



## MOMORDICA CHARANTIA LINN. (KARELA): NATURE'S SILENT HEALER

Madhu Gupta, Sushil Sharma, Ajay K. Gautam and Rekha Bhaduria\*  
 School of Studies in Botany, Jiwaji University Gwalior (M.P.) 474011, India.  
 \*Corresponding author's E-mail: [rekhabhaduria@yahoo.com](mailto:rekhabhaduria@yahoo.com)

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### ABSTRACT

*Momordica charantia* Linn. (karela) is an herbal climber grown in tropical and subtropical regions, belonging to the Cucurbitaceae family. *Momordica charantia* (Karela) have provided many remedies for various diseases from ancient days to now a day. It has been used in various Asian traditional medicines for the treatment of cholera, bronchitis, anemia, blood diseases, ulcer, diarrhea, dysentery, gonorrhoea rheumatism, gout, worms, colic, disease of liver and spleen, cancer and diabetes etc. The main constituents of Karela are triterpene, protein, steroid, alkaloid, inorganic, lipid, and phenolic compounds, which are responsible for biological and pharmacological activities including anti-diabetic, anti-cancerous and anti-tumorous, anti-microbial, anti-viral, anti-helminthic, anti-malarial, anti-ulcerative and immunomodulatory. Combination of its Ayurvedic properties i.e. Gunna, Rasa and Virya (Dry, pungent, light, bitter and hot) makes it the real nature's wonder. In this article, general description, traditional uses and medicinal properties of *Momordica charantia* Linn (Karela) have been reviewed.

**Keywords:** *Momordica charantia* Linn. (karela), general description, medicinal properties.

### INTRODUCTION

*Momordica charantia* Linn. (Karela) commonly known as Bitter melon or Bitter gourd is tropical and subtropical climber of the family Cucurbitaceae. It is widely distributed in China, Malaysia, India and tropical Africa. The Latin name *Momordica* means "to bite" (referring to the jagged edges of the leaf, which appear as if they have been bitten). All parts of the plant, including the fruit taste very bitter<sup>1</sup>, as it contains a bitter compound called momordicin that is believed to have a stomachic effect<sup>2</sup>. In Ayurveda, various parts of *Momordica charantia* (Karela) are recommended for many diseases like; cholera, bronchitis, anemia, blood diseases, ulcer, diarrhea, dysentery, sexual tonic and as a cure for gonorrhoea<sup>3</sup>. Karela contains an array of biologically active plant chemicals including triterpens, proteins, steroids, alkaloids, saponins, flavonoids and acids due to which plant possesses anti-fungal, anti-bacterial, anti-parasitic, anti-viral, anti-fertility, anti-tumorous, hypoglycemic and anti-carcinogenic properties<sup>4-8</sup>. Fruits are used as traditional medication to cure various diseases like: rheumatism, gout, worms, colic, disease of liver and spleen<sup>9</sup>. It is also found useful in the treatment of cancer and diabetes<sup>10</sup>. It is a potent hypoglycemic agent due to alkaloids and insulin like peptides and a mixture of steroidal saponins known as charantin<sup>11</sup>.

### ORIGIN AND DISTRIBUTION

The Karela is believed to be originated in the tropics of the old world. It is widely grown in India and other parts of the Indian subcontinent, Southeast Asia, China, Africa, and the Caribbean and South America as a food and medicine<sup>12</sup>.

### Cultivation

Karela is an annual or perennial climber found throughout India and also cultivated up to an altitude of 1500m. It is cultivated during warm season i.e. during April to July by sowing seeds in a pit. Seeds are sown at a distance of half a meter and provided with manures. Only one plant is retained and plant seedlings are watered once or twice a week. Plants begin to flower 30-35 days after sowing and fruits are ready for harvesting after flowering 15-20 days<sup>13, 14</sup>.

### GENERAL DESCRIPTION OF THE PLANT

*Momordica charantia* Linn. (Karela) has many synonyms like *M. chinensis*, *M. elegans*, *M. indica*, *M. operculata*, *M. sinensis*, *Sicyos fauriei*<sup>2</sup>. It is known with different common names in different languages i.e. Hindi – Karela; English – Bitter gourd; Sanskrit – Karavelli; Marathi – Karli; Gujarati – Karelo; Bangali – Baramasiya; Kannada – Karali; Malayalam – Kaypa; Tamil – Pakar; Telugu – Kakara<sup>15</sup>.

### Botanical Description

*Momordica charantia* Linn. (Karela) (FIG.1) is a flowering climber of family cucurbitaceae. The herbaceous, tendril-bearing plant grows to six meter or longer. It bears simple, alternate leaves 4-12 cm across, with 3-7 deeply separated lobes (FIG.2). The lobes are mostly blunt, but have small marginal points. Stipules are absent. Flowers are actinomorphic and always unisexual. Perianth has a short to prolonged epigynous zone; yellow on short (female) or long (male) peduncles that are short-lived. Fruit has ovoid, ellipsoid or spindle shaped usually distinct warty looking exterior and an oblong shape (FIG.3). It is hollow in cross-section with a relatively thin layer of flesh surrounding a central seed cavity filled with large flat seed and pith<sup>12</sup>. Seeds in size 8-13mm, long compressed, corrugate on the margin, sculptured on both faces<sup>3</sup>.



In India, it has typical morphology i.e. narrower shape, pointed ends and surface covered with jagged, triangular “teeth” and ridges with green coloration. It has a strong bitter taste among all vegetables<sup>12</sup>.



Figure 1: Plant of *Momordica Charantia* bearing fruits



Figure 2: Leaves of *Momordica Charantia*



Figure 3: Fruits of *Momordica Charantia*

## Parts Used

The fruits of bitter melon are utilized as vegetable where as the whole plant parts like, fruits, leaves, roots and seeds of bitter melon as medicine.

## BIOLOGICAL ACTIVITIES

The different parts of the Karela contain following various biological activities:

**Root** - Acrid, astringent, bitter.

**Leaf** - Antipyretic, bitter, emetic, purgative.

**Fruits** - Acrid, anthelmintic, anti-diabetic, anti-inflammatory, appetizer, bitter, depurative, digestive, purgative, stimulant, stomachic, thermogenic<sup>15</sup>.

## Ayurvedic Properties

*Momordica charantia* Linn. (Karela), a vegetable/ medicinal plant is used in the Ayurvedic system of medicine for treating various diseases including diabetes mellitus, measles, fever, hepatitis, itch etc.

According to Ayurveda it contains:

1. **Gunna (properties)** laghu (light), ruksh (dry)
2. **Rasa (taste)** katu (bitter) and tikta (pungent)
3. **Virya (potency)** vshna (hot)

Combination of these properties makes karela a magic potion for diseases<sup>15</sup>.

## BIOCHEMICAL CONSTITUENTS

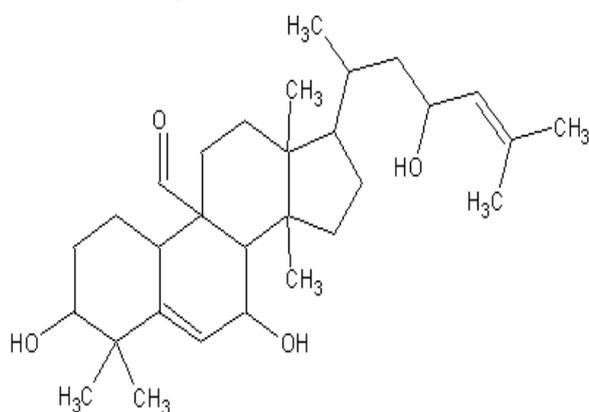
The main constituents of bitter melon (Karela) are triterpene, protein, steroid, alkaloid, inorganic, lipid, and phenolic compounds<sup>5</sup>.

*Momordica charantia* (Karela) consists the following chemical constituents those are alkaloids, momordicin and charantin (FIG.4), charine, cryptoxanthin, cucurbitins, cucurbitacins, cucurbitanes, cycloartenols, diosgenin, elaeostearic acids, erythrodiol, galacturonic acids, gentisic acid, goyaglycosides, goyasaponins, guanylate cyclase inhibitors, gypsogenin, hydroxytryptamines, karounidiols, lanosterol, lauric acid, linoleic acid, linolenic acid, momorcharasides, momorcharins, momordenol, momordicillin, momordicin, momordicosides, momordin, momordolo, multiflorenol, myristic acid, nerolidol, oleanolic acid, oleic acid, oxalic acid, pentadecans, peptides, petroselinic acid, polypeptides, proteins, ribosome-inactivating proteins, rosmarinic acid, rubixanthin, spinasterol, steroidal glycosides, stigmastadiols, stigmasterol, taraxerol, trehalose, trypsin inhibitors, uracil, vacine, v-insuline, verbascoside, vicine, zeatin, zeatinriboside, zeaxanthin, zeinoxanthin Amino acids- aspartic acid, serine, glutamic acid, thscinne, alanine, g-amino butyric acid and pipecolic acid, ascorbigen, b-sistosterol-d-glucide, citruline, elasterol, flavochrome, lutein, lycopene, pipecolic acid<sup>16-18</sup>.

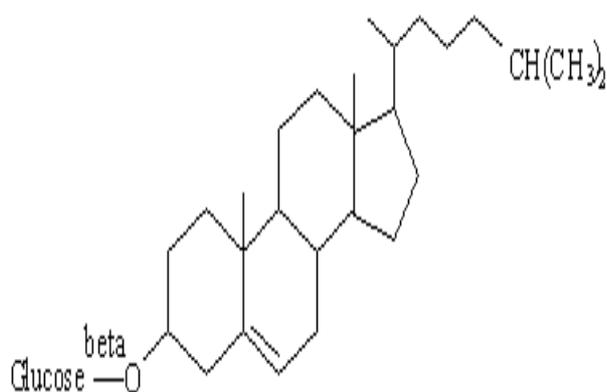
**Fruits** consists glycosides, saponins, alkaloids, reducing sugars, resins, phenolic constituents, fixed oil and free acids<sup>12</sup>.

**Leaves** are nutritious and have been reported as a source of calcium (1%), magnesium (4%), potassium (7%), phosphorus (5%), and iron (3%); fruits and leaves are great source of B vitamins; Thiamine (vit.B<sub>1</sub>) 4%, Riboflavin (vit.B<sub>2</sub>) 4%, Niacin (vit.B<sub>3</sub>)2%, vit.B<sub>6</sub> 3%, Folate (vit.B<sub>9</sub>)13%<sup>16, 2, 17</sup>.

#### Structure of Important Chemical Constituents



Momordicin



Charantin

**Figure 4:** Phytochemicals: Momordicin and Charantin (Source: Kumar *et al.*, 2010)

#### TRADITIONAL AND MEDICINAL USES

Karela has been used in various Asian traditional medicine systems for a long time, as useful for preventing and treating various diseases.

**Fruits** of *Momordica charantia* (karela) used in asthma, burning sensation, colic, constipation, cough, diabetes, fever (malaria), gout, helminthiasis, inflammation, leprosy, skin diseases, ulcer and wound. It has also been shown to have hypoglycaemic properties (antidiabetic) in animal as well as human studies. Juice of the Karela leaves used to treat piles completely. Karela is used as a blood purifier due to its bitter tonic properties. It can heal

boils and other blood related problems that show up on the skin. Juice of karela is also beneficial in treating and preventing the liver damage<sup>19, 20</sup>.

**Leaves** are used in treatment of menstrual troubles, burning sensation, constipation, fever (malaria), colic, infections, worms and parasites, as an emmenagogue, measles, hepatitis and helminthiasis<sup>12</sup>. In Guyana traditional medicine, leaf tea is used for diabetes, to expel intestinal gas, to promote menstruation, and as an antiviral for measles, hepatitis, and feverish condition. It is used topically for sores, wound, infections and internally and externally for worms and parasites<sup>21</sup>.

**Seeds** are used in the treatment of ulcers, liver and spleen problems, diabetes, intestinal parasites, high cholesterol, and intestinal gas, heal wounds and stomachache etc.<sup>15</sup>.

**Roots** are used in the treatment of syphilis, rheumatism, boils, ulcer, septic swellings, ophthalmia, and in Prolapsus vaginae<sup>15, 19</sup>.

Karela juice helps to reduce the problem of Pyorrhoea (bleeding from the gums). Karela capsules and tinctures are widely available in the United States for the treatment of diabetes, viruses, colds flu, cancer, tumors, high cholesterol and psoriasis<sup>2</sup>.

#### Ethnomedical Uses

In India, *Momordica charantia* Linn. (Karela) used by tribal people for abortions, birth control, increasing milk flow, menstrual disorders, vaginal discharge, constipation, food, diabetes, hyperglycemia, jaundice, stones, kidney, liver, fever (malaria), gout, eczema, fat loss, hemorrhoids, hydrophobia, intestinal parasites, skin, leprosy, pneumonia, psoriasis, rheumatism, scabies, snakebite, vegetables, piles, tonic, anthelmintic, purgative<sup>5</sup>.

#### PHARMACOLOGICAL ACTIVITY

##### Antioxidant Activity

Different parts of this plant have been used in the Indian medicinal system for a number of ailments besides diabetes. Antioxidant activity of extracted phenolic compound from bitter melon has been reported by<sup>22</sup>. Antioxidant properties of *Momordica charantia* (Karela) Seeds on Streptozotocin induced-diabetic rats has been studied and results clearly suggest that seeds of *Momordica charantia* (Karela) may effectively normalize the impaired antioxidant status in streptozotocin induced-diabetes<sup>23</sup>.

##### Antidiabetic Activity

Karela contains bitter chemicals like, charantin, vicine, glycosides and karavilosides along with polypeptide-p a plant insulin, which are hypoglycemic in action and improve blood sugar levels by increasing glucose uptake and glycogen synthesis in the liver, muscles and fat cells.

Reports indicate that they also improve insulin release from pancreatic beta cells, and repair or promote new growth of insulin-secreting beta cells. P-Insulin, a polypeptide from the fruits and seeds rapidly decreased and normalized the blood sugar level in rats. Bitter melon contains another bioactive compound i.e. lectin that has insulin like activity. The insulin-like bioactivity of lectin is due to its linking together 2 insulin receptors. This lectin lowers blood glucose concentrations by acting on peripheral tissues and, similar to insulin's effects in the brain, suppressing appetite. This lectin is a major contributor to the hypoglycemic effect that develops after eating Karela. Charantin extracted by alcohol, is a potent hypoglycemic agent composed of mixed steroids which is sometimes used in the treatment of diabetes to lower the blood sugar levels<sup>12, 24-27</sup>.

### Anticancerous and Antitumorous Activity

Bitter melon and its extract inhibit cancer and tumor formation. A novel phytochemical in Karela has clinically demonstrated the ability to inhibit an enzyme named guanylate cyclase. This enzyme is thought to be linked to the pathogenesis and replication of not only psoriasis, but leukemia and cancer as well<sup>28, 29</sup>. Other phytochemicals that have been documented with cytotoxic activity are a group of ribosome-inactivating proteins named alpha and beta momorcharin, momordin and cucurbitacin B. In 1996, Lee-huang *et al.*<sup>30</sup> have developed and patented one more chemical compound "MAP-30", which was able to inhibit prostate tumor growth.

Momordin, another phytochemical has clinically demonstrated anti cancerous activity against Hodgkin's lymphoma *in vivo*<sup>31</sup> and several other *in vivo* studies have shown the cytostatic and antitumor activity of the entire plant of bitter melon. Further studies reported that a water extract blocked the growth of rat prostate carcinoma and a hot water extract of the entire plant inhibited the development of the mammary tumors in mice<sup>29</sup>. Numerous *in vitro* studies have also demonstrated the anti-cancerous and anti-leukemic activity of bitter melon against numerous cell lines including liver cancer, human leukemia, melanoma and solid sarcomas<sup>28, 29</sup>.

### Antimicrobial Activity

Sankaranarayanan and Jolly<sup>32</sup> have clinically demonstrated broad spectrum antimicrobial activity of leaf extracts of Karela. They have reported the *in vitro* antibacterial activities of water, ethanol, and methanol leaf extracts of Karela against *E. coli*, *Staphylococcus*, *Pseudomonas*, *Salmonella*, *Streptobacillus* and *Streptococcus*; an extract of the entire plant have shown anti-protozoal activity against *Entamoeba histolytica*. In another study, a fruit extract of Karela has demonstrated antibacterial activity against the stomach ulcer-causing bacteria *Helicobacter pylori*<sup>33</sup>.

Various plant species possessed antimicrobial activity against different microorganisms<sup>34-36</sup>.

The antifungal potential of crude ethanolic extract of kaffir lime, bitter cucumber and tobacco has been studied by Thanaboripat *et al.*, (2006)<sup>37</sup> against *Aspergillus flavus*. Jagessar *et al.*, (2008)<sup>21</sup> evaluated antibacterial and antifungal activity of leaf extracts of *Momordica charantia* (Karela) against *Candida albicans*, *Staphylococcus aureus* and *Escherichia coli* and reported that the ethanol extracts of *Momordica charantia* (Karela), can be used for controlling *E. coli* and *S. aureus* induced diseases.

### Antifertility Activity

Stepka *et al.*, (1974)<sup>38</sup> have demonstrated *in vivo* antifertility effect of fruit and leaf of bitter melon in female animals.

### Antiviral Activity

Karela and its isolated phytochemicals, also has been documented with *in vitro* antiviral activity against numerous viruses including *Epstein-Barr*, herpes and HIV viruses<sup>39, 40</sup>. In an *in vivo* study, a leaf extract demonstrated the ability to increase resistance to viral infections as well as to provide an immunostimulant effect in humans and animals (increasing interferon production and natural killer cell activity)<sup>41</sup>. Two proteins known as alpha-and beta- momorcharin (which are present in the seeds, fruit and leaves) have been reported to inhibit the HIV virus *in vitro*<sup>39, 40</sup>. In one study, HIV-infected cells treated with alpha- and beta-momorcharin showed a nearly complete loss of viral antigen while healthy cells were largely unaffected<sup>42</sup>. In 1996 the inventors of the chemical protein along MAP-30 filed a U.S. patent, stating it was "useful for treating tumors and HIV infections. In treating HIV infection, the protein is administered alone or in conjunction with conventional AIDS therapies<sup>43</sup>. Another clinical study showed that MAP-30's antiviral activity was also relative to the herpes virus *in vitro*<sup>44</sup>.

### Anti-Genotoxic Activity

Balboa and Lim-Sylianco, (1992)<sup>45</sup> have reported that *Momordica charantia* (Karela) decreases the genotoxic activity of methylnitrosamine, methanesulfonate and tetracycline, as shown by the decrease in chromosome breakage.

### Anti-Helminthic Activity

*Momordica charantia* (Karela) was found more effective in the treatment of *Ascaridia galli*<sup>46</sup>. Ethanol (95%) extract of fruit juice, was found active on *Ascaridia galli*, whereas, hot water extract of seed at concentration of 1:50 was active on *Haemonchus contortus*<sup>47</sup>.

### Anti-Malarial Activity

Karela is traditionally regarded by Asians, as well as Panamanians and Colombians, as useful plant for preventing and treating malaria. Laboratory studies have confirmed that various species of Karela have anti-malarial activity. Leaves brewed in hot water to create a tea to treat malaria<sup>48</sup>.



### Antineoplastic Activity

Various preliminary studies, both *in vitro* and *in vivo*, have found antineoplastic activity in crude extracts and purified fractions of *M. charantia*<sup>5</sup>. In a skin carcinogenesis in mice, aqueous extract of the fruit of *M. charantia* provide protection against the development of skin tumors and increases life expectancy. The extract also reduced carcinogen-induced lipid peroxidation in the liver, DNA damage in lymphocytes, and significantly activated hepatic glutathione-S-transferase, glutathione-peroxidase, and catalase, all of which had become functionally depressed by exposure to the carcinogen used in the study<sup>49</sup>. Many studies suggest a potentially prophylactic role against carcinogenesis of water-soluble constituents of bitter melon fruit, possibly mediated by their modulatory effect on enzymes involved in the biotransformation and detoxification of xenobiotic substances<sup>49</sup>.

### Antiulcerative and Immunomodulatory Activity

The traditional use of bitter melon for treating gastrointestinal ulcers is recommended. Dried fruits powder administered in filtered honey have significant and dose-dependent activity against ethanol-induced ulcerogenesis in rats. Various studies have found both immunostimulating and immunosuppressive effects, due to extracts and isolated constituents of bitter melon<sup>16</sup>. It is highly dependent on the type of extract or constituent, its dosage and its route of administration.

### CONCLUSION

*Momordica charantia* Linn. (Karela) is a potential herbal plant which is used as vegetable and medicine. It is a good source of various medicinally important biochemicals like, triterpene, protein, steroid, alkaloid, and phenolic which are responsible for its biological and pharmacological activities including anti-diabetic, anti-oxidant, anti-cancerous and anti-tumorous, anti-microbial, anti-fertility, anti-viral, anti-helminthic, anti-malarial, anti-ulcerative and immunomodulatory etc. on the basis of all these properties *Momordica charantia* Linn. (Karela) can be utilized as a good source of nutritional, medicinal and pesticidal agent.

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