

STUDY ON THE MEDICINAL APPLICATIONS OF *MOMORDICA CHARANTIA* SPECIES: A REVIEW

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Abstract

Natural products are useful in the treatment of many human ailments as well as in the process of finding new drugs. In general, medications made from naturally occurring products are safer, less expensive, easier to get, and more effective than pure manufactured medications for treating a variety of illnesses. A bitter melon's abundance of bioactive substances, including as saponins, alkaloids, polypeptides, minerals, and vitamins, can help prevent and treat a number of illnesses, including diabetes, cancer, kidney stones, diabetes mellitus, stomach pain, tumor growth, and fever. Steroid saponins, the primary component of BM known as charantin, function similarly to peptides and certain alkaloids in regulating blood sugar levels. By controlling blood cholesterol, *M. charantia*'s therapeutic qualities help reduce cardiovascular diseases including atherosclerosis. tannins are examples of secondary metabolites. Alkaloids, flavonoids, and tannins are only a few of the secondary metabolites with antibacterial qualities found in both fresh and dried leaf extracts of bitter melon. It was demonstrated that the phytochemical content of both leaves exhibited antibacterial action against a range of bacteria, including *Bacillus*, *Streptococcus*, *E. Coli*, *Pseudomonas aeruginosa*, and *Salmonella*.

Key words: *Momordica charantia*, bitter melon, antidiabetic, wound healing, antimicrobial, anticancer.

INTRODUCTION

Momordica charantia is a plant used in herbal medicine and as food. It is also known as bitter melon. The scientific name *Momordica* comes from the Latin meaning "to bite", which refers to the leaves' pointed edges. Momordicinso is a bitter chemical found in every part of the plant, including the fruits. It tastes incredibly bitter. The plant is found in tropical regions such as Thailand, tropical Africa, America, Malaya, Bangladesh, India, China, and the Middle East. *Momordica charantia* contains several physiologically active phytochemicals, including proteins, triterpens, saponins, flavonoids, steroids, alkaloids, and acids. The plant possesses anti-tumorous, anti-fungal, anti-parasitic, anti-cancer, antiviral, anti-fertility, antibacterial, and hypoglycemic properties due to its abundance of phytochemicals. Traditional medicine uses fruits and leaves to treat a wide range of conditions, including worms, gout, rheumatism, colic, and liver and spleen disorders. Because *Momordica* contains peptides and alkaloids that resemble insulin and charantin, a class of

steroidal sapogenins, it possesses hypoglycemic qualities.

BOTANICAL INFORMATION

Momordica is a thin, climbing, monoecious plant that grows in the axils of leaves and has long, stalked leaves. It has distinct male and female flowers that are colored yellow. It belongs to the family Cucurbitaceae. The 4- 10 cm single or alternating leaves have 3-6 deeply separated lobes, and the tendrils are either unbranched or have two branches. Fruits have an oval, small-cucumber-like, ellipsoidal, or spindle shape. They are packed with flat, pulp-filled seeds that typically have a ridged surface. The seeds either dehisce irregularly into a fleshy capsule or they are indehiscent. When the fruits are young, they are green in color; as they develop, they become orange or yellow. The fruit splits into three uneven valves and folds backward, releasing a large number of white or reddish-brown seeds that are covered in reddish-purple arils. The seeds and pith of unripe fruits are white, whereas those of

maturing fruits are red. Flowers: Single flowers have a shallow hypanthium, five lobed calyx, five yellow petals, one to three incurved scales at the base, and broad filaments with three stamens typically inserted toward the base of the hypanthium; pistillate flowers are usually solitary on a bracteate scape; anthers are distinct or coherent, with two of them being dithecal and the other monothechal; and curved or flexuous cells. With multiple horizontal ovules, three stigmas, two lobed stigmas, and either no staminodes or three, the hypanthium's perianth, which forms an oval to spindle, is frequently smaller than that of staminate flowers. There are a few to many ovate seeds that are usually carved.

ACTIVE CONSTITUENTS

Bitter melon has 91.8% water, 1.4% fiber, 0.20 percent fat, and 4.2% carbs. It is an edible vegetable and a naturally occurring medicinal plant. Albumin makes up 49.3% of the protein makeup, globulin 29.3%, and glutelin 3.1% (Farhan Saeed et al., 2018).

The fatty acid profile of the seeds indicates that they include 3.3% of monounsaturated fatty acids and 36.71% of saturated fatty acids. Additionally, the seeds account for 35% to 40% of the oil extracted from them. Sixty percent is the highest concentration of polyunsaturated fatty acids (PUFA) in bitter melon. The principal constituents of fruits include β -sitosterol- β -D-glucoside, momordicoside G, momordicoside F1, momordicoside F2, momordicoside I, momordicoside K, momordicoside L, momordin, stigmasta-5, momordicin, and 25-dien3- β -O-glucoside (Chekka et al., 2020).

α -eleostearic acid (54%), a conjugated linolenic acid, is remarkably important in PUFA (Grossmann et al., 2009; Liu et al., 2010).

The highest concentrations of minerals in BM may be found in the fruit and leaves, including potassium, sodium, calcium, phosphorus, and magnesium. Naturally, seeds are the best source of zinc (45.45 mg/100 g) and chromium (5.65 mg/100 g). Momordica has a wide range of physiologically active chemicals, including two groups of saponins: triterpenoids of the oleanane and cucurbitane types (Popovich et al., 2020).

Approximately 20-25 phytochemical components, accounting for 91% of the oil applied. The oil's primary constituents are cisdihydrocarveol, trans-nerolidol apiole, and germacrene (Mesia et al., 2008; Ahmad et al., 2012).

Alpha-eleostearic acid is rich in oil, has potent blood fat-lowering qualities, and acts as an anti-inflammatory and anti-cancer agent by inhibiting the growth of tumor cells. Minerals, especially zinc and cr, have a significant impact on proteins or polysaccharides and can predict the development of hyperlipidemia, hyperglycemia, and hypercholesterolemia (Hsu et al., 2011).

A wide range of health-promoting phytochemicals, Leafy greens, fruits, and seeds are rich in many compounds, such as steroidal saponins, volatile oils, resins, vitamins, polypeptides, minerals, and alkaloids. Standard components include p-insulin, which is a polypeptide found in nature, momordicine alkaloid, and steroidal saponin, or charantin (Tan et al., 2014).

Bitter melon fruit pulp has no free pectic acid and only soluble pectin. Among the elements of BM include momordium, minerals, alkaloids, ascorbic acid, steroidal saponin glucosides, and carantin. Phenolic components, epicatechin, catechin, gentisic acid, chlorogenic acid, and gallic acid are all present in Momordica extract (Horax et al., 2010).

MEDICINAL USES OF *MOMORDICA CHARANTIA*

Potassium, calcium, manganese, magnesium, zinc, iron, phosphorus, and dietary fiber are among the minerals that are abundant in Momordica, as well as nutrients like betacarotene, foliate, thiamine, and riboflavin. Momordica's strong antioxidant content is attributed to its flavonoid, phenolic, anthroquinone, terpene, isoflavone, and glucosinolate content, which collectively give it its bitter flavor (Snee et al., 2012).

The beta-carotene concentration of bitter melon juice improves vision and lessens eye diseases, while regular usage of the juice increases bodily stamina and prevents chronic weariness. Bitter melon stimulates the digestive system, which increases acid output and helps alleviate dyspepsia (Ahmad et al., 1999).

Juice from bitter melon lowers blood sugar and controls insulin levels. The hypoglycemic quality of bitter guard is attributed to a combination of phytochemicals called charantin, alkaloids, and insulin-like peptides, which also improve without increasing blood insulin levels, glucose tolerance. These living ingredients help with glucose absorption, fuel metabolism regulation, AMPK protein activation, and all other diabetic-related activity impairments. Bitter melon increases the number of beta cells in the pancreas that release insulin. Numerous research have demonstrated the anticancer, anti-inflammatory, and anti-diabetic properties of bitter gourd. Some pharmaceutical companies have included this fruit in their formulae as a result (Jayasooriya et al., 2000).

Bitter gourd juice protects against jaundice and strengthens the liver. In addition to nourishing the liver and aiding in hangover recovery, bitter melon juice detoxifies (Murray et al., 1995).

It is hypothesised that in cancer patients, bitter melon can enhance immune cell function and modify immunity. It is also used to treat cancer, psoriasis, malaria, tumors, high cholesterol, flu, and fever (Leatherdale et al., 1981).

The fresh juice of bitter guard leaves was used to treat diarrhoea and treat cholera in its early stages.

ANTIDIABETIC ACTIVITY

Momordica charantia contains a variety of phytochemicals, including charantin, polypeptide-p, plant insulin, vicine, karavilosides, and glycosides. These substances operate as hypoglycaemic agents by promoting the liver, muscles, and fat cells' production of glycogen and increasing their uptake of glucose (Chekka et al., 2020).

A polypeptide found in fruits and seeds called TP-insulin helps treated rats' blood sugar levels fall and return to normal. Bitter melon contains lectin, a bioactive substance that functions similarly to insulin. It functions similarly to insulin by connecting the two receptors for insulin. Lectin functions similarly to insulin in peripheral tissues and lowers blood glucose levels. Lectin is crucial to the hypoglycemic impact that results from eating bitter guard. Charantin's alcoholic extract it is a potent

hypoglycemic medication used to treat diabetes and lower blood sugar levels. It is composed of a mixture of steroids. By encouraging the production of insulin, which in turn promotes the uptake of glucose by cells, the bitter melon fruit improves the action of insulin. In diabetic mice, fruit extract (fresh and dried) lowered blood sugar levels. In rats with alloxan-induced diabetes, bitter gourd extracts exhibit hypoglycemic, anti-diabetic, hypolipidemic, and hepato-renal protective effects. By lowering capillary permeability at the arteriolar and capillary levels, bitter melon controls microvascular dysfunction, a typical diabetes consequence. Charantin, a hypoglycemic chemical, is a member of the steroidal saponins family, which is composed of a mixture of stigmasteryl glucoside and sitosteryl glucoside (1:1). When given orally or intravenously, candantin causes hypoglycemia in rabbits (Lotlikar et al., 1966).

P-insulin, another bitter guard hypoglycemic agent, is a polypeptide made up of 166 amino acids with a molecular weight of roughly 11,000 Da. Clinical research demonstrated that polypeptide-pZnCl₂ had a blood sugar-lowering impact. When administered intraperitoneally, pyrimidine nucleoside, A vicine that can be found in fruits and seeds might make rats hypoglycemic. Individuals with type 2 diabetes benefit from *Momordica* extracts high in charantin (Banerjee et al., 2019).

ANTI-MICROBIAL ACTIVITY

The elements included in fresh leaf extracts Multiple secondary metabolites of *M. charantia* have distinct medicinal uses. Secondary metabolites include flavonoids (anticarcinogenic, antioxidant, antiviral, and antihemorrhagic); and tannins (moluscicidal, antiviral, antimicrobial, and antitumoral). The antibacterial qualities of BM leaves are effective against *Bacillus*, *Streptococcus*, *Salmonella*, and *Pseudomonas aeruginosa*. and *Escherichia coli* (Brandao et al., 2016).

Various fresh leaf extractions shown efficacy against distinct strains of *B. cereus*, *S. aureus*, and *Escherichia coli*. Both the fresh and dried leaf extracts include a large number of secondary metabolites of different types,

including as flavonoids, alkaloids, and tannins, which have a variety of biological activities, including antibacterial ones. Bitter melon seed extracts have antimicrobial properties that inhibit the growth and infection of gram-positive and gram-negative bacteria and viruses, including *Shigella*, *Salmonella*, *H. pylori*, *Escherichia coli*, *Pseudomonas*, *Streptococcus*, and *H. pylori* and *Streptobacillus*, as well as parasitic organisms like *Plasmodium falciparum* and *Entamoeba histolytica*. Potential chemotherapeutic possibilities against leishmaniasis include the bioactive compounds found in bitter melon (Gupta et al., 2010).

ANTI-MALARIAL ACTIVITY

A naturally occurring medicinal herb called *Momordica charantia* is used to cure and prevent malaria. Historically, people from Asia, Panama, and Colombia have all thought that bitter

guard guards against malaria. Malaria is treated using tea made from leaves that have been boiled in water. Laboratory studies have demonstrated the antimalarial activity of some *Momordica* variants (Olasehinde et al., 2014).

ANTIOXIDANT ACTIVITY

Antioxidants are chemicals that help lessen or stop the harm that free radicals do to cells. High levels of antioxidant activity. are present in the ethanolic extracts of bitter melon such as phenolic substances (Aljohi et al., 2016; Qader et al., 2011).

Inhibiting stress-induced lipid peroxidation, bitter guard lowers glutathione levels and improves catalase activity. There is antioxidant action in the phenolic chemicals that are isolated from bitter melon. The antioxidant-rich *Momordica charantia* seeds successfully restore the reduced antioxidant status in streptozotocin-induced diabetic rats (Sathishsekar et al., 2005).

ANTI-TUMOR PROPERTIES

Bitter gourd inhibits the growth of tumor cells and has anti-carcinogenic properties. Anti-carcinogens or chemopreventive agents are

present in BM. In a study using rat models, bitter guard water extract can stop the progression of prostate cancer. The whole plant's extract in hot water prevented the growth of tumor cells in the mammary glands of mice. Bitter melon has been shown to have anti-leukemic and anti-cancerous properties in a number of *in vitro* experiments using a wide range of cell lines. These studies include melanoma, liver cancer, solid sarcomas, and human leukemia (Fang et al., 2012) (Grover et al., 2004).

In cancer patients, bitter gourd is a potent immunomodulator that enhances immune cell function. Bitter melon extracts from the fruit and seeds stop the growth of several cancer cell lines, such as those from metastatic breast cancer, prostate adenocarcinoma, and human colon cancer. Research using MDAMB. 23140-41 *in vitro*.

HYPO-CHOLESTEROLEMIC ACTIVITY

Research on both normal and diabetic animals has shown that *Momordica charantia* has hypocholesterolemic effects. Rats fed sunflower for four weeks were given *Momordica charantia* seeds, which contained octadecatrienoic fatty acid. After four weeks, the rats' levels of nonenzymatic liver tissue lipid peroxidation, Erythrocyte membrane lipid peroxidation and plasma lipid peroxidation both decreased. For about 21 days, bitter gourd fruit and/or seeds were given to the diabetic rats. during which time their cholesterol and triglyceride levels returned to normal. Rats' blood and liver lipids are affected by bitter gourd oil (BGO) (Anilakumar et al., 2015).

ANTI-VIRAL PROPERTIES

Studies conducted *in vitro* have demonstrated the bitter gourd's antiviral properties against a variety of viruses, such as the Epstein-Barr, herpes, and HIV viruses (Bourinbaier et al., 1995).

Bitter melon leaf extract stimulates natural killer cell activity, produces more interferon, boosts resistance to viral infections, and has an immunostimulant impact on animals. The proteins or glycoproteins that bitter gourd contains have antiviral properties. Because

bitter gourd absorbs poorly when taken orally, it may not be able to stop the spread of the virus in HIV-positive individuals. On the other hand, taking *Momordica* orally counteracted the side effects of anti-HIV medications. Bitter guard leaf extracts exhibit antibacterial properties against *Salmonella*, *Escherichia coli*, *Pseudomonas*, *Streptobacillus*, and *Streptococcus*. The whole plant extract exhibits antiprotozoal action against *Entamoeba histolytica* (Gupta et al., 2010).

Helicobacter pylori, the bug that causes stomach ulcers, is susceptible to the antibacterial qualities and activity of fruit and fruit juice.

LARVICIDAL ACTIVITY

Bitter Guard contains phytochemicals that may have larvicidal effects. Several investigations have been carried out targeting two mosquito vectors, namely *Anopheles stephensi* and *Culex quinquefasciatus*. (Balboa et al., 1992).

ANTI-GENOTOXIC ACTIVITY

Momordica charantia has antigenotoxic action that decreases the genotoxic effects of methylnitrosamine, tetracycline, and methanesulfonate, hence reducing chromosome breakage (Hussan et al., 2014).

ANTI-HELMINTIC ACTIVITY

M. charantia fruit, leaves, and seed extracts have been shown to have pharmacological activity against helminths. Aqueous extracts of *Momordica* are more effective than piperazine in treating *Ascaridia galli*. The anthelmintic saponins cause paralysis in the worms by inhibiting the function of the enzyme acetylcholinesterase, which ultimately results in death.

WOUND HEALING ACTIVITY

Momordica charantia fruit powder ointment is superior to the control group in a rat model with respect to wound contracting, wound closure time, epithelization period, tensile strength of the wound, and tissue regeneration at the wound site. It is comparable to a

reference medication, povidone iodine ointment (Subhashchandra et al., 2010).

Bitter melon has a strong ability to heal wounds. Bitter melon contains phytochemicals, such as candelin, that promote the synthesis of growth factors, cause fibroblasts to proliferate, and quicken the wound's oxygenation and capillary circulation. The antimicrobial and antioxidant qualities of phytochemicals like flavonoids and glycosides speed up the healing process. *Momordica* has a positive impact on how quickly wounds heal. In addition, it accelerates the rate of wound contraction, accelerates wound closure, and increases wound tension.

CONCLUSIONS

For many years, *M. charantia*, a naturally occurring dietary supplement, has been utilized as an ethnomedical treatment for a range of ailments, such as diabetes, cancer, inflammation, and other conditions. Worldwide research has been done on *M. charantia*'s natural therapeutic qualities, which include antioxidant, antimalarial, anticancer, antibacterial, and antidiabetic effects. A plant with various uses, bitter guard has the ability to treat practically every illness. The plant has a number of therapeutic components that can function collectively or individually to produce its therapeutic effects. Phytochemicals like charantin, insulin-like peptide, and alkaloid-like extracts have hypoglycemic properties in relation to diabetes, much like the plant or its pure extracts do. Numerous compounds present in plant extracts possess the capability to modulate various systems implicated in the supervision and therapy of diabetes mellitus. *M. charantia* is a workable and naturally occurring choice for people who are more likely to develop diabetes.

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