*Review Article*

# Enumerations on seed-borne and post-harvest diseases of bitter gourd (*Momordica charantia* L.) and their management

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**Abstract**

Bitter gourd (*Momordica charantia* L.) of cucurbitaceae is a climber and medicinal crop grown worldwide. It contains several bioactive compounds and secondary metabolites with possess pharmacological and anti-microbial properties. Traditionally, the plant used in medication to treat as rheumatism, gout, worms, colic, disease of liver, spleen and to cure diabetes. The plant is attacked by fungi, bacteria, virus, mycoplasma etc that reduces commercial or trade value of crop which indirectly and directly affected the economy of farmer or crop provider. These microorganisms reduces the yield in terms of quality and quantity; nutritional and medicinally properties of crop. Due to harvesting, packing and transportation various kinds of mechanical injuries occurred, which facilitate the entry of certain pathogens. The numerous diseases, which occur in transit and storage, result mainly from the activity of microorganisms. In this review article a study on ethnobotanical uses, phytochemical constituents and pharmacological activity associated with plant.

***Keywords*:** Disease incidence, seed-borne diseases, management of diseases, bitter gourd

## Introduction

In human diet vegetables are so common that are belong to about 13 plant families and some of them are native of India. India is the largest producer of vegetables after China. Bitter gourd (*Momordica charantia* L.) or bitter melon or balsam pear is tropical and subtropical climber plant of family cucurbitaceae believed to be originated in the tropics of the old world grown in India and other parts of the Indian subcontinent, Southeast Asia, China, Africa, Caribbean and South America as a food and Medicine (Nadkarni, 1993; Warrier et al., 1995; Kumar et al. 2010). In India, the bitter gourd growing states are Andhra Pradesh, Tamil Nadu, Kerela, Karnataka, Maharashtra, Gujarat, Rajasthan, Punjab, West Bengal, Orissa, Assam, Uttar Pradesh and Bihar (Anonymous, 2018).

All the parts of plant are medicinally useful including fruits which is bitter in taste (Taylor, 2002), due to presence of momordicin. Bitter gourd possesses anti-fungal, anti-bacterial, anti-parasitic, anti-viral, anti-fertility, hypoglycemic (Raman and Lau, 1996; Welihinda et al., 1986) and anti-carcinogenic properties due to biologically active substances like triterpens, proteins, steroids, alkaloids, saponins, flavonoids and acids (Scartezzini and Speroni, 2000; Grover and Yadav, 2004; Beloin et al., 2005). It is used as folk medicine (Heiser, 1979; Sharma et al., 2011) as fruits are used as medication to cure rheumatism, gout, worms, colic pain, disease of liver and spleen (Nazimuddin and Naqvi, 1984). It is a potent hypoglycemic agent due to alkaloids or insulin like peptides and a mixture of steroidal sapogenins known as charantin (Agrawal and Kamal, 2004; Anonymous, 2004).

## Botanical enumerations

Plant is flowering climber, herbaceous; tendril bearing grows up to six meters or longer. It bears simple, alternate leaves with 3-7 deeply separated lobes. Flowers are actinomorphic and unisexual. Perianth has a short to prolonged epigynous zone; yellow on short (female) or long (male) peduncles that are short-lived. Fruits are ovoid, ellipsoid or spindle shaped usually distinct warty looking exterior and an oblong shape. Seeds are long compressed, corrugate on the margin, sculptured on both faces (Kumar et al., 2010).

## Nutritional value

Bitter melon has higher nutritive value than most of the other

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cucurbits (Desai and Musmade, 1998; Miniraj et al., 1993). It contains per 100g of edible portion approximately: energy, 79KJ (19kcal); moisture, 93.95g; carbohydrates, 4.32g; sugars, 1.95g; dietary fiber, 2g; protein, 0.84g; vitamin A equiv. 6ug (1%); beta-carotene, 68ug (1%); lutein and zeaxanthin, 1323ug; thiamine (vitamin $B_1$), 0.051mg (4%); riboflavin (vitamin $B_2$), 0.053mg (4%); niacin (vitamin $B_3$), 0.28mg (2%); pantothenic acid (vitamin $B_5$), 0.193mg (4%); vitamin $B_6$, 0.041mg (3%); folate ($B_9$), 51ug (13%); vitamin C, 33mg (40%); vitamin E, 0.14mg (1%); vitamin K, 4.8ug (5%); calcium, 9mg (1%); iron, 0.38mg (3%); megnesium, 16mg (5%); manganese, 0.086mg (4%); phosphorus, 36mg (5%); potassium, 319mg (7%); sodium, 6mg (8%) and zinc, 0.77mg (8%) (Lako et al., 2007). These values made it also better than other vegetables.

**Traditional and medicinal uses**

In Asian traditional medicine systems fruit of bitter gourd is used from long time for preventing and treating various diseases as asthma, burning sensation, colic pain or constipation, cough, diabetes, fever (malaria), gout, helminthiases, inflammation, leprosy, skin diseases, ulcer and wound. Juice of leaves used as blood purifier or to treat piles, heal boils and other blood hypoglycaemic properties (antidiabetic) or to preventing the liver damage (Garau et al*.,* 2003). Seeds used in the treatment of ulcers, liver and spleen problems, diabetes, intestinal parasites, and high cholesterol and intestinal gas; heal wounds and stomachache (Jadhav, 2008).

Tribal people used bitter gourd as ethno medicine for abortions, birth control, increasing milk flow, menstrual disorders, vaginal discharge, constipation, diabetes, hyperglycemia, jaundice, stones, kidney, liver, fever (malaria), gout, eczema, fat loss, hemorrhoids, hydrophobia, intestinal parasites, leprosy, pneumonia, rheumatism, scabies and snakebite. It is purgative used to cure piles and anthelmintic (Grover and Yadav, 2004).

**Phamacological activities**

It has anti-oxidant (Horax et al., 2005; Sathishsekar and Subramanian, 2005), anti-diabetic (Virdia et al*.,* 2003; Shetty et al., 2005; Kumar et al., 2010), anti-cancerous and anti-tumorous (Cunnick et al. 1990; Terenzi et al. 1996), anti-microbial (Zaid et al., 2011; Ghosh et al*.,* 2011; Johnsona et al*.,* 2011), anti-fertility (Stepka et al., 1974) and anti-helmintic activities (Grewal, 2000). Phytochemicals of bitter melon has been documented with *in vitro* antiviral activity against numerous viruses including *Epstein-Barr*, herpes and HIV viruses (Bourinbaiar and Lee-Huang, 1995; Lee- Huang et al*.,*1995). Various preliminary studies (*in vitro* and *in vivo*) found anti-neoplastic activity in crude extracts and purified fractions of *M. charantia* (Grover and Yadav, 2004). The extract also reduced carcinogen-induced lipid peroxidation in the liver, DNA damage in lymphocytes and significantly activated hepatic glutathione-S-transferase, glutathioneperoxidase and catalase. All of them had become functionally depressed by exposure to the carcinogen used in the study (Ganguly and Das, 2000).

**National status of research**

***Fungal diseases***

Fungi reported from seeds of bitter gourd are *Aspergillus* sp., *Coleophoma empetri, Fusarium equiseti, Macrophomina phaseolina, Myrothecium roridum, Rhizoctonia solani, Alternaria* spp., *Pythium aphanidermatum*, *Colletotrichum lagenarium, Rhizopus* sp. and *Sclerotium rolfsii* (Manthachitra, 1971; Verma and Sengupta, 1981; Nair, 1982; Maholay, 1986; Mathur, 1990; Sawant et al., 2000).

The plant is effected by several diseases as fruit rot (*Myrothecium roridum, Alternaria tenuissima, Fusarium oxysporum, Sclerotium rolfsii*); root rot (*Rhizoctonia solani*); leaf spot (*Cercospora citrullina, C. momordicae, Myrothecium roridum, Phyllosticta cucurbitacearum*); flower rot (*Choanephora cucurbitarum*); powdery mildew (*Erysiphe cichoracearum*); leaf, stem and fruit gall (*Synchytrium wurthii*) (Sharma and Bharghava, 1977; Mukerji and Bhasin, 1986), powdery mildew (*Sphaerotheca fuliginea*) with initially, white of fluffy growth appear in circular patches on the under surface of the leaves (Gupta and Singvi, 1980), downy mildew (*Pseudoperonospora cubensis*) (Phookan and Gogoi, 1995), gummy stem blight and black rot of bitter gourd (*Didymella bryoniae*) (Singh and Shetty, 1996) and Fusarium wilt and rot in cucurbits and bitter gourd (*Fusarium oxysporum* f. *niveum*), (Khanzada et al., 2002) and blight disease (*Alternaria cucumerina, Alternaria alternata*) (Avinash and Ravishankar, 2013).

***Bacterial diseases***

Bacterial wilt is caused by *Ralstonia solanacearum* race 1, biovar 3. This is claimed to be the first report of this bacterial wilt pathogen of cucurbits from kerala, India (Mathew et al*.,* 2002). Nazir (2009) reported Angular leaf spot disease by *Pseudomonas syringae* pv. *lachrymans* on bitter gourd in India.

***Virus diseases***

It is natural host of many viruses which affected its cultivation all over the world. These viruses are: *Bitter gourd mosaic virus* (Nagarajan and Ramkrishanan, 1970), *Mosaic Bombay, Cucumis virus 3 Smith, Phyllody* (Mukerji and Bhasin, 1986) *Begomovirus* (Raj et al., 2005), *Bitter gourd yellow mosaic virus* (Rajinimala et al., 2007), *Watermelon mosaic virus*-1 (Tomar and Jitendra, 2005), ToLCDV and *Indian cassava mosaic virus* (Rajinimala and

Rabindran, 2007). Recently, *Tomato leaf curl New Delhi virus* (Tiwari et al., 2010) *and Pepper leaf curl Bangladesh virus* (Raj et al., 2010) have also been investigated on bitter gourd. Three viruses in varying proportions causing yellowing, mosaic, curling and stunting of plants affecting the yield and great loss to farmers and is found in all the areas of cultivation as Begomo is whitefly borne while CMV and POTY is aphid borne. Continuous cultivation, presence of insect vectors and suitable environmental conditions for the multiplication of insect vectors make these viruses a persistent field problem.

***Root-knot nematode disease***

It is caused by *Meloidogyne incognita* one of the important pests of bitter gourd and reported to cause 38-48.2% yield losses (Mukerji and Bhasin, 1986; Kaur and Pathak, 2011; Singh et al., 2012).

***Post-harvest diseases***

Post-harvest pathogens caused great economical losses to freshly harvested fruits and vegetables. Various pathogens both fungi and bacteria are responsible for postharvest diseases namely rot of bitter gourd (*Aspergillus flavus, Geotrichum* sp.) and fruit rot (*Myrothecium roridum, Alternaria tenuissima, Fusarium oxysporum, Sclerotium rolfsii*) (Mohapatra et al*.,* 2014). Mukherjee and Raghu (1997) reported that use of *Trichoderma* sp. suppress the growth of *Sclerotium rolfsii* on fruit during storage and transport.

**International status of research work**

***Fungal diseases***

Worldwide several diseases have been reported on bitter gourd such as leaf spot (*Cercospora* spp., *Myrothecium roridum*), powdery mildew (*Oidium* sp.), white rot of fruit (*Sclerotium rolfsii*, *Rizoctonia solani*) (Khan and Kamal, 1963; Ali et al*.,* 1988). The fungi *Aspergillus* spp., *Chaetomium* spp., *Cladosporium* spp., *Fusarium semitectum* and *Rhizopus* sp., were found most frequent attacking pathogens on bitter-gourd seed. *Rhizopus* spp. was consistently isolated from seeds of bitter gourd (Nasreen and Ghaffar, 2007). Downy mildew (*Pseudoperonospora cubensis*) is a foliar disease, easily recognizable by the development of chlorotic lesions on the adaxial leaf surface or necrotic centers (Thomas, 1996; Lindenthal et al., 2005; Oerke *et* al., 2006; Keinath et al., 2007; Savory et al., 2011). The disease control can be achieved with an integrated disease management approach (Watson and Napier, 2009).

Fusarium wilt (*Fusarium oxysporum* f. sp. *momordicae*) is important threat of bitter gourd reported from Taiwan (Sun and Haung, 1985). It is a devastating disease in all over the world (Santos et al., 2002; Leslie and Summerll, 2006; Mahfooz et al., 2011) which can be controlled by using resistant cultivars, chemical or fungicides (Fravel et al., 2005), soil solarisation (Tamietti and Valentino, 2006), biological control agent (Idris et al., 2007), crop rotation and grafting (Zhao et al., 2011).

Leaf spot disease is caused by *Cercospora* and *Oidium* spp. on bitter gourd (Khan and Kamal, 1962, 1963, Brooks, 2000). In 1985-86 it was reported that the crop was infected with a leaf spot disease suspected to be caused by *Myrothecium roridum* in Pakistan (Shaukat et al*.,* 1988). Alternaria leaf spot (*Alternaria cucumerina*), gummy stem blight (*Didymella bryoniae*), powdery mildew (*Erysiphe cichoracearum* and *Sphaeotheca fuligena*) (Lowell, 2001), damping off or root rot or root tip *(Pythium aphanidermatum*) (Heine et al., 2007), scab or gummosis (*Cladosporium cucumerinum*) (Watson and Napier, 2009) were also found important diseases.

***Bacterial diseases***

Crop was infected by several bacterial diseases as angular leaf spot (*Pseudomonas syringae* pv. *lachrymans*) (Young et al*.,* 1978; Bradbury, 1986; Watson and Napier, 2009) and bacterial wilt (*Erwinia tracheiphila*) (Lowell, 2001). Fruit blotch caused by *Acidovorax avenae* subsp. *citrulli* was identified as the causal agent of bacterial fruit blotch on melon and bitter gourd in Taiwan (Cheng and Huang, 1998). Bacterial wilt disease caused by *Ralstonia solanacearum* was reported in Philippines (Valdez, 1986) and in Taiwan (Hean, 2008) as a destructive disease.

Angular leaf spot disease (*Pseudomonas syringae* pv. *lachrymans*) has become apparent on cotyledons, leaves and fruits in Bangladesh (Shila *et al*., 2013). Agrios (2005) reported three main bacterial diseases cause brown spots on gourd fruits and plants namely angular leaf spot (*Pseudomonas syringae* pv. *lachrymans*), bacterial leaf spot (*Xanthomonas campestris* pv. *cucurbitae*) and fruit blotch (*Acidovorax avenae* subsp. *citrulli*).

***Virus diseases***

Crop attacked by several viruses namely *Zucchini yellow mosaic virus* (Fukumotu et al., 1993), *Watermelon silver mottle virus* (Tokashiki and Yasuda, 1991), *Begomovirus* (Khan et al., 2002), ToLCDV (Tahir and Haider, 2005), *Papaya ring spot virus* (Gonzalez et al., 2003; Chin and Ahmad, 2007) and *Cucumber mosaic virus* (Takami et al., 2006). Recently, *Squash vein yellowing virus, Cucurbit leaf crumple virus* (Adkin et al., 2008), *Melon yellow spot virus* (Takeuchi et al., 2009) and *Tomato leaf curl palampur virus* (Ali et al., 2010) have also been investigated on bitter gourd. A new virus disease called cucurbit aphid-borne yellow was observed in the Philippines and spreading South-East Asia

(Grubben, 2004). *Cucurbit aphid-borne yellows virus* (CABYV) is the first luteovirus reported that naturally infects cultivated bitter gourd in China (Xiang et al., 2007).

***Mycoplasma diseases***

Little leaf disease caused by *Candidatus phytoplasma asteris* was reported by Spoodee et al., (1999). Flowers of affected plants were reduced in size, did not fully open at maturity and finally withered within a few days (Nang et al., 2014).

***Post-harvest diseases***

Bitter gourds are susceptible to a number of post-harvest fungal and bacterial diseases including Alternaria rot (*Alternaria alternata*), belly rot (*Rhizoctonia solani*), cottony leak (*Phythium sp*.), Rhizopus soft rot (*Rhizopus stolonifer*), Botryodiplodia rot (*Botryidiplodia theobromae*), Fusarium rot (*Fusarium sp*.), waxy rot (*Geotrichum candidum*) and bacterial soft rot (*Erwinia carotovora*) (Annonynous, 2004, Naureen et al., 2009).

**Conclusion**

In recent years the trends of research move to the demand for natural products and plant based medicines is growing throughout the world. Major chemical constituents of bitter gourd can be more effective than conventional medicines and their non-toxic nature or can be administrated over long period. Bitter gourd of cucurbitaceae is medicinal crop grown worldwide contains several bioactive compounds possess pharmacological and anti-microbial properties. But due to the attack of several microorganisms the crop reduces commercial or trade value. During harvesting, packing and transportation various kinds of mechanical injuries can be seen which facilitate the entry of several saprophytic and pathogenic microorganisms. In this review article a study on ethnobotanical uses, phytochemical constituents and pharmacological activity associated with plant was studied.

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