22kD polypeptide (p-22) in the female sex which was not detected in its male counterpart. Further studies by immunoblot assay demonstrated that anti-body raised against p-22 not only cross-reacted at 22kD antigen of the female sex but also with 29kD and 32kD polypeptides of the male

and female sex forms. It indicates that these 3 polypeptides are electrophoretically distinct but antigenically similar. 22kD protein found in female sex is, therefore, not sex specific rather sex linked. Moreover, variation in the intensity of 29kD and 32kD polypeptides of male and female sex forms suggests that the interplay of these 2 sex linked polypeptides may be a contributing factor in controlling sex mechanism of dioecious *Momordica dioica* [35].

Joshi et al extracted the anti-H lectin from the seeds of the plant *Momordica dioica Roxb.* ex.wild and tested for its hemagglutination and inhibition properties, using standard serological methods and pael RBCs, serum, saliva, milk and oligosaccharides purified from milk . The extract displayed strongest agglutination with group O RBCs and was weakest with group A,B RBCs in a spectrum.They also concluded that the lectin in the *Momordica dioica Roxb.* ex.wild agglutinated RBCs from persons other than those of the Bombay phenotype [36].

Tirmizi *et al* evaluated the level of chromium and zinc in ,sweet ,sour , and bitter testing fruits, vegetables and medicinal plants .The amount of Cr and Zn were observed in unpeeled and peeled fruit of *Momordica dioica*. The concentration of Cr in unpeeled fruit is 0.26mg/kg and in peeled is 0.27mg/kg .While the concentration of zinc is higher in unpeeled fruits, which contains 11.0 mg/kg and in peeled 4.91mg /kg [37].

Ali and Deokul have found some important nutrient in different plants and provided the concentration of important nutrients .*Momordica dioica* also possess many essential nutrient compound which are essential for proper functioning of the body .It contains Calcium -0.5 mg/g, Sodium -1.5 mg/g,Potassium -8.3 mg/g, Iron -0.14mg/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 , 4.1calories and ash value was 6.7% [38].

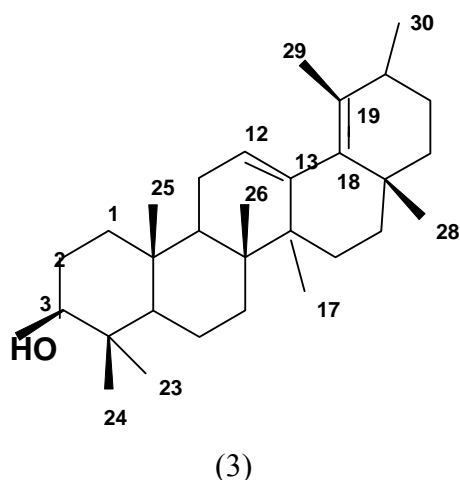
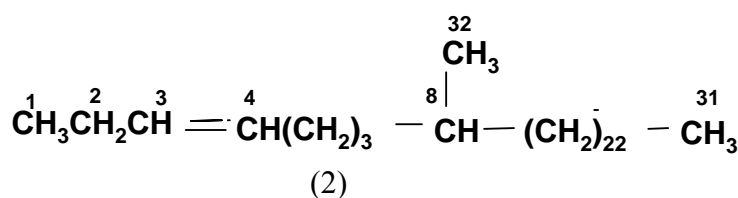
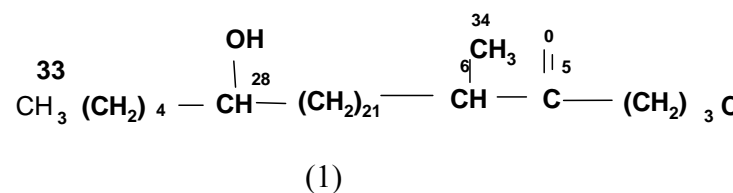


Fig 2 Structures of (1) 6-methyl tritriacont-5-on-28 ol
(2) 8-methyl hentriacont -3-ene (3) Momordicaursenol .

Tissue culture

Nabi *et al* studied the organogenesis in *Momordica dioica* Roxb. They found that, of the four type of explants of *Momordica dioica* viz. node , shoot tip ,leaf and the cotyledon, the cotyledon showed the best performance. The combination 1.0mg/1BAP and 0.1mg / 1NAA .was found most suitable in callus induction followed by 0.2mg/1NAA. The highest number of multiple and tallest shoots were obtained on MS medium fortified with 1.0mg/1BAP and 0.1mg / 1NAA. For rooting, half strength MS supplemented with IBA proved to be better than

IAA, although on half strength MS supplemented with IAA tallest shoot were observed [39].

Deokar et al studied the tissue culture in *Momordica dioica* .The shoot tip ,axillary bud, cotyledon and hypocotyl explants were collected from *Momordica dioica* plant and grown in the laboratories, applied with different kind of treatments like with MS, BPA, MSHP, Kinetin, IBA, agar, gelrite for crop establishment. The best treatment for crop establishment was MSHP +Ads +BPA+ 10 mg/litre + IBA at 5 mg/litre +gelrite . The best treatment for induction and development of roots was MSHP +Ads+ IBA at 1 mg/litre+Agar. The maximum survival was observed when plantlets were transferred in sterilized water for 6 h, transferred to soilrite trays ,covered with polyethylene and kept open in a poly house [40].

Thiruvengadam *et al.* (2006) reported the somatic embryogenesis and plant regeneration from petiole-derived callus of Spine Gourd (*Momordica dioica*). This is efficient protocol for plantlet regeneration from the cell suspension cultures of spine gourd (*Momordica dioica* Roxb. ex Wild.) through somatic embryogenesis is reported. Petiole-derived embryogenic calli were cultured on Murashige and Skoog medium augmented with 4.5 fÊM 2,4-dichlorophenoxyacetic acid (2,4-D) and 10% coconut milk (CM). The maximum frequency of somatic embryos (36.3%) was observed on MS medium supplemented with 2.2 fÊM 2,4-D for three weeks of culture. Ontogenic studies of somatic embryos revealed that the cells destined to become somatic embryos divided into spherical proembryos and then progressed to globular, heart and further differentiated properly into torpedo and cotyledonary stages within 5 weeks. Embryo development was asynchronous and strongly influenced by the 2,4-D concentration. The MS liquid medium augmented with 2.2 fÊM 2,4-D and 0.5 fÊM L-glutamine was effective to achieve high frequency of somatic embryo induction (44.5%). The cotyledonary-stage somatic embryos were transferred to MS liquid medium with no plant

growth regulators to achieve complete maturation within 7-days. Lack of 2,4-D in suspensions increased somatic embryo maturation with decreased abnormalities. Sucrose was found to be the best carbon source for callus induction, embryo maturation and embryo germination. Relatively, only few numbers of embryos developed into root/shoot when transferred to 1/10 MS solid medium containing 0.5 μ M abscisic acid (ABA), 2% (w/v) sucrose and 0.2% (w/v) Gelrite. About 11% of somatic embryos germinated into morphologically normal fertile plants within 2 weeks. Regenerated plantlets were successfully hardened, with a survival rate of approximately 60%, and established in the field. This regeneration protocol assured successful embryo induction, maturation and plantlet conversion. [41].

Yasuhiro *et al.* (2006) reported that the Chromosome doubling through seed and multiple shoot treatments was conducted to obtain octoploid kakrol (*Momordica dioica* Roxb.) plants. Seed treatments with 0.2, 0.4% colchicine or 0.003% amiprofos-methyl were effective to chromosome doubling, among which the treatment with 0.4% colchicine was most effective. Amiprofos-methyl treatment also brought octoploid plants with high rate of seed germination. Multiple shoot treatments with 0.05% colchicine for 12 and 24 hours, and 0.1% colchicine for 24 hours also brought octoploid plants. Leaf and guard cell size were bigger, and leaf shape index (leaf length/leaf width) was lower in the octoploid than in tetraploid plants. Leaves of the octoploid plants were uneven on the surface with clear serrations [42].

Mohammad *et al.* (2008) conducted an experiment on the plant fruit to find out the possibility of inducing parthenocarpic fruit. Seven plant growth regulators with three concentrations were used. Out of seven only three were effective in parthenocarpic fruit development. Increase in size and weight of fruit were increased with the concentration of growth regulators [43].

Conclusion

M. Diocia has been studied yet many aspects are still to explained viz aphrodisiac, anticancer, immunomodulatory, sedative and anxiolytic activity.. The villagers and tribal used it for as medicine for many impairments hence the plant can be investigates on these lines.

References

1. Duthie JF .Flora of the upper Gangatic plans. Botanical survey of India.Calcutta, 1965, 1:89-91.
2. Khare CP. Encyclopedia of Indian Medicinal Plants .Springer. New York, 2004:104.
3. Kirtikar KR, Basu BD. Indian Medicinal Plants. International Book Distributors, Dehradun, 1999,2:1129-1135.
4. Nadkarni KM. Medicinal plants of India. Reprint publication Dehradun. India. 2004: 236-237.
5. Oommachan M. The flora of Bhopal .J.K. Jain brothers, Bhopal. India, 1977 .180-181.
6. Chopra RN, Nayar SL, Chopra ZC. Glossary of Medicinal Plants of India. Publication Council of Scientific of industrial Research New Delhi. 1956:169.
7. Ram D, Kalloo G, Banerjee MK. Popularizing kakrol and kartoli: the indigenous nutritious vegetables. *Indian Horticulture*. 2002, 6:9-11.
8. Rashid MM. Bangladeshi shabjee.1st ed. Bangla academy .Dhaka, Bangladesh, 1976, 494.
9. Singh AK. Cytogenetics and evaluation in the cucurbitaceous In ; Bats ,DM ,Robinson RW and Jaffy , C (eds) .Biology and utilization of cucurbitaceae .Comstock Publishing Associates ,Cornell Univ. Press ,Ithaca , New York and London. 1990: 10-28.

10. Kirtikar KR, Basu BD. Indian Medicinal Plants. Lalit Mohan Basu, Allahabad, India. 1981, 2:11-2.
11. Sharma GK. Medical ethnobotany in the Shivalik Range of the Himalayas. Journal of the Tennessee Academy of Science. 2004,7:12-16.
12. Nadkarni KM. In Indian materia medica, Populer prakashan. Bombay, 1976: 807.
13. Satyavati GV, Gupta AK ,Tandon N. In Medicinal plants of India, vol.2, ICMR, New Delhi, 1987 :287.
14. Satyavati GV, Raina MK, Sharma M .In Medicinal plants of India, vol. 1, ICMR New Delhi, 1987:327.
15. Anjaria J, Parabia M, Bhatt G, Khamar R. Natural heals: A glossary of selected indigenou medicinal plants of India .Sristi innovations 2nd edition .Ahamedabad, 2002: 35.
16. PLANTS Database, database (version 4.0.4) (1996). National Plant Data Center, NRCS, USDA. Baton Rouge, LA 70874-4490 USA. <http://plants.usda.gov> .
17. Misra P, Pal NL, Guru PY, Katiyar J, Tandon JS. Antimalarial Activity of Traditional Plants against Erythrocytic Stages of Plasmodium berghei. Pharmaceutical Biology. 1991, 29: 19 - 23.
18. Gupta PP, Simal RC, Tandon JS. Antiallergic activity of some traditional Indian medicinal plants. International Journal of pharmacognosy. 1993, 31(1) :15-18.
19. Shreedhar CS, Pai KSR, Vaidya VP .Postcoital antifertility activity of the root of *Momordica dioica Roxb* .*Indian J Pharmaceuticals Sciences* . 2001,6: 528-531.
20. Ilango K, Maharajan G, Narasimhan, S. Analgesic and Anti-inflammatory Activities of *Momordica dioica* Fruit Pulp. *Natural product sciences*. 2003, 9(4):210-212.
21. Narsimhan S, Kannan S, Maharajan G. Antifectent activity of *Momordica dioica* fruit pulp extract on *Spodoptera Litura*. *Fitoterapia* . 2005, 76(7-8):715-717.
22. Kushwaha SK, Jain A, Jain A, Gupta VB, Patel JR. Hepatoprotective activity of the fruits of *Momordica dioica*. *Nigerian Journal of Natural Products and Medicine*, 2005, 9: 29-31.
23. Thirupathi Reddy G, Ravikumar B, Krishna mohan G, Ramesh M. Antihyperglycemic activity of *Momordica dioica Roxb. ex.wild* fruits in alloxan –induced diabetic rats . *Asian J Pharmacodynamics and Pharmacokinetics*. 2006,6:327-329
24. Mishra D, Shukla AK, Dubey AK, Dixit AK, Singh K. Insecticidal activity of vegetable oils against Mustard aphid ,*Lipaphis erysimi* Kalt. under field condition .*Journal of Oleo Science* ,2006, 55 :227-231.
25. Mishra D, Shukla AK, Tripathi KK, Singh A, Dixit AK, Singh K. Efficacy of application of vegetable seed oils as grain protectant against infestation by *Callosobruchus chinensis* and its effect on milling fractions and apparent degree of dehusking of legume-pulses. *J Oleo Sci*. 2006, 56:1-7.
26. Thirupathi K, Satesh KS, Govardhan P, Ravikumar B, Rams Krishna D, Krishna mohan G . Protective effect of *Momordica dioica* against hepatic damage caused by carbon tetrachloride in rats .*Acta Pharmceutics Scientia* . 2006, 48:213-222.
27. Jain A, Soni M, Deb L. Antioxident and hepatoprotective activity of ethanolic and aqueous extracts of *Momordica dioica Roxb*. Leaves. *Journal of Ethnopharmacology*, 2008, 4: 115-118
28. Luo L, Li Z. Two new triterpenes of urosolic acids from *Momordica dioica*. *Acta .Bot.Yunn*, 1997, 19:316-320.

29. Sadyojatha AM, VaidyaVP. Chemical constituents of rhizome of *Momordica dioica* Roxb. International seminar on recent trends in pharmaceutical sciences. Ootacamund. 1995, 46:18-20.
30. Gosh PN, Dasgupta BB, Sircar PK. Purification of lectin from a tropical plant *Momordica dioica* Roxb. ex. Wild. Indian Journal of Experimental Biology. 1981, 19:253-225.
31. Ali M, Srivastava V. Characterization of phytoconstituents of *Momordica dioica*. Indian J Pharma. Sci, 1998, 60: 287-289.
32. Jian CC, Ming HC, Rui LN, Geoffrey A, Cordell SX. Cucurbitacins and cucurbitane glycosides: structures and biological activities. Nat. Prod. Rep., 2005, 22:386-399.
33. Sadyojatha AM, Vaidya VP. Chemical constituents of the roots of *Momordica dioica* Roxb. Indian drugs, 1996, 39: 473-475.
34. Luo L, Li Z, Zhang Y, Huang R. Triterpenes and steroidal compounds from *Momordica dioica*. Yao-Xue-Xue-Bao, 1998, 33: 839-42.
35. Sinha S, Debnath B, Guha A, Sinha RK. Sex Linked Polypeptides in Dioecious *Momordica dioica*. Cytologia. 2001,66:55-58.
36. Joshi SR, Vasantha K, Robb JS. An unusual anti-H lectin inhibited by milk from individuals with the Bombay phenotype. Immunohematology, Journal of Blood group serology and Education, 2005, 21:1-4.
37. Tirmizi SA, Hamid M, Watto S, Mazhar M, Wattoo FH, Menon AN, Iqbal J. Analytical investigation of Chromium and Zinc in Sweet, sour and bitter testing fruits vegetables and medicinal plants. Quim. Nova. 2007,30:1573-1577.
38. Ali A, Deokule SS. Studies on nutritional values of some wild edible plants from Iran and India. Pakistan Journal of Nutrient. 2008, 8: 26-31.
39. Nabi SA, Rasid MM, Al-Amin M, Rasul MG. Organogenesis in Teasle gourd (*Momordica dioica* Roxb.). Plant Tissue Cult. 2002, 12: 173-180.
40. Deokar PL, Panchabhai DM, Tagade UG. Tissue culture studies in spine gourd (*Momordica dioica* Roxb.). Annals of plant physiology, 2003, 17(1): 64-69.
41. Thiruvengadam M, Rekha KT, Yang CH. Somatic Embryogenesis and Plant Regeneration from Petiole-Derived Callus of Spine Gourd (*Momordica dioica* Roxb. ex Willd). Functional Plant Science and Biotechnology Global Science Books. 2007: 200-206.
42. Yasuhiro C, Yukio O, Hiroshi O, Shikanori M. Induction of Octoploids in Kakrol (*Momordica dioica* Roxb.). Science bulletin of the Faculty of Agriculture, Kyushu University. 2006, 61: 055-061.
43. Mohammad GR, Mohammad AKM, Yasuhiro C, Yukio O, Hiroshi O. Application of Plant Growth Regulators on the Parthenocarpic Fruit Development in Teasle Gourd (Kakrol, *Momordica dioica* Roxb.). J. Fac. Agr., 2008, 53:39-42.