

***Momordica dioica* Roxb (Spine Gourd)- An underutilized vegetable and medicinal plant in Sri Lanka**

M.G.W.K. Weerasinghe and N. Dahanayake*.

Department of Agriculture Biology, Faculty of Agriculture, University of Ruhuna, Sri Lanka

*Email: daha_27@yahoo.com

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ABSTRACT

Momordica dioica Roxb belongs to the family Cucurbitaceae is a wild, perennial and creeping plant growing in the tropical and subtropical countries; Pakistan, China, India, Nepal and Sri Lanka. It is well known as folk medicine and nutritious vegetable as it contains various nutrients and phyto-chemicals with huge medicinal value. Different plant parts of *M. dioica* provide a number of phyto-constituents; alkaloids, steroids, triterpenoids, flavonoids, glycosides, ursolic acid, vitamins, minerals and rich in fibre. They are potential to cure asthma, excessive salivation and inflammation caused by lizards, snake bite, elephantiasis, fever, mental and digestive disorders and maintain skin health. According to the indigenous knowledge spine gourd plays a vital role in reducing various disorders like urinary disorders, digestive disease and as a remedy for bleeding. At the present scenario, *M. dioica* is considered as an underutilized, non-neglected plant in Sri Lanka. Extensive identification of *M. dioica* and its phyto-constituents provide huge potential to protect the plant biodiversity and enhance medicinal utilization. The paper highlighted the nutrient content, different uses, botany and cultivation aspects of *M. dioica* which will be helpful for the students and the interested peoples.

Keywords: Green medicine, *Momordica dioica*, phyto-constituents, spine gourd, underutilized vegetables.

INTRODUCTION

Use of synthetic drugs create the global health hazard and enhances the possibility of cancer, diabetes, neurodegenerative disorders. As a remedy for that, there is an urgent need for production of medicines using the natural herbs. Indigenous medicinal provide the favourable solution for the global health hazard by reducing the negative impact of the synthetic drugs (Jha *et al.*, 2017). *Momordica dioica* is a plant that considered as folk medicinal and nutrient rich vegetable. It contains a number specific constitution, called as phyto-constituents (alkaloids, tannins, fixed oil, flavonoids, sterol and amino acids) (Anjana *et al.*, 2020). In Sri Lanka, it is a kind of underutilized vegetable but, according to the Thiruvengadam *et al.* (2011) there is a high demand in East India. It is considered a higher protein containing fruit in the Cucurbitaceous family (Bharathi *et al.*, 2010). Spine gourds are very famous because of native bitter taste, due to the presence of phytochemicals like Triterpenes Momordicin, Lectins, β -Sitosterol, Saponin, Glycosides are few of these alkaloid compound cause for its native bitterness (Jha *et al.*, 2017).

Many researchers pay attention to developed new *Momordica dioica* varieties by up gradating the existing poor qualities. Indira Kantola I (RMF 37) is a new commercial variety developed by the Indira Gandhi Agricultural University in India. It was resistant to the major pest and can have harvest within 35- 40 days after the cultivation (Anjana *et al.*, 2020). In the present situation underutilized useful plants like *Momordica dioica* face the extinction challenge (Dahanayake, 2015). Therefore; there should be proper conservation measures and awareness programme about nutritional and medicinal value of these plants.

BOTANICAL DESCRIPTION

Momordica dioica is a kind of vine, flowers are born during June to July and fruiting period from November to September. Male and female flowers are borne separately, so called as monosexual (Hitinayake *et al.*, 2017). According to the literatures, around 22% of possibility to fruit set under the normal environment conditions and 100% possibility under the hand pollination conditions (Sandilya *et al.*, 2019). Every node produces male and female floral buds. Male buds are produced during the second week of the August and continue to the first week of October. Female flowers are



Fig. 1: Morphology of *M. dioica* leaf (simple leaf with deep lobes)



Fig. 2: Morphology of *M. dioica* fruits (short beak with soft spines)

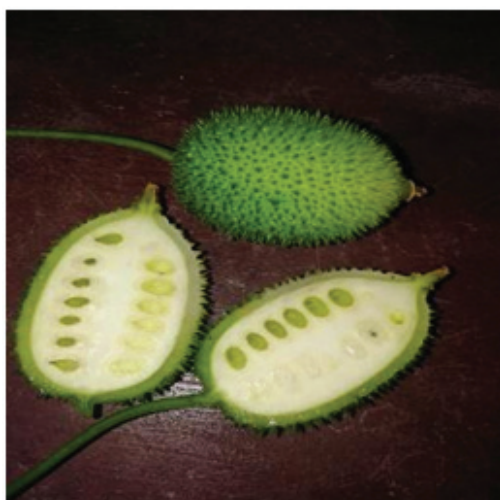


Fig. 3: Longitudinal section of *M. dioica* (axil placentation)



Fig. 4: Cross section of *M. dioica*.



Fig. 5: Morphology of male flower



Fig. 6: Morphology of the female flower

open during the first - second week of September to third week of October (Sandilya *et al.*, 2019). Male flowers are light yellow in colour, long around 2.8 cm. Petals with the shape of oblong or lanceolate and consist of five calyx with linear or lanceolate with five corolla and three stamen. Female flowers consist of small yellow colour bracts having three nectar glands (Bawara *et al.*, 2010). According to Sandilya *et al.*(2019), male flowers are open around 4.00 am and female flowers around 6.00 am. Therefore 5.00-6.00 am is considered as best period for the hand pollination. Fruit sizes are 2-3 cm in diameter and 2.9 to 5 g weight. Fruits are short beaked and exocarp is soft, present the spines (Jha *et al.*, 2017). Pods are green during immature and turn to yellow, light green during maturity (Salvi and Katewa, 2015). Ovules are arranged along the free central column of the fruit and seeds are covered with the regulated and hard endocarp (Tissa *et al.*, 2013) because of that, it shows tolerance against the caterpillars;pumping caterpillar, gall fly and root knot nematodes(Anant *et al.*, 2019).

Leaves are simple and broadly ovate with deep lobes in outline, generally length is in between 3.8 to 10 cm (Bawara *et al.*, 2010). Stem round and branched, furrowed one and elongated tendrils are present (Sandilya *et al.*, 2019).

Utilization of *Momordica dioica*

Several studies have been confirmed that *M.dioica* is a nutritious vegetable and used as folk medicine (Salvi and Katewa, 2015; Nawarathna *et al.*, 2020). According to Bharathi *et al.* (2010), kernels of the seeds are used for the dying oil for varnish industry. Hexane, an extracted compound, showed the anti-feeding effect of *Spodoptera litura*. Seed oil of the *Momordica* shows the insecticidal effect 100% mortality with the 4% seed oil concentration. *M. dioica* contains a number of phyto-constituents, bioactive compounds with numerous properties are important in the western medicinal treatments and used as insecticidal effects too (Table 1).

Table 1: Phyto-constituents of different plant parts of *M. dioica* and their effect

Plant parts	Extracted compound	Effect of each compound
Fruits	Hexane extract	Anti-inflammatory property, Neuro-protective ability
	Methanol extract	Protect the liver cells from damages on hepatocytes , anticancer effect
	n-butanol extract	Reduction of pancreatic lipase activities
	Hexane and ethyl acetate extract	Provide protection against the anti-feeding activity of cotton leaf worm, Anti-diabetic and antidepressant properties
Leaves	Methanol extract	Hepato-protective, Anti-hepatotoxicity effect
	Aqueous extract	Allelopathic activity on seedling growth, seed germination
Root	Alcoholic extraction	Inhibit the formation of free oxygen radical
	Ethanol extraction	Inhibit the growth, Anti-fertility effect
	Methanol	Anticancer effect
Seeds	Seed oil	Provide protectant against <i>Callosobruchus chinensis</i> , Antiallergic effect

(Source: Talukdar *et al.*, 2014; Jha *et al.*, 2017).

Nutritional values

According to the available reports, three triterpenes and two steroids compounds could be isolated from the *M. dioica* fruit (Jha *et al.*, 2017; Talukdar *et al.*, 2014). Phytochemical studies indicated that spine gourd have high nutritional value which contain proteins, triterpenes and high amount of vitamin C, iodine, alkaloid, flavonoids,

glycosides, amino acids and trace of manganese (Talukdar *et al.*, 2014); carotene, thiamine, riboflavin and niacin (Salvi and Katewa, 2015) and good source of chromium and zinc (Talukdar *et al.*, 2014). Results showed that 50g of edible fruit contain 42.1% moisture, 3.35g carbohydrate, 1.9g protein, 1.56 g fat, 1.5g fibre and 0.5 g minerals calcium 16.5 mg, iron 2.3mg and phosphorous 4.21mg (Jha *et al.*, 2017).

Medicinal value

Antioxidant Activity: *M. dioica* have compounds with antioxidant property and have the ability inhibit the formation of oxygen derived free radicals and protect the cells (Anant *et al.*, 2019).

Fruit extracts have diuretic, alexiteric stomachic, laxative, hepatoprotective, and antivenom properties. It is used to cure asthma, leprosy, excessive salivation (Bawara *et al.*, 2010) and to prevent the inflammation caused by lizard, snake bite, fever, mental, digestive disorders and troubles of heart. Because of these properties fruits are used for treating the pimples and acnes on the skin (Talukdar *et al.*, 2014).

Anticancer activity: According to the report of Anjana *et al.* (2020), root extracts have different constitutions with anti-cancer property. Á-spinasterol-3-o-â-D-glucopyranoside is the one of major compound that show effect against the cancer cells (Jha *et al.*, 2017; Talukdar *et al.*, 2014).

Antifertility effect: Talukdar *et al.* (2014), mentioned that *M. diocia* have effect on anti-fertility. He concluded that fruit extracts have ability to induces the anti-fertility effects on female rats while have no effect on male rats.

Allelopathic activity: *M. dioica* seed oil has naturally insecticidal properties. By spraying the extracted oil on the cereal grain, it provides anti-feed activity against the cereals feed insects (Anjana *et al.*, 2020).

Ayurvedic values

Ancient peoples used *M. dioica* as a folk medicine other than the vegetable (Anjana *et al.*, 2020). Spine gourd root juices contain the antidiabetic, anti-inflammatory effect and extract of the spine gourd leaves applying on the head is better treatment for the headache. When applied, root extracts over the whole body provides the superficial effect for high fever. Oral administration of the leaf past is used for many skin diseases as pimples, acnes and softening the skin (Talukdar *et al.*, 2014). *M. diocia* is the most effective nutrient vegetable for the children, lactating and pregnant mothers because, it creates good strength on the immune system in the body (Salvi and Katewa, 2015), used to treatment the eye diseases and as a medicine for diabetes (Jha *et al.*, 2017).

Cultivation

It is a worm seasonal crop, successfully cultivated in the subtropical and tropical regions.

Plenty of sunshine and low humidity conditions with well drained sandy loam soil with neutral pH value (between 5.5- 6.5) provide a comfortable zone for the plant growth. Around 27- 33°C is ideal condition for the maximum growth and yield of the plant (Ponnusamy and Balusamy, 2019). Before planting, the land should be well ploughing with organic manure or farm yard manure. The plant spacing will be at 1-2 m between two plants and seeds are sown at a depth of 1-2 cm. Plants are highly susceptible to water logging and also affected by drought condition. Insect and pest damage is correlated with the environment factors. Insect pests population is more during August-September and make considerable damage to the plants (Anant *et al.*, 2019). Fruit fly (*Bactrocera cucurbitae*) are the most devastating group of pests that affect on the potential yield of the *Marmodica*. Red pumpkin beetle, leaf eating caterpillar, cucumber moth and hairy caterpillar are some of threatening insects for the *dioica* (Anant *et al.*, 2019).

Propagation

M. dioica can be propagated by seeds, cutting (Nawarathna *et al.*, 2020) or tuber (Jha *et al.*, 2017). Seeds have dormancy for 5-6 months. Dipping the seeds in water for a day at the 30°C showed better germination (Thiruvengadam *et al.*, 2011). The cutting of terminal vine with 2-3 nodes is the best portion for easily rooting (Ponnusamy *et al.*, 2019). 70-80 days after sowing plants reach commercial maturity (Anjana *et al.*, 2020). Tissue culture is another propagation way that was identified recently. There are four types of explants, *M. dioica* node, shoot tip, leaf and the cotyledon; cotyledons are the best propagating material. MS media with the combination of 0.1mg/1NAA and 1.0mg/1BAP shows the best performances for the callus formation. MSHP +Ads+ IBA +Agar are the best combination treatment combination for root development (Deokar *et al.*, 2003). Other than conventional breeding methods, direct organogenesis is the novel method for the propagation of *diocia* (Thiruvengadam and Chung, 2011).

Conclusion

Nearly 90% of global food demand is fulfilled by the few of dominated crops worldwide. Another 10% is covered by the rest of the crop types, which

are considered as the underutilized and non-neglected crops. The majority of these underutilized crops have significant nutritional and the health benefits. Also have a long history as its uses in the Ayurvedic industry. Most of these underutilized crops are dominant in the rural agriculture and provide to the rural household income, food and nutritional security. *M.dioica* is a medicinal and nutritious vegetable with capability to grow in the limited space even as a potted plant with simple potting media.

M. dioica is a kind of wild relative of *Momordica* plant spp, there are a number of identified poor qualities such as small size fruit, low yield, flowers ratio are not synchronized properly resulting yield of low quality and quantity. Breeders should pay their attention to develop the new *dioica* spp, by replacing the unwanted wild features. As the fruits are seasonal and limited availability, there is huge potential to prepare the value added and nutritious products.

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