

## Bitter Gourd: The Reservoir of Nutrients

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In the context of nutrition, plants and the products they produce are essential for both the supply of essential nutrients and the defense against a number of diseases. They indeed improve the quality of life throughout the world. Since ancient times, plant-based traditional medicines have also been used, but standardizing them is necessary to evaluate their potential. The widespread prevalence of various maladies including coronary heart diseases, diabetes mellitus, cancer insurgence, degenerative disorders, and lack of body inherent defense mechanism are often attributed to the change in lifestyle. The plants and their metabolites offer protections against such illness if included in the diet. They possess, hypoglycemic, anticarcinogenic, hypocholesterolic and other beneficial qualities. Additionally, consuming them is associated with stronger immunity against oxidative stress and related disorders. Certain plants that are high in phytochemicals are bitter or astringent by nature, which makes them less appealing to consumers and limits their popularity. However, these plants offer a wide range of protection against several ailments. *Momordica charantia* is one such specimen that has a rich phytochemistry and functions well as a remedy in nutritional regimens to ward against various illnesses.



Many countries utilize it as a vegetable, but it has also been used for centuries to treat a wide range of illnesses, including ulcers, diabetes, inflammation,

and more. In India, this crop is cultivated mainly in Madhya Pradesh, Chattisgarh, Tamil Nadu and Andhra Pradesh. All portions of the plant are edible in nature but frequently grown for the bitter fruit. Bitter gourd is filled with pulp and large flat seeds, which surrounding a comparatively thin layer of flesh. The bitterness of bitter gourd is due to the cucurbitacin-like alkaloid momordicine and triterpene glycosides.



### Nutrient Profile

Bitter melon has ability to fight against numerous life style associated disorders, due to the presence of bioactive substances including polypeptides, minerals, vitamins, alkaloids, flavonoids, isoflavones, terpenes, steroidal saponins, aromatic volatile oils, anthraquinones, and glucosinolates. The 100 g edible fruit constitutes moisture (83.2-92.4%), carbohydrates (4.2-9.8%), fat (0.2-1.0%), fiber (0.8-1.7%), protein (1.6-2.9 grams), iron (2.2-9.4 milligrams), calcium (20-50 milligrams) and vitamin C (70-120 milligrams). The caloric values for leaf, fruit and seed were 213.26, 241.66 and 176.61 Kcal/100 g respectively. In the recent past, this species has gained immense importance for its nutritional traits and phytomedicinal properties in other parts of the world too. Drinking fresh bitter gourd juice is recommended by naturopaths. Root, leaves and stem of wild bitter gourd are used in many ayurvedic medicines.

**Traditional and Ethnomedicinal uses:****Leaves**

Traditionally, the juice of bitter gourd leaves is used for applying on the skin for treating insect bites, bee stings, burns, contact rashes, and wounds. Decoction of its leaves is drunk as preventative or treatment of indigestion, toothache, liver diseases, diabetes, hypertension, and cancer. In Asia, bitter gourd has been considered effective for treating and prevention of malaria. The tea from bitter gourd leaves has been considered to be useful for the treatment of malaria. Crude ethanolic extracts from *Momordica* have shown strong anti-malarial activity. Oral consumption of leaves exhibited strong antimalarial activity.

**Fruit**

Bitter gourd has been used in various Asian traditional medicine systems for a long time, for preventing and treating a wide range of illness. Its fruits and pulp are used in treating asthma, constipation, colic, diabetes, cough, fever (malaria), gout, helminthiasis, leprosy, inflammation, skin diseases, ulcer, and wound. It has also shown hypoglycaemic (antidiabetic) properties in animal as well as human studies. Juice of bitter gourd is used to treat piles and beneficial in treating and preventing the liver damage. It also functions as a blood purifier due to its bitter tonic properties. In India, bitter gourd is used by tribal people for abortions, birth control, increasing milk flow, menstrual disorders, constipation, food, hyper-glycemia, diabetes, jaundice, stones, kidney, liver, eczema, gout, fat loss, haemorrhoids, hydrophobia, intestinal parasites, skin, pneumonia, leprosy, psoriasis, rheumatism, scabies, piles, snakebite, and as an anti-helminthic. It is used topically for sores, fungal and wound infections.

**Seeds**

Bitter gourd seeds have shown its effectiveness in treatment of ulcers, liver and spleen problems, diabetes, high cholesterol, intestinal parasites, heal wounds, and stomach-ache. Juice from bitter gourds helps in reducing the problem of pyorrhoea (bleeding from the gums).

**Roots**

Bitter gourd roots are also used in the treatment of syphilis, rheumatism, ulcer, boils, and septic swellings. Bitter gourd capsules and tinctures are widely available in the USA for the treatment of diabetes, cold, flu, viruses, tumours, cancer, high cholesterol, and psoriasis.

**Bioactive compounds:**

Several published clinical research have demonstrated that the fruit, seeds, and leaves of bitter melon extract contain an array of bioactive compounds that function as hypoglycemia agents in humans and diabetic animals. Momordicine II and 3-hydroxycucurbita-5, 24-dien 19-al-7, 23-di-O- $\beta$ -glucopyranoside (4), were isolated as saponins from *M. charantia*. At concentrations of 10 and 25  $\mu\text{g/mL}$ , both drugs demonstrated considerable insulin-releasing action in MIN6  $\beta$ -cells. The three main substances; charantin, polypeptide-p and vicine have been extracted from bitter melon and identified as hypoglycemic agents.

**Charantin**

Charantin is a typical cucurbitane-type triterpenoid in *M. charantia* and is a potential substance with antidiabetic properties. It is a mixture of two compounds, namely, sitosteryl glucoside and stigmasteryl glucoside. The compound is more effective than the oral hypoglycemic agent tolbutamide.

**Polypeptide-p**

Bitter melon is one of the most commonly used vegetable that contains polypeptide-p and is used to control diabetes naturally. Subcutaneous injections of polypeptide-p, also known as p-insulin, a hypoglycemic protein similar to insulin, have been demonstrated to lower blood glucose levels in humans. The p-insulin works by replicating the action of human insulin in the body and thus may be used as plant-based insulin replacement in patients with type-1 diabetes.



## Vicine

The other major compound that has been isolated from the seeds of bitter melon is a glycol alkaloid known as vicine. The vicine found in fava bean has been shown to induce favism, an acute disease characterized by hemolytic anemia. Therefore, the individuals susceptible to the disease should avoid eating the fruit.

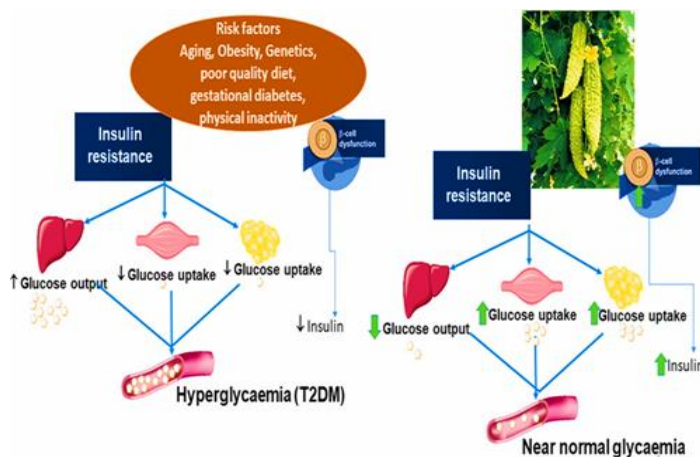
## Medicinal Properties

Bitter gourd has long been recognized for its potential medical benefits, including its ability to lower cholesterol, reduce inflammation, combat cancer and control blood sugar. Numerous phenolic compounds found in it may have antimutagenic and antioxidant properties. In traditional medicine, the fruit, stems, leaves, and roots of the bitter melon have all been used to treat conditions like hyperlipidemia, gastrointestinal issues, microbial infections, and menstruation issues. Research has demonstrated that bitter melon possesses potent antiviral qualities that can boost the immune system and trigger the body's natural killer cells, assisting in the defence against viruses including the human immunodeficiency virus and the white spot syndrome virus. Additionally, research has shown that bitter melon can be employed as a cytotoxic agent against a variety of cancer types and possesses anti-carcinogenic qualities. As a broad-spectrum antibacterial agent, bitter melon extract can also be used to treat illnesses brought on by *Salmonella*, *Escherichia coli*, *Staphylococcus aureus*, *Streptobaccilus* and other bacteria. Furthermore, the plant has anti-helmintic qualities that are useful in the treatment of malaria. Bitter melon has also traditionally been used as an abortifacient, or substance that causes abortions. Pregnant women are therefore warned against consuming the plant. Additionally, the seed extract has anti-spermatogenic properties.

## Hypoglycaemic Activity

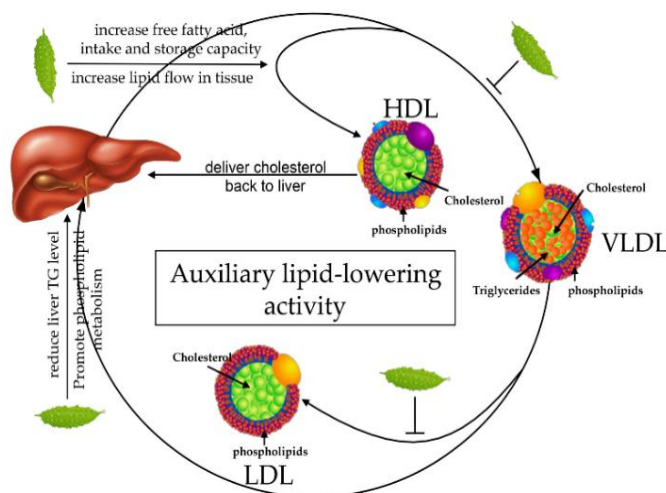
Bitter gourd extracts traditionally used as vegetable insulin possess hypoglycemic, antioxidative, and antidiabetic agents that are useful in the treatment of diabetes. Parts of the bitter gourd plant have at least three components (alkaloids, insulin-like chemicals, and steroidal saponins) that have the ability to lower blood sugar levels and/or provide additional benefits to people with diabetes mellitus. These substances have a more noticeable hypoglycemic effect in fruit due to their high concentration present. Among the

diverse range of hypoglycemic chemicals found in bitter gourd fruit, charantin, vicine, and polypeptide-P are believed to offer the primary health benefits for individuals with diabetes. A previously undiscovered insulin-like protein called Polypeptide-P was found in bitter gourd fruit and seed. BG has stimulatory effects on insulin secretion, but not glucagon secretion, through its direct action on  $\beta$  cells of the pancreas.



## Antioxidant activity

Natural antioxidants, primarily plant phenolics and polyphenolic compounds (e.g., in fruits and seeds of bitter gourd), are alternatives to synthetic antioxidants for alleviating oxidative deterioration in fruit. Organosulfur compounds, phenolic acids, vitamin C, and vitamin B are additional chemopreventive antioxidants found in bitter gourd. Gallic acid, gentisic acid, epicatechin, catechin and chlorogenic acid are potentially excellent natural sources of food antioxidants, given their abilities to reduce total cholesterol/triglyceride, blood pressure, and the incidence of cancer and cardiovascular diseases.



**Gallic acid** is one of the major phenolic compounds in bitter melon. Gallic acid can be found in free form or as a part of tannin molecules. The concentration of gallic acid in the freeze-dried seed was almost 50% less than that of the flesh.

**Gentisic acid** is a biosynthetic derivative of salicylic acid, the well-known analgesic drug in humans.

**Saponins** are present in bitter gourd, both steroids and triterpenoids, in their flesh and seeds. The most well-known steroidal glycosides from bitter melons are  $\beta$ -sitosteryl glucoside and 5,25-stigmasteryl glucoside, and both together (1:1) are often referred to as charantin.

**Antibacterial activity:** Bitter gourd leaf extracts have antibacterial properties, primarily against *Salmonella*, *Escherichia coli*, *Staphylococcus*, *Pseudomonas*, *Streptobacillus* and *Streptococcus*. Furthermore, whole plant extracts have shown antiprotozoal activity against *Entamoeba histolytica*.

**Antimicrobial activity:** The bitter melon extract may act as a useful biolarvicide against mosquitoes. In Asia, *Momordica charantia* has been considered effective for the management and prevention of malaria. Crude ethanolic extracts from BG has strong anti-malarial activity.

**Antiviral activity:** Ribosomes that inactivate proteins are found in bitter melon. Ribosome inactivating proteins limit the spread of viruses by preventing the synthesis of proteins that encourage viral infections. Numerous compounds such as MAP-30, MRK-29, momorcharin, and lectin are isolated from bitter melon, these compounds have a protective effect against viral infections. It's interesting to note that momordicosides A and B found in bitter gourds prevent tumor formation. Additionally, some phytochemicals found in bitter gourds exhibit antiviral action against several viruses, such as the Epstein-Barr, herpes, and HIV viruses, in vitro.

**Antitumor activity:** In addition to the above evidence of its AIDS preventive potential, BG seems also

beneficial for cancer prevention and to cancer patients. The crude fruit and leaf extracts of BG demonstrated antitumor potential on some tumors, including prostate cancer, DMBA-induced skin tumorigenesis, and melanoma and cytogenicity. The combinational use of  $\alpha$ -momorcharin and  $\beta$ -momorcharin against cancer seems more effective than monotherapy. MCP30 is a chromatographic fraction derived from BG, and is composed of  $\alpha$ -momorcharin and  $\beta$ -momorcharin.

**Anti-obesity activity:** *Momordica charantia* stimulates adenosine 5 monophosphate kinase (AMPK), an enzyme that aids in the uptake of glucose and the oxidation of fatty acids within cells. Bitter melon contains compounds that enhance lipid profiles. They reduce liver secretion of apolipoprotein B (Apo B) and increases the expression of apolipoprotein A-1 (ApoA1) the major protein component of high density "good" cholesterol.

### Summary

Bitter gourd has been used historically for various traditional medicinal purposes in addition to being a nutritious food. Its extensive array of bioactive compounds is a gold mine, proving its broad applicability to a wide range of illnesses. The way it functions on several receptors lends even more validity to the usage of many medications in therapy. Bitter gourd has a variety of chemical elements that make it a valuable functional food and nutraceutical for enhancing health. The bitter gourd is an extremely vibrant, multipurpose natural plant. In addition to its amazing potential as a functional food in a variety of culinary firms, it can also be applied as a nutraceutical in the pharmaceutical sector. Most of its chemical parameters have been explored for curing problems such as bacterial and viral infections, diabetes mellitus, pain, stomach problems, as well as life-threatening diseases such as cancer and HIV infections. As a result, bitter gourd is a versatile plant with putative therapeutic uses.

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