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Momordica charantia as a Potential Medicinal Herb: An Overview

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Abstract
Momordica charantia a member of the Cucurbitaceae family, is known as bitter melon, karela, and pare. It grows in tropical areas of the Amazon, East Africa, Asia, India, South America, and the Caribbean and is used traditionally as both food and medicine. The plant is a climbing perennial with elongated fruit that resembles a warty gourd or cucumber. It is a monoecious climber found throughout the country often under cultivation, upto an altitude of 1500 m the unripe fruit is white or green in color and has a bitter taste that becomes more pronounced as the fruit ripens. Its main action is blood sugar lowering effect. It consists the following chemical constituents those are alkaloids, momordicin and charantin, charine, momorchanins *M. charantia* extracts increase glucose utilization by the liver,8 decrease gluconeogenesis via inhibition of two key enzymes (glucose-6-phosphatase and fructose-1,6 bisphosphatase),. *M. charantia* extracts (primarily from the fruit) are currently being used include diabetes, dyslipidemia, microbial infections, and potentially as a cytotoxic agent for certain types of cancer. In ayurveda, the fruit is considered as tonic, stomachic, stimulant, emetic, laxative and alterative. Bitter melon has been used in various Asian traditional medicine systems for a long time. Like most bitter-tasting foods, bitter melon stimulates digestion.

Keywords: *M. charantia,* momordicine, karela, extract.

1. Introduction
Momordica charantia a member of the Cucurbitaceae family, is known as bitter melon, bitter gourd, balsam pear, karela, and pare. It grows in tropical areas of the Amazon, East Africa, Asia, India, South America, and the Caribbean and is used traditionally as both food and medicine. The plant is a climbing perennial with elongated fruit that resembles a warty gourd or cucumber. The unripe fruit is white or green in color and has a bitter taste that becomes more pronounced as the fruit ripens [1]. It is a monoecious climber found throughout the country often under cultivation, upto an altitude of 1500 m [2]. It is a slender climbing annual vine with long-stalked leaves and yellow, solitary male and female flowers borne in the leaf ails. The Latin name Momordica means “to bite” referring to the jagged edges of the leaves, which appear as if they have bitten [3]. Clinical conditions for which *M. charantia* extracts (primarily from the fruit) are currently being used include diabetes, dyslipidemia, microbial infections, and potentially as a cytotoxic agent for certain types of cancer [4, 5]. In ayurveda, the fruit is considered as tonic, stomachic, stimulant, emetic, laxative and alterative. Bitter melon has been used in various Asian traditional medicine systems for a long time. Like most bitter-tasting foods, bitter melon stimulates digestion. While this can be helpful in people with sluggish digestion, dyspepsia, and constipation, it can sometimes make heartburn and ulcers worse. The fact that bitter melon is also a demulcent and at least mild inflammation modulator, however, means that it rarely does have these negative effects, based on clinical experience and traditional reports [6].

2. Vernacular Name [7]:

Eng:	Bitter gourd	Hindi:	Karela
Sansk:	Karavella, Kathlla, Karavalli	Assam:	Kakiral, Kakral,
Beng:	Karolla	Guj:	Karela
Kan:	Hagalakai	Mal:	Kaippa, Pavackkai

Momordica charantia Plant

Momordica charantia Leaves

3. Mode of Action

The mechanism of action of *Momordica charantia* is its blood sugar lowering effect. Research using a validated animal model of diabetes has demonstrated *M. charantia* extracts increase glucose utilization by the liver [8], decrease gluconeogenesis via inhibition of two key enzymes (glucose-6-phosphatase and fructose-1,6 bisphosphatase), and improve glucose oxidation through the shunt pathway by activating glucose-6-phosphate dehydrogenase [9]. Extracts of MC also enhance cellular uptake of glucose, promote insulin release and potentiate its effect, and increase the number of insulin producing beta cells in the pancreas of diabetic animals. MC extracts have broad-spectrum antimicrobial activity, having been shown to prevent infection by numerous viruses, bacteria, parasitic organisms, and fungi [10]. Although mechanisms have not been determined for all organisms, in the case of viral infection it is thought that certain bitter melon constituents prevent viral penetration of the cell wall. Animal studies demonstrate MC extracts, particularly the saponin fraction, have lipid-lowering effects resulting from inhibition of pancreatic lipase activity and subsequent decreased lipid absorption [11].

4. Active Constituents

The main constituents of bitter melon (Karela) are triterpene, protein, steroid, alkaloid, inorganic, lipid, and phenolic compounds [4]. *Momordica charantia* (Karela) consists the following chemical constituents those are alkaloids, momordicin and charantin, charine, momorchanins, momordenol, momordicilin, momordicius, momordicinin, momordin, momordolol, charantin, charine, cryptoxanthin, cucurbitns, cucuritacins, cucuritanes, cycloartenols, diosgenin, elaeostearic acids, erythrodiol, galacturonic acid, gentisic acid, goyaglycosides, goyasaponins, and multiflorenol 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, momordenol, momordicillin, momordicinin, momordicosides, momordin, momordolo [12, 13].

5. Morphological evaluation of fruit and seed of *Momordica charantia*

Immature fruit is green, elongated, fusiform, longitudinally grooved, ridged and warty, 2.5 to 25 cm long, 2 to 7 cm in diameter, pulp pithy, whitish yellow at maturity, splitting into 3 compartments, exposing numerous seeds, enclosed in whitish aril which becomes bright red on maturity; seeds pale brown up to 1.5 cm long, flattened, elliptic with scalloped markings on the flat side and on the edge of seed, endosperm thin, embryo bulky; consisting of large cotyledons and short straight radicle. Odour is characteristic [14].

6. Transverse section of fruit of *Momordica charantia*

Transversely cut surface of the fruit is circular in outline with many external longitudinal rugose folds, of the outer mesocarp encircling the inner whitish, pithy, spherical mesocarp occupying the major area of the section with scattered seeds encircled by arillus and placentation parietal. The epidermis consists of squarish to rectangular thin-walled cells traversed with stomata, cuticle striated; it bears short glandular trichomes with multicellular head, hypodermis consists of thin-walled chlorenchymatous tissue, containing crystals of calcium oxalate; outer and middle mesocarp tissue is spongy and porous and contains starch grains. The cells of the inner mesocarp are smaller in size and contain numerous small crystals of calcium oxalate. Anastomosing bicollateral vascular bundles and latex tubes traversed throughout the mesocarp tissue; endocarp consists of thinwalled more or less tangentially elongated cells often adhering to the seed. TS of seed consists of outer epidermis of palisade cells with thick cuticle; subepidermis 3 to 4 layered of small isodiametric cells, followed by thick-walled tangentially elongated sclerenchymatous layer and below this lies spongy parenchyma containing starch grains. Perisperm narrow consists of collapsed cells, endosperm one layered containing oil and aleurone grains, followed by tissue of the cotyledon [14].

7. Pharmacological activity

7.1. *Anti –Diabetic Activity*

Perhaps the best-researched use of bitter melon is to lower blood sugar levels in diabetics. Alcohol extracted charantin from *Momordica charantia* consists of mixed steroids, and in an animal model of diabetes it improved glucose tolerance to a degree similar to the oral hypoglycemic agent, tolbutamide [15]. A clinical trial of nine patients with confirmed type 1 diabetes found that subcutaneous injection of an MC extract containing crystallized p-insulin resulted in a statistically significant decrease in blood sugar levels compared with controls. Fasting blood sugar was drawn prior to the administration of p-insulin and plasma glucose levels were used to determine the dosage of p-insulin given to each patient. The onset of p-insulin's effect was noted 30-60 minutes after administration, with peak effect ranging widely from 4 12 hours [16].

7.2. Antimicrobial Activity

In vitro studies have shown bitter melon extracts and the MAP30 protein analog, isolated from the seeds of MC extracts, possess broad-spectrum antimicrobial activity. MC extracts inhibit infection and growth of several viruses, including HIV, 24 *Herpes simplex* [17], and Epstein Barr virus.2 A preliminary report on the effect of MC extract in three HIV patients showed a normalization of CD4/CD8 ratios with MC treatment. It is believed MC extracts inhibit HIV replication by preventing syncytial formation and cell-to-cell infection [18]. MC extracts also appear to inhibit the growth of numerous gram-negative and gram-positive bacteria, including

E. coli, Salmonella, Shigella, Staphylococcus, Pseudomonas, Streptobacillus, Streptococcus, and *H. pylori*, and parasitic organisms *E. histolytica* and *Plasmodium falciparum* [19].

7.3. Dyslipidemia
Several animal studies using a rodent model of diabetes have examined the effect of bitter melon extracts on abnormal lipid parameters. Significant decreases in triglycerides and LDL cholesterol and increases in HDL cholesterol were noted in all studies. In the longest study (10 weeks) MC extract was given to normal and streptozotocin-induced type-1 diabetic rats. Diabetic rats had elevated total cholesterol, triglycerides, and phospholipids, as well as decreased HDL cholesterol; moderate increases in plasma lipid peroxides and malondialdehyde (signs of increased oxidative stress) were also observed. After 10 weeks, diabetic rats receiving MC extract experienced a normalization of all parameters compared to control rats not given the extract [20-21].

7.4. Anti-Cancer Activity
Although clinical trials have not been conducted using MC extracts in cancer patients, *in vitro* studies indicate bitter melon fruit and seed extracts inhibit the growth of several cancer cell lines, including prostate adenocarcinoma, human colon cancer (Caco-2 cells) [22], and the highly metastatic breast cancer cell line MDAMB 231 [23].

7.5. Side effect and Toxicity
Oral ingestion of bitter melon fruit is safe as demonstrated by long-term consumption of the fruit in Asian cultures. Subcutaneous injection of p-insulin extracted from MC appears to be safe; however, intravenous injection of MC extracts is significantly more toxic and not recommended. Because bitter melon seeds contain momorcharin, shown to have antifertility effects in female mice, bitter melon seed consumption is not recommended in those seeking to become pregnant [24].

7.6. Dosage
Dosage recommendations depend on the form of bitter melon being consumed. The dose of fresh juice is 50-100 mL but it is extremely bitter and difficult to drink. Although encapsulated dry powder is easier to ingest, the standard dose is 3-15 g daily – a large dose in capsule form. A standardized, encapsulated extract dosage ranges from 100-200 mg three times daily [25].

7.7. Warnings and Contraindications
Because seed extracts have been shown to induce abortion in mice and the root is a documented uterine stimulant, use is not recommended in pregnant women or those seeking pregnancy [26].

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