Research Article

Pharmakon evaluation in *Momordica cymbalaria*

S. Anbuselvi*, A. Roshini Esther, R. Punithavathy

ABSTRACT

Aim: *Momordica cymbalaria* is an Indian vegetable which belongs to the family Cucurbitaceae. It is considered as underutilized vegetable crop as it is not commercially cultivated. Its versatile utility as a nutritious vegetable, folk medicine, and functional food ingredient provoked us to compile a comprehensive study of this multipurpose fruit on the distribution, nutritional attributes, and phytochemicals composition and its medicinal properties. The major constraints in the propagation of *M. cymbalaria* are non-availability of standardized propagation methods and low yield, and due to anthropogenic activity, it is under threat of existence. **Materials and Methods:** Here, we selected seeds and flesh of *M. cymbalaria* which includes variations of nutritional values such as protein, carbohydrate, fat, and crude fiber which were analyzed. **Results and Discission:** The study deals with in vitro antidiabetic, anti-ulcer, and antihyperlipidemic properties of seeds and flesh which were analyzed. The maximum nutrients were found to be higher in dry seeds when compared with flesh form which is used for siddha formulations. Phytochemical screening of seed was analyzed using gas chromatography–mass spectrometry and structural relationship in phytochemicals confirmed by Fourier-transform infrared spectroscopy. **Conclusions:** This study deals with nutritional and pharmacological property of seeds used for future analysis.

KEY WORDS: Antidiabetic activity, Antihyperlipidemic activity, Anti-ulcer activity, Momordica cymbalaria

INTRODUCTION

Momordica cymbalaria is a vine of the *Momordica* genus found in the Indian states of Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, and Tamil Nadu. The plant is a climber, annual, or perennial herb with scandent, branched, striate stem. The leaves are orbicular-reniform deeply cordate at the base, obtusely lobed with 5–7 lobes. The fruits are 20–25-mm long, pyriform with 8 sharp ridges, 24 mm × 15 mm attenuated at the apex, and with the base narrowed into the curved peduncle. It is fleshy, dark green, and ribbed. The seeds are 4.6-mm long, ovoid-shaped, smooth, and shiny. Flowers are unisexual. The male flower peduncle is 5–30-mm long, filiform, puberulous, ebracteate with 2–5 flowers in racemes with a pale-yellow corolla and two stamens for each flower. The female flower is solitary on a peduncle of 28-mm length. The roots are woody, tuberous, and perennial. The plant is allowed to grow along bunds (boundary of fields) and fences. A limited number of perennial tubers survive in soil and produce single plant in the next season. The plants belonging to this family are frost sensitive, drought tolerant, and intolerant to wet and poorly drained soils.[1]

Access this article online	
Website: jprsolutions.info	ISSN: 0975-7619

This crop is not cultivated by the farmer as a regular crop, even though it comes very well during Kharif and Rabi season. Initially, it was considered as a weed, but the tubers were used for medicinal purpose, in ancient times. Due to the nutritional value of the fruits, it is used as a vegetable in Tamil Nadu. It is reported as a medicinal plant in India, and various parts of plant are useful for treating the common ailments. Not only the fruits but also leaves be used as a leafy vegetable.[2]

Plants are sources of many potent and powerful drugs *M. cymbalaria* fruits were used as tonic, stomachic, stimulant, laxative, and alternative. The fruit juice and leaf tea of *M. cymbalaria* are mostly employed for diabetes, malaria, colic, sores and wounds, infections, worms, and parasites, as an emmenagogue, and for measles, hepatitis, and fever. The root acts as astringent, abortifacient, and aphrodisiac and also used to treat constipation, indigestion, diabetes, and diarrhea. The other species of *Momordica charantia* and *Momordica foetida* have been reported to have hypoglycemic effect. Researchers in tissue culture in many Cucurbitaceae members such as *Coccinia*

Department of Industrial Biotechnology, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India

***Corresponding author:** S. Anbuselvi, Department of Industrial Biotechnology, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India. E-mail: anbuselvichennai@yahoo.com

Received on: 22-11-2018; Revised on: 18-12-2018; Accepted on: 18-01-2019

indica, *Momordica dioica*, *Cucumis sativus*, *Cucumis angurina*, showed antidiabetic activity.[3]

The fruit extracts of *M. cymbalaria* were shown to have antidiabetic, hypolipidemic, antidiarrhea, and anti-ulcer activity.[4] The fruit juice and leaves of *M. cymbalaria* are highly recommended for diabetes, malaria, colic, sores and wounds, infections, worms and parasites. It is also used for treatment of measles, hepatitis and fever. Fruit pulp, leaf juice, and seeds possess anthelmintic activity.[5]

Plants belonging to *Momordica* species have been used as therapeutic agents for the treatment of diabetes mellitus. The other species of this genus, *M. charantia* and *M. foetida,* have also been reported to have hypoglycemic effects.[6] The concentration of Vitamin C and potassium in *M. cymbalaria* was found to be 2 times higher than that of bitter gourd, and iron content in both the vegetables was almost the same.[7] The methanol extract of *M. cymbalaria* fruit extract exhibited mild antimicrobial activity against bacteria and fungi. Petroleum and chloroform extracts showed significant activity against the entire microorganism.[8]

Antimicrobial activity of the fruits of *M. cymbalaria* Hook. F (*Momordica tuberosa*) was tested against different bacteria (including *Escherichia coli, Staphylococcus aureus, Bacillus subtilis, Shigella sonnei, Klebsiella pneumoniae, Salmonella typhi, Proteus vulgaris,* and *Pseudomonas aeruginosa*) and fungi (such as *Candida albicans and Aspergillus niger*).[9]

The medicinal value of plants is due to the presence of phytochemicals that produce a definite physiological action on the human body. The knowledge of the chemical constituents of the plant is essential for the discovery of therapeutic agents which may be of value as precursors for the synthesis of complex chemical substances.[10] The researchers reported that methanolic extract of *M. cymbalaria* was applied externally on albino Wister rats by excision wound model. It showed faster in wound closure and wound contraction as compared to standard marketed formulation called as nitrofurazone ointment.[11]

M. cymbalaria contains a lectin that has insulin-like activity which reduces blood glucose concentrations by acting on peripheral tissues and similar to insulin effects in the brain and suppressing appetite.[12] The sudden increase in the levels of CK-MB – Creatine kinase-(Muscle or Brain) and lactate dehydrogenase in the heart tissue homogenate and significantly reversed in the treated groups.[13]

High-performance thin-layer chromatography profile of fruit extracts of *M. cymbalaria* with hexane solvent was to ascertain the total number of chemical moieties that help in designing the bioactive compound.[14] *M.cymbalaria* fruit was extracted with solvents toluene:acetone:water (20:40:1) for the isolation, purification and characterization of marker chemical compounds.[15]

M. cymbalaria exhibits antihyperglycemic activity and antidiabetic activity with the possible involvement in the regeneration of cells and by increasing insulin level. Profiling of phytochemicals by liquid chromatography–mass spectrometry and further structural elucidation of compounds to find a better food based therapy to treat diabetes without side effects of antidiabetic drugs.[11,16,17]

MATERIALS AND METHODS

M. cymbalaria is a relative of bitter melon plant (*M. charantia*) which is also used against diabetes. The plant has also been named *Luffa tuberosa* or *M. tuberosa*. Pharmacological studies indicate possible action of extracts of the plant on several medical conditions. *M. cymbalaria* was collected from Aruppukottai, Virudhunagar district of Tamil Nadu, India, and authenticated by a botanist. The dried powder of the fruit and seed and fresh samples were used for the following study. The physical properties of pH, turbidity, and moisture contents were analyzed. The biochemical constituents of carbohydrate, reducing sugar, protein, and crude fiber were analyzed.

Alpha-amylase Inhibition Assay

Alpha-amylase activity was carried out by starch-iodine method. 10 µL of α-amylase solution (0.025 mg/mL) was mixed with 390 µL of phosphate buffer (0.02 M) containing 0.006 M NaCl, pH 7.0) containing different concentrations of extracts. After incubation at 37°C for 10 min, 100 µL of starch solution (1%) was added, and the mixture was reincubated for 1 h. Next, 0.1 mL of 1% iodine solution was added, and after adding 5 mL of distilled water, the absorbance was taken at 565 nm. Inhibition of enzyme activity was calculated as (%) = (A−C)×100/(B−C), where A = Absorbance of the sample, B = Absorbance of blank (without α-amylase), and C = Absorbance of control (without starch, acarbose can be used as standard drug).

Alpha-glucosidase Inhibition Assay

Alpha-glucosidase activity can be measured *in vitro* by determination of the reducing sugar (glucose) arising from hydrolysis of sucrose by α-glucosidase enzyme using 3,5-dinitrosalicylic acid. 225 µl of 80 mM phosphate buffer pH 7.0 was added to the positive control. Different concentrations of test samples + 75 µl of α-glucosidase are pre-incubated at 37°C for 30 min, then added 500 µl of 37 mM sucrose, and incubated at 37°C for 20 min. All the samples were kept in boiling water bath for 2 min, cooled, added 250 µl

of 3,5-dinitrosalicylic acid reagent, and incubated at room temperature for 10 min. The color intensity was measured at 510 nm spectrophotometrically. Acarbose can be used as a positive control.

Acidity Reduction Assay

Different test samples were used for measuring acidity levels. Acetic acid was used as a standard. All the test samples were also titrated with 0.1M NaOH, using 2 drops of phenolphthalein as an indicator. The acidity reduction was calculated. Ranitidine was used as a positive control.

Lipase Activity

Lipase is a pancreatic enzyme secreted into the small intestine. It catalyzes the hydrolysis of triacylglycerols to free fatty acids and glycerol. The release of fatty acids in the solution will cause a decrease in the pH, and the rate of the reaction showed the release of free fatty acids at different enzyme concentration was titrated with 0.05N NaOH. Coconut oil is used as substrates and $CaCl_2$ is used as emulsifying agent.

RESULTS AND DISCUSSION

The dry seed of *M. cymbalaria* was found to be higher proportions of all nutrients. The minimum moisture was found in 29% of fresh flesh and high of 64% in dry seed. The pH of all fresh and dried form of seed and flesh of fruit *M. cymbalaria* was found to be in the range of 4–6. The turbidity of all samples was observed in 30–75 NTU. The maximum amount of protein was found to 46.8 mg% in dry seed. The minimum content of 16% was observed in fresh seed [Figure 1]. The protein content was found to thrice when fresh seed sample is subjected to dry. However, fresh flesh showed 19.2 mg% when compared with 13.2 mg% of dried flesh. The carbohydrate content of dry seed was 50.4 mg/100 ml. The seed showed 2.8 mg/100 ml in fresh and 3.2 mg/100 ml in dry form. The reducing sugar of dry seed found a high concentration of 67.2 mg%. The content was found to be half reduced in fresh seed. The reducing sugar was found to be 24.4 mg of fresh flesh and declined to 2.8 mg in dry flesh. The low content of crude fiber of fresh seed was 3% and rapidly raised to 66% on drying. The drying form of seed showed maximum biochemical constituents when compared with fresh form. The flesh contained 15.5% of crude fiber and raised gradually to 25.5% on drying.

The α-amylase inhibition of *M. cymbalaria* was analyzed in terms of zone of clearance quantitatively. The maximum zone of clearance was observed as 73% in dry seed. The minimum zone of clearance was found in fresh flesh of 15% [Figure 2]. The presence of blue color intensity is directly proportional to inhibitory action The inhibition activity of fresh flesh was calculated quantitatively as IC value of 66 µg/ml and dry seed was found to be IC value of 11.6 µg/ml [Table 1].

The α-glucosidase inhibition activity is also expressed both qualitatively and quantitatively. The high zone of clearance was observed as 60% in dry seeds of *M. cymbalaria* and 13% in fresh flesh [Figure 3]. The α-glucosidase inhibition activity was found to be high in fresh IC values of 44.05 µg/ml quantitatively and low in dry seed of IC value of 12 µg/ml [Table 1]. The antidiabetic activity of *M. cymbalaria* fruit may be due to availability of its hypoglycemic compounds such as polypeptide-p, plant insulin, phenolic acids, flavonoids, carotenoids, cucurbitane, triterpenoid, phytosterol, and glycosides which improve blood sugar levels by increasing glucose uptake and stimulate glycogen synthesis in the liver, muscles, and fat cells. *M. cymbalaria* rapidly decreased and normalized the blood sugar level (Koneri *et al*., 2015). Miniraj *et al*. 1993 reported that, on exploring nutritional and nutraceutical properties and physiological bioactivities of *Momordica* species on human health.[18]

The nutritional study of the fruits of *M. cymbalaria* has reported that they possess a high level of protein, carbohydrate, fat, in addition to its high crude fiber

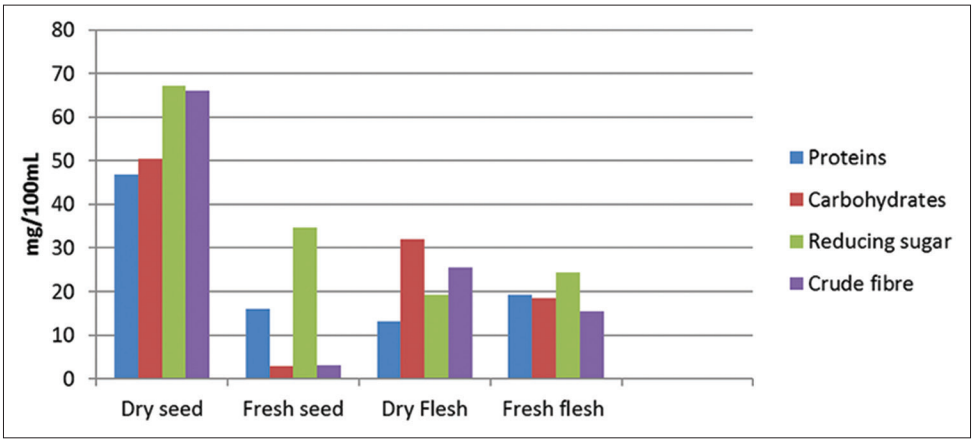

Figure 1: Biochemical constituents of *Momordica cymbalaria*

Table 1: Antidiabetic activity of *Momordica cymbalaria*

Sample	α-Amylase inhibition assay (%)		α-Glucosidase inhibition assay (%)	
	Zone of clearance	Quantitative analysis (µg/ml)	Zone of clearance	Quantitative analysis (µg/ml)
Dry seed	73	11.6	60	12.0
Fresh seed	67	22.3	30	25.3
Dry flesh	54	28.5	42	21.6
Fresh flesh	15	66.0	13	44.05

Table 2: Anti-ulcer and antihyperlipidemic activity of *Momordica cymbalaria*

Sample	Acidity reduction (%)	Fat reduction (%)
Dry seed	68	59
Fresh seed	52	23
Dry flesh	28	18
Fresh flesh	15	12

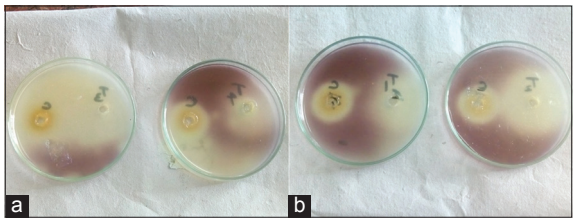

Figure 2: (a and b) α-amylase inhibition assay (seed and flesh) of *Momordica cymbalaria*

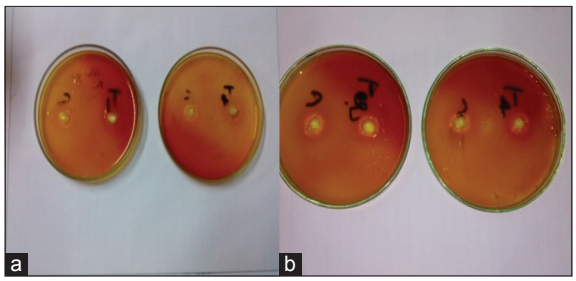

Figure 3: (a and b) α-glucosidase inhibition assay (seed and flesh) of *Momordica cymbalaria*

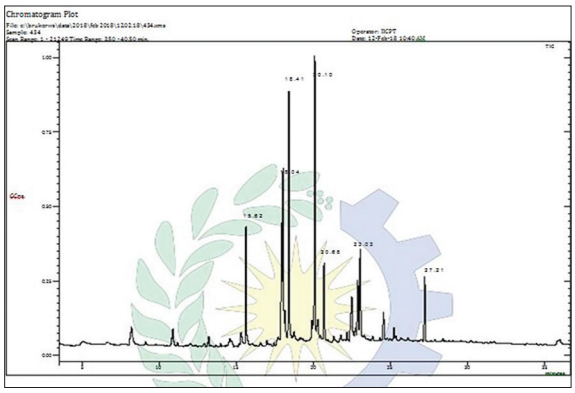

Figure 4: GC-MS spectra of *M.cymbalaria* seed extract.

content (Bharathidasan, 2010). The dry seed extracts of *M. cymbalaria* were shown to have antidiabetic, anti-ulcer, and antihyperlipidemic properties. The decoctions of *M. cymbalaria* have been used in traditional medicine. Although traditionally it is used, the plant has not been shown on the basis of scientific data [Table 2].

The dry seed of *M. cymbalaria* was found to be higher (68%) in acid reduction when compared with fresh seed. The minimum reduction was observed in flesh forms which included both fresh and dry forms (15% and 28%). Similar results were reported in fruit extract of *M. cymbalaria* by Koneri *et al*., 2015. Therefore, all samples are shade dried to preserve the phytonutrients which are useful for pharmaceutical application. The maximum fat reduction of 59% was identified in dry form of seed and 23% in fresh seed, respectively. The flesh either in dry or fresh forms showed slow fat reduction in terms of 18% and 12%.

There are 25 phytoconstituents of *M. cymbalaria* extract analyzed using gas chromatography–mass spectrometry. The maximum peak of 18.97 was measured in 9, 12, 15-octadecatrienoic acid, ethyl to be shown maximum peak of 15.84. Ethyl-14-methylhexadecanoate and Methyl 4,6, tetra decanoate were found to be minimum peak of 0.26 and 0.77, respectively. These compounds are responsible for anticancer, antitumor, and antihyperlipidemic activities [Figure 4].

Fourier-transform Infrared Spectroscopy (FTIR)

FTIR transmission spectrum of seed extract is shown in Figure 5. The spectrum demonstrates the peak found at 292, 3.62, 2853.58, 1743.61, 1638.57, 1542.45, 1455.8, 1237, 1149.9, 990.7, 662.86, 598.9, and 550.2 cm^{-1}. The broad and intense band was found at 2923.62 and 550.2 cm^{-1}. The band of 1638 and 662 are assigned to O-H stretching -C-, O-H, C-O-C and C-N which are derived from water soluble metabolites such as flavonoids, alkanoids and tannin present in seed extract. FTIR results reveal that the water-soluble fraction of seed plays a crucial role in the stabilization of secondary metabolites.

CONCLUSION

M. cymbalaria is a crop found in tropical India; it is not commercialized due to lack of seeds or tubers availability in market. Since seeds are poor in germination, it has to be grown by tubers. As it also considered as a medicinal crop due to its medicinal properties, this crop can be genetically manipulated

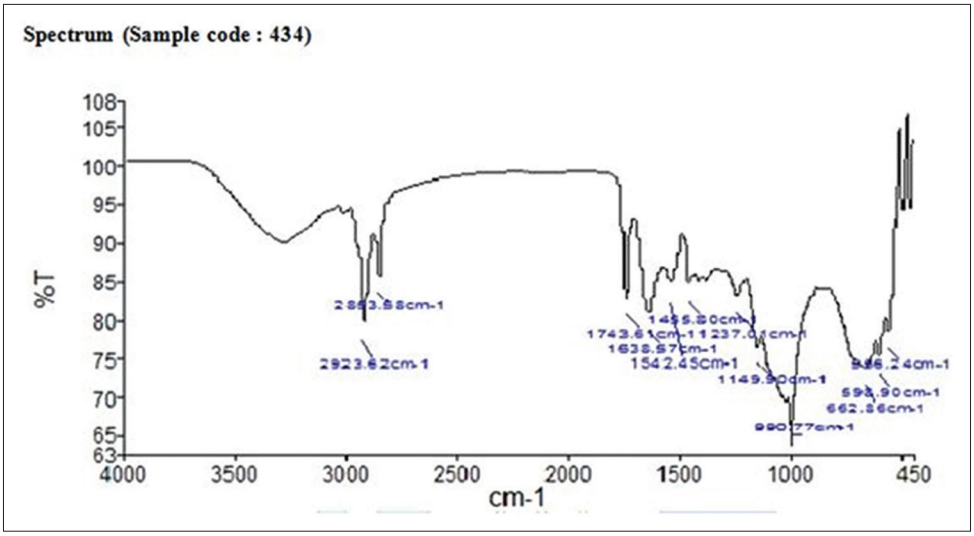

Figure 5: FTIR spectrum of *M.cymbalaria* seed extract.

to exploit its potentiality. Further studies need to be conducted as mentioned in future approach.

REFERENCES

1. Parvathi S, Kumar VJ. Studies on chemical composition and utilization of the wild edible vegetable athalakkai (*Momordica tuberosa*). Plant Foods Hum Nutr 2002;57:215-22.
2. Kirtikar KR, Basu MD. Indian Medicinal Plants, II. Allahabad: Lalit Mohan Publication; 1933. p. 1130-3.
3. Fernandes NP, Lagishetty CV, Panda VS, Naik SR. An experimental evaluation of the antidiabetic and antilipidemic properties of a standardized *Momordica charantia* fruit extract. BMC Complement Altern Med 2007;7:29.
4. Parkash A, Ng TB, Tso WW. Purification and characterization of charantin, a napin-like ribosome-inactivating peptide from bitter gourd (*Momordica charantia*) seeds. J Pept Res 2002;59:197-202.
5. Sajjan S, Chetana SH, Paarakh PM, Vedamurthy AB. Antimicrobial activity of Momordica cymbalaria Fenzl aerial parts extracts. Indian J Natl Prod Res 2010;1:296-300.
6. Ailenia M, Kotaa SR, Kokkiralaa VR, Umatea P, Abbagania S. Efficient *in vitro* regeneration and micro propagation of medicinal plant *Momordica tuberosa* Roxb. J Herbs Spices Med Plants 2009;15:141-8.
7. Verma AK, Kumar M, Tarafdar S, Singh R, Thakur S. Development of protocol for micro propagation of gynoecious bitter gourd (*Momordica charantia* L). Int J Plant Anim Environ Sci 2014;3:24-32.
8. Mathew J. Antimicrobial activity of selected aromatic plants. Indian Drugs 2005;42:28-32.
9. Vahidi H, Kamalinejad M, Sedaghati N. Antimicrobial properties of *Croccus sativus* L. Iran J Pharm Res 2002;1:33-5.
10. Ilango K, Maharajan G, Narasimhan S. Preliminary phytochemical screening and antibacterial activity of fruit pulp of *Momordica dioica* Roxb. (*Cucurbitaceae*). Afr J Basic Appl Sci 2012;4:12-5.
11. Bharathidasan P, Jegadeesan M, Kavimani S. Antiulcer activity of aqueous extract of fruits of *Momordica cymbalaria* Hook F. in Wistar rats. Pharm Res 2010;2:1.
12. Mouhieddine S, Tresallet N, Boucher F, Leiris JD. Ultra structural basis of free- radical scavenging effect of indapamide in experimental myocardial ischemia and reperfusion. J Cardio Pharm 1993;22:47-52.
13. Mukumbayi PM, Koneri R, Samaddar S. Cardioprotective effects of saponin *Momordica cymbalaria* in ischemia reperfusion injury. Int J Pharm Rev Res 2015;5:385-90.
14. Santhi R, Lakshmi G, Priyadharshini AM, Anandaraj L. Phytochemical screening of Nerium oleander leaves and *Momordica chrantia* leaves. Int Res J Pharm 2011;2:131-5.
15. Devi MY, Wesley EG, Johnson M. Phytochemical studies on the terpenoids of medicinally important plant *Aerva lanata* L. using HPTLC. Asian Pac J Trop Biomed 2011;1:S220-5.
16. Jeevanantham P, Vincent S, Balasubramaniam A, Jayalakshmi B, Kumar BN. Anti cancer activity of methanolic extract of aerial parts of *Momordica cymbalaria* Hook F. against Ehrlich ascites carcinoma in mice. J Pharm Sci 2011;3:1408-11.
17. Koneri R, Samaddar S, Bhattarai A, Chandrasekhar KB. *In vitro* glucose uptake activity of an oleanane-type triterpenoid saponin isolated from Momordica cymbalaria. *Indo Am J Pharm Res* 2015;5:2071-7.
18. Miniraj N, Prasanna KP, Peter KV. Bitter gourd Momordica. In: Kalloo G, Bergh BO, edtiors. Genetic Improvement of Vegetable Plants. New York: Pergamon Press; 1993. p. 239-46.

Source of support: Nil; Conflict of interest: None Declared