MOMORDICA CHARANTIA LINN.: A MINI REVIEW

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ABSTRACT

Momordica charantia Linn. is herbal drug that has been mentioned in many medicinal literature. This article discuss about the medicinal values of *Momordica charantia Linn.* In this communication, we reviewed the Phytochemistry and its applications in the treatment of various ailments like diabetes mellitus, cancer, obesity, Researchers also reported about its teratogenic activity, antigenotoxic, viral, anti inflammatory, anti depressant, anxiolytic, wound healing activity anti feedent activity. The major constituent of the plant are Terpenoids, Proteins, Sterols and Fatty acids, Volatile constituents are identified and isolated active chemical moieties from this plant are α, β and γ momorcharins , momordins a and b momordicin, momordicinin, charantin. This review discusses the investigation by various workers related to chemical constituents, pharmacological action and toxicological studies of this plant since years till date.

Keywords: *Momordica charantia* Linn.; Diabetes mellitus; Terpenoids; Charantin

1. INTRODUCTION

The plant *Momordica charantia* Linn (family- Cucurbitaceae) is also known as bitter gourds, karela, bitter melon and balsam pear. These species include *M. angustisepala, M. balsamina* (Linn), *M. cochinchinensis* (Spreng), *M. cabrei, M. dioica* (Roxb), *M. elaterium, M. foetida, M. grosveroni, M. tuberosa or cymbalaria* [1]. It is a tropical vegetables is a common food in India. Other vernacular names of *Momordica charantia* have been listed later under the heading of vernacular name [2-3].

A monoecious climber or scrambling harbaceous vine found throughout India in the family curcubitaceae. Stem slender, more or less pubescent, leaves suborbicular, alternate, the blade with 5-7 deep palmate lobes and quite variable in their size [4].

Fruits are 5.0-25.0c.m.long, ovoid, ellipsoid or spindle shaped usually ridged or warty, dehiscent irregularly as a 3 valved fleshy capsule or indehiscent. Flower monoecious, unisexual, tubular 5 lobed, moderate sized, pale yellow to orangish in colour. Male flower solitary and female flowers bracteate at the base with a fusiform and muricate ovary[5] as shown in figure 1.

Fig. 1 *Momordica Charantia Linn.* Fruit

Seeds are brownish 13.0-16.0 mm long. The plant is cultivated throughout India and widely grown as a vegetable crop all over the tropical countries especially in India, china, Africa and various part of Africa at an altitude of 1500 m. [2].

The fruit of the plant is reported to posses tonic, stomachic, antibilious, stimulant, emetic, laxative, fruit pulp, leaf juice, and seed are showed anthelmintic activity (in lumbrici) [6]. The fruits and leaves are useful in piles, jaundice, diabetes, leprosy, snake bite and it is found to have vermifuge and antioxidant property. Fruit is also useful in gout, rheumatism and sub acute cases of spleen and liver [7].

The general description and analytical parameters of plant *M. charantia* has been summarized below. [8-9]

1.1. Vernacular names[4, 9]**-**
Sanskrit - Sushavi, Karavella
English - Bitter gourd, Balsam pear, Balsam apple.
Hindi - Karela, Kardi
Bengali - Karela, Uchchhe, Kerula
Tamil - Pakal, Pavaka,Chedi,Paharkai
Kannada- Hagal
Malayalam-Kaipp, Kaippavlli, Paval
Guajarati -Karela
Bombay -Kurela, Jangro
Telgu -Koekara, Kaaya
Arab -Quisaul – barri
Urdu -Karela
Oria -Kalara, Salara
Assam -Kakiral, Kakral

1.2 General description-

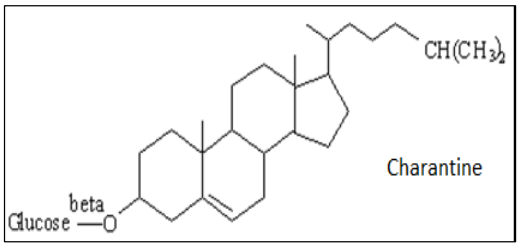
1.2.1. Habitat - Common in coastal thickets, along creeks & streams and liwland food margins also occasionally cultivated.
1.2.2. Parts used - fruits, leaves, seeds.
1.2.3. Leaves - Alternate, petiolate, the blade with 5-7 deep palmate lobes and quite variable in size.
1.2.4. Flowers – Flower are unisexual, tabular, 5-lobed moderate sized, pole yellow to orangish.
1.2.5. Fruits – Fruits a pepo with black seeds embedded in a reddish pulp.
1.2.6. Propagation – By seeds and vegetative method[9].

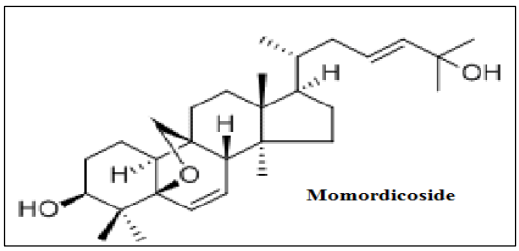
1.3. Analytical parameters –
1.3.1 Foreign matters-Nil
1.3.2. Total ash - Not more than – 8.5%
1.3.3. Acid Insoluble ash - Not more than – 0.6%
1.3.4. Alcohol soluble extractive value- Not less than – 6%
1.3.5. Water soluble extractive value- Not less than – 28%

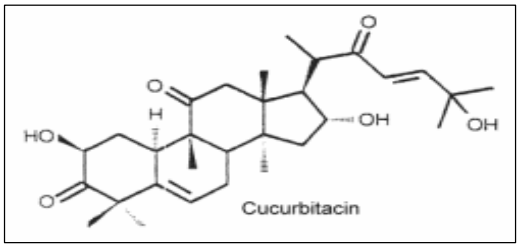
1.4. Properties and Action –
Rasa -Tikt, katu
Guna -Laghu
Virya -Usna
Vipaka -Katu
Karma -Vatahara, Kaphaharr, Raktadosahara, Dipana, Hrdya, Bhedi

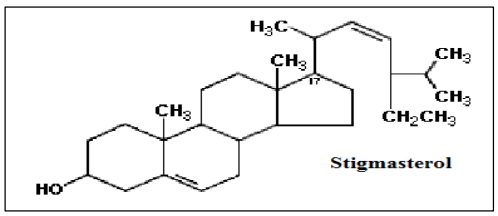
2. Phytochemistry: *M. charantia* primarily consists of glycosides, Proteins, Sterols and fatty acids and volatile constituents [10]. The fruit and leaves of the plant contain two alkaloids one of them being momordicine. The plant contains a glycoside, a soponin like substance a resin with an unpleasant taste, an aromatic volatile oil and mucilage. The seeds contain an alkaloid (m.p. 236) and an anthelmintic principle in the germ; they also contain urease [11]. The fruit contains ascorbigen a bound from ascorbic acid [12]. The free amino acids present in the fruit are aspartic acid, serine, glutamic acid, threonine, alanine, g-amino butyric acid and pipecolic acid. The green fruit contains luteolin, Carotene is the principal pigments of carpels [13-14]. The fruit pulp has soluble pectin but no free pectic 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 Vitamin B [15].
Momordica charantia Linn**.** has a non-nitrogenous neutral principle charantin, and on hydrolysis gives glucose and a sterol. Charantin having 266^{o} melting point[16]. The fruit pulp of *Momordica charantia* has soluble pectin but not having free pectic acid. Galactouronic acid is also obtained from the pulp. *Momordica charantia* Linn. fruits also contain saponins, alkaloids, reducing sugars, resins and phenolic constituents. The presence of an unidentified alkaloid and 5-hydroxytryotamine is also reported. The ether extract residue of the alcoholic concentrate from the leaves of *Momordica charantia* is reported to reveal hypoglycemic activity comparable to that of tolbutamide [17-18].

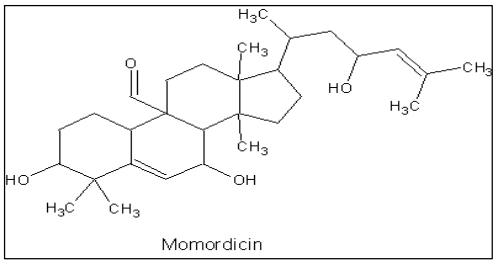
2.1. Terpenoids : Terpenoids are natural product and derived from five – carbon isoprene units. Terpenoids are having c-30 skeleton more extensive backbone rearrangement of the protostane cation affords the curcubitane skeleton. Curcubitacins are typical group of curcubitane type triterpenoids which are found in cucumber family (cucurbitaceae).They are generally known for their bitterness and toxicity [10]. There cucurbitane triterpenoids I, II and III isolated from leaves along with the momordicine I and II [19]. A series of cucurbitane type- triterpene glycosides called Goyaglycosides have been isolated along with momordicosides. The pyrimidine, arabinopyanosides, charine, vicine and others along with the triterpene momordicin, momordicinin reported. Charantin is cucurbitane type triterenoids in *M. charantia* and potential substanes which have antidiabetic properties. Charantin is mix of two compound sitosteryl glucoside and stigmasteryl gluciside [20].

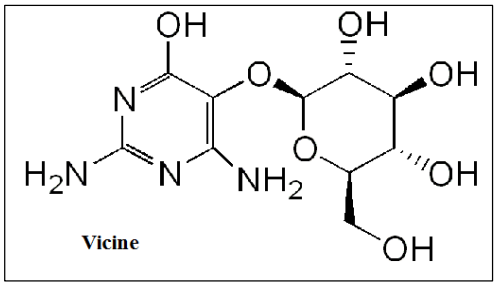












2.2. Proteins: α, β and γ momorcharins with N – glycosides activity and momordins a and b were identified along with ribosome – inactivating proteins and lectins [21].

2.3. Sterols and fatty acids: Mainly palmitic acid and oleic acid are major components with trace constitued such as steric acid, lauric acid, linoleic acid, arachidic acid, myristic acid and capric acids. β – sitosterol, compesterol , daucosrerol and momordenol identified in seed oil as the sterol. The four mono methylsterols are also present known as obtusifoliol, cycloeucalenol, 4 – α – methylzymosterol, lophenol and the desmethylsterols spinasterol [22].

2.4. Volatile constituents –

Voleris acid, aldehydes mainly pentanal, 2 hexenal, 2 heptenal and nonadienal. 2 butylfusan, menthol, nerolidol, pentadecanol , hexadecanal , mystenol , 3 hexanol are present as volatile constituent in *Momordica charantia* Linn. Fruit. [5]

3. T.L.C. profile –

T.L.C. of alcoholic extract of the drug on silica gel G paste using chloroform methanol (90:10) shows under U.V. (366nm) four fluorescent zones at Rf. 0.23(red), 0.61(light sky blue), 0.96(sky blue), and 0.98(red and sky blue). On exposure to Iodine vapour four spots show at Rf 0.17, 0.46, 0.67 and 0.98 (all yellow). On spraying with 5% methanolic phosphomolybaic acid reagent nine spots show at Rf. 0.03, 0.16, 0.34, 0.43, 0.50, 0.60, 0.75, 0.81 and 0.98 (all blue) [9].

4. Pharmacological Studies –

From literature survey it was found that the whole plant leaves and mainly fruits of the plant *M. Charantia* Linn. is used in the treatment of various diseases.

4.1. Antidiabetic activity: Leung *et al.* (2009) elucidated the *M. charantia* is choice of fruit used for the complementary and alternative medicine [23]. Srivastava *et al.* (1993) reported that water extract of *M. charantia* was tested on alloxan induced diabetic rats experimentally a fall of blood sugar level after 3 weeks treatment [18]. Abdollahi *et al.* (2010) reported further that the aqueous extract of *Momordica charantia* fruit tested on the streptozocin induced diabetes mellitus type II rats. The results showed that a reduction of blood glucose and increment in insulin level [24]. Raman *et al.* (1996) studied that the oral administration of fresh Fruit juice (dose 6 c.c. /kg. body wt.) lowered the blood sugar level in normal and alloxan-diabetic rabbits. Oral administration of alcoholic extracts of the plant to some diabetic patients did not produce any hypoglycaemic action. Karela preparations have been shown to significantly improve glucose tolerance without increasing blood insulin levels and to improve fasting blood glucose levels. Blood and urine sugar levels and postprandial (after eating) blood glucose levels also fell [25]. Garau *et al.* (2003) studied that the effects in diabetes mellitus treatment with *M. charantia* fruit juice reduced blood glucose levels, improved body weight and glucose tolerance. *M. charantia* fruit juice can also inhibit glucose uptake by the gut and stimulate glucose uptake by skeletal muscle cells [26]. Saxena *et al.* (2004) reported that *Momordica charantia* is beneficial for treating type II diabetes. Mechanisms such as the stimulating or regenerating effect on beta cells or extrapancreatic effects are proposed for the hypoglycaemic action of these herbs [27]. Huang *et al.* (2007) reported that the different fractions of extract have cell repairing activity and its ability of stimulating insulin secretion [28]. Singh *et al.* (2008) studied that the anti diabetic properties of alcoholic extract of *Momordica charantia* showed blood sugar never fell below normal values even with a high dose in pancreatic islets, beta cells showed definite improvement [29]. Mishra *et al.* (2009) reported that the inhibition on the postprandial rise in hyperglycaemia in normoglycaemic rats by the *M. Charantia* powder [30]. Leung *et al.* (2009) reported further that the pre-clinical studies have documented the anti-diabetic and hypoglycaemic effects of *M. charantia* through various mechanisms [31]. Miura *et al.* (2009) studied that the water extract of the fruits of *M. Charantia* produced a hypoglycaemic effect [32].

4.2. Anti cancer activity: Semiz *et al.* (2007) elucidated the aqueous extract killed human leukaemia lymphocytes in dose-dependent manner. Bitter Melon and Bitter Melon Extracts inhibit cancer and tumor. An inhibitory action on both viral and host cell RNA and protein synthesis. One clinical trial found very limited evidence that bitter melon might improve immune cell function in people with cancer, but this needs to be verified and amplified in other research. Cytotoxic activity are a group of ribosome-inactivating proteins named alpha- and beta-momorcharins, momordins, and cucurbitacin B. Experimental studies reported that, water extract blocked the growth of rat prostate carcinoma and hot water extract of the entire plant inhibited

the development of mammary tumors in mice [33].

4.3. Antiobesity activity: Kumar *et al.* (2010) reported that the *Momordica charantia* increase the activity of adenosine 5 monophosphate kinase (AMPK), an enzyme that facilitates cellular glucose uptake and fatty acid oxidation. Compounds in bitter melon improve lipid profiles. They reduce liver secretion of apolipoprotein B (Apo B) - the primary lipoprotein of low-density "bad" cholesterol reduce apolipoprotein C- III expression, the protein found in very-low density cholesterol which turns into LDL/Bad Cholesterol and increases the expression of apolipoprotein A-1 (ApoA1) the major protein component of high density "good" cholesterol [3].

4.4. Anxiolytic activity: Ganesan *et al.* (2008) studied that the oral Administration of 5 ml kg-1 of propylene glycol (vehicle control) Methanol extract of dried leaves of *Momordica charantia* Linn (Cucurbitaceae) was investigated for anxiolytic activities in animal models. Anxiolytic activity of methanol extract of dried leaves of *Momordica charantia* Linn was tested by elevated plus maze test. The results showed a significant anxiolytic effect comparable, with diazepam in all the tested doses [7].

4.5. Antidepressant activity : Ganesan *et al.* (2008) elucidated the propylene glycol as vehicle control (5 ml kg-1); 100, 200 and 300 mg kg-1 of methanol extract of *M. charantia* Linn leaves were administered orally to the groups I to IV respectively and 5 mg kg-1 of imipramine (drug control) was administered intraperitonealy. The extract treatment showed antidepressant effect by decreasing mobility time of subjected rats to forced swimming dose of 300 mg/kg extract, the swimming behaviour of the animals was comparable to the standard drug imipramine [7].

4.6. Anti inflammatory activity : Ganesan *et al.* (2008) reported further that the anti-inflammatory activity was studied by Carrageenin-induced edema in rats and 60 % oedema inhibitions was observed with 300 mg/kg methanol extract of dried leaves of *Momordica charantia* Linn, which was nearly equivalent to that of 10 mg/kg of indomethacin**.** The anti-inflammatory effect was significant (p<0.001) in the dose of 100, 200 and 300 mg kg-1 of methanol extract when compared to the control Group [7].

4.7. Anti viral activity: Puri *et al.* (2009) studied that in vitro antiviral activity against numerous viruses including Epstein-Barr, herpes, and HIV viruses. An in vivo study a leaf extract have the ability to increase resistance to viral infections as well as to provide an immunostimulant effect in humans and animals (increasing interferon production and natural killer cell activity). Anti-viral activities of ribosome inactivating proteins from *M. charantia* an interesting paradigm emerges which may safely be used in treating viral diseases. It has been reported that ribosome inactivating proteins are member of the single chain ribosome inactivating protein (SCRIP) family which act irreversibly on ribosome by removing adenine residue from eukaryotic ribosomal RNA. Various activities of ribosome inactivating proteins include anti-tumor, broad anti-viral, ribonuclease and deoxyribonuclease. MAP30 (Momordica Anti-HIV Protein), α- and β-momorcharins inhibit HIV replication in acutely and chronically infected cells and thus are considered potential therapeutic agent in HIV infection and AIDS [34].

4.8. Mosquito larvicidal activity : Singh *et al.* (2006) studied that the *Momordica charantia* was shown good larvicidal activity. The mosquito larvicidal property of *Momordica charantia* against three mosquito species— anopheles stephensi, Culex quinquefasciatus and Aedes aegypti (Diptera: Culicidae) [35].

4.9. Antifeedent and antioviposition activity : Lee *et al.* (2009) reported that the methanol extract of bitter melon leaves exhibited strong oviposition deterrent

activity against *Liriomyza trifolii* females on the host plant leaf when it was dipped in the methanol extract at a concentration of 1 gm of fresh leaf equivalent/ml [10].

4.10. Teratogenic activity: Nwachi *et al.* (2010) reported that the safety of its use during pregnancy has not been fully investigated. The water extract of the unripe fruit was given to pregnant Sprague Dawley rats on days 7, 8, 9, 10, 11, 12, 13 and 14 of gestation. The litter size was determined for each group and the litters were examined for gross malformations. The gross and histological examinations of various organs of the litters were also carried out. Results show that 8.65% of the litters from experimental animals were malformed as against 1.62% of control. It also showed that 31.2% of all the malformed litters had multiple congenital malformations. It also showed that the experimental rats had nine resorption sites while control had none. This demonstrates that the water extract of *Momordica charantia* is teratogenic in Sprague Dawley rats and should be used with caution in man [36].

4.11. Anti fertility activity : Kumar *et al.* (2010) elucidated that the ethanol and water extracts of the fruit and leaf (ingested orally) to be safe during pregnancy However the seeds have demonstrated the ability to induce abortions in rats and mice and the root has been documented with a uterine stimulant effect in animals. The fruit and leaf of bitter melon has demonstrated an in vivo antifertility effect in female animals in male animals it was reported to affect the production of sperm negatively. The momorcharins are effective in inducing early and mid term abortions, but have teratogenic effects [3].

4.12. Anti-genotoxic activity : Paul *et al.* (2010) studied that the *Momordica charantia* decrease the genotoxic activity of methylnitrosamine, methanesulfonate and tetracycline, as shown by the decrease in chromosome breakage [37].

4.13. Wound healing activity: Sharma *et al.* (2009) reported that *Momordica charantia Linn*. fruit powder, in the form of an ointment (10% w/w dried powder in simple ointment base) showed a statically significant response ($P < 0.01$) in terms of wound contracting ability, wound closure time, period of epithelisation, 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 reference drug povidone iodine ointment in an excision, incision and dead space wound model in rats [38].

5. Toxicological studies: Panda *et al.* (2000) elucidated the alcoholic extract of *Momordica charantia* fruits was found to enhance T3, T4 was reduced. Since two higher doses inhibited thyroid hormone concentrations and increased hepatic lipid peroxidation so Panda et al. suggest that *M. Charantia* fruit extract, when used in excess may prove to be harmful with respect to thyroid function and lipid peroxidation [39]. Abalaka *et al.* (2009) reported that the administration of *Momordica charantia* extract up to 800mg/kg-1 body weight is safe (P>5mg/kg) and tolerated by the body. *Momordica charantia* is therefore safe to use as Ethnochemotherapeutic agent [40]. Krawinkel *et al.* (2006) reported that the plant contains substances with antidiabetic properties such as charantin, vicine, and polypeptide-p as well as other unspecific bioactive components such as antioxidants. Metabolic and hypoglycaemic effects of bitter gourd extracts have been demonstrated in cell culture, animal, and human studies [41]. Sumant *et al.* (2010) reported that there was a significantly decreased the formation of micronucle, inhibited the formation of chromosomal aberrations and increased the mitotic index. Hence, Momordica charantia has significant antimutagenic activity [42]. Basch *et al.* (2003) reported that the Bitter melon may have hypoglycaemic effects but data are not sufficient to recommend its use in

the absence of careful supervision and monitoring [43].

CONCLUSION

We concluded that *Momordica charantia* Linn. is a potential herb in the world. *M. charantia* is a useful medicinal and vegetable plant for human health and one of the most promising plants for diabetes. Further studies are required to find many more activities of this plant.

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