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REVIEW ARTICLE

An Update Review on the Anthelmintic Activity of Bitter Gourd, *Momordica charantia*

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ABSTRACT

Momordica charantia (Family: *Cucurbitales*), as known as bitter melon or gourd, is a daily consumption as food and traditional medicinal plant in Southeast Asia and Indo-China. It has been shown to possess anticancer, antidepressant, antidiabetic, anti-inflammatory, antimicrobial, antiobesity, antioxidant, and antiulcer properties. Its common phytochemical components include alkaloids, charantin, flavonoids, glycosides, phenolics, tannins, and terpenoids. This plant is rich in various saponins including momordicin, momordin, momordicoside, karavilagenin, karaviloside, and kuguacin, all of which have been reported to contribute to its remedial properties including antibacterial, antifungal, antiviral, and antiparasitic infections. Based on established literature on the anthelmintic activity of *M. charantia* and possible mode of action, this review article has attempted to compile *M. charantia* could be further explored for the development of potential anthelmintic drug.

Key words: Helminth, infection, *Momordica charantia*, plant, traditional medicine, worm

ANTHELMINTIC PLANTS

Helminthic infection is one of the health problems that affect human and livestock in the world. The helminths which infect the gastrointestinal system are cestodes, nematodes, and trematodes. The synthetic drugs available have been shown to have side effects; moreover, resistance of the parasites to existing drugs is increasing.[1] Because of limited availability and affordability of modern medicines, most of the world's population depends to a greater extent on traditional medical remedies.[2,3] Helminthic infection could be prevented by maintaining environment sanitary and treatment as well as pharmacotherapy using synthetic drugs or traditional medicine as alternative; one of them is *Momordica charantia*. The present review explores scientific evidence to provide updated information about the properties of *M. charantia*, one of the anthelmintic plants, which is being investigated for its mechanism.

TAXONOMICAL CLASSIFICATION

The taxonomy of *M. charantia* is in the Kingdom: *Plantae*; Subkingdom: *Viridiplantae*; Infrakingdom: *Streptophyta*; Superdivision: *Embryophyta*; Division: *Tracheophyta*; Subdivision: *Spermatophytina*; Class: *Magnoliopsida*; Superorder: *Rosanae*; Order: *Cucurbitales*; Family: *Cucurbitaceae*; Genus: *Momordica*; Species: *M. charantia*.[4] The plant genus *Momordica* is a small shrub or perennial climber belonging to the family *Cucurbitaceae*, which comprised almost sixty species distributed across tropical and subtropical regions.[5,6]

NOMENCLATURE

M. charantia is a native of the tropics areas including East Africa, South America, Asia, the Caribbean, India, and Southeast Asia.[7] The genus "*Momordica*" from Latin "*Mordeo*" means to bite and the species "*charantia*" from Greek means beautiful flower.[8] The vernacular names of *M. charantia* include bitter melon, bitter gourd, balsam pear, or African cucumber (English); kyethinkhathee (Burmese); lai pu tao, ku gua (Chinese); balsamagurk (Danish); margose, momordique amere (French); balsambirne (German); karela, tita kerala (Hindi); paria, pare (Indonesian); pomo meraviglia (Italian); niga uri, tsuru reishi (Japanese); mreah (Khmer); kaypa (Malayalam); karli (Marathi); karelaa (Nepalese); karavelli (Sanskrit); karavila, pavakai (Sinhalese); balsam, *Momordica* amarga (Spanish); bittergurka (Swedish); kakara (Telugu); mara (Thai); and la khoqua (Vietnamese).[9,10]

PLANT DESCRIPTION OF *MOMORDICA CHARANTIA*

M. charantia is an annual or perennial monoecious climber, 2–3 m height with no hair or slightly hairy. It can be cultivated up to high altitude. Stem: The well-branched, slender, green stem is usually slightly five angled or ridged and carries unbranched tendrils in the leaf axils. Root: The central taproot comes to the apex where the stem spreads to climb. Leaf: The leaf is simple, alternate, rounded rim in 4–12 cm long with 3–7 deeply separated lobes. It is carried singly along the stem on

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3–5 cm long stalks. It has an unpleasant smell when crushed. Flower: Male and female flowers are separated with a little different. They have five oval yellow petals 10–20 cm long and five central stamens. Fruit: The orange to yellow pendulous cylindrical fruit is egg shaped and 2–10 cm long, which covered with longitudinal ridges and warts. Seed: The seed is 8–15 mm long black but covered with a soft, flesh white in unripe to red in ripe [Figure 1].[10,11]

PHYTOCHEMICAL SUBSTANCES

The active phytochemical substances of *M. charantia* are as follows: (1) athocyanins, ascorbigen, a bound from of ascorbic acid;[12-14] (2) carotene, pigment of carpels, while lycopene characterizes the red aril;[15] and (3) charantin, a natural steroidal glucoside mixture of stigmasterol glucoside and sitosterol glucoside, which has antidiabetic property.[8,16,17] There also are flavonoids, quercetin, and luteolin.[18,19] Saponins include momordicin, momordin, momordicoside, karavilagenin, karaviloside, and kuguacin.[20-22] Steroids include sitosterol, daucosterol,[23] terpenoids, curcubitacins, and cucurbitane-type triterpenoids, known for its bitterness and antioxidant properties.[24-26]

TRADITIONAL USES

The fruits of *M. charantia* have been used not only as a vegetable but also as a traditional medicine. The uses or phytochemical properties of *M. charantia* from several literature reviews are antibacterial,[27,28] anticancer,[29,30] antidepressant,[31] antidiabetic,[32-34] antifungal,[35,36] anti-inflammatory,[37,38] antiobesity,[39] antioxidant,[40,41] antipyretic,[42] antiulcer,[43,44] and antiviral activities.[45] It also uses to treat the cardiovascular,[46] gout,[47] and hepatic diseases.[48]

ANTHELMINTIC ACTIVITY

The extracts of various plant parts of *M. charantia* including the leaf, fruit, and seeds have been investigated and found to be pharmacologically active against helminths.

Ascaris suum

Tjokropranoto and Nathania[49] from Indonesia reported that the mean percentage of paralyzed or dead of *Ascaris suum*, large roundworm of pigs, after treated for 3 h with 10%, 20%, and 40% concentrations of 70% ethanolic extract of *M. charantia* leaves was 75%, 83%, and 88%, compared with 100% of pyrantel pamoate, a standard drug treatment. Chastity *et al.*[50] from Indonesia studied the effect of 70% ethanolic extract of *M. charantia* leaves on *A. suum.* The mortality time of worms was 16, 12, and 10 h in 20%, 40%, and 80% concentrations of plant extracts compared with 4 h of pyrantel pamoate.

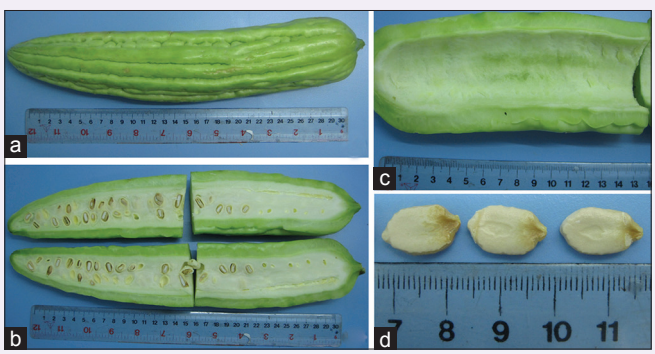

Figure 1: Fruit of *Momordica charantia* (a) external morphology, (b) cut surface, (c) pericarp, and (d) seeds

Ascaridia galli

Shahadat *et al.*[51] from Bangladesh revealed the effects of 3% aqueous extract of *M. charantia* fruit, against *Ascaridia galli*, gastrointestinal nematode in chicken. They reported that the *in vitro* mortality rate was 38% and 75% after 4 and 12 h of plant extract, respectively. Alam *et al.*[52] from Bangladesh reported the 22%, 70%, and 90% mortality of *A. galli*, *Heterakis gallinae*, and *Capillaria* spp., gastrointestinal nematodes of chicken, after treatment with 25, 50, and 100 mg/ml concentrations of *M. charantia* leaves.

Fasciola hepatica

Pereira *et al.*[53] from Brazil studied the effect of *M. charantia* leaves extract on the eggs of *Fasciola hepatica*, liver fluke in mammals. They reported that no larvae were found after 12 days exposure with 12.5 mg/ml of plant extract. Moreover, *F. hepatica* eggs incubated with plant subfractions at concentrations of 1000, 100, 10, 1, 0.1, 0.01 µg/mL affected embryonic development with n-butanol showed the strongest inhibition of miracidia formation.

Stellantchasmus falcatus

Buddhachat *et al.*[54] (2012) from Thailand studied the effect of aqueous extract of *M. charantia* fruit on the mortality and tegumental surface change on *Stellantchasmus falcatus*, a gastrointestinal trematode of fresh fish, birds, and mammals. They reported that the 12.5%, 50%, and 100% concentrations of plant extracts were able to kill all the worms at 280, 270, and 80 min, respectively. The tegumental surface of worm exhibited bleeding, rupturing, and curving of the spine.

Strongyloides spp.

Amin *et al.*[55] from Bangladesh reported that the effects of 25, 50, and 100 mg/ml of aqueous extract of *M. charantia* leaves showed 24%, 80%, and 100%, respectively, efficacy against *Strongyloides* sp. in the cattle. The seeds extract showed 20%, 60%, and 98%, respectively.

Caenorhabditis elegans

Beloin *et al.*[56] reported that the effect of 500 µg/ml of *M. charantia* leave extract in West Africa was shown potent activity against *Caenorhabditis elegans*, a nematode.

Earthworm

Sen *et al.*[12] from India studied *in vitro* anthelmintic activity of methanolic extract of 150 mg/ml of whole fruit, fruit peel, seed, whole fruit juice, and peel juice of *M. charantia* against Indian adult earthworms (*Eisenia foetida*). They reported the fruit peel showed paralysis time at 8.5 min and death time at 14.5 min like those of 8.2 min and 16.3 min of 40 mg/ml of albendazole, standard drug treatment. Vedamurthy *et al.*[57] from India studied the *M. charantia* seed extract against *Pheretima posthuma*, Indian adult earthworm. The chloroform extract exhibited the best anthelmintic activity by inducing paralysis within 3 min and death within 8 min, followed by ethanol, aqueous, and petroleum ether extract. Vinav *et al.*[58] from India studied the effect of *M. charantia* fruit on *E. foetida*. They reported that the 10 mg/ml of aqueous and methanolic extracts exhibited paralysis time at 117 min and 100 min and death time at 151 min and 140 min, respectively.

PHYTOCHEMICAL SUBSTANCES IN ANTHELMINTIC ACTIVITIES

The mechanism of drugs or anthelmintic plants against helminthes are following mechanism: nicotinic agonists, acetylcholinesterase inhibitors, calcium permeability increase, β-tubulin binding, inhibition of oxidative

phosphorylation, and inhibition of arachidonic acid metabolism.[59] Recent studies have suggested that phytochemical substances or plant secondary metabolites may offer a promising alternative approach to control helminthic infections. Saponins can potentially act as anthelmintic effect by inhibiting the enzyme acetylcholinesterase, hence the worm paralysis, and lead to death. They affect the permeability of the cell membrane of worms and cause vacuolization and disintegration of tegument. Moreover, saponin can irritate the mucous membrane channel gastrointestinal of worms that interfere with the absorption of food.[60,61] Alkaloids including steroidal alkaloid and oligoglycosides have neurotoxic properties, which effect on acetylcholine-stimulated body wall muscle contraction, so act as acetylcholinesterase inhibitors, course worm paralysis. They also act as an antioxidant, capable of reducing the nitrate generation which can interfere in local homeostasis that is essential for the development of helminths.[62,63] Flavonoid compounds including apigenin can inhibit larval growth and inhibit the arachidonic acid metabolism which may lead to the degeneration of neurons in the worm's body and lead to death.[64,65] Tannins can be potentially act as anthelmintic effect by reducing migratory ability and survival of newly hatched larvae. They reduce worm burden and caused damage to the cuticle and digestive tissues of worms. Moreover, tannins inhibit energy generation of worms by uncoupling the oxidation phosphorylation and bind to glycoprotein on the cuticles of the worms and lead to death.[66,67]

CONCLUSION

Many of the traditional medicinal plants have been evaluated for their anthelmintic activities; several plants still need to be confirmed the efficiency and safety. Several researchers reported that *M. charantia* may present the anthelmintic property using the *in vitro* and *in vivo* studies and the phytochemical substances analysis. This review article has attempted to compile the new medicinal plant *M. charantia* to be one of the choices of anthelmintic plants.

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Conflicts of interest

There are no conflicts of interest.

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