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Review
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Anthelmintic activities of *Momordica charantia* linn (bitter melon): a review

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ABSTRACT

Medicinal plants and thier products continue to be an important therapeutic aid for alleviating ailments and maintenance of human and animal health. The significance of plants in medicine remains a greater relevance with the current global shift to obtain drugs from plant sources, as a result of which attention has been given to the medicinal value of herbal remedies for safety, efficacy and economy. The major impediment in the livestock sector is the increasing problems of development of resistance to synthetic drugs or high cost of commercially produced anthelmintic and the side effects they produce than the treatments efficacy in the host. However, the routine use of synthetic anthelmintic drugs has led to the development of anthelmintic resistance, whereby the efficacy of anthelmintic drugs against gastro-intestinal nematodes is becoming ineffective in livestock production. *Momordica charantia*, also known as bitter melon or bitter gourd, is a popular plant used for treating various kinds of diseases. Its anthelmintic activities on most parasites may be attributed to the high phytochemical compounds contained in the plant such as phenols, alkaloids, saponins, flavonoids, anthroquinones, momordin and glucosinolates. Previous studies revealed that *Momordica charantia* possessed antibacterial, antifungal, antiviral, and antiparasitic properties. Therefore, medicinal preparations from *Momordica Charantia* for purpose of treating helminths in animal may play a key role in the treatment of parasitic infections.

Keywords: Anthelmintic, *Momordica charantia*, Traditional, Phytochemical, Medicinal plants.

INTRODUCTION

Plants have been used as valuable sources of food and medicine for the prevention of illness and maintenance of human and animal health. In the Northern Nigeria, many indigenous plants were consumed as food and also used as home remedies in the treatment or management of certain diseases (Burkill, 1985). The importance of medicinal plants remains even of greater relevance with the current global shift to obtain drugs from plant sources, as a result of this, attention has been given to the medicinal value of herbal remedies for safety, efficacy and economy (Mahabir & Gulliford, 1997). Medicinal plants are traditionally used for the treatments of different kinds of diseases, it also offer enormous potential source of new chemotherapeutical agents with varieties of biological and chemical compounds that have activities against virus, cancer and parasites (Tagboto & Townson, 2001; Ahmed *et al.*, 2001). These plants contain chemical compounds mainly secondary metabolites such as alkaloids, glycosides, flavonoids, terpenes and coumarins (Rates, 2001). Plants have been reported to provide better and cheaper alternatives to synthetic chemotherapeutics (Adewummi *et. al.*, 2001, Nok, 2005).

Globally, parasitic infections in livestock production pose a serious health challenges that severely limits the productivity of livestock by causing a debilitating impact on animal health due to morbidity and mortality of the animals (Jegede *et al*., 2015). Helminthosis, a disease condition caused by helminth infection is a major constraint to livestock production at the global level. Therefore, chemotherapeutics remain the corner stone for treating these conditions by overcoming certain factors such as chemical residues, toxicity, high cost and non-availability of drugs in the remote

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areas especially of Africa and Asia (Hussain *et al*., 2011). Diseases due to gastrointestinal parasites have been a challenge, serious threat and a major economic constraint to livestock production (Jabbar *et al*., 2007; Knox *et al*., 2012). In the past years, gastro-intestinal nematodes have been controlled with broad-spectrum anthelmintics, which are inexpensive and easy to use (Sargison, 2011). The routine and sometimes indiscriminate uses of synthetic anthelmintic drugs have led to the development of anthelmintic resistance, whereby the efficacy of these drugs against gastro-intestinal nematodes becomes ineffective in livestock production (Morgan, 2013).

*Momordica charantia (*Cucurbitaceae) also known as bitter melon or bitter gourd is a flowering vine climbing perennial plant that usually grows up to 5 m, and bears elongated fruits with a knobbly surface. *Momordica charantia* that belongs to the family, genus and specie called *Cucurbitaceae*, *Momordica* and *M. charantia* respectively (ITIS, 2016). *Momordica* is a small shrub or perennial climber which comprises almost sixty species distributed across tropical and subtropical regions (Sharma *et al*., 2011; Sharathi & John, 2013). This plant is popularly known in Hausa as garafunii. It is an edible plant grown in many cultures in tropical and subtropical regions of Asia, India, East Africa, and South America (Volpato *et al*., 2009). They are intensely bitter fruits, vegetable plant commonly used in cooking and as a natural remedy for treating different ailments in humans and most especially diabetes (Hussain, 1991; Keller *et al*., 2011). The various plant parts such as fruits, foliage, seeds, stems, and roots are used in traditional medicine to treat diseases such as anemia, arthritis, infertility, kidney stones, stomach ache and worms (Grover and Yadav, 2004; WHO, 2009). Medicinal plants have been used in the past years to treat different kind of ailments or disease problem, because they are readily available and sustainable in the environment (Oliviera *et al*., 2009). The objective of this review is to highlight anti-helminthic properties of *M. Charantia,* proposing various physiological mechanisms underlying these properties and possibly incite further studies on this theme to harness more benefit from *M. Charantia*

MOMORDICA CHARANTIA ANTHELMINTIC ACTIVITIES ON PARASITIC HELMINTHS

Previous studies has revealed the anthelmintic inhibitory effects of *M. charantia* crude extract against *Meloidogyne* spp, *Caenorhabditis elegans***,** *Haemonchus contortus* and *Ascaridia galli* (Batista *et al*., 1999; Beloin *et al*., 2005; Ononuju & Nzenwa, 2011). Reports from other studies showed that extracts prepared from *M. charantia* fruits and other plant parts had chemical compounds such as triterpenoid and glycosides which are responsible for the anthelmintic properties associated with the plant (Ma *et al*., 2010). Previous studies carried out by scientist on various plant parts (leaf, fruit and seed) of *M. charantia* include:

Seventy percent (70%) ethanolic extract of *M. charantia* leaves at various inhibition concentrations of 75%, 83%, and 88% compared with pyrantel pamoate at 100% caused paralysis and death of *Ascaris suum* after 3h (Tjokropranoto & Nathania, 2011).

Seventy percent (70%) ethanolic extract of *M. charantia* leaves at various inhibition concentrations of 20%, 40%, and 80% induced the mortality of helminths when compared with pyrantel pamoate after 4h (Chastity *et al*., 2015).

The 3% aqueous extract of *M. charantia* fruit was tested against *Ascaridia galli*, the *in vitro* mortality rate was 38% and 75% after 4 and 12 h of exposure to the plant extract respectively as reported by Shahadat *et al* (2008), while *M. charantia* leaves induced mortality rate of 22%, 70%, and 90% at concentrations of 25, 50, and 100 mg/ml for *A. galli*, *Heterakis gallinae*, and *Capillaria* spp respectively (Alam *et al*., 2014).

The leaves extract of *M. charantia* were experimented on *Fasciola hepatica*, it inhibited the hatching of eggs of *F. hepatica at* 12.5 mg/ml after 12 days exposure (Pereira *et al*., 2016), while the *F. hepatica* eggs incubated with the plant subfractions at concentrations of 1000, 100, 10, 1, 0.1, 0.01 mg/ml inhibited the embryonic development of *F. hepatica* eggs, whereas n- butanol showed the strongest inhibition of miracidia formation.

The anthelmintic effect of aqueous extract of *M. charantia* fruit at concentrations of 12.5%, 50%, and 100% induced mortality and tegumental surface change on *Stellantchasmus falcatus* at 280min, 270 min and 80min respectively after exposure to the plant extract as reported by Buddhachat *et al*. (2012).

At the concentration of 500µg/ml, *M. charantia* leave extract induced anhelmintic activity against *Caenorhabditis elegans*as observed by Beloin *et al* (2005). The methanolic extract of *M. charantia* fruit peel has been tested for *in vitro* study by Sen *et* al. (2014) which showed a potential anthelmintic effect against *Eisenia foetida* at the concentrations of 150 mg/ml. The results showed paralysis and death of parasites at 8.5 min and 14 min respectively while albendazole at the concentration of 40 mg/ml induced paralysis and death of parasites at 8.2 min and 16.3 min respectively.

Vinav *et al*. (2016) reported the effects of 10 mg/ml of aqueous and methanolic extracts of *M. charantia* fruit on *E. foetida*. It was revealed that the extracts exhibited paralysis

at 117 min and 100 min and death time at 151 min and 140 min respectively post exposure.

Figure 1 - *Momordica charantia* (Eman & Almarzooq, 2009).

THE BIOACTIVE, NUTRITIONAL CONSTITUENTS AND MEDICINAL PROPERTIES OF *M. CHARANTIA*

Momordica charantia contains bioactive and nutritional complex array of important compound such as bioactive chemicals, vitamins, minerals and antioxidants which makes the plant able to treat some major illnesses. The fruits contain high amounts of vitamin C, vitamin A, vitamin E and almost the B-complex group of vitamins (Li *et al*., 2015). The caloric and nutritional values obtained from the leaf, fruit and seed were 213.26, 241.66 and 176.61 Kcal/100 g respectively as revealed by Li *et al* (2015). Bitter melon (fruits) contains minerals such as potassium, calcium, zinc, magnesium, phosphorus and iron which are good source of dietary fiber (bitter melon "monograph", 2008). *M. charantia* medicinal properties includes antidiabetic, anticancer, anti-inflammation, antivirus, antihelmintic, antimutagen and cholesterol lowering effects (Lee *et al*., 2009; Ajilore & Ayannuga, 2012). *M. charantia* as an antivirus helps to stimulate the immune system and activate the body's natural killer cells to help fight off viruses such as HIV (Shahadat *et al*., 2008; Alam *et al*., 2014; Chastity *et al*., 2015) . As an anti-carcinogenic agent, it is used as a cytotoxic compound against many types of cancer such as breast cancer (Periera *et al*., 2016; Buddhachat *et al*., 2012). This plant also possess antibacterial agent that fights infections caused by *Escherichia coli, Staphylococcus aureus, Staphylococcus* and *Streptobaccilus*as reported by Amin *et al.* (2009) and finally it serves as an antispermatogenic agent (Beloin *et al*., 2005). The major chemical constituents of the whole plants are alkaloids, terpenoids, flavonoids, proteins and fatty acids. It has diverse medicinal properties such as anti-inflammatory, antidiabetic, antibacterial and antiprotozoan and antipaarasitic (Ahmed *et al; 2001*).In addition, the plant possesses anthelmintic properties, which are effective in the treatment of helminths. Various parts of the plant parts have also been used traditionally to treat ailments such as hyperlipidemia, digestive disorders, microbial infections and menstrual problems (Tjokropranoto & Nathania, 2011). Medicinal value of bitter melon cannot be overemphasized without mentioning its attribute as an antioxidant agent due to the chemical compounds such as phenols, flavonoids, isoflavones, terpenes, anthroquinones, and glucosinolates it possess (Kim *et al*., 2013 ; Budrat & Shotipruk, 2009). This plant is rich with various phytochemical compounds such as saponins, momordicin, momordin, momordicoside, karavilagenin, karaviloside, and kuguacin which are contained in the various plants part that contributes to its remedial properties including antibacterial, antifungal, antiviral, and antiparasitic agents. Based on established studies, the anthelmintic activity of *M. charantia* and its possible mode of action could be further explored for the development of potential anthelmintic drug.

MECHANISM OF ACTION OF *MOMORDICA CHARANTIA* ON PARASITIC HELMINTHS

The mechanism of action of *M. charantia* on heminths includes calcium permeability increase, inhibition of oxidative phosphorylation, inhibition of arachidonic acid metabolism, nicotinic agonists and acetyl-cholinesterase inhibitoin (Hrckova & Velebny, 2013). Previous study has established that phytochemical compounds or plant secondary metabolites contained in plants such as *M. charantia* may offer good alternative approach to the control of parasitic diseases caused by helminths (Sutthaya & Wannee, 2017). Saponins are plant metabolites that have potential anthelmitic activities capable of inhibiting the enzymes acetylcholinesterase of the parasites (Sutthaya & Wannee, 2017) Saponin cause paralysis of the parasites and finally leads to death of the parasites (Olayemi *et al*., 2019). Saponin also affects the permeability of the cell membrane of worms and cause vacuolization and disintegration of tegument. They can (saponin) irritate the mucous membrane channel gastrointestinal of parasitic

helminths that interferes with the absorption of food (Melzig *et al*., 2001; Bauri *et al*., 2015). Harinantenaina *et al* (2006) revealed that saponin fractions contained in *M. charantia* extracts have lipid-lowering effects resulting from inhibition of pancreatic lipase activity and subsequent decreased lipid absorption in worms.

The effect of tannins is similar to some synthetic phenolic anthelmintics like niclosamide and nitroxynil. Tannin interferes with the generation of energy by uncoupling oxidative phosphorylation in the helminth parasites (Martin, 1997). Tannins also have the ability to bind free protein available for larval nutrition and reducethe nutrient available for the parasites chemical metabolism or directly through inhibition of oxidative phosphorylation which results in larval starvation and finally larval death (Athanasiadou *et al.*, 2007; **).** Tannin act as anthelmintic substances that reduce the migratory ability and survival of newly hatched larvae. They reduce worm burden and caused damage to the cuticle and digestive tissues of helminths (Iqbal *et al*., 2002; Williams *et al*., 2014).

Alkaloids including steroidal alkaloid and oligoglycosides have neurotoxic properties, which affect acetylcholine-stimulated body wall muscle contraction that leads to helminths paralysis. Alkaloids also act as an antioxidant, capable of reducing the nitrate generation which can interfere in local homeostasis essential for the development of helminths (Wink, 2012; Jain *et al*., 2013). 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 (Ferandiz, 1991; Yoon *et al*., 2006).The immune-stimulating properties of *M. Charantia* extracts may also contribute to decreased rates of microbial infection observed in animal research.This simply means that some of the phytochemical compounds and secondary metabolites found in *M. Charantia* possessed anthelmintic activity which could be responsible for the ovicidal and larvicidal inhibitory effects on parasitic worms.

Conclusion

Many medicinal plants have been evaluated for their ovicidal and larvicidal inhibitory effects and further studies are essentially required to confirm the efficacy and safety of these plants before usage. However, some studies have revealed the *in vitro* and *in vivo* effects of *M. charantia* extracts on animals, such study includes the beneficial effect of *M. charantia* on the feotus heart of the zebrafish (*Danio rerio*) embryos (khan *et al*., 2019). *Momordica charantia* extract has been used against cyclophosphamide induced liver injury (hepatic damage) in winstar rats, *M. charantia* extract protected the liver hepatic tissues from oxidative damage (Subramanian *et al*. (2012). *M. charantia* has attracted the attention of researchers owing to its excellent anti-diabetic, antioxidant, anthelmintic and the phytochemical compounds this plant contained. Therefore, this reviewed article on *M. charantia* showed that this plant has some potential metabolites and chemical compounds which can be used as a novel anthelmintic agents for parasitic diseases treatments.

CONFLICT OF INTEREST

The authors are in agreement on the publication of this reviewed study, therefore no conflicts of interest.

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