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# A Review on Salient Pharmacological Features of *Momordica charantia*

Aparna Upadhyay, Pooja Agrahari and D.K. Singh
Malacology Laboratory, Department of Zoology, DDU Gorakhpur University, Gorakhpur, 273 009, U.P., India

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Corresponding Author:
D.K. Singh,
Malacology Laboratory,
Department of Zoology,
DDU Gorakhpur University,
Gorakhpur, 273 009, U.P., India
Tel: +91 551 2202187(O)/0509(R)

ABSTRACT
Plant *Momordica charantia* Linn., known as bitter gourd, belongs to family Cucurbitaceae. It is cultivated throughout India, Malaya, China, Tropical Africa and America. Earlier claims showed that its bitter fruits have carminative, aphrodisiac and anthelmintic properties are used in syphilis, rheumatism, troubles of spleen and ophthalmia. It is also useful in piles, leprosy, jaundice and used as a vermifuge. Literature review reveals that the fruit of plant contains moisture (83.2%), proteins (2.9%), fat (1.0%), carbon (9.8%), fibers (1.7%), mineral matters (1.4%), calcium, phosphorus, iron, carotene, thiamine, nicotinic acid, riboflavin, ascorbic acid (88 mg/100 g), copper and potassium. Charantin, β-sitosterol-glucoside, stigmast-5, 25-dien-3 β-O-glucoside, stigmast-7, 25-dien-3 β-ol and stigmast-7, 22, 25-trien-3 β-ol are isolated from the fruit. Many pharmacological properties of *M. charantia* have been reported, including antioxidant, adipogenesis-reducing, antilipolytic, hypoglycemic, antidiabetic, anticancer, antifertility, anthelmintic, antimicrobial, antiviral and hepatoprotective activity. The present review highlights the salient pharmacological uses of *Momordica charantia.*

**Key words:** Charantin, cucurbitacin, diabetes mellitus, *Momordica charantia*, momordicin, pharmacology

## INTRODUCTION

The plant *Momordica charantia* L., Cucurbitaceae, is known variously as bitter gourd, balsam pear, bitter melon, bitter cucumber and African cucumber (Dasgupta *et al*., 2009; Heiser, 1979). Although it has many culinary uses, especially in South, Southeast and East Asia, it is also grown as an ornamental and is used extensively in folk medicine (Heiser, 1979; Sharma *et al*., 2011). The fruits are cooked with other vegetables, stuffed, stir-fried or added in small quantities to beans and soups to provide a slightly bitter flavor. However, for most food preparation, fruits are blanched, parboiled or soaked in salt water before cooking to reduce the bitter taste. In addition to frying or cooking (e.g., for curries), the fruits can be dehydrated, pickled, or canned. Fruits, flowers and young shoots are also used as flavoring agents in various Asian dishes. Young *Momordica* shoots and leaves are also cooked and eaten as leafy vegetables, leaf and fruit extracts are used in the preparation of tea (Reyes *et al*., 1994; Tindall, 1983). Unlike other cucurbitaceous vegetables, the bitter fruit flavor of *M. charantia* is considered desirable for consumption and thus bitter flavor has been selected during domestication (Marr *et al*., 2004). The present review highlights the salient pharmacological uses of *Momordica charantia.*

**Taxonomy:** Kingdom: Plantae, Division: Magnoliophyta Class: Magnoliopsida, Order: Violales, Family: Cucurbitaceae Genus: *Momordica* and Species: *Charantia*

**Origin and distribution:** The original home of the species is not known, other than that it is a native of the tropics. Bitter melon grows in tropical areas, including parts of the Amazon, East Africa, Asia and the Caribbean. It is widely grown in India and other parts of the Indian subcontinent, Southeast Asia, China, Africa and the Caribbean (Warrier *et al*., 1995; Nadkarni, 1993).

**Cultivation:** It is a genus of annual or perennial climbers found throughout India and is cultivated up to an altitude of 1500 m. It is cultivated during warm season i.e., during April

to July by using 2-3 seeds in a pit. The pits are prepared at a distance of half a meter and provided with manures. Only one plant is retained and seedlings are watered once or twice a week. Plants begin to flower in 30-35 days, after sowing and the fruits are ready for harvesting after 15-20 days from flowering.

**Botanical description:** *Momordica charantia* (Bitter melon or Bitter gourd) is a flowering vine in the family Cucurbitaceae.

**Plant:** Annual, slender climber, 2-4 m high, scarcely to densely pubescent (tender parts woody), monoecious.

**Stem:** Round, internodes 5-6 cm, tendrils delicate and 12-15 cm long.

**Leaf:** Deeply and palmately, 5-9 lobed, reniform to orbicular or suborbicular in outline, 2.5-8×4-10 cm, cordate at base, acute or acuminate at apex, lobes ovate or obovate, narrowed at base, margins sinuate to undulate, mucronate, petioles 1.5-5 cm long.

**Flower:** Male flower stalks slender with bract midway or toward base; peduncle 2-5 cm long, bract reniform, 5-11 mm diameter, green, pedicel 2-6 cm long; receptacle-tube cup shape, 2-4 mm long and 2-3 men wide; sepals ovate-elliptic, 4-6×2-3 mm, pale green; petals obovate, 10-20×7-15 mm, mucronate at apex, scales 2; filaments 1.5-2 mm long, inserted in the throat of the receptacle tube: Anthers coherent. Female flower peduncle 1-6 cm long; bract 1-9 mm diameter; pedicel 1-8 cm long: Sepals narrow, oblong lanceolate, 2-5 mm long; petals smaller than or equal to that in male, 7-10 mm long; ovary fusiform, narrowly rostrate, 5-11×2-3 mm, muricate, tuberculate or longitudinally ridged; style 2 rare long.

**Fruit:** Pendulous, stalk 2-8 cm long; fruit discoid, ovoid, ellipsoid to oblong or blocky, often narrowed at ends, sometimes finely rostrate, 3-20×2-5 cm, white or green turning orange on maturity, soft tuberculate with 8-10 broken or continuous ridges, splitting from base in to 3 irregular valves.

**Seed:** The 5-30, squarish rectangular, ends subtridentate, faces compressed, sculptured, 5-9×3-6 rare, margins grooved; testa brown or black.

**Nutritional uses:** Bitter gourd fruits are a good source of carbohydrates, proteins, vitamins and minerals (Table 1) and have the highest nutritive value among cucurbits (Desai and Musmade, 1998; Miniraj *et al*., 1993). The vitamin C content of Chinese bitter gourd varies significantly (440-780 mg $kg^{-1}$ edible portion). Considerable variation in nutrients, including protein, carbohydrates, iron, zinc, calcium, magnesium, phosphorous and ascorbic acid has been observed in bitter gourd (Yuwai *et al*., 1991). Moreover, the crude protein content (11.4-20.9 g $kg^{-1}$) of bitter gourd fruits is higher than that of tomato and cucumber (Xiang *et al*., 2000).

Table 1: Proximate constituents and nutrient composition of bitter gourd (*Momordica charantia* L.) fruits

| Constituents | Quantity |
|---|---|
| Moisture (g/100 g) | 83.20 |
| Carbohydrates (g/100 g) | 10.60 |
| Proteins (g/100 g) | 2.10 |
| Fiber (g/100 g) | 1.70 |
| Calcium (mg/100 g) | 23.00 |
| Phosphorus (mg/100 g) | 38.00 |
| Potassium (mg/100 g) | 171.00 |
| Sodium (mg/100 g) | 2.40 |
| Iron (mg/100 g) | 2.00 |
| Copper (mg/100 g) | 0.19 |
| Manganese (mg/100 g) | 0.08 |
| Zinc (mg/100 g) | 0.46 |
| B carotene | 126.00 |
| Vitamin C | 96.00 |

**Medicinal properties:** Bitter gourd has been used for centuries in the ancient traditional medicine of India, China, Africa and Latin America. Bitter gourd extracts possess antioxidant, antimicrobial, antiviral, antihepatotoxic and antiulcerogenic properties while also having the ability to lower blood glycaemia (Raman and Lau, 1996; Welihinda *et al*., 1986). These medical activities are attributed to an array of biologically active plant chemicals, including triterpenes, pisteins and steroids (Grover and Yadav, 2004). Ethnomedicine reports of *M. charantia* indicate that it is used in folkloric medicine for treatment of diabetes, various ulcers and infections (Beloin *et al*., 2005; Gurbuz *et al*., 2000). While the root decoctions have abortifacient properties, leaf and stem decoctions are used in treatment of dysentery, rheumatism and gout (Subratty *et al*., 2005). In addition, juice of *M. charantia* drawn directly from fruit has traditionally been used for medicinal purposes worldwide. Likewise, the extracted juice from leaf, fruit and even whole plant are routinely used for treatment of wounds, infections, parasites (e.g., worms), measles, hepatitis and fevers (Behera *et al*., 2008).

**Phytochemical constituents:** *M. charantia* primarily consists of glycosides, proteins, sterols, fatty acids and volatile constituents (Haque *et al*., 2011; Lee *et al*., 2009) (Table 2). The fruit and leaves of the plant contain two alkaloids one of them being momordicin. The plant contains a glycoside, a saponin like substance, a resin with an unpleasant taste, an aromatic volatile oil and mucilage. The seeds contain an alkaloid (236°C) and an anthelmintic principle in the germ; they also contain urease (Rivera, 1941). The fruit contains ascorbigen, a bound form of ascorbic acid. Large sized fruits, borne by certain types of *M. charantia*, are richer in ascorbigen than small fruits borne by other cultivated types. The free amino acids present in the fruit are aspartic acid, serine, glutamic acid, threonine, alanine, γ-amino butyric acid and pipecolic acid. The green fruit contains luteolin (flavone, a type of flavonoid). Carotene is the principal pigment of carpels, while lycopene characterizes the red aril (Ganju and Puri, 1959). The fruit pulp has soluble pectin but no free pectic

Table 2: Major phytochemicals in bitter gourd (*Momordica charantia* L.) fruit and their health benefits

| Phytochemicals | Plant parts | Classes and uses | References |
|---|---|---|---|
| β-momorcharin | Seeds | Glycoprotein that acts as midterm abortifacient | Chan *et al*. (1984) |
| Vicine | Seeds | Hypoglycemic glycoalkaloid | Dutta *et al*. (1981) and Handa *et al*. (1990) |
| Charantin | Fruits | Non nitrogenous compound having hypoglycemic activity | Lotlikar and Rao (1962) |
| Momordicosides A and B | Seeds | Triterpene glycosides that inhibit tumor growth | Okabe *et al*. (1980) |
| MAP30 (momordica anti-HIV protein of 30 kDa)-anti-HIV plant protein | Seeds, fruits | Basic protein that inhibits Human Immunodeficiency Virus (HIV) | Lee-Huang *et al*. (1990, 1995) |
| Polypeptide-p | Seeds, fruits | Hypoglycemic peptide, called plant insulin | Khanna and Jain (1981) |
| Phenols | Seeds | Antioxidants that reduce blood pressure and with anticancer and cardioprotective properties | Horax *et al*. (2005) |
| Carotenoids | Seeds, fruits | Antioxidants with anticancer and cardioprotective effects | Rodriguez *et al*. (1976) |

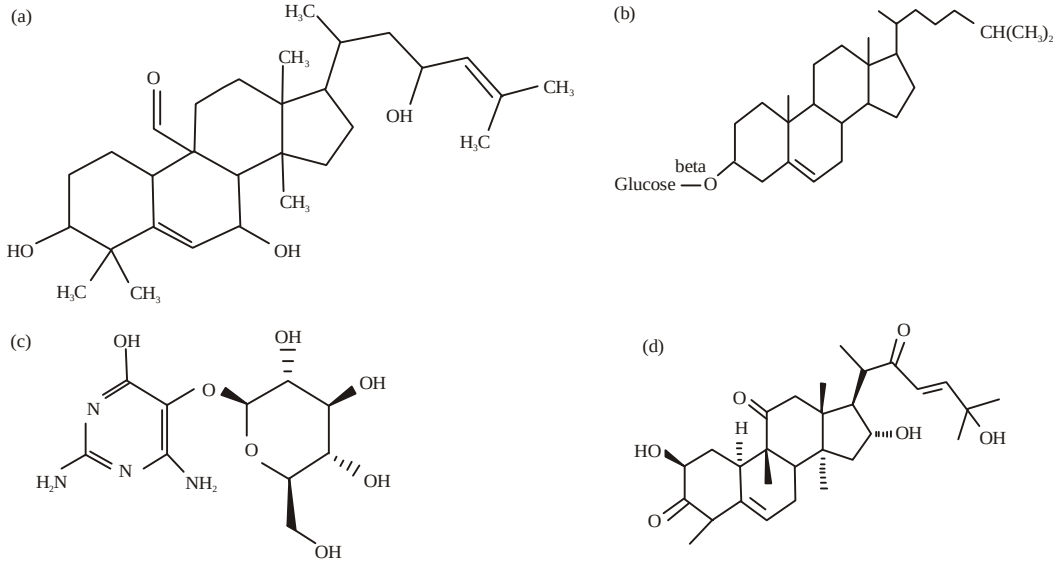


Fig. 1(a-d): Structures of some phytoconstituents isolated from *Momordica charantia*, (a) Momordicin, (b) Charantin, (c) Vicine and (d) Cucurbitacin

acid. Research has found that the leaves are nutritious sources of calcium, magnesium, potassium, phosphorus and iron; both the edible fruit and the leaves are great sources of the Vitamins B. *M. charantia* has a non nitrogenous neutral principle charantin (266°C) and on hydrolysis gives glucose and a sterol (Dhalla *et al*., 1961). The fruit pulp of *M. charantia* has soluble pectin but not having free pectic acid. Galactouronic acid is also obtained from the pulp. *M. charantia* fruits also contain saponins, alkaloids, reducing sugars, resins and phenolic constituents. The presence of an unidentified alkaloid and 5-hydroxytryptamine is also reported. The ether extract residue of the alcoholic concentrate from the leaves of *M. charantia* is reported to reveal hypoglycemic activity comparable to that of tolbutamide (Rastogi and Mehrotra, 1998a; Srivastava *et al*., 1993).

**Terpenoids:** Terpenoids are natural product and derived from five-carbon isoprene units. These are the largest groups of naturally occurring chemicals. This class has been subdivided according to the number of carbon atoms. The triterpenoids are terpenoids with a C30 skeleton. These C30 constituents are isolated and characterized from various sources in nature, particularly in resins and may occur as either esters or glycosides. More extensive backbone rearrangement of the protostane cation affords the curcubitane skeleton. Curcubitacins are typical group of curcubitane type triterpenoids which are found in cucumber family (Cucurbitaceae). They are generally known for their bitterness and toxicity (Lee *et al*., 2009). The cucurbitane triterpenoids I, II and III are isolated from leaves along with the momordicin I and II (Rastogi and Mehrotra, 1998b). A series of cucurbitane type triterpene glycosides called goyaglycosides have been isolated along with momordicosides. The pyrimidine, arabinopyranosides, charantin, vicine and others along with the triterpene momordicin, momordicinin has been reported (Fig. 1). Charantin is cucurbitane type triterpenoid in *M. charantia* and a potential substance which has antidiabetic properties. Charantin is mixture of two compound sitosteryl glucoside and stigmasteryl glucoside.

**Proteins:** The α, β and γ momorcharins with N-glycosidic activity and momordins a and b were identified along with ribosome inactivating proteins and lectins (Rastogi and Mehrotra, 1998c).

**Sterols and fatty acids:** Palmitic acid and oleic acid are major components with trace constituents such as stearic acid, lauric acid, linoleic acid, arachidic acid, myristic acid and capric acids. The β-sitosterol, compesterol, daucosrerol and momordenol were identified in seed oil as the sterols. The four mono methylsterols are also presently known as obtusifoliol, cycloeucalenol, 4-α-methylzymosterol, lophenol and the desmethylsterols spinasterol (Rastogi and Mehrotra, 1998d).

**Volatile constituents:** Voleric acid, aldehydes mainly pentanal, 2 hexenal, 2 heptenal and nonadienal. The 2 butylfusan, menthol, nerolidol, pentadecanol, hexadecanal, mystenol and 3 hexanol are present as volatile constituent in *M. charantia* fruit (Williamson, 2002).

**Pharmacological actions**

**Hypoglycaemic activity:** Bitter gourd extracts traditionally used as vegetable insulin possess hypoglycemic, antioxidative and antidiabetic activities (Birdee and Yeh, 2010; Fang and Ng, 2011) that are useful in the treatment of diabetes (Baynes, 1995). The hypoglycemic effects of extracts have been well documented in animal (Ahmed *et al*., 1998, 2001; Grover *et al*., 2002; Leung *et al*., 2009; Ooi *et al*., 2010; Rathi *et al*., 2002; Raza *et al*., 2000) and human (Srivastava *et al*., 1993; Welihinda *et al*., 1986) experiments. The beneficial hypoglycemic properties in fruit pulp, seed and whole plant extracts have also been documented in rat (Jayasooriya *et al*., 2000; Ojewole *et al*., 2005) and the medicinal attributes of such extracts have received broad review (Basch *et al*., 2003; Krawinkel and Keding, 2006; Subratty *et al*., 2005). One study cites that there was a significant increase in the number of cells in the pancreas of streptozotocin-induced diabetic rats after 8 weeks of bitter gourd fruit juice treatment (Ahmed *et al*., 1998). *M. charantia* has tremendous beneficial values in the treatment of diabetes mellitus (Garau *et al*., 2003; Nahas and Moher, 2009). The hypoglycemic effect of these chemicals is more pronounced in fruit, where they are present in higher abundance. These hypoglycemic compounds either regulate insulin release directly or alter glucose metabolism and its insulin-like effect. Abdollahi *et al*. (2011) reported that *M. charantia* fruit aqueous extract might have a significant role in alleviating kidney damage in the streptozotocin-induced diabetic rats. Bitter melon effectively ameliorates the fructose diet-induced hyperglycemia, hyperleptinemia, hyperinsulinemia and hypertriglyceridemia as well as decreases the levels of Free Fatty Acid (FFA) (Shih *et al*., 2009).

**Antioxidant activity:** The antioxidant properties of carotenoids that protect plants during photosynthesis may also protect humans from carcinogens and mitigate free radical effects associated with heart disease. 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. For instance, bitter gourd fruit contains as many as 14 carotenoids depending on stage of maturity, where cryptoxanthin becomes the principal chloroplast and chromoplast pigment found in ripe fruit (Rodriguez *et al*., 1976). Other carotenoids, such as β-carotene, zeaxanthin, lycopene (at ripe stage) and lutein are also prevalent in the fruits, where they could serve as a model for studying carotenogenesis during ripening (Rodriguez *et al*., 1976). The plant phenolic compounds are potentially excellent natural sources of food antioxidants, given their abilities to reduce total cholesterol/triglycerides (Ahmed *et al*., 2001; Jayasooriya *et al*., 2000), blood pressure and the incidence of cancer and cardiovascular diseases (Gorinstein *et al*., 2002; Hannum, 2004). Semiz and Sen (2007) reported that *M. charantia* fruit extract possesses anti-oxidant effects besides having chemoprotective activities in rats.

**Antifertility effects:** Excessive consumption of the fruit and leaves of bitter gourd can reduce sperm production (Prakash and Mathur, 1976). Bitter gourd ethanol seed extracts have also shown to have potent male antifertility effects (Basch *et al*., 2003) when administered to dogs (Dixit *et al*., 1978) and guinea pigs (Udoh *et al*., 2001).

**Antiviral activity:** In recent years, a number of chemical component that possess medicinal attributes have been isolated from bitter gourd, such as c-momorcharin which inactivates ribosome function (Feng *et al*., 1990; Leung *et al*., 1997) and stimulates MAP30 (*Momordica* anti-HIV protein) production which in turn, simultaneously suppresses HIV (human immunodeficiency virus) activity (Lee-Huang *et al*., 1990, 1995). Interestingly, momordicoside A and B present in bitter gourd inhibit tumor growth (Okabe *et al*., 1980) and several bitter gourd phytochemicals have *in vitro* antiviral activity against viruses including Epstein-Barr, herpes and HIV viruses (Lee-Huang *et al*., 1990; Nerurkar *et al*., 2006).

**Antimicrobial activity:** The leaf extracts of bitter gourd possess antimicrobial activity principally against *Escherichia coli*, *Staphylococcus*, *Pseudomonas*, *Salmonella*, *Streptobacillus* and *Streptococcus* (Leelaprakash *et al*., 2011; Omoregbe *et al*., 1996). Moreover, whole plant extracts have shown antiprotozoal activity against *Entamoeba histolytica.* Generally, fresh fruit extracts have exhibited similar antibacterial properties against all bacterial strains tested, specially *Escherichia coli* (Costa *et al*., 2011); fruit extracts of *M. charantia* have demonstrated activity against tuberculosis and the stomach ulcer causing bacteria *Helicobacter pylori* (Omoregbe *et al*., 1996; Yesilada *et al*., 1999). Application of bitter gourd fruit powder to wound sites is similarly effective in stimulating tissue regeneration and wound healing in rats (Prasad *et al*., 2006). Aqueous extracts of seeds of *M. charantia* exhibited higher antibacterial activity as compared to its petroleum ether, methanolic and ethanolic extracts towards *Staphylococcus aureus* (Roopashree *et al*., 2008). Mahmood *et al.* (2012) investigated the antimicrobial

activity of *M. charantia* seed extracts against mammalian and poultry pathogens. The aqueous seed extract showed the highest antimicrobial activity against *Pasteurella multocida* while ethanol, n-hexane and petroleum ether extracts were effective against *Staphylococcus aureus.*

**Antifeedant activity:** Ling *et al*. (2008) reported that ethanolic extracts of *M. charantia* leaves show antifeedant activity against the diamondback moth, *Plutella xylostella* larvae. The results showed that momordicin I and momordicin II had significant antifeedant activity on the larvae of *Plutella xylostella* and momordicin II was more active than momordicin I. In addition, momordicin I and momordicin II had significant inhibitive effect on the rate of weight gain and survival of *Pluella xylostella larvae.* Yasui (2002) demonstrated that methanolic extract of *M. charantia* leaves inhibited feeding of two armyworm larvae, *Spodoptera litura* and *Pseudaletia seperata*. Momordicin II, a triterpene monoglucoside was identified as an antifeedant compound.

**Anti-cancer activity:** The anti-tumor activity of bitter melon has recently begun to emerge (Fang and Ng, 2012). Bitter Melon Extract (BME) modulates signal transduction pathways for inhibition of breast cancer cell growth and can be used as a dietary supplement for prevention of breast cancer (Ray *et al*., 2010). Nerurkar and Ray (2010) reviewed the recent advancements in cancer chemopreventive and anti-cancer efficacy of bitter melon and its active constituents. Asiamah *et al*. (2011) investigated the chemopreventive properties of bitter melon on azoxymethane (AOM)-induced Aberrant Crypt Foci (ACF) in Fisher 344 male rats and determined its effects on selected hepatic detoxification and antioxidant enzymes. Gunasekar (2011) reported in his doctoral thesis that *M. charantia* can be used frequently as an anti-cancer agent. The green leaves, fruits, seeds and stems of *M. charantia* are composed of many different proteins and steroids that are chemically active. These proteins are α and β momorcharins which possess anti-cancer and anti-HIV properties similar to crude water and methanol soluble extracts of *M. charantia*.

**Analgesic and anti-inflammatory activity:** Ullah *et al*. (2012) evaluated that *M. charantia* fruit extract exhibits analgesic and anti-inflammatory activities. Acetic acid induced writhing test and tail immersion test in mice were used to study the analgesic effect, while the effect of extract on acute inflammation was investigated by carrageenan-induced paw edema in rats. The oral administration of *M. charantia* extract up to 2 g $kg^{-1}$ in mice was found to be safe. The extract significantly inhibited acetic acid induced writhing and tail immersion test induced pain at dose 500 mg $kg^{-1}$. The ethanolic extract showed 42.10% anti-inflammatory effect at dose 500 mg $kg^{-1}$.

**Antipyretic effect:** The ethanolic extracts (500 mg $kg^{-1}$) of *M. charantia* fruit showed antipyretic effect in a study which was carried out using yeast-induced pyrexia in rats. The antipyretic activity of *M. charantia* may be due to the individual or combined action of bioactive constituents present in it (Patel *et al*., 2010).

**Adipocyte inhibition:** Bitter melon can suppress the visceral fat accumulation and inhibit adipocyte hypertrophy which may be associated with markedly down regulated expressions of lipogenic genes in the adipose tissue of rats fed a high fat diet. Bitter melon appears to have multiple influences on glucose and lipid metabolism that strongly counteract the untoward effects of a high fat diet (Huang *et al*., 2008; Nerurkar *et al*., 2010).

**Neuroprotective effect:** *M. charantia* possess neuroprotective effects on High-Fat Diet (HFD)-associated blood brain barrier disruption, stress and neuroinflammatory cytokines (Nerurkar *et al*., 2011). Malik *et al*. (2011) showed that cerebral oxidative stress and damage and neurological deficits were dose dependently attenuated by pre-treatment with the lyophilized *M. charantia* juice (200-800 mg $kg^{-1}$).

**Trypanocidal activity:** The effective concentration of ethanolic extract of *M. charantia* leaves, capable of killing 50% of *Trypanosoma cruzi* parasites ($IC_{50}$) was 46.06 μg $mL^{-1}$. The Minimum Inhibitory Concentration (MIC) was ≤1024 μg $mL^{-1}$. Metronidazole showed a potentiation of its antifungal effect when combined with an extract of *M. charantia* (Santos *et al*., 2012).

**Metabolic syndrome improvement:** Tsai *et al*. (2012) first reported that Wild Bitter Gourd (WBG) improves metabolic syndrome (MetS) in human (Taiwanese adults). The waist circumference was also significantly decreased after the supplementation ($p<0.05$). This finding provides a firm base for further randomized controlled trials to evaluate the efficacy of WBG supplementation.

**Antimalarial activity:** *M. charantia* has some antimalarial activities, though further studies are required to ascertain the same. A study showed moderate *in vivo* activity of *M. charantia* extract against rodent malaria *Plasmodium vinckei petteri* and an excellent anitimalarial activity *in vitro* on *Plasmodium falciparum* (Munoz *et al*., 2000).

**Immunomodulatory activity:** Studies conducted to explore the immunomodulatory activity of *M. charantia* showed that it has a variable effect on the immune system in some conditions, like allograft rejection, where it was shown to have immunosuppressive effect and in some other cases immunostimulant. The immunomodulatory activity has been attributed to increase in interferon production and natural killer cell activity (Cunnick *et al*., 1990).

**Antipsoriasis activity:** In many countries, *M. charantia* has been used in the treatment of psoriasis in the traditional

medicine. It has also shown to have guanylate cyclase inhibiting property (Vesely *et al*., 1977).

**Hypocholesterolemic activity:** Experiments carried out in normal as well diabetic animals have shown hypo-cholesterolemic effects by *M. charantia*. In a study, sunflower fed rats were fed with conjugated octadecatrienoic fatty acid isolated from *M. charantia* seeds for 4 weeks. After 4 weeks, these rats showed significant lowering of the plasma lipid peroxidation and erythrocyte membrane lipid peroxidation as well as nonenzymatic liver tissue lipid peroxidation (Dhar *et al*., 1999).

**Wound healing activity:** Researchers found that *M. charantia* fruit powder, in the form of an ointment (10% w/w dried powder in simple ointment base), showed a statically significant response, in terms of wound contracting ability, wound closure time, period of epithelization, tensile strength of the wound and regeneration of tissues at wound site when compared with the control group and these results were comparable to those of a reference drug povidone iodine ointment in an excision, incision and dead space wound model in rats (Sankaranarayanan and Jolly, 1993).

**Larvicidal activity:** *M. charantia* has shown good larvicidal activity against three breeding mosquito's species: *Anopheles stephensi*, *Culex quinquefasciatus* and *Aedes aegypti* (Singh *et al*., 2006).

## CONCLUSION

Bitter gourd (*M. charantia*) is both a nutritious and healthy food with a distinctive bitter flavor and it is also widely exploited in folklore medicine. During the last few decades numerous studies have been carried on *M. charantia* to explore its pharmacological activities. Today, some of the herbal formulations containing *M. charantia* fruit and seed extracts are being marketed. Role of *M. charantia* in diabetes control is of great importance. It showed promising results in managing secondary complications of diabetes too. In many of the developing countries and in traditional medicine, *M. charantia* has been documented for its antiviral, antipsoriasis, anthelmintics, antiulcer and antibacterial activities. Further studies are required to screen its anticancer and anti-HIV potentials. Few studies also emphasized its abortifacient and antifertility activities which need to be cautioned, especially for pregnant women. This review will be helpful for further phytochemical and pharmacodynamic investigations to find the active constituents responsible for the known activities, as well as to explore some new and promising therapeutic efficacy of this wonderful plant.

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