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A SYSTEMATIC REVIEW ON *MOMORDICA CHARANTIA*

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ABSTRACT

Plants and herbal remedies have been utilised as medicine since the dawn of humanity. Many of these claims about the usage of various plants in traditional medicine have been validated by research conducted in the previous few decades. Momordica charantia (MC) is widely used as a purgative, anthelmintic, contraceptive, emmenagogue, antimalarial, galactagogue, gout, jaundice, abdominal pain, kidney stone, leprosy, leucorrhoea, piles, pneumonia, psoriasis, rheumatism, fever, and scabies in various systems of traditional medicine. Its utility as an antibacterial and antiviral agent (including against HIV infection), as an anthelmintic, and as an abortifacient has been verified by more than 100 investigations carried out with the use of contemporary technology.

KEYWORDS: Momordica charantia, Antidiabetic activity, anticancer activity, Momordicin, Gliclazide.

INTRODUCTION

Around the world, 80% of the population still relies on conventional medicine for basic medical issues. Therefore, research has concentrated during the last ten years on the scientific assessment of conventional medications with plant origins. One such plant that has been used regularly as medicine is Momordica charantia (MC) (Giron et al., 1991; Lans and Brown, 1998). The climbing MC, a member of the Cucurbitaceae family, is also known as Karela in Hindi and Bitter Gourd in English. Momordica, which refers to the jagged, seemingly-bitten margins of the leaf, means "to bite." Bitterness permeates the entire plant, including the fruit. The fruit is oblong and looks like a little cucumber. When the fruit is young, it is emerald

green, but when it is ripe, it turns orange-yellow. The plant flourishes in the Caribbean, the Amazon, east Africa, and tropical regions of Asia. It is grown all over the world for both culinary and medicinal purposes. In underdeveloped nations, including Brazil, China, Colombia, Cuba, Ghana, Haiti, India, Mexico, Malaya, New Zealand, Nicaragua, Panama, and Peru, MC has a long history of usage as medicine. It is frequently used to treat colic, diabetes, and as a carminative worldwide (Yesilada et al., 1999; Satyawati et al., 1987; http://www.raintree.com/bitmelon.htm). It is applied topically for the management of worms and parasites both internally and externally, as well as for the healing of wounds. It is also employed as an emmenagogue, antiviral, and hepatitis treatment. In traditional Turkish medicine, ripe fruits are used both orally and topically for the treatment of peptic ulcers. In India, MC is said to have a number of medicinal properties, including antidiabetic, abortifacient, anthelmintic, contraceptive, antimalarial, and laxative. It is also used to treat a number of conditions, including dysmenorrhea, eczema, emmenagogue, galactagogue, gout, jaundice, kidneystone, leprosy, leucorrhea, piles It is, nevertheless, frequently eaten as a vegetable.

Its widespread medical applications have driven research in recent decades, and hundreds of studies using cutting-edge techniques have been conducted with MC. These studies have shown that MC has antidiabetic, antiviral, antitumor, antileukemic, antibacterial, anthelmintic, antimutagenic, antimycobacterial, antioxidant, antiulcer, anti-inflammatory, hypocholesterolemic, hypotriglyceridemic, hypotensive, immunostimulant, and insecticidal properties. This study intends to emphasise the primary therapeutic benefits of MC in order to concentrate future research on this strategy.

Biological source

M. charantia grows under a very wide range of conditions throughout the tropics and subtropics. Its rapid growth and maturation allow it to colonize any area where there is sufficient short-term soil moisture, whilst it can also survive as a perennial in conditions of continuous soil moisture. It grows from sea level to over 1300 m (Tjitrosoedirdjo, 1990), and in areas with annual rainfall as low as 480 mm. Minimum average annual temperatures may be as low as 12.5°C, though the plant is unlikely to thrive in such cold areas. It grows in soils with pH ranging from 4.3 to 8.7 (Holm et al., 1997). M. charantia is a fast-growing vine and quickly covers the supporting vegetation or structure. In general, this species can be found growing in coastal areas, along creeks and rivers, forest edges and disturbed sites (Hall et al.,

2012). For optimum growth, M. charantia needs a strong support, 1-4 m tall, however, it will also grow as a matted ground cover.

Taxonomy

Domain: Eukaryota

Kingdom: Plantae

Phylum: Spermatophyta

Subphylum: Angiospermae

Class: Dicotyledonae

Order: Violales

Family: Cucurbitaceae

Genus: Momordica

Species: Momordica charantia

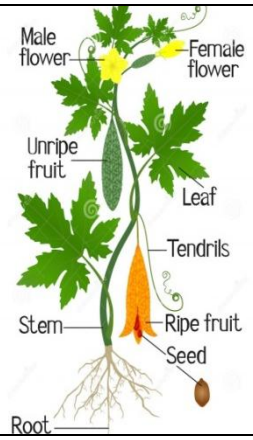


Figure 1: Climber.

Figure 2: Fruit.

Figure 3: Flower.

Bitter melon comes in a variety of shapes and sizes. The cultivar common in China is 20–30 cm (7.9–11.8 inches) long, oblong with bluntly tapering ends, and pale green in colour, with a gently undulating, warty 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. It is green to white in colour. Between these two extremes are any number of intermediate forms. Some bear miniature fruits of only 6–10 cm (2.4–3.9 inches) in length, which may be served individually as stuffed vegetables. These miniature fruits are popular in Bangladesh, India, Pakistan, Nepal, and other countries in South Asia. The sub-continent variety is most popular in Bangladesh and India.

Habitat

Cultivated all over India for its fruits.

Action

Fruit or seeds—improves the diabetic state. Fruit is diuretic, emetic, antibilious, and anthelmintic. It is used for gout and rheumatism, as well as for skin problems, intestinal worms, and coughing fits. Fruit powder is used topically for ulcers and cuts. The leaf is emetic, purgative, and antibilious. Obstinate fruit, leaf, and root acts also as a anthelmintic, the leaf or seed. Roots having astringent property can be applied to haemorrhoids. Immature fruits give several non-bitter and bitter momordicosides. Fruits, seeds, and tissue culture give a polypeptide containing amino acids. Fruits provided hydroxytryptamine, charantin (a steroidal glycoside), diosgenin, cholesterol, lanosterol, and betasitosterol as well. The bitter principles are cucurbitacin glycosides. Hypoglycaemic effects of the fruit have been demonstrated by blood tests in both humans and animal studies.

Chemical constituents

Today, around 228 different medicinal compounds have been isolated from the stems, leaves, pericarp, entire plant, aerial parts of the plant, endosperm, callus tissues, cotyledons and mainly the seeds and unripe fruit in different laboratories in India, Japan, USA, Thailand, Egypt, China, Taiwan, Australia, Nigeria, Pakistan, Brazil, Nepal, Philippines, and Peru. These different compounds have been classified into different chemical types.

These include proteins, triterpenes, lipids, inorganic compounds, phenylpropanoids, carotenoids, steroids, alkaloids, monoterpenes, alkenes to C3, carbohydrates, benzanoids, alcohol C5 or more, other unknown structures (e.g. kakara I-B, II-A, and III-B), sterols, and sesquiterpenes). Of the 228 different compounds, most of these fall under the groups of proteids and triterpenes.

The plant has many different chemical components, which help medicinally either alone or when combined. One of the hypoglycemic components is a steroid saponin called momocharin (charantin) (1) with an insulin-like chemical effect. Charantin has a molecular weight of 9.7 kDa and it is believed that charantin is the active hypoglycaemic agent of M. charantia.

The table shows similarities in the chemical structures of momocharin, momordicin, gliclazide, Glipizide, Metformin hydrochloride, Pioglitazone hydrochloride, and other compounds used in the treatment of T2DM. The hypoglycemic action of M. charantia and its isolated components may be due to its insulin-like structure.

Recently, two other anti-diabetic constituents were isolated from *M. charantia* and both substances exerted hypoglycemic effects in mice. The cucurbitane triterpenoids were found to have the structures, 5β, 19-epoxycucurbita-6, 5β, 19-epoxy-19, 25-dimethoxycucurbita-6 23-(E)-dien-3β-ol and 3β-7β-25-trihydroxy-cucurbita-5, 23 (E)-dien-19-al.

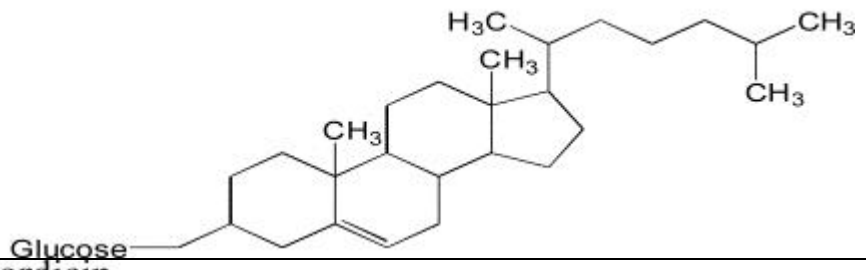
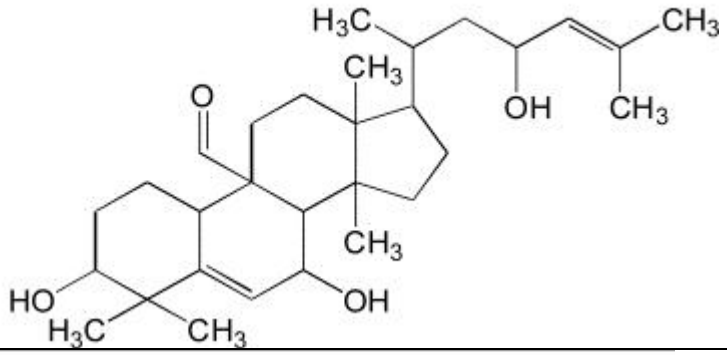
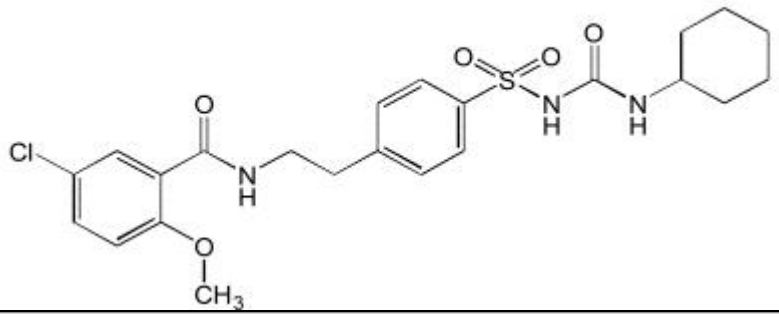
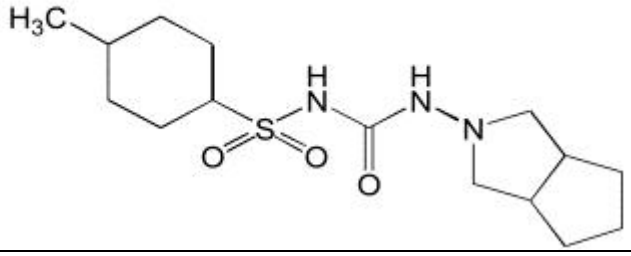
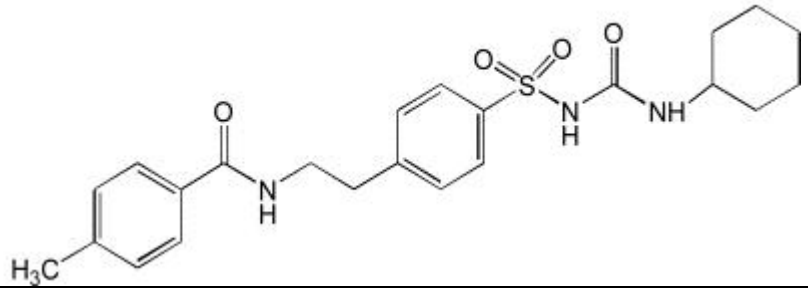
• Momocharin and momordicin have the same parent structure as these two compounds. More recently, momordicin 1.
• was isolated from M. charantia and its chemical structure was characterised as momordicin1 3, 7, 23,-Trihydroxycucurbitan-5,24-dien-19-al This compound is more or less similar to the one identified by Harinantenaina et al.

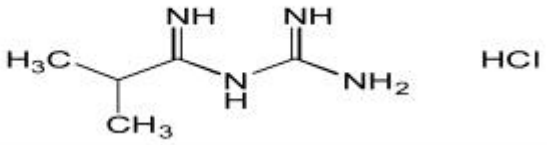
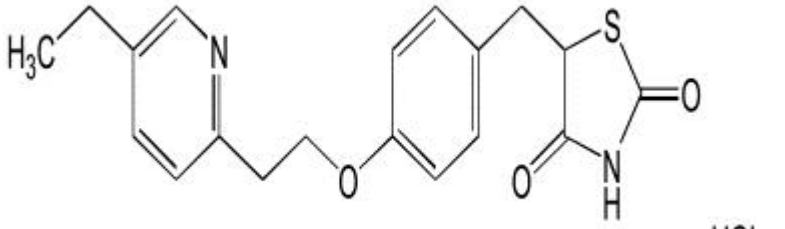
Ref: Medicinal Chemistry of the Anti-Diabetic Effects of Momordica Charantia:Active Constituents and Modes of Action.

Chemical Structures of Momorcharin

1. Momordicine
2. Glibenclamide
3. Gliclazide
4. Glipizide
5. Metformin Hydrochloride
6. Pioglitazone hydrochloride

Note similarities in structure momorcharin and Momordicin and Hypoglycemic agents

Sl.no	Chemical Structure
(1)	Momorcharin 
(2)	Momordicin 
(3)	Glibenclamide 
(4)	Gliclazide 
(5)	Glipizide 

(6)	Metformin HCl 
(7)	Pioglitazone HCl 

Uses

i. Anorexia: Bitter melon is an appetite stimulant. Hence it is used in the treatment of anorexia, a disorder in which a person is unable to eat the required amount of food.

ii. Blood Impurities: Bitter gourd is used as a blood purifier due to its bitter tonic properties. It can heal boils and other blood related problems that show up on the skin. For treatment, a cupful of the juice of the bitter melon must be taken each day in the morning, with a teaspoon of the juice of the citrus lemon in it.

iii. Diabetes Mellitus: A lot has been written lately about the very beneficial aspects of bitter melon in the treatment of diabetes. As already discussed above, bitter melon has a host of bitter chemicals in which, which are hypoglycemic in action. It also has at least one substance that is like the insulin secreted by the human pancreatic glands. Hence, bitter melon is extremely effective in the treatment of diabetes mellitus. Doctors all over the world prescribe having either bitter melon juice early in the morning or to include it in some other fashion in the daily diet. Regular use of bitter melon over a period of time helps to bring the blood sugar level down.

iv. Diarrohea: For diarrhea, the juice of a bitter lemon is mixed with the juice of the spring onions, both two teaspoons in quantity. This is then added with the juice of a lemon. This juice is given to the patient twice a day. This remedy is also effective in curing the diarrhea that is caused due to cholera.

v. Hangovers: The juice of the bitter melon is excellent remedy for hangovers. It is also very beneficial in preventing the liver damage that occurs due to excessive alcoholism.

vi. Piles: In case of piles, the fresh juice of bitter melons is prescribed to the patient with positive results. Three teaspoons of juice of the bitter melon leaves is to be extracted each morning, added to a glassful of buttermilk and then consumed on an empty stomach.

Carrying on this routine for thirty days will treat piles completely. Even externally, the paste of the leaves can be applied over the hemorrhoids.

vii. Pyorrhea: Pyorrhea is bleeding from the gums. Including bitter melon in the daily diet or having some of its juice every morning on an empty stomach helps to reduce this problem.

viii. Respiratory Problems: The paste of the leaves of the bitter melon is mixed with equal amounts of the paste of tulsi leaves. This is taken with honey each morning as a treatment and prevention for respiratory problems such as asthma, bronchitis, common colds and pharyngitis.

ix. Skin Infections: In case of scabies, ringworm and psoriasis, etc. one cup of bitter melon juice must be had each morning on an empty stomach. This juice can be made more potent by adding a teaspoonful quantity of the juice of the lime in it. It is also used in prevention of leprosy in vulnerable regions of the world.

x. Special Ayurvedic Preparations: Bitter melon is used mostly as a vegetable. It is incorporated in the daily diet. Its juice is also prescribed, generally mixed with other citrus juices like those of the lemon. There are no special preparations made out of the karela, as it is generally consumed in its basic form.

Therapeutic Activity

Anthelmentic activity

In case of scabies, ringworm and psoriasis etc. One cup of bitter melon juice must be had each morning on an empty stomach. This juice can be made more potent by adding a teaspoonful quantity of the juice of the lime in it. It is also used in prevention of leprosy in vulnerable regions of the world.

Antibacterial activity

Leaf extracts (water, ethanol, and methanol) of bitter melon have clinically as well as experimentally demonstrated broad-spectrum antimicrobial activity (Khan et al., 1998). In vitro antimicrobial activity of leaves extract was seen against Escherichia coli, Salmonella paratyphi, Shigella dysenterae and against Streptomyces griseus (Omoregbe et al., 1996; Ogata et al., 1991), an extract of the entire plant was also shown to have antiprotozoal activity against Entamoeba histolytica (Khan et al., 1998). Fruit extract has also shown activity against Helicobacter pylori-organism—MICs ranged between 1.95 and 250g/m (Yesilada et al., 1999). In a phase II study, MC leaves extract showed inhibition of

Mycobacterium tuberculosis growth using the BACTEC 460 susceptibility test method (Frame et al., 1998). It is of great importance that those living in tropical countries be encouraged to consume fruit of this plant as it protects against organisms that cause diseases prevalent in these areas.

Antiviral activity

MC and several of its isolated phytochemicals, e.g. alpha and beta-momorcharin, lectin and MAP 30, have been documented to have in vitro antiviral activity against Epstein–Barr, herpes, HIV, coxsackievirus B3 and polio— viruses. Promising anti HIV activity has been attributed to a isolated protein known as MAP 30 (MW, 30 kDa).

Anti-HIV activity

Alpha momorcharin, was found to have a combination of abortifacient, tumor suppressive, and anti-HIV properties (Ng et al., 1992). Anti HIV activity of Map 30, recombinant MAP30, and proteolytic fragments of MAP 30 was exhibited in several in vivo and in vitro studies (Lee-Huang et al., 1990; Lee-Huang et al., 1995a,b; Huang et al., 1999). At the same time MAP 30 is non-toxic to normal non-infected cells, as it does not penetrate healthy cells (Lee-Huang et al., 1990). Antiviral activity of MAP30 was attributed to inhibition of HIV-1 integrase (Lee-Huang et al., 1995b). More importantly in a clinical study, combination of MAP 30 with low doses of dexamethasone and indomethacin improved efficacy of anti-HIV therapy (Bourinbaiar and Lee-Huang, 1995). In 1996, Lee-Huang and workers, inventor of MAP-30, obtained US patent for tumor and HIV treatments. In an in vivo study, the leaf extract of MC demonstrated an ability to increase resistance against viral infections as well as to provide immunostimulant effects in clinical as well as experimental settings (Cunnick et al., 1990). Anti HIV activity of two proteins—alpha- and beta-momorcharin (present in seeds, fruit, and leaves) has been reported in vitro (Zheng et al., 1999; Au et al., 2000) and it was found to be inhibition of HIV-1 integrase (Au et al., 2000). Lectins as well as MRK29 from MC have been shown to act through inhibition of viral reverse transcriptase (Wang and Ng, 2001a; Jiratchariyakul et al., 2001). The salt-precipitated fraction of MRK29 caused 82% reduction of viral core protein p24 expression in HIV-infected cells and an increased in TNF activity (Jiratchariyakul et al., 2001). 3.3.2. Antiherpes activity Two in vitro studies have shown antiherpes activity of MC ribosome-inactivating proteins and MAP30 against HSV-2 and HSV-1 (Foa-Tomasi et al., 1982; Bourinbaiar and Lee-Huang, 1996). This effect is probably mediated through inhibition of protein synthesis (Foa-Tomasi et al., 1982).

Antipoliovirus activity

MC ribosome-inactivating proteins inhibited poliovirus replication by inhibiting protein synthesis1 (Foa-Tomasi et al., 1982). Schreiber et al. (1999) suggested its use against sexually transmitted diseases, as it had no effect on the motility or vitality of spermatozoa.

Anticancer activity

Various preliminary studies (in vitro as well as in vivo) with crude MC extract and its various purified fraction—including MAP 30—have shown anticancer activity against lymphoid leukemia, lymphoma, choriocarcinoma, melanoma, breast cancer, skin tumor, prostatic cancer, squamous carcinoma of tongue and larynx, human bladder carcinomas and Hodgkin's disease (Licastro et al., 1980; Ng et al., 1994; Battelli et al., 1996; Ganguly et al., 2000; Sun et al., 2001; Basch et al., 2003;). However, Kusamran et al. (1998) demonstrated chemopreventive potential of Thailand Momordica charantia but not by the Chinese variety.

Anti‐ diabetic activity

A metabolic condition known as diabetes mellitus is characterised by hyperglycemia brought on by deficiencies in insulin production, action, or both. The traditional treatment momardica charantia has been used for centuries in complementary and alternative medicine to control diabetes.

Anticancer property

The anti-cancer ability of Momordica charantia has been discovered and established over the past few decades through a number of early experiments. According to studies, M. charantia's bioactives may have a role in the control of several cancers, including colon, breast, liver, nasopharyngeal, and cervical cancers. Although several in vitro and in vivo tests have been performed to investigate the activity against carcinoma, comprehensive clinical studies in cancer patients are required to demonstrate the anti-cancer benefits of M. charantia.

Anti-oxidative property

Obesity, diabetes, hypertension, and other illnesses of lifestyle are mostly brought on by oxidative stress. Studies on the effectiveness of Momordica charantia and certain chemicals it contains against oxidative stress are being undertaken, and the majority of them indicate that bitter gourd has the potential to be an antioxidant**.**

Anti-microbial

Due to its anti-microbial properties and established potential as an antibacterial agent, bitter gourd is a traditional remedy for a variety of skin and gastrointestinal conditions. Eschericia coli, Staphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa, Salmonella typhi, and Klebsiella pneumonia were shown to be effectively inhibited by the ethanol extract of M. charantia leaves.

CONCLUSION

The different plant extracts of Momordica charantia shows various pharmacological activities which are reported in various research papers such as anthelmintic, antibacterial, anti-HIV, anticancer, antiviral, antimicrobial, anti-diabetic and antioxidant.

The current review concentrated on the anthelmintic, antioxidant activity, antimicrobial activity of Momordica charantia leaves.

In this review article, we have collected and compiled the details of research information on Momordica charantia, which was summarised in this article.

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