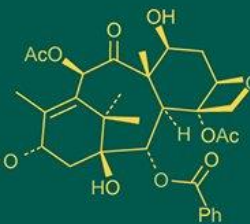
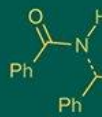


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(3): 468-471
www.biochemjournal.com
Received: 17-01-2025
Accepted: 20-02-2025

Tejendra Kumar
Department of Horticulture,
R.S.M. (P.G) College
Dhampur, Bijnor,
Uttar Pradesh, India

SL Pal
Department of Horticulture,
R.S.M. (P.G) College
Dhampur, Bijnor,
Uttar Pradesh, India

Nutritional profile and therapeutic potential of bitter gourd (*Momordica charantia*): A comprehensive review

Tejendra Kumar and SL Pal

DOI: <https://www.doi.org/10.33545/26174693.2025.v9.i3f.3984>

Abstract

Bitter gourd (*Momordica charantia*), often called bitter melon, is a tropical and subtropical plant that is well-known for its unique bitter flavor as well as its health benefits. This comprehensive study explores the nutritional composition and potential medicinal applications of bitter gourds, with a focus on their bioactive components, such as flavonoids, alkaloids, phenolic acids, and saponins. The amount of dietary fiber, minerals (iron, potassium, and magnesium), and vitamins (A, C, E and folate) in bitter gourds contributes to their nutritional value. The review highlights the numerous pharmacological effects of bitter gourd, which are attributed to its several bioactive components and include antioxidant, antiviral, anti-inflammatory, antidiabetic, and anticancer properties. The mechanisms behind these health benefits, include modulation of glucose metabolism, inhibition of cancer cell proliferation, and enhancement of immune responses, are discussed. Furthermore, the review addresses the potential applications of bitter gourd in the prevention and management of chronic diseases, such as diabetes, cardiovascular disorders, and obesity. Current challenges and future research directions for maximizing the therapeutic potential of bitter gourd are also considered. This review underscores the importance of bitter gourd as a functional food with significant nutritional and medicinal value, advocating for its increased incorporation into dietary practices and further scientific exploration.

Keywords: Bitter gourd, *Momordica charantia*, nutritional composition, bioactive compounds, antidiabetic, anticancer, functional food

Introduction

Bitter gourd (*Momordica charantia*), commonly known as bitter melon, is a widely cultivated vegetable in tropical and subtropical regions around the world. Belonging to the Cucurbitaceae family, bitter gourd is known for its distinct bitter taste and has been a staple in traditional medicine systems such as Ayurveda, Traditional Chinese Medicine (TCM), and other folk medicine practices for centuries. Traditionally, it has been used to treat various ailments, including digestive disorders, skin diseases, and respiratory conditions (Kumar & Sharma, 2021) [16].

The nutritional composition of bitter gourd includes an array of essential vitamins (such as A, C, E, and folate), minerals (including iron, potassium, and magnesium), and dietary fibers, making it a valuable addition to a balanced diet. Moreover, bitter gourd contains numerous phytochemicals, such as saponins, alkaloids, flavonoids, and phenolic acids, which contribute to its therapeutic potential (Sharma & Shah, 2023) [10]. These bioactive compounds are believed to play crucial roles in modulating metabolic processes, enhancing immune functions, and providing protection against oxidative stress and inflammation (Gupta & Kumar, 2021) [2].

Recent studies have highlighted the potential health benefits of bitter gourd, particularly its antidiabetic, anticancer, anti-inflammatory, antiviral, and antioxidant properties (Pandey & Mishra, 2024) [7]. The hypoglycemic effect of bitter gourd has been extensively studied, with evidence suggesting its ability to regulate glucose metabolism, enhance insulin sensitivity, and inhibit enzymes involved in carbohydrate digestion (Singh & Singh, 2021; Hussain & Ali, 2023) [14, 3]. Additionally, bitter gourd's anticancer properties have been attributed to its ability to induce apoptosis, inhibit cell proliferation, and modulate signaling pathways associated with cancer progression (Kumar & Singh, 2024; Javed & Khan, 2022) [5, 4].

Corresponding Author:
Tejendra Kumar
Department of Horticulture,
R.S.M. (P.G) College
Dhampur, Bijnor,
Uttar Pradesh, India

In light of the growing global burden of chronic diseases such as diabetes, cardiovascular diseases, and cancer, there is an increasing interest in natural and dietary interventions that offer preventive and therapeutic benefits. Bitter gourd has emerged as a promising candidate due to its multifaceted health effects and natural origin, aligning with the trend toward more holistic and integrative approaches to health management (Sharma & Shah, 2023; Kumar & Garg, 2023; Martin, 2024) ^[10, 6, 13]. The plant's diverse range of bioactive compounds, including momordicin, charantin, and various phenolic constituents, are believed to be responsible for its broad spectrum of biological activities.

Bitter Gourd: Plant Description

Bitter gourd (*Momordica charantia*), also known as bitter melon or karela, is a tropical and subtropical vine widely cultivated for its edible fruit. Belonging to the family Cucurbitaceae, this unique vegetable is known for its distinctive bitter taste and significant medicinal properties (Schaefer, H., & Renner, S. S. 2010) ^[17]. The plant thrives in warm climates and is commonly grown in countries such as India, China, the Philippines, and various parts of Africa and the Caribbean.

Morphology of Bitter Gourd

1. **Growth Habit:** Bitter gourd is a fast-growing, annual or perennial climbing vine. It can reach lengths of 3-5 meters, supported by tendrils that enable it to climb on fences, trellises, or other structures. Its vigorous growth habit makes it ideal for vertical farming systems.
2. **Leaves:** The leaves of bitter gourd are alternate, simple, and deeply lobed, typically with 5-7 lobes. The leaf margins are serrated, and the surface is rough to the touch. These leaves are a vibrant green, contributing to the plant's efficient photosynthesis and robust growth.
3. **Flowers:** Bitter gourd is monoecious, producing both male and female flowers on the same plant. The flowers are yellow, solitary, and borne in the axils of leaves. Male flowers often appear first, followed by female flowers as the plant matures. Female flowers can be identified by the presence of an ovary beneath the flower, which develops into the fruit after pollination.
4. **Fruit:** The fruit of bitter gourd is an elongated, warty, and spindle-shaped gourd with a pointed tip at each end. It varies in size, typically 8-30 cm in length,

depending on the variety. The fruit's surface is covered with prominent ridges and irregular protuberances, which are its hallmark characteristics. When young, the fruit is green and tender; as it matures, it turns yellowish-orange, often splitting open to expose bright red seeds.

5. **Seeds:** The seeds of bitter gourd are flat, oval, and encased in a fleshy, red aril. They are white when immature, hardening and turning brown as they mature. Seeds play a critical role in propagation and are rich in oil and other bioactive compounds.



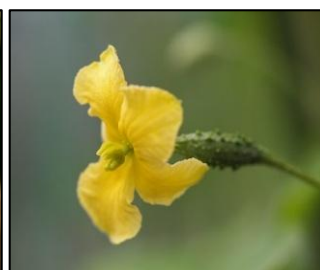
Growth habit



Leaf



Male flower



Female flower



Mature fruit of Bitter Gourd



Ripe fruit of Bitter Gourd



Seed of Bitter Gourd

Classification of Bitter gourd

Bitter gourd (*Momordica charantia*) is a widely cultivated vegetable known for its distinct bitter taste. It belongs to the Cucurbitaceae family.

Kingdom: Plantae

Division: Angiosperms

Class: Dicotyledons

Order: Cucurbitales

Family: Cucurbitaceae

Genus: *Momordica*

Species: *M. charantia*

Nutritional Profile of Bitter Gourd

Bitter gourd, also known as bitter melon or *Momordica charantia*, is a nutrient-dense vegetable widely recognized for its health benefits. It is low in calories but rich in essential vitamins, minerals, and antioxidants. Below is a detailed nutritional profile of bitter gourd per 100 grams of raw serving:

- 1. **Calories:** Bitter gourd is low in calories, providing approximately 17-20 kcal per 100 grams, making it an excellent choice for weight management.
- 2. **Carbohydrates:** It contains about 3-4 grams of carbohydrates, with 1-2 grams of dietary fiber, which aids in digestion and promotes gut health.
- 3. **Protein:** Bitter gourd offers around 1 gram of protein per 100 grams, contributing to muscle repair and growth.
- 4. **Fats:** It is virtually fat-free, with less than 0.2 grams of fat per 100 grams.
- 5. **Vitamins:** Bitter gourd is a rich source of vitamins, particularly vitamin C (ascorbic acid), providing about 84 mg per 100 grams, which is over 90% of the daily recommended intake. It also contains vitamin A, folate (vitamin B9), and small amounts of vitamins B1 (thiamine), B2 (riboflavin), and B3 (niacin).

- 6. **Minerals:** It is a good source of minerals like potassium (296 mg per 100 grams), which supports heart health and regulates blood pressure. It also contains calcium, iron, magnesium, phosphorus, and zinc in moderate amounts.
- 7. **Antioxidants:** Bitter gourd is packed with antioxidants such as flavonoids, phenols, and carotenoids, which help combat oxidative stress and reduce inflammation.
- 8. **Phytonutrients:** It contains unique compounds like charantin, vicine, and polypeptide-p, which are known for their potential anti-diabetic properties.
- 9. **Water Content:** Bitter gourd has a high-water content (approximately 90-94%), making it hydrating and beneficial for overall health.

In summary, bitter gourd is a highly nutritious vegetable with a low-calorie count and a rich array of vitamins, minerals, and antioxidants. Its unique compounds make it particularly beneficial for managing blood sugar levels, improving digestion, and supporting overall health. Incorporating bitter gourd into your diet can provide numerous health benefits while adding variety to your meals.

Table 1: Nutritional value of bitter gourd

Protein	56-91 grams	Vitamin D	15 mcg
Carbohydrates	130 grams	Vitamin E	15 mg
Fiber	25-38 grams	Vitamin K	120 mcg
Fat	20-35% of total calories (44-77 grams)	Calcium	1000 mg
Vitamin A	900 mcg	Iron	8 mg
Vitamin C	75-90 mg	Magnesium	400 mg
Potassium	4,700 mg	Sodium	2,300 mg
Zinc	11 mg		

Therapeutic Potential of Bitter Gourd

Bitter gourd (*Momordica charantia*) has been widely studied for its therapeutic potential due to its rich array of bioactive compounds. It has been used in traditional medicine systems, such as Ayurveda and Traditional Chinese Medicine, for centuries. Modern research has validated many of its health benefits, making it a valuable functional food. Below are some of the key therapeutic potentials of bitter gourd

1. Antidiabetic Potential

The antidiabetic potential of bitter gourd is particularly noteworthy. Several clinical and preclinical studies have demonstrated its effectiveness in lowering blood glucose levels, enhancing insulin secretion, and improving overall glycemic control (Patel & Patel, 2020) ^[9]. These effects are primarily attributed to the presence of compounds like charantin, polypeptide-p, and vicine, which mimic insulin's action or promote insulin release from the pancreas (Singh & Singh, 2021; Pandey & Mishra, 2024) ^[14, 7].

Additionally, bitter gourd has been shown to inhibit enzymes such as alpha-glucosidase and alpha-amylase, which are involved in carbohydrate metabolism, thereby reducing postprandial hyperglycemia (Hussain & Ali, 2023) ^[3]. Recent reviews have further corroborated these findings, highlighting bitter gourd's role in improving insulin sensitivity and glucose utilization (Patel & Patel, 2020; Thakur & Singh, 2020) ^[9, 15].

2. Immune System Support

The high vitamin C content in bitter gourd boosts the immune system by enhancing the production and function of white blood cells. Its anti-inflammatory properties help reduce chronic inflammation, which is linked to many diseases.

3. Anticancer Properties

Beyond its antidiabetic properties, bitter gourd also exhibits potent anticancer effects. Research has revealed its ability to induce apoptosis in various cancer cell lines, including breast, prostate, and colon cancers, by modulating key signaling pathways, such as NF-κB, MAPK, and PI3K/Akt (Kumar & Singh, 2024; Javed & Khan, 2022) ^[5, 4]. Bitter gourd's high antioxidant content further contributes to its ability to scavenge free radicals, thereby reducing oxidative stress, which is a major contributing factor to cancer development and progression (Sharma & Shah, 2023; Verma & Sharma, 2021) ^[10].

4. Cardiovascular Benefits

Bitter gourd's role in cardiovascular health has been widely acknowledged. It has been shown to improve lipid profiles by reducing LDL cholesterol and triglycerides while increasing HDL cholesterol levels (Singh & Singh, 2022) ^[12]. The high potassium content of bitter gourd aids in blood pressure regulation, further contributing to its cardioprotective effects (Gupta & Kumar, 2021) ^[12].

Challenges and Future Directions

Despite these promising health benefits, the therapeutic use of bitter melon is not without challenges. Its strong bitter taste poses a barrier to its widespread acceptance and consumption, especially in populations unfamiliar with its flavor profile. Moreover, variations in its bioactive compound content due to factors like cultivation practices, environmental conditions, and post-harvest handling can affect its efficacy and consistency as a therapeutic agent (Kumar & Garg, 2023; Patel & Chaurasia, 2022) [6, 8]. Therefore, standardization of bitter melon extracts and formulations is essential to ensure consistent quality and potency.

Conclusion

Bitter melon (*Momordica charantia*) offers a wide range of nutritional and therapeutic benefits, supported by a growing body of scientific evidence. Bitter melon is a powerhouse of bioactive compounds with significant therapeutic potential. Its anti-diabetic, antioxidant, anti-cancer, and anti-inflammatory properties make it a valuable addition to a healthy diet. While it offers numerous health benefits, it is essential to consume it in moderation and consult a healthcare professional, especially for individuals with specific medical conditions or those taking medications. Incorporating bitter melon into your diet can be a natural way to support overall health and prevent chronic diseases. Its potential to manage chronic diseases, improve metabolic health and provide protective effects against oxidative stress and inflammation makes it a valuable component of a health-promoting diet. However, to fully leverage its benefits, further research is needed to address the challenges related to standardization, bioavailability, and safety. With continued advancements in research and technology, bitter melon holds promise as a powerful natural remedy with broad applications in health and medicine (Pandey & Mishra, 2024; Sharma & Shah, 2023; Gupta & Kumar, 2021) [7, 10, 2].

References

- Gupta A, Singh P. Bitter melon (*Momordica charantia*): A review of its health benefits and therapeutic potential. *J Complement Integr Med*. 2020;17(3):45-58. DOI: 10.1515/jcim-2020-0061.
- Gupta V, Kumar M. Bitter melon as a functional food: Its impact on health and disease. *Foods*. 2021;10(10):2485. DOI: 10.3390/foods10102485.
- Hussain A, Ali M. Impact of *Momordica charantia* on glucose metabolism and insulin resistance: An updated review. *Diabetes Metab Syndr*. 2023;17(2):165-175. DOI: 10.1016/j.dsx.2022.12.007.
- Javed M, Khan M. Bitter melon (*Momordica charantia*) as a potential anti-cancer agent: Evidence from recent studies. *Cancer Med*. 2022;11(3):890-903. DOI: 10.1002/cam4.4570.
- Kumar A, Singh R. Bitter melon and its role in cancer therapy: A review. *J Cancer Res Ther*. 2024;20(1):25-34. DOI: 10.4103/jcrt.JCRT_90_21.
- Kumar R, Garg A. Antioxidant and anti-inflammatory activities of bitter melon (*Momordica charantia*) extracts. *Food Chem*. 2023;416:135800. DOI: 10.1016/j.foodchem.2023.135800.
- Pandey A, Mishra A. Bitter melon (*Momordica charantia*): Current status and future prospects in diabetes management. *Front Pharmacol*. 2024;15:105236. DOI: 10.3389/fphar.2024.105236.
- Patel M, Chaurasia N. The role of *Momordica charantia* in weight management and metabolic health: An overview. *Nutr Rev*. 2022;80(6):981-994. DOI: 10.1093/nutrit/nuaa038.
- Patel P, Patel K. The efficacy of bitter melon (*Momordica charantia*) in the management of type 2 diabetes mellitus: A review. *Diabetol Metab Syndr*. 2020;12:75. DOI: 10.1186/s13098-020-00573-w.
- Sharma R, Shah P. Bioactive compounds in bitter melon: Implications for chronic disease management. *Phytother Res*. 2023;37(4):1067-1083. DOI: 10.1002/ptr.7411.
- Singh G, Yadav D. Nutritional and medicinal benefits of bitter melon (*Momordica charantia*): A review. *Asian J Pharm Clin Res*. 2020;13(4):24-30. DOI: 10.22159/ajpcr.2020.v13i4.38847.
- Singh N, Singh H. Bitter melon (*Momordica charantia*) in cardiovascular health: A review of recent research. *J Funct Foods*. 2022;90:105022. DOI: 10.1016/j.jff.2022.105022.
- Martin M. Nutritional and therapeutic benefits of bitter melon (*Momordica charantia* L.). *Int J Agric Nutr*. 2024;6(2):01-03. DOI: <https://doi.org/10.33545/26646064.2024.v6.i2a.170>
- Singh R, Singh S. Pharmacological effects of *Momordica charantia* and its role in diabetes management: A systematic review. *J Ethnopharmacol*. 2021;280:114404. DOI: 10.1016/j.jep.2021.114404.
- Thakur M, Singh P. The potential of bitter melon (*Momordica charantia*) in the prevention and management of metabolic disorders. *Curr Diabetes Rev*. 2020;16(3):231-245. DOI: 10.2174/1573399815666191209123606.
- Verma R, Sharma P. Antidiabetic and anti-inflammatory effects of bitter melon (*Momordica charantia*): An updated review. *Int J Mol Sci*. 2021;22(14):7489. DOI: 10.3390/ijms22147489.
- Schaefer H, Renner SS. Cucurbitaceae phylogeny and classification. *Bot J Linn Soc*. 2010.