

BITTER MELON: A BITTER BODY WITH A SWEET SOUL

Trivedi Rashmi V*, Wadher Kamlesh J, Taksande Jayashri B, Umekar Milind J
Smt Kishoritai Bhoyar College of Pharmacy, Kamptee, Nagpur, Maharashtra, India

Received on: 23/01/2011 Revised on: 26/02/2011 Accepted on: 05/03/2011

ABSTRACT

Bitter melon commonly called as karela in India, consist of number of constituents which contribute to nutritional value of the plant. It has long been used in India, Japan, china, Philippines, America and many other countries as a folk remedy for diabetes mellitus, constipation, as an Abortifacient, an antihelminthic. Rich in iron, beta carotene, potassium, and contains vitamins C and B 1 to 3, phosphorus and good dietary fiber. It is believed to be good for the liver and found to contain insulin like components which are helpful in treating diabetes. Many of its chemical constituents have been explored for its benefits in treating conditions like malaria, viral and bacterial infections, pains, stomach disorders etc.. MAP 30 is protein isolated from bitter melon which has shown anti HIV and anti cancer activities. Constituents of bitter melon can be utilized for preparing many herbal formulations which can cure with no adverse effects. Thus we can say that bitter melon although bitter in taste but is filled with number of qualities in it for curing ailments in human being. In this article we have discussed some of the therapeutic applications of bitter melon in brief.

KEYWORDS: bitter melon, *Momordica charantia*, antiviral, analgesic, MAP30.

***Corresponding Author**

Rashmi V. Trivedi, Smt Kishoritai Bhoyar College of Pharmacy, Behind Rly station, New Kamptee, Kamptee, Dist. Nagpur (Maharashtra). 441 002 E-mail: rashmitrivedi@rediffmail.com

INTRODUCTION

Bitter Melon or Bitter gourd is the English name of *Momordica charantia*. It is also known by the names Karela in hindi and Karavallalw, Angarvelli in Sanskrit. The Latin name *Momordica* means "to bite" (referring to the jagged edges of the leaf, which appear as if they have been bitten¹. Synonyms of *M. charantia* are *M. indica* L., *M. elegans* Salisb., *M. chinensis* Sprengel, and *M. thollonii Cogn*². Bitter Melon grows in tropical areas, including parts of East Africa, Asia, the Caribbean, and South America, where it is used as a food as well as a medicine. Fruits and leaves are consumed as vegetables, and have a several medicinal uses. It is a green cucumber shaped fruit with gourd-like bumps all over it. It looks like an ugly, light green cucumber. The fruit is firm and it tastes very bitter. Although the seeds, leaves, and vines of Bitter Melon have all been used, the fruit is the safest and most prevalent part of the plant used medicinally. The leaves and fruit have both been used occasionally to make teas and beer, or to season soups in the Western world.

Bitter melon consists of number of constituents which contribute to nutritional value of the plant. Some of the

important constituents present in different plant parts are as follows

- **Leaf:** contains two acidic resins and momordicine (bitter substance), vitamin C, carotene, aminobutyric acid. Research has found that the leaves are nutritious sources of calcium, magnesium, potassium, phosphorus and iron, and vitamin B.
- **Root :** contains about 13% ash (major elements: silicon, calcium, phosphorus, strontium, copper, lead, zinc, sodium, and iron)
- **Fruit:** contains about 7% ash (major elements: see root), no free pectic acid but soluble pectins, saponins, 5-hydroxytryptamine, alkaloid momordicine, 0.3% total alkaloid, steroidal glucosides. It also contains 0.035% charantin isolated in pure state as a neutral non-nitrogenous principle presenting the characters of phytosterolines
- **Seed :** contains 32%–35% of a purgative fixed oil (stearic acid, oleic acid, linoleic, and _eleostearic acid); albumin; globulin; glutelin; niacin, pantothenic acid, and other B-vitamin, carotene, amino butyric acid

- **Entire plant** : contains trace amounts of alkaloids and saponins, no flavonoids, tannins, quinines, steroids, and terpenes (Congo), orthophthalic acid (Brazil)

Bitter melon not only possesses important nutritional constituents but also contains several other chemical constituents which offer an array of medicinal activities

Chemical constituents of bitter melon

Bitter melon fruits consist of glycosides, saponins, alkaloids, reducing sugars, resins, phenolic constituents, fixed oil and free acids. It also consists of Alkaloids, charantin, charine, cryptoxanthin, cucurbitins, cucurbitacins, cucurbitanes, cycloartenols, diosgenin, elaeostearic acids, erythrodiol, galacturonic acids, gentisic acid, goyaglycosides, goyasaponins, guanilate cyclase inhibitors, gypsogenin, hydroxytryptamines, karounidiols, lanosterol, lauric acid, linoleic acid, linolenic acid, momorcharasides, momorcharins, momordenol, momordicilin, momordicins, 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, stigmasta-diols, stigmasterol, taraxerol, trehalose, trypsin inhibitors, uracil, vacine, v-insulin, verbascoside, vicine, zeatin, zeatin riboside, zeaxanthin, zeinoxanthin Amino acids- aspartic acid, serine, glutamic acid, threonine, alanine, γ -amino butyric acid and pipercolic acid, ascorbigen, b-sitosterol-d-glucoside, citrulline, elasterol, flavochrome, lutein, lycopene, pipercolic acid³.

Traditional uses of various parts

Various plant parts of bitter melon exhibit some or other medicinal activities. Some of these are given below

Fruit: In Ayurveda, the fruit is considered as tonic, stomachic, stimulant, emetic, antibilious, laxative and alterative. It is also useful in gout, rheumatism and subacute cases of the spleen and liver diseases, purification of blood and to dissipate melancholia and gross humours. It has also been shown to have hypoglycaemic properties in animal as well as human studies.

Leaves: Leaves act as galactagogue. Leaf tea is employed for diabetes, malaria, colic, sores and wounds, infections, worms and parasites, as an emmenagogue, and for measles, hepatitis, and fevers. Leaf juice is reported to have antihelmintic activity.

Seeds: seeds are antihelmintic.

Root: It is an astringent.

Whole plant: Abortifacient, anthelmintic, aphrodisiac, burn, catarrh, constipation, digestion, demulcent, dermatosis, diabetes, diarrhea, 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), anemia, colitis, kidney (stone), sterility (female), dysentery, gonorrhoea, appetite stimulant, insecticide, laxative, rage, rhinitis, contraceptive, dysmenorrhoea, fat loss, galactagogue, gout, hydrophobia, piles, pneumonia, psoriasis, sore, asthma, headache, scald, sprue, stomachache, cold, cough, hypertension, tonic gallbladder, contusions, lung, measles, suppurative, rheumatoid arthritis and lupus.

Although first cultivated in Asia, Africa and Australia, bitter melon is now planted in all the countries with warm climate. Bitter melon has long been used in India, Japan, China, Philippines, America and many other countries as a folk remedy for diabetes mellitus, constipation, as an abortifacient, an antihelmintic and many more as shown mentioned in table 1. Bitter melon is often used in Chinese cuisine for its bitter flavor, typically in fries, in soups and also as tea. The vegetable is cultivated extensively all over India and used as a food and in the form of chips. Bitter melon is a significant component of Okinawan cuisine in mainland Japan, where it is known as goya or nigauri. It is called ampalaya and prepared in the form of various dishes in the Philippines.

Clinical importance

Rich in iron, bitter melon has twice the beta carotene of broccoli, twice the calcium of spinach, twice the potassium of bananas, and contains vitamins C and B1 to 3, phosphorus and good dietary fiber. It is believed to be good for the liver and found to contain insulin, act as an anti-tumor agent, and inhibit HIV-1 infection. At least 32 active constituents have been identified in bitter melon so far, including beta-sitosterol-d-glucoside, citrulline, GABA, lutein, lycopene and zeaxanthin. Nutritional analysis reveals that bitter melon is also rich in potassium, calcium, iron, beta-carotene, vitamins B1, B2, B3 and C.

Antidiabetic

Since ancient times bitter melon has been used widely to prevent or counteract type-II diabetes. The hypoglycaemic activity is attributed to a mixture of steroidal saponins known as charantins, insulin-like peptides and alkaloids that are concentrated in the fruit. Polypeptide -p, a plant insulin, charantin, vicine, glycosides, and karavilosides improve blood sugar levels by increasing glucose uptake and glycogen synthesis in the liver, muscles, and fat cells⁴. 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 rats⁵. The Philippine Department of Health has recommended bitter melon as a scientifically validated herbal medicinal plant, which can lower elevated blood sugar levels. The study revealed that a 100 milligram per kilo dose per day is comparable to 2.5 milligrams of the anti-diabetes drug Glibenclamide taken twice per day. Bitter Melon contains four very promising bioactive compounds which activate a protein called AMPK, well known for regulating fuel metabolism and enabling glucose uptake, processes which are impaired in diabetics. Bitter melon contains a lectin that has insulin-like activity which lowers blood glucose concentrations by acting on peripheral tissues and, similar to insulin's effects in the brain, suppressing appetite. Charantin extracted by alcohol, is a hypoglycemic agent composed of mixed steroids that is more potent than the drug tolbutamide an anti diabetic drug.. Bitter melon also contains an insulin like polypeptide, polypeptide-P, which lowers blood sugar levels when injected subcutaneously into type 1 diabetic patient. Fried fruits consumed as a daily supplement to the diet produced a small but significant improvement in glucose tolerance. It has been shown to increase the number of beta cells in the pancreas thereby improving the body's ability to produce insulin, the ability to enhance cells' uptake of glucose, to promote insulin release, and potentiate the effect of insulin.

The oral hypoglycemic activity was observed with the aqueous extract powder for fresh unripe whole fruits at a dose of 20mg/kg b.wt of rat reducing the fasting glucose levels. The extract was also evaluated for hepatotoxicity and nephrotoxicity and was found to be safe⁶. A water soluble extract of the fruits significantly improved glucose tolerance levels in rats was found not associated with increase in serum insulin response which was proven clinically in type 2 diabetic patients⁷⁻¹⁰.

Antihyperlipidemic

Fruit extract, flavonoids extracted from bitter melon or a methanolic fraction of the plant of Bitter melon exhibited decrease in triglyceride and LDL levels and increases in HDL levels. Its anti-hyperlipidemic effect represents a protective mechanism against the development of atherosclerosis, especially in diabetic condition¹¹.

Antiviral

Several chemical constituents found in bitter melon like alpha- and beta-momorcharin, lectin and MAP 30 have demonstrated in vitro antiviral activity against Epstein-

Barr, HSV-1, HIV, coxsackievirus B3 and polio viruses^{12,13}.

Antibacterial

Broad-spectrum antibacterial activity has been demonstrated for the leaf extracts⁴. *In vitro* antimicrobial activity occurred against *Escherichia coli*, *Salmonella paratyphi*, *Shigella dysenteriae* and against *Streptomyces griseus*. Leaf extracts has been found to inhibit the growth of *Mycobacterium tuberculosis*. The extracts of the entire plant have been reported for antiprotozoal activity against *Entamoeba histolytica* and a fruit extract exhibited activity against *Helicobacter pylori*. Both pulp and skin of *M. charantia* were found effective against several tested organisms. Active constituents of bitter melon specially 5-a-stigmasta-7, 25-dien-3-b-ol, elasterol and lanosterol may be responsible for antibacterial activity. Leaf extracts of bitter melon showed broad spectrum antimicrobial activity since various water, ethanol and methanol extracts of the leaves have exhibited antibacterial activities against *E. coli*, *Staphylococcus*, *Pseudomonas*, *Salmonella*, *Streptobacillus*. Extract of the entire plant has shown antiprotozoal activity against *Entamoeba histolytica* and its fruit extract has demonstrated antibacterial properties against *Helicobacter pylori*, the bacteria causing stomach ulcer¹⁴⁻¹⁸.

Anthelmintic

The anthelmintic activity of the leaves of bitter melon against *Caenorhabditis elegans* has been reported¹⁴. Triterpene glycosides of bitter melon (momordicins I and II) were found to be very active nematicides. A preparation of *M. charantia* exhibited stronger anthelmintic activity in vitro than piperazine hexahydrate against *Ascaridia galli*. The seeds contain an alkaloid and an anthelmintic principle and urease¹⁹.

Abortifacient

Experimental studies with mice have demonstrated that bitter melon can induce abortions. The glycoproteins α and β -momorcharin isolated from the seeds are effective in inducing early and midterm abortions²⁰.

Anticancer

MAP 30, momordin I, alpha-momorcharin a various constituents of crude bitter melon extract have shown anticancer activity. It also displays cytotoxic activity against leukemic cells *in vitro* (guanylate cyclase inhibitor). The MAP30 extract has a cytostatic effect on MDA - MB - 231 human breast cancer cells xenografted into mice. Bitter melon contains an array of biologically active plant chemicals including triterpenes, proteins, and steroids. One chemical has clinically demonstrated the ability to inhibit the enzyme guanylate cyclase which is necessary for the growth of leukemia and cancer cells.

Momordin a protein found in bitter melon has clinically showed anticancerous activity against Hodgkin's lymphoma in animals. Other proteins in the plant, α and β -momorcharin and cucurbitacin B, have been tested for possible anticancerous effects¹³.

Anti HIV

Two of bitter melon proteins- α and β -momorcharin have been reported to inhibit HIV virus in test tube studies²¹ HIV-infected cells treated with α and β -momorcharin showed a nearly complete loss of viral antigen without toxic effects on healthy cells. MAP-30 isolated from bitter melon is a protein useful for treating tumors and HIV infections¹³.

Analgesic and Anti Pyretic

The ethanolic extracts of bitter melon showed an analgesic and antipyretic effect biswas et al 1991 reported a dose-dependent analgesic effect for a methanolic extract of bitter melon seeds²².

CONCLUSION

Bitter melon is a highly nutritious plant found in several countries. Its a wonderful plant not only providing nutrition but also offering several components which show medicinal activities against number of diseases. Many of its chemical constituents have been explored for its benefits in treating conditions like diabetes, viral and bacterial infections, pains, stomach disorders etc. Newer applications include treatment of life threatening cancer and HIV infections too. Constituents of bitter melon can be utilized for preparing many herbal formulations which can cure with no adverse effects. This bitter plant gives many sweet gifts to life some of which we have unwrapped but it may still be holding many more surprises which need to be explored. Bitter melon is truly a bitter body with sweet soul for human lives! Indeed.

REFERENCES

1. Kumar SD, Sharathnath KV, Yogeswaran P, Harani A, Sudhakar K, Sudha P, Banji D. A Medicinal Potency Of *Momordica charantia*. Int J Pharm Sci Rev Res 2010;1:95
2. Michel B, Krawinkel MD, Gudrun B, Keding M. Bitter Gourd (*Momordica charantia*): A Dietary Approach to Hyperglycemia. 2006;1: 331-337
3. Dhalla NS, Gupta KC, Sastry MS and Malhotra CL. Chemical composition of the fruit of *Momordica charantia* Linn. Indian J Pharm. 1961;23: 128
4. Grover JK, Yadav SP. Pharmacological actions and potential uses of *Momordica charantia*: a review. J. Ethnopharmacol. 2004;93: 123-132.
5. Rao BK, Kesavulu MM, Giri R, Appa Rao C. Antidiabetic and hypolipidemic effects of *Momordica cymbalaria* Hook. fruit powder in alloxan-diabetic rats. J Ethnopharmacol.1999; 67: 103-9.
6. Virdi J, Sivakami S, Shahani S, Suthar AC, Banavalikar MM, Biyani MK. Antihyperglycemic effects of three extracts from *Momordica charantia*. J Ethnopharmacol.2003; 88: 107-11.
7. Khan BB, Flier JS. Obesity and insulin resistance. J.Clin.Investig.2000; 106: 473-481
8. Shetty AK, Kumar GS, Sambaiah K, Salimath PV. Effect of bitter gourd (*Momordica charantia*) on glycaemic status in streptozotocin induced diabetic rats. Plant Foods Hum Nutr.2005; 60 : 109-12
9. Leatherdale BA, Panesar PK, Singh G, Atkins TW, Bailey CJ, Bigne AH.1981. Br. Med. J. Clin Res Ed 282(6279): 1823-4.
10. Welihinda J, Karunanayake EH, Sheriff MH, Jayasinghe KS. J. Ethnopharmacol.1986 ;17: 227-82.
11. Raman A, Lau C. Antidiabetic properties and phytochemistry of *Momordica charantia* L(cucurbitacea).phytochemistry.1996;2: 349
12. Beloin N, Gbeassor M, Akpagana K, Hudson J, De Soussa K, Koumaglo K, Arnason JT. Ethnomedicinal uses of *Momordica charantia* (Cucurbitaceae) in Togo and relation to its phytochemistry and biological activity. J. Ethnopharmacol.2005; 96: 49-55
13. Lee-Huang S, Huang PL, Huang PL, Bourinbaiar AS, Chen HC, Kung HF. Proc Natl Acad Sci U S A. 1995;92:8818-22.
14. Ogata F, Miyata T, Fujii N, Yoshida N, Noda K, Makisumi S, Ito A. Purification and amino acid sequence of a bitter gourd inhibitor against an acidic amino acid-specific endopeptidase of *Streptomyces griseus*. J. Biol. Chem.1991; 266: 16715-16721.
15. Omoregbe RE, Ikuibe OM, Ihimire. IJ. Antimicrobial activity of some medicinal plants extracts on *Escherichia coli*, *Salmonella paratyphi* and *Shigella dysenteriae*. African J. Med. Sci.1996; 25:373-375.
16. Yesilada E, Gürbüz I, Shibata H. Screening of Turkish anti-ulcerogenic folk remedies for anti-*Helicobacter pylori* activity. J Ethnopharmacology.1999 ; 66: 289-293.
17. Sabhat S, Perween T. Antibacterial activities of mentha piperita, pisum sativum and *Momordica charantia*. pak. j. bot.2005; 37: 997-1001.
18. Jagessar RC, Mohamed A, Gomes G. An evaluation of the Antibacterial and Antifungal activity of leaf extracts of *Momordica charantia* against *Candida albicans*, *Staphylococcus aureus* and *Escherichia coli*. Nature and Science,2008 ;6.
19. Lal J, Chandra S, Raviprakash V, Sabir M. In vitro anthelmintic action of some indigenous medicinal plants on *Ascaridia galli* worms. Ind J Physiol and Pharmacol, 1976; 64.
20. Chan WY, Tam PP, Yeung HW, Contraception. The termination of early pregnancy in the mouse by beta-momorcharin.1984 ;29:91-100.
21. Wang YX, Jacob J, Wingfield PT, Palmer I, Stahl SJ, Kaufman JD, Huang P L, Lee-Huang S, Torchia DA. Anti-HIV and anti-tumor protein MAP30, a 30 kda single-strand type-I RIP, shares similar secondary structure and beta-sheet topology with the A chain of ricin, a type-II RIP. Protein Sci. 2000 ; 9: 138-144
22. Patel R, Mahobia N, Upwar N, Waseem N, Talaviya H, Patel Z,. Analgesic and antipyretic activities of *Momordica charantia* linn. Fruits.J Adv.Pharm tech res.2010;1:415-418.

Table 1-MEDICINAL USES OF BITTER MELON IN VARIOUS COUNTRIES

| NAME OF COUNTRY | MEDICINAL USES |
|-----------------|--|
| India | For diabetes ,abortions, birth control, constipation, , eczema, fat loss, food, fever, gout , hyperglycemia, increasing milk flow, intestinal parasites, jaundice, kidney stones, leprosy, liver, menstrual disorders, pneumonia, psoriasis, rheumatism, scabies, snakebite, vaginal discharge |
| Brazil | For diabetes ,abortions, burns, colic, constipation, dermatosis, diarrhea, eczema, fever, flu, hemorrhoids, itch, impotency, leprosy, leukemia, libido, liver inflammation, malaria, menstrual problems, pain, rheumatism, scabies, tumor, vaginal discharge, vaginitis, worms |
| Mexico | For diabetes, bowel function, burns, , dysentery, impotency, libido, scabies, sores, worms |
| Panama | For menstrual problems, colds, diabetes, fever, hypertension, itch, malaria, and as an insecticide |
| China | For renal insufficiency kidney problems, breast cancer, diabetes, fever, impotency, , |
| Japan | For piles, diabetes ,abortions, burns, colic, constipation, dermatosis, diarrhea, |