



Turning Bitter Into Better: The Secret Powers of Bittergourd

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Bitter gourd is a tropical vine grown mainly in India, China and South East Asia. The plant is cultivated mainly for its fruit part which is edible. Bitter gourd is unaccepted widely due to its bitter taste. Nevertheless, the fruit is a source of several key nutrients. The plant, as a whole contains, more than 60 phyto-medicines that are active against more than 30 diseases, including cancer and diabetes. Currently, the incorporation of the bioactive compounds isolated from bitter gourd into functional foods and beverages finds a new horizon. Nanoencapsulation and novel green extraction methods can be employed to improve the yield and quality of extracted compounds and their stability while incorporation into food products. The present review is an attempt to throw light to nutritional aspects, various bioactive compounds present and important nutraceutical properties of the bitter gourd plant in detail.

Keywords: *Momordica charantia L*, nutritional profile, bioactive compounds.

Introduction

Bitter gourd (*Momordica charantia L*) known also as bitter apple or bitter melon or balsam pear, is a tropical vine belonging to the order Cucurbitales, 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 though whole plant is palatable in nature, bitter gourd is mainly grown for its fruit part. It is considered widely as a folk lore medicine against diabetes amongst the indigenous population of Asia, South America, India and East Africa. 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 (K. S. Gayathry & Jenny Ann John. 2022).

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. It has also been shown to have anti-cholesterol, anti-cancer, anti-dementia, anti-bacterial & anti-fungal, antioxidant and anti-inflammatory activities. 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. The present review covers nutritional aspects of bitter gourd plant, important nutraceutical properties attributed to the bitter gourd and various studies conducted to prove it (K. S. Gayathry & Jenny Ann John. 2022).

Nutritional Profile

Bitter gourd is an often discarded vegetable, due to its bitter taste despite the fact that it is a source of several key nutrients. It has a higher nutritional value than other cucurbits such as squash, pumpkin, cucumber and zucchini owing to its high mineral and vitamin content (Krawinkel & Keding 2006). The fruit is rich in vitamins namely vitamin A, vitamin E, thiamine, riboflavin, niacin, folate and vitamin C. Similarly, it also has high amount of

potassium, iron, calcium, magnesium, phosphorous and zinc. It contains a good amount of dietary fiber. Detailed nutritional composition of bitter gourd fruit:

Constituents	Amount
Water (%)	83.2 – 92.4
Lipids (%)	0.1 – 1
Carbohydrates (%)	4.2 – 9.8
Proteins (%)	1.6 – 2.9
Fiber (%)	0.8 – 1.7
Ash (%)	7 – 18
Calcium (mg/100mg)	20 – 50
Phosphorus (mg/100mg)	70 – 140
Iron (mg/100mg)	2.2 – 9.4
Magnesium (mg/100mg)	16
Sodium (mg/100mg)	3 – 10
Potassium (mg/100mg)	8 – 170
Zinc (mg/100mg)	0.1
Manganese (mg/100mg)	0.08 – 0.32
Copper (mg/100mg)	0.18 – 5
Vitamin A as carotenes	210 – 220IU
Vitamin C	70 – 120 mg
Thiamine (mg)	0.05
Riboflavin (mg)	0.03
Niacin (mg)	0.4

The calorific value for leaf, fruit and seed were 213.26, 241.66 and 176.61 kcal / 100 g respectively. Vitamin C is one of the abundant compounds in the plant. It was pointed out that leaf contains an average of 205 mg/100 g DW and fruits contain an average of 2022 mg/100 g DW and also noted that the content was higher in young stage fruits. The seeds of bitter gourd also are a rich source of quality proteins and they meet amino acid requirements/standards laid down by FAO/WHO/UNU for preschool children. The bitter gourd seeds contain 35 to 40% of oil with fatty acid profile containing monounsaturated fatty acids (3.33%), saturated fatty acids (36.71%) and poly unsaturated fatty acids (59.96%) (Saeed et al. 2018). Bitter gourd is one of the few edible fruit which contains conjugated α linolenic acid in its seeds. The presence of a long chain PUFA, α eleostearic acid has been reported in bitter gourd seed oil. They are one of the naturally best sources of chromium (5.65 mg / 100 g) and zinc (45.45 mg / 100 g) (Saeed et al. 2018).

Bioactive Compounds Present In Bitter Gourd

The primary metabolites in bitter gourd are common sugars, proteins and chlorophyll while secondary metabolites are phenolics, carotenoids, cucurbitane triterpenoids, alkaloids, saponins etc. Secondary metabolites are responsible for the nutraceuticals properties of bitter gourd which scarcely contribute to the nutritional value but produce beneficial physiological effects in the body. Around 228 different compounds were identified from different parts of *M. charantia* and the important compounds are:

Broad category	Compounds identified	Plant parts
Phenolic compounds	Flavonoids such as catechin, epicatechin	Fruits
	Non flavonoids such as gallic acid, gentisic acid, chlorogenic acid, tannic acid, tannins	Leaves Stem
Carotenoids	Lutein, a & carotene, zeaxanthin, cryptoxanthin, lycopene	Fruits

Cucurbitane Triterpenoids	Charantin. Kuguacins A – S, momordicine and, Karavilagenin A, B, C,D,E, saponins (triterpenoid glycosides), goyasaponins, sapogenins such as diosgenin	Fruits Leaves
Phytosterols	Decortinone, clerosterol, ergosterol peroxide, stigmasterol, campesterol, sitosterol	Fruits
Alkaloids		Fruits, Leaves Seeds

Aqueous extract of bitter gourd contained carbohydrates, proteins, amino acids, sterols, flavonoids, phlobatannins, terpenoids, cardiac glycosides and saponins. Qualitative tests found out the presence of carbohydrates, proteins, amino acids, phenolics, saponins, sterols, alkaloids, cardiac glycosides, cholesterol and phlobatannins in the ethanolic extract of bitter gourd. The essential oil obtained from the seeds of *M. charantia* was analyzed by GC/MS and 25 constituents representing 90.9% of the oil were identified; the main constituents being *trans*- nerolidol, apiole and *cis* – dihydrovarveol. Kumari et al. (2017) concluded that the phytochemical composition of bitter gourd genotypes exhibited genetic diversity in phytochemical composition in flesh of bitter gourd and this variation may be due to genotype, level of phytochemicals present in genotypes, agro climatic condition and other agricultural practices (K. S. Gayathry & Jenny Ann John. 2022).

Health Benefits

Hypoglycemic Activity: Contains astringent chemicals that have a hypoglycemic impact and lower blood sugar levels. These compounds work in tandem with polypeptide-P, also known as plant insulin. Charantin, vicine, glycosides, and karavilosides are some of these substances. Another bioactive substance found in bitter melon is lectin, which binds two insulin receptors together to provide insulin-like activity.

Blood Impurities: Bitter gourd is utilized to purify blood because of its bitter tonic properties. It can be used to treat boils and other blood problems related to the skin.

Respiratory Issues: Equal parts of the tulsi leaf paste are combined with the bitter melon leaf paste. This is taken every morning with honey to treat and prevent respiratory conditions like pharyngitis, bronchitis, asthma, and common colds.

Skin Infections: In case of scabies, ringworm, psoriasis, and other skin conditions require the morning consumption of one cup of bitter melon juice on an empty stomach. You can increase the strength of this juice by mixing in a teaspoonful of lime juice. It is also used in prevention of leprosy in vulnerable regions of the world.

Antioxidant Activity: The antioxidant properties of carotenoids protect humans from carcinogens and mitigate free radical effects associated with heart disease.

Antifertility Effects: The bitter gourd's fruit and leaves should not be consumed in excess since it can lower sperm production. When given to dogs and guinea pigs, ethanol seed extracts from bitter gourd have also demonstrated to have strong antifertility effects on males.

Anti-cancerous and Anti-tumorous Activity: Karela contains a new phytochemical that has been clinically shown to have the ability to inhibit the guanylate cyclase enzyme. This enzyme is thought to be linked to the pathogenesis and replication of not only psoriasis, but leukemia and cancer as well.

Antiviral Activity: In recent years, a number of chemical components have been isolated from bitter gourd, such as c-momorcharin, which inactivates ribosome function and stimulates MAP30 (Momordica anti-HIV protein) production, which, in turn, simultaneously suppresses HIV (human immunodeficiency virus) activity.

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. Numerous researches had identified the bioactive

compounds present in the bitter gourd and different parts of the plant. In vitro and in vivo studies have also extensively investigated bioactive properties such as anti-diabetic, anti-cancer, hypocholesterolemic, anti-dementia activities among others. Various novel technologies and concepts like nanoencapsulation and green extraction methods enhance the possibilities of bitter gourd as a functional food thereby adding the need of value addition. However, researches are still at its infancy. The applications of bitter gourd and the identified phytochemicals in food and pharmaceutical industries are yet to be explored widely. The long term effects of consumption of bitter gourd have not been studied and moreover the bioactivities are proven mostly in vitro and in vivo trials. Proper clinical trials are required to know the efficient and effective positive effects of these properties on human systems.

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