A REVIEW ON KARELA

Sharma Neeraj*, Pooni Neeraj, Singh Manmohan, Verma Kamal, Kaur Manjot, Dhiman Neha, Kamini and Bhandari Neeraj

Sri Sai College of Pharmacy, Badhani, Pathankot, Punjab, India.

INTRODUCTION

Momordica charantia (Karela)

Karela is one of the best gifts given by nature to us which has magical powers to treat a wide variety of diseases. Karela is obtained as fresh green fruit of the plant *Momordica Charantia* Linn., family Cucurbitaceae.[1]

*M. charantia* is one of the medicinal plants with hypoglycemic activity being studied majorly. It is a climber widely cultivated as food in Asia, Africa and South America. It is also cultivated all over India and cultivated upto an altitude of 1500 m. The word *Momordica* is derived from the Latin word *Mordeo* which means to bite and the species name is derived from Greek word and it means beautiful flower. Fruit of this plant is known as bitter melon, bitter gourd, balsam pear or African cucumber.[2]

In the Amazon, local people and indigenous tribes grow bitter melon in their gardens for food and medicine. They add the fruit and/or leaves to beans and soup for a bitter or sour flavor; soaking it first with salt may remove some of the bitter taste. Medicinally, the plant has a long history of use by the indigenous peoples of the Amazon. Karela leaf tea is employed for diabetes; as a carminative for colic; topically for sores, wounds, and infections; internally and
externally for worms and parasites; and as an antiviral for measles, hepatitis, and fever conditions.\[3\]

In Brazilian herbal medicine, bitter melon is used for tumors, wounds, rheumatism, malaria, leucorrhea, inflammation, menstrual problems, diabetes, colic, fevers, worms, to induce abortions and as an aphrodisiac. It is also employed topically for skin problems, vaginitis, hemorrhoids, itchy rashes and leprosy.\[4\]

In Mexico the entire plant is used for diabetes and dysentery; the root is a majorly employed as aphrodisiac.

In Peruvian herbal medicine, the leaf or aerial parts of the plant are used to treat measles, malaria and all types of inflammation.

In Nicaragua the leaf commonly is used for stomach pain, diabetes, fevers, colds, coughs, headaches, malaria, skin problems, menstrual disorders, aches and pains, hypertension, infections and as an aid in childbirth.\[5\]

1.1 Scientific Classification\[6\]

**Kingdom** - PLANTAE

ANGIOSPERMS

EUDICOTS

ROSIDS

**Order** - CUCURBITALES

**Family** - CUCURBITACEAE

**Genes** - MOMORDICA

**Species** - *M.charantia*

1.1 Origin and distribution

The original home of the species is not known precisely, other than that it is a found mainly in the tropical areas. Bitter melon grows in tropical areas, including parts of the Amazon, east Africa, Asia and the Caribbean. It is widely grown in India and other parts of the Indian subcontinent, Southeast Asia, China, Africa and the Caribbean.\[7\]

1.2 Macroscopic Characters

**Colour** - Green when raw and yellowish when ripe, some species are white also.
Odour- slight to no smell.
Taste – bitter
Size- 20- 30 cm long generally
Shape - oblong with blunt tapering ends and pale green in colour[8]

1.3 Cultivation and Collection
It is a type of annual or perennial climbers found throughout India and is also cultivated Upto an altitude of 1500m. It is cultivated during warm season i.e. during April to July by using 2-3 seeds in a pit. The pits are prepared at a distance of half a meter and provided with manures. Only one plant is retained and seedlings are watered once or twice a week. Plants begin to flower 30-35 days after sowing and the fruits are ready for harvesting 15-20 days after flowering. Bitter gourd, also known as balsam pear, is a tropical vegetable widely Cultivated in Asia, Africa and South America.[9]

- Best soil for bitter gourd farming
The best medium for seeds is a fertile, well drained soil with a pH ranging from 5.5 to 5.7, enriched with organic matter, such as compost or dried manure. But it will tolerate any soil
that provide a good drainage system (sandy loam soil, but it will grow in areas with poorer soils.) It should be in a free area and will prefer the climate with daytime temperatures between 24 C and 35 C. The soil must be prepared well by adding organic matter before planting. Seeds soaked in water will germinate sooner. Soil temperature for germination is at least 20 C to 25 C.\(^9,10\)

- **Time of sowing and seed rate in bitter gourd farming**
  The seed is sown from January to march for summer season crop, june – july for rainy season crop in the plains and march to june in the hills. The seed rate is 4 to 5 kg/ha.\(^9,10\)

- **Method of sowing in bitter gourd farming**
  The seed is sown by dibbling method at a spacing of 120*90 cm. Generally 3 to 4 seeds are sown in a pit at 2.5 to 3 cm depth. The seeds are soaked in water over night before sowing for better germination. Seed germination was enhanced by soaking the seeds for 24 hrs in solution of 25 to 50 ppm GA and 25 ppm boron. In flatbed layout seeds are dibbled at the spacing 1*1 m.\(^11\)

- **Irrigation/water supply in bitter gourd farming**
  Irrigation should be carried out in 3 to 4 days interval during the initial stages of plant vine growth. It is crucial to irrigate alternate days at the rime of flowering and fruiting stage. Irrigate the vines on need base, it does not require any irrigation rainy season or when there is a sufficient moisture in the soil. In case of flooding or heavy water stagnation, make sure to drain out the water problem areas, drip irrigation would be the best choice to utilize the water effectively.\(^12\)

- **Harvesting in bitter gourd farming**
  The harvesting in bitter gourd farming starts from 60 to 65 days after sowing the seeds. Harvesting should be carried out when fruit are young and tender at every alternate day. Fruits should be harvested carefully without damaging the plant vine. Unless, it grown foe seed purpose, they should not be allowed to ripe on the vines. The harvested bitter gourd can be stored for 2-3 days in cool conditions.\(^13\)
Yield in bitter gourd farming

In most of the crops, yield depends upon the cultivar (variety), soil, type, climatic conditions and farm management practices. In bitter gourd farming, an average yield of 65 to 100 quintal/ha can be obtained.\[14\]

1.4 Description

- **Leaves:** simple, usually palmately 5-7 lobed, tendrils unbranched or 2 branched. The herbaceous, tendrils bearing vine grows to 5 m. It bears simple, alternate leaves 4–12 cm across, with 3–7 deeply separated lobes.\[15\]

- **Fruit:** ovoid, ellipsoid, or spindle shaped, usually ridged or warty, irregularly as a 3 valved fleshy capsule. The fruit has a distinct warty looking exterior and an oblong shape. It is hollow in cross-section, with a relatively thin layer of flesh surrounding a central seed cavity filled with large flat seeds and pith. Seeds and pith appear white in unripe fruits, ripening to red; the flesh is crunchy and watery in texture, similar to cucumber or green bell pepper. The skin is soft and edible. Bitter melon comes in a variety of shapes and sizes. The typical Chinese type is 20–30 cm long, oblong with blunt tapering ends and pale green in colour, with a gently undulating, uneven surface. The bitter melon more typical of India has a narrower shape with pointed ends and a surface covered with jagged, triangular "teeth" and ridges. Coloration is green or white. Some bear miniature fruit of only 6–10 cm in length, which may be served individually as stuffed vegetables. These miniature fruit are popular in Southeast Asia as well as India. In Panama bitter melon is known as Balsamino. The pods are smaller and bright orange when ripe with very sweet red seeds.\[16\]
Flowers: Staminate flowers usually solitary on a bracteates scape, hypanthium shallow, calyx 5 lobed, petals 5, usually yellow, distinct, 1-3 with incurved scales at base, stamens usually 3, inserted toward base of hypanthium, filaments distinct, broad, anthers distinct or coherent, 2 of them dithecal, the other monothecal, cells curved or flexuous; pistillate flowers usually solitary on a bracteates scape, hypanthium ovoid to spindle shaped, perianth usually smaller than in staminate flowers, staminodes absent or 3, ovules numerous, horizontal, stigmas 3, 2 lobed. Seeds few to numerous, ovate, usually sculptured. Each plant bears separate yellow male and female flower.[17]

1.5 Chemical Constituents
The active constituents of the fruits are triterpenes including momordicin and momordicinin, and a series of cucurbitanes, momordicosides, goyaglycosides and kuguacins; proteins including α, β and γ-momorcharins and momordins a and b and polypeptide P, also known as vegetable or plant insulin (v- or p-insulin). Pyrimidines such as vicine and charine are found particularly in the seed and many sterols (including charantin), fatty acids and volatile compounds have also been identified in the fruit. The chemical composition of the leaf is less well-known, but it does contain goyasaponins.[18]

Following is the list of all types of chemical constituents in the M.charantia.

Glycosides; Momordin, charantin.

Alkaloids; Momordicin
Others; Polypeptide-P
Oils (seeds only); Stearic acids, linoleic acids, oleic acids.
Glycoprotein; Alpha- momorcharin, beta-momorcharin, lectins.
Amino acids; aspartic acid, serine, glutamic acid, thscinne, alanine, g-amino butyric acid and pipecolic acid.
Others; Vicine (pyrimidine nucleoside), protein.[19,20] The fruit pulp has soluble pectin but no free pectic acid.

1.6 Charantin
Charantin is steroidal glycoside and exist as equal mixture of stigmasterol glucoside and β-sitosterol glucoside. It has got blood sugar lowering property equivalent to insulin.

1.6.1 Description
- It is a white crystalline, neutral and tasteless compound.
- Charantin is freely soluble in non-polar solvents such as chloroform and dichloromethane whereas it is slightly soluble in polar solvents such as ethanol or; methanol. Charantin is soluble in ether.
- It’s melting point ranges from 266-268 degree Celsius.[21]

1.6.2 Phytochemistry
With Libermann-Burchard test charantin gives violet colour changing to blue, green and yellow. On hydrolysis with acid it produces glucose and sterol. It gives violet- blue colour and pink colour on spraying with anisaldehyde sulphuric acid reagent and vanillin sulphuric acid reagent, respectively.[22]

1.6.3 Isolation of charantin
Few attempts have been made to extract and isolate charantin from fruits of *M. charantia* using various chromatographic techniques.

Effect of different solvents (acetone, dichloromethane, ethanol and water), solvent composition (ethanol and water), solvent flow rate and temperature on extraction efficiency of charantin was evaluated. Ethanol was found to be the most effective solvent for extraction of charantin. Yield was increased with increase in temperature. Purification of charantin was done by treating extract using 50-70% of methanol solutions and pure hexane. T.B. Ng *et al.* isolated charantin from seeds of *M. charantia* by affinity chromatography, ion-exchange chromatography and gel filtration chromatography. Seeds were extracted with 10 mM Tris-HCl (pH 7.2). The extract was filtered and chromatographed on affinity column DEAE cellulose column, Affi-gel Blue gel and then by ion-exchange chromatography on Mono S column to get pure charantin. Charantin was extracted by mixing dry powder of fruits with water. The mixture was boiled and filtered. Different amounts of PEG, K2HPO4 and ethanol
were added to various amounts of water extract and an aqueous two-phase system was prepared. The system was vortexed, centrifuged and charantin containing salt-rich layer was extracted with 95% ethanol. The ethanol extract thus prepared was kept overnight at 4 0C and salt was allowed to precipitate. Precipitates were removed and amount of charantin was estimated by UV spectrometry. Charantin was isolated from dried fruits by successive extraction with petroleum ether (60-80 0C) and 80% ethanol. The ethanol extract was concentrated to a small volume and basified with KOH. After 48 h, the ethanol solution was diluted with water and extracted with ether. The ether extract was washed with water, HCl and again with water. The aqueous and acid washings were discarded. The ether layer was distilled off and the residue was recrystallized several times using 95% ethanol to get charantin.\cite{23,24}

1.7 Pharmacological actions of Karela

- **Hypoglycaemic activity**
Charantin isolated from fruits of *M. charantia* was tested for its hypoglycemic activity. In fasting rabbits, it gradually lowered blood sugar within one to four hours and recovered slowly to initial level. At an oral dose of 50 mg/kg, blood sugar level was declined by 42% at the 4th hour. The average blood sugar fall during 5 hours was 28%. Charantin was found to be more potent than tolbutamide however both compounds produced similar pattern of blood sugar change. The hypoglycaemic activity of charantin in depancreatixed cats was less, but abolished, indicating a pancreatic as well as extra-pancreatic action.\cite{19}

- **Cardiovascular effects**
Effect of charantin on cardiovascular system was studied. At the dose of 800 mg/kg, 5-10% of blood pressure lowering of anaesthetized cat was observed. The contraction of isolated heart of frog was increased at dose of 5-10 mg and the same dose was effective to terminate action of acetylcholine.\cite{20}

- **Anti-sialogogue**
Charantin at dose of 10-15 mg/kg delayed the onset of tremors but did not affect salivation produced by tremorine.\cite{20}

- **Anticancer**
Bitter Melon and Bitter Melon Extracts inhibit cancer and tumor. A novel phytochemical in bitter melon 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. One clinical trial found very limited evidence that bitter melon might improve immune cell function in people with cancer, but this needs to be verified and amplified in other research. 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. A chemical analog of bitter melon proteins was developed and named MAP-30 and its inventors reported that it was able to inhibit prostate tumor growth. The phytochemical momordin has clinically demonstrated cytotoxic activity against Hodgkin’s lymphoma in vivo and several other in vivo studies have demonstrated 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 mammary tumors in mice. 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.\[21\]

- **Digestive system**

Leaf juice is purgative and emetic. It has been used in traditional Chinese medicine as an appetite stimulant and a treatment for gastrointestinal infection. Bitter melon contains a bitter compound called momordicin that is said to have a stomachic effect.\[22\]

- **Antiobesity**

Five compounds in bitter melon increase the activity of adenosine 5 monophosphate kinase (AMPK), an enzyme that facilitates cellular glucose uptake and fatty acid oxidation. Hypoglycemic agents in bitter melon promotes efficient oxidation of glucose into fuel and conversion into starch. (Glycogen or animal starch is stored in the liver and muscle cells). During glucose shortages, fats/fatty acids are used as fuel. Continued demand for energy in the absence or shortage of glucose causes fat cells to release their fat contents to maintain energy balance. This increased fatty acid oxidation eventually leads to weight loss. Compounds in bitter melon improves lipid profiles. They reduce liver secretion of apolipoprotein B (Apo B) – the primary lipoprotein of low-density "bad" cholesterol; reduce apolipoprotein C- III expression, the protein found in very-low density cholesterol which turns into LDL/bad cholesterol; and increases the expression of apolipoprotein A-I (ApoA1) - the major protein component of high-density "good" cholesterol. It also lowers cellular
triglyceride content. In other in vivo studies, bitter melon fruit and/or seed have been shown to reduce total cholesterol and triglyceride in both the presence and absence of dietary cholesterol. In one study, elevated cholesterol and triglyceride levels in diabetic rats were returned to normal after 10 weeks of treatment. The fruit and seed of bitter melon have demonstrated (in animal studies) to lower blood cholesterol levels. Persons on medications to lower blood cholesterol should monitor their cholesterol levels. Various cautions are indicated.[23]

- **Skin**

Fruit and leaves are used in leprosy. Bitter melon inhibits the enzyme guanylate cyclase, which may benefit people with psoriasis. This enzyme is thought to be linked to the pathogenesis and replication of psoriasis.[24]

- **Reproductive system**

Leaves act as a galactogogue. The seeds, however, have demonstrated the ability to induce abortions in rats and mice and the root has been documented with a uterine stimulant effect in animals. The fruit and leaf of bitter melon has demonstrated an in vivo antifertility effect in female animals; in male animals, it was reported to affect the production of sperm negatively. Bitter melon traditionally has been used as an abortive and has been documented with weak uterine stimulant activity; therefore, it is contraindicated during pregnancy. This plant has been documented to reduce fertility in both males and females and should therefore not be used by those undergoing fertility treatment or seeking pregnancy. The active chemicals in bitter melon have shown in animal studies to be transferred through breast milk; therefore, it is contraindicated in women who are breast feeding.[21,24]

- **Liver**

Fruit is useful in sub acute cases of liver and spleen. Another method for carcinogen-induced lipid peroxidation in liver and DNA damage in lymphocytes were reduced by following treatment of *M.*charantia. The fruit extract was found to significantly active liver enzymes glutathione transferase, glutathione peroxidase and catalase, which showed a depression following exposure to the carcinogen. The result suggest the preventive role of water soluble constituents of *M.*charantia fruit during carcinogenesis, which is mediated possibly by their modulatory effect on enzymes of biotransformation and detoxification system of host.[25]
• **Antimicrobial activity**

In addition to these properties, leaf extracts of bitter melon have clinically demonstrated broad spectrum antimicrobial activity. Various water, ethanol and methanol extracts of the leaves have demonstrated in vitro antibacterial activities against E. coli, Staphylococcus, Pseudomonas, Salmonella, Streptobacillus and Streptococcus; an extract of the entire plant was shown to have antiprotocoal activity against Entamoeba histolytica. The fruit and fruit juice has demonstrated the same type of antibacterial properties and, in another study, a fruit extract has demonstrated activity against the stomach ulcer-causing bacteria Helicobacter pylori. Although all parts of the plant have demonstrated active antibacterial activity, none have shown activity against fungi or yeast. Long-term use of this plant may result in the die-off of friendly bacteria with resulting yeast/candida opportunistic overgrowth. Cycling off the use of the plant (every 30 days for one week) may be warranted and adding probiotics to the diet may be beneficial if this plant is used for longer than 30 days.[26-28]

**A) Antiviral activity**

Bitter melon (and several of its isolated phytochemicals) also has been documented with in vitro antiviral activity against numerous viruses including Epstein-Barr, herpes and HIV viruses. 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). Momordica Anti-human Immunovirus Protein (MAP30) activates natural killer cells, interferes with the ability of HIV viruses to divide and spread. It also increases the body's production of *interferon-gamma*, a natural substance that fights all types of viruses. Another clinical study showed that MAP-30’s antiviral activity was also relative to the herpes virus in vitro. It contains three anti-HIV proteins: alpha- and beta momorcharin, and MAP-30, and charantin, beta-DSitosterl- beta-D-glucoside, 5,25-Stigmastadien-3-beta-Dglucoside, serotonin, and many kinds of amino acids.[26-28]

**B) Anti HIV activity**

Bitter melon has also been suggested as a treatment for AIDS, but the evidence thus far is too weak to even mention. Laboratory tests suggest that compounds in bitter melon might be effective for treating HIV infection. As most compounds isolated from bitter melon that impact HIV have either been proteins or glycoproteins (lectins), neither of which are well-absorbed, it is unlikely that oral intake of bitter melon will slow HIV in infected people. It is
possible oral ingestion of bitter melon could offset negative effects of anti-HIV drugs, if a test tube study can be shown to be applicable to people. Clearly more research is necessary before this could be recommended. The other realm showing the most promise related to bitter melon is as an immunomodulator. One clinical trial found very limited evidence that bitter melon might improve immune cell function in people with cancer, but this needs to be verified and amplified in other research. If proven correct this is another way bitter melon could help people infected with HIV. 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 but research has only been demonstrated in test tubes and not in humans. Another study explained that HIV-infected cells treated with alpha- and beta-momorcharin showed a nearly complete loss of viral antigen while healthy cells were largely unaffected. “Useful for treating tumors and HIV infections. In treating HIV infections, the protein is administered alone or in conjunction with conventional AIDS therapies” stated by inventors of MAP-30 protein analog in U.S. Patent. The proteins (alpha and beta momorcharin) appeared to modulate the activity of both T and B lymphocytes and significantly suppressed the macrophage activity.[26-28]

- **Larvicidal activity**

*M. charantia* has shown good larvicidal activity against three container breeding mosquitoes.[27]

- **Wound healing property**

Researchers found that *Momordica charantia* Linn. Fruit powder, in the form of an ointment (10% w/w dried powder in simple ointment base), showed a statically significant response, in terms of wound contracting ability, wound closure time, period of epithelization, tensile strength of the wound and regeneration of tissues at wound site when compared with the control group and these results were comparable to those of a reference drug povidone iodine ointment in an excision, incision and dead space wound model in rats.[29]

### 1.8 MATERIALS AND METHODS

- **Plant materials and extraction procedure**

The ripe and unripe fruits of *M. charantia* were obtained from Adana, Turkey. The *M. charantia* fruits were washed with distilled water, and the seeds were separated. The fruits were then sliced into small pieces and dried in drying oven at 50°C. The dried plant materials
were then blended into powder using an electric blender for extraction. The powdered seeds and fruits of *M. charantia* were separately extracted with ethanol by using Soxhlet apparatus for 24 h. The extracts were concentrated by using a rotary evaporator and used for further test.\(^{[2,3]}\)

**Determination of extraction yield**

The yield of evaporated dried extracts based on dry weight was calculated from the equation shown below:

\[
\text{Yield (\%)} = \left( \frac{W_1}{W_2} \right) \times 100
\]

Where, \(W_1\) = weight of extract after evaporation of solvent
\(W_2\) = dry weight of the sample.\(^{[3]}\)

**Microbial strains**

*In vitro* antimicrobial studies were carried out on four gram-positive bacteria (*Listeria monocytogenes* ATCC 7644, *Staphylococcus au-reus* ATCC 25923, *Bacillus cereus* RSKK 863, *Micrococcus luteus* NRRL B-4375), seven gram-negative bacteria (*Escherichia coli* ATCC 11229, *Escherichia coli* ATCC 35218, *Escherichia coli* O157:H7, *Salmonella enteritidis* ATCC 13076, *Pseudomonas aeru-ginosa* ATCC 27853, *Shigella sonnei* Mu:57, *Yersinia enterocolitica* NCTC 11175) and one yeast (*Candida albicans* ATCC 10231). Nutrient agar (NA) and Tryptic Soy Agar (TSA) were used for the cultivation of bacteria while YPD medium was used to culture yeast. All bacterial cultures were incubated at 37°C for 24 h whereas yeast cultures were incubated at 30°C for 48 h.\(^{[4,5]}\)

**Inhibitory effect with the disc diffusion method**

The disc diffusion method was employed for the determination of the antimicrobial activity (Murray et al., 1995). The culture suspensions were adjusted by comparing with 0.5 McFarland. 100 µl of suspension of the test microorganisms were spread on solid media plates. Filter paper discs (6 mm in diameter) were impregnated with 10 µl of the extracts, and then placed on the inoculated plates. Afterwards, they were kept for 2 h in refrigerator to enable prediffusion of the extracts into the agar. Then, the inoculated plates were incubated for 24 and 48 h for bacterial and yeast strains, respectively. Antibiotic discs of Ampicillin (Amp, 10 µg/disc), Gentamicin (CN, 10 µg/disc) were also used as positive controls. Absolute ethanol was used as negative control. The diameters of inhibition zones (mm) were used as a measure of antimicrobial activity and each assay was repeated twice.\(^{[6]}\)
Determination of minimal bactericidal (MBC) or fungicidal (MFC) concentrations

The MBC/MFC values of the extracts were determined by the microdilution method using serially diluted (two folds) plant extracts according to Chandrasekaran and Venkatesalu (2004). Some modifications were made to the method. The extracts were studied for microorganisms which are sensitive to the extracts in the disc diffusion assay. Inocula of the microorganisms were prepared using 12 h cultures, and the suspensions were adjusted to 0.5 McFarland standard turbidity. The test samples were added to growth broth medium to get a final concentration of 90.00 mg/ml, and serially diluted to reach 45.00, 22.50, 11.25, 5.63, 2.82, 1.41 and 0.71 mg/ml. The final volume in each tube was 100 μl. 2.5 μl of standardized suspension of each tested microorganism was transferred to each tube. A positive control (containing 2.5 μl inoculum and 100 μl growth medium) and a negative control (containing 2.5 μl of extract, 100 μl growth medium without inoculum) were included on each microtube. The contents of the tubes were mixed by pipetting, and they were incubated for 24 h.

The MIC was defined as the lowest concentration of an anti-microbial agent that inhibits the visible growth of a microorganism (Andrews, 2001). However, the tested plant extracts in the study were colored and the visible growth could not be observed and so, 5 μl samples from all tubes were plated on solid growth medium to confirm microbial growth (Şahin et al., 2003). The MBC and MFC were recorded as the lowest concentration of the extract that did not permit any visible bacteria and fungal colony growth on the appropriate agar plate after the period of incubation (Chandrasekaran and Venkatesalu, 2004). Therefore, the concentrations of the extracts that prevent the growth of a microorganism on the solid media were evaluated as MBC or MFC values in this study. Each test was repeated twice.\[7\]

1.9 Traditional uses of Karela plant parts

- Fruits

The fruit is considered as tonic, stomachic, stimulant, emetic, antibilious, laxative and alterative. The fruit is useful in gout, rheumatism and subacute cases of the spleen and liver diseases. It is supposed to purify blood and dissipate melancholia and gross humours. It has also been shown to have hypoglycaemic properties (antidiabetic) in animal as well as human studies. Fruit pulp, leaf juice and seeds are antihelminthic.\[2\]
• **Fruit juice or leaf tea**
The fruit juice and/or a leaf tea is employed for diabetes, malaria, colic, sores and wounds, infections, worms and parasites, as an emmenogogue and for measles, hepatitis and fevers.[3]

• **Leaves** - Leaves act as galactogogue

• **Roots** - Root is astringent.

• **Other uses**
Abortifacient, anthelmintic, aphrodisiac, burn, catarrh, constipation, digestion, demulcent, dermatosis, diabetes, diarrhoea, dyspepsia, eczema, emetic, emmenagogue, emollient, fever, febrifuge, hemorrhoids, hepatitis, hypoglycemic, inflammation (liver), leprosy, leucorrhoea, leukemia, malaria, menstrual colic, pain, pruritus, purgative, rheumatism, scabies, skin, tumor, wound, vaginitis, vermifuge, cancer (breast), food, glucosuria, halitosis, hematuria, polyuria, refrigerant, bite (snake), anaemia, colitis, kidney (stone), sterility (female), dysentery, gonorrhoea, appetite stimulant, insecticide, laxative, rage, rhinitis, contraceptive, dysmenorrhea, fat loss, galactagogue, gout, hydrophobia, piles, pneumonia, psoriasis, sore, asthma, headache, scald, sprue, stomachache, cold and cough.[4]

➢ **RESEARCH REVIEW AND CLINICAL INDICATIONS**

**Diabetes**
The ability of bitter melon to decrease serum glucose levels has been studied in animal studies and in a small number of human studies. Reductions in blood sugar can be seen quickly, as soon as 30 minutes, with the peak effect between 4-12 hours after taking a dose of bitter melon.

A clinical trial that included 9 type 1 diabetics in the treatment group and 10 type 1 and 2 diabetics in the placebo group, found that injections of bitter melon extract, isolated for its crystallized p-insulin, resulted in a statistically significant decrease in blood sugar. The effect
was noted 30-60 minutes after subcutaneous injection, a 21.5% drop from baseline glucose, with a peak effect ranging from 4-12 hours and a 28% drop after 12 hours. This study was not blinded, randomization did not occur and the placebo group had lower average fasting blood glucose at baseline than did the treatment group, all of which weaken the validity of the results.

A small case series study was published in 1981, where nine type 2 diabetics took 50 mL of bitter melon juice after a baseline glucose tolerance test (GTT), another dose after drinking the juice, and again 8-11 weeks later after daily ingestion of 0.23 gm of fried bitter melon. The mean drop in glucose was 6% one hour after the fried fruit intake. There was a mean drop of 12% in the GTT, 1 hour after the bitter melon juice. Mean glycosylated hemoglobin (HbA1c) also dropped by about 8% from baseline after the 8-11 weeks of fried bitter melon. While the methodology of this study is weak, including lack of controls, the results are important in the effect of bitter melon on type 2 diabetics, for both the lowering of glucose and HbA1c.

Type 2 diabetics were also studied in a case series of 18 patients. Each patient was given 100 mL of bitter melon fruit juice 30 minutes before a glucose load and a GTT. Results were compared to each patient’s own previous GTT the day before after drinking just water. Improved glucose tolerance was observed in 13 of the 18 patients with a statistically significant improvement in their GTT. While each patient served as their own control, there was no true control or randomization, but yet again, we do see this blood glucose lowering effect of administering bitter melon.

Lastly, more recently and more importantly, a randomized, double-blind, placebo-controlled, three month trial was done in type 2 diabetics who were either newly diagnosed or had poor glucose control. A bitter melon extract powder was given two capsules three times per day (dosage per capsule not given), or placebo capsules with 20 individuals in each group. There was a small decrease in HbA1.

**Other potential indications**

Several animal studies have shown significant decreases in triglycerides and LDL cholesterol and increases in HDL cholesterol.
In vitro antiviral activity has been observed with bitter melon seeds and its inhibitory effects on HIV integrating into host cells. In vitro research has also demonstrated reduced rates of T lymphocyte infections with HIV-1 and reduced viral replication in infected cells.

There have been some reported in vitro antineoplastic effects, and bitter melon may potential the function of natural killer cells.

1.10 CONCLUSION
Karela is obtained as fresh green fruit of the plant *Momordica Charantia* Linn., family Cucurbitaceae. It is an annual or perennial climber widely cultivated as food in all over world, in India too. Fruit of this plant is known as bitter melon, bitter gourd, balsam pear or African cucumber. It is cultivated during warm season i.e. during April to July. Leaves are green, fruits are green when raw and yellow to orange when ripe. It has bitter taste with slight to no odour. Chemical constituents include glycosides, alkaloids, glycoproteins, oils, amino acids etc. The majorly studied chemical constituents of Karela are charantin and momordicin. Isolation of charantin can be done by phytochemical extraction and screening processes. Chromatographic methods can be used for isolation and analysis of charantin. Karela have many pharmacological actions on human body which includes hypoglycemic activity, cardiovascular activity, anti- sialogogue, anti- cancer, anti-obesity, anti-microbial activity, anti-larvicidal activity, wound healing property. It is also observed to enhance digestion and have purgative effect, also shown positive effect on the leprotic patients. It has also been used as an anti fertility plant from ancient times. Along with so many benefits comes some side effects too. Overuse of Karela can cause irregular heart rhythms, hypoglycaemic coma, can affect liver, cause drug interactions. If given in higher amounts to a pregnant lady can induce miscarriage. Thus it should be avoided in pregnant lady cases.

Hence we concluded that *Momordica charantia* is a potential herbal in the world. Further studies are required to find many more activities of this plant.

1.12 REFERENCES


