MOMORDICA CHARANTIA (BITTER GOURD), A POTENT ANTIDIABETIC PHYTOMEDICINE
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Introduction
Bitter gourd (Momordica charantia L.) known also as bitter apple or bitter melon, is a tropical vine belonging to the family Cucurbitaceae and genus Momordica. The plant is cultivated as medicinal as well as vegetable crop widely in India, China and South East Asia (Behera et al. 2008). Even bitter gourd is mainly grown for its fruit part. Fruits, flowers and young shoots are used as flavouring agents in various Asian dishes. However, in Indian cuisines, fruits are mainly used after blanching or par boiling or soaking in salt water to reduce bitterness (Saeed et al. 2018). It is considered widely as a folk lore medicine against diabetes amongst the indigenous population of Asia, South America, India and East Africa (Joseph & Jini 2013). Apart from fruits, the roots, leaves and vines are used as a suppressant for tooth ache, diarrhoea and furuncle. Various products of bitter gourd like bitter gourd tea, which is known as herbal tea made from dried slices of bitter gourd, is gaining popularity as herbal medicine (Jia et al. 2017). Researches have proved that bitter gourd contains an insulin like principle which is often being designated as plant insulin, which has positive effects in lowering the blood and urine glucose content (Janagal et al. 2018). All part of the plants mainly the fruits and seeds, contain more than 60 phyto-medicines active against more than 30 diseases including cancer and diabetes (Kole et al. 2020). In general, the plant is a monoeocious slender, tendril climbing annual vine of almost 2 to 4 m high. The plant possesses characteristic leaves with serrate margins which typically giving a look like bites. Each plant has separate yellow coloured male and female flowers. Different varieties of bitter gourd have different shapes of fruits, being discoid or ovoid or ellipsoid to oblong and pointed towards the end (Kole et al. 2020). Usually fruits are 2 to 10 cm long. The exterior of the fruits are warty and the cross section is hollow with a thin layer of flesh. Flattened seeds and pith are seen in the central cavity which is surrounded by the thin flesh layer.
Nutritional Composition of Bitter Gourd

Momordica charantia (bitter gourd or bitter melon) contains several phytonutrients and bioactive compounds like, Water, Lipids, Carbohydrates, Proteins, Fiber, Ash, Phosphorus, Calcium, Iron, Magnesium, Potassium, Sodium, Zinc, Manganes, Copper, Vitamin as carotenes, Vitamin Thiamine, Riboflavin, Niacin. (Adapted from Behera et al. 2008; Nagarani et al. 2014; Sorifa 2018; Saeed et al. 2018). Phenolic compounds- Flavonoids such as catechin, epicatechin Non flavonoids such as gallic acid, gentistic acid, chlorogenic acid, tannic acid, tannins, (Ullah et al. 2011; Ingle & Kappatge 2018; Nagarani et al. 2014; Mahwish et al. 2018). Carotenoids - Lutein, α & β carotene, zeaxanthin, β cryptoxanthin, lycopenes, Fruits-(Shubha et al. 2018). Cucurbitane Triterpenoids like Charantin, kugucains, monomordicine I, II and III, Karavilagenin A, B, C, D, E, sapogenins (triterpenoid glycosides), goyasaponins, sapogenins such as diosgenin- Fruits and Leaves (Ullah et al. 2011; Ingle & Kappatge 2018; Ummi et al. 2018; Shubha et al. 2018; Mahwish et al. 2018; Li et al. 2015) Phytosterols- Decortinone, clerosterol, ergosterol peroxide, stigmasterol, campesterol, β sitosterol - Fruits- (Ullah et al. 2011; Ummi et al. 2018; Shubha et al. 2018; Kim et al. 2013). Alkaloids- Fruits & Leaves, Seeds (Shubha et al. 2018; Ingle & Kappatge 2018; Mahwish et al. 2018).

Anti-Diabetic Properties of Bitter Gourd Fruit

Diabetes mellitus is a metabolic disorder of multiple causes characterized by chronic hyperglycemia with disturbances of carbon rate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. The effects of diabetes mellitus include long-term damage, dysfunction, and failure of various organs [1]. Diabetes mellitus is divided into three main types [1–5]. Type 1 diabetes (insulin-dependent diabetes mellitus) is an autoimmune disorder developing when insulin-producing cells of the pancreas have been destroyed and the pancreas produces little or no insulin. A person who has type 1 DM must take insulin daily to live. It develops most often in children and young adults. Type 2 diabetes has also been known as another term "insulin-independent diabetes mellitus" which accounted for more than 90% of diagnosed cases of DM in adults. It is a diagnosis in which the pancreas produces enough insulin but the body cannot use the insulin effectively, a condition called insulin resistance. Gestational diabetes mellitus (GDM) is a degree of glucose intolerance with onset after the third trimester of pregnancy. GDM is caused by the hormone of pregnancy or shortage of insulin. GDM is one of the most common disorders of metabolism during pregnancy. Diabetes mellitus is a metabolic disease characterised by hyperglycaemia resulting from defects in insulin secretion, insulin action or both. M. charantia is a traditional remedy used since ages for management of diabetes in alternative and complementary medicine. Extensive research has been conducted to identify the compounds and the mechanism of anti-diabetic activity attributed to the bitter gourd is enlisted.

Shetty et al. 2005. In vivo trial in streptozotocin induced diabetic rats. Treatment given Bitter gourd in powder form incorporated at 10% level at expense of equivalent amount of corn starch in AIN 76 basal diet for 45 days. Results obtained to improved diabetic status by significantly reducing in glomerular filtration rate;

Klomann et al. 2010. In vivo study in insulin resistant db/db mice, Administration of whole fruit powder, a lipid fraction, a saponin fraction or the hydrophilic residue of bitter gourd at a daily dosage of 150 mg/kg body weight for 5 weeks. Lower glycated Hb level in all treatment groups. Saponin and lipid fraction treated group shown reduced lipid peroxidation in adipose tissue and reduced protein tyrosine phosphate 1 B (PTB 1 B) activity in skeletal muscles (first study to demonstrate PTB 1 B regulation).

Fuangchan et al. 2011. Multicentre, randomised, double blind, active control trial in newly diagnosed type 2 diabetes patients, Bitter melon capsule with 500 mg of dried powder of fruit pulp containing 0.04 – 0.05 (w/w) of charantin at the rate of 500/1000/2000 mg bitter melon per day and 1000 mg metformin per day for 4 weeks. Modest hypoglycaemic effect and significant reduction in fructosamine levels from baseline in 2000 mg treated patients. But less effect than metformin 100 mg per day.

Devaki & Premavalli et al. 2014. Randomised clinical trial on diabetic patients treatments given 45 ml of bitter gourd fermented beverage as a morning drink. Significant improvement in reducing symptoms of diabetes reduced fasting and post prandial blood sugar.

Abas et al. 2015. In vivo rat model with induced diabetes with streptozotocin-- Administration of fruit extract at the rate of 1.5 g/kg of rats for 28 days after induction of diabetes– Improved vascular compilation by decreasing
blood pressure, serum total cholesterol, triglyceride levels, aortic tissue MDA level increased aortic nitrous oxide level.

Salam et al. 2015 Preliminary clinical trial on non-insulin dependent diabetes mellitus patients, Powdered bitter gourd made into a tablet having a polypeptide of 20 mg. Dose of 4 to 6 tablets per day half an hour before meals, t.d.s for 8 weeks—Effective oral adjunct hypoglycemic effect without no reportable clinical side effects.

Poovitha & Parani 2016, In vitro alpha amylase and alpha glucosidase activities treatment given Spectrophotometric assay of protein extracts from two varieties of bitter gourd. Inhibition of alpha amylase and alpha glucosidase activity on par with acarbose.

Poovitha & Parani 2016, In vivo assay in streptozotocin induced diabetic rats, 10 mg/ kg body weight of protein extract from bitter gourd cultivars was fed to rats. Blood drawn after 10, 30, 60 and 120 min of oral administration results a Significant reduction in peak blood glucose and area under the curve.

Yousaf et al. 2016, In vivo study on diabetes induced mice by streptozotocin an aqueous and ethanol extracts of bitter gourd at the rate of 200 mg / kg weight of mice for 3 weeks—Significant reduction in blood glucose level.

Mahwish et al. 2018, In vivo study in high sucrose diet induced diabetic rats, skin, flesh and fruit powder at the rate of 150 and 300 mg / kg body weight for 56 days—Decrease in blood glucose level & increasing serum insulin level at the rate of 30 mg.

Krawinkel et al. 2018, Randomized placebo controlled single blinded clinical trial with 52 individuals with prediabetics—Daily bitter gourd consumption of 2.5 g of powder over a course of 8 weeks: Cross over design, 8 weeks for each study period & 4 weeks wash out. Lowered fasting plasma glucose.

Conclusion
Bitter gourd is a wonder fruit which has nutritional and functional properties but due to its bitter taste, usage among population is limited. Not only the fruit but other parts of the plant also have proven functional attributes. In vitro and in vivo studies have also extensively investigated bioactive properties such as anti-diabetic, anti-cancer, hypo cholesterolomic, anti-dementia activities among others. Among the several investigations bitter gourd is used for the treatment and prevention of diabetes. Proper clinical trials are proven mostly in vitro and in vivo required to know the efficient and effective positive effects of these properties on human systems.

Funding
No Funding

Conflict of Interest
Not Declared

Inform Consent and Ethical approval
Not Required

Author Contribution
All authors are contributed equally.

References


