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Unveiling Nutritional and Medicinal Benefits of Spine Gourd (*Momordica dioica Roxb.*)

Avantika Iyengar[1], Sakshi Gupta[1], Vishal Chugh[2], Neeraj Kumar[3], Noah N. Khan[4], Ashutosh Singh[1]

[1]RLBCAU, Jhansi 284003, U.P. India
[2]BUA&T, Banda 210001,
[3]BHU, Varanasi 221005,
[4]CSA, Kanpur 208002,
U.P. India

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INTRODUCTION

Spine Gourd (Momordica dioica Roxb.), also known as Teasel Gourd, is an intriguing vegetable with a deep cultural significance and a rich history. Spine Gourd is the native to the Indo-Malayan region. It is well-adapted to the tropical climates of Asia, where it has spread extensively across the Indian subcontinent. This versatile vegetable is cultivated and consumed in several countries, including India, Bangladesh, Sri Lanka, Nepal, Pakistan, and China, each of which values it for its distinctive taste and numerous nutritional benefits (Dahanayake, 2015). In India, the Spine Gourd holds a special place in the culinary traditions of tribal communities and is an integral part of the regional diets. It is primarily cultivated in states such as Karnataka, West Bengal, and the North-Eastern regions of the country. Additionally, it is grown in Orissa, Chhattisgarh, and Maharashtra, demonstrating its adaptability to various climates and soil conditions (Bawara, et al., 2010). The vegetable is known by different names across these regions, reflecting its deep integration into local cultures and cuisines. In Tamil Nadu, it is called Pazhupavakkai; in Kerala, it is known as Kattu Pavakkai; in Karnataka, it is referred to as Madahagalakayi; in Maharashtra, it is named Kartoli; and in Andhra Pradesh and Telangana, it is called Aakakarakayi. Despite its wide distribution and cultural importance, the Spine Gourd is a seasonal vegetable that is typically available in the market only during the monsoon season. This seasonal nature makes it a sought-after delicacy when in season. The Spine Gourd belongs to the Cucurbitaceae family, which includes other well-known vegetables such as bitter gourd (*Momordica charantia*) and cucumber. This family is renowned for its diverse range of edible and medicinal plants. The Spine Gourd is a dioecious, perennial climbing plant with tuberous roots. It is characterized by its distinctive spine-covered fruits, which give it its common name.

The plant's climbing nature allows it to grow vertically, making it well-suited for cultivation in small spaces and on trellises. The fruit is typically green and covered with small, sharp spines, which can serve as a distinguishing feature in local markets (Hitinayake, et al., 2017).

Recently, the Spine Gourd has garnered renewed interest due to its impressive nutritional profile and medicinal properties. It is a rich source of essential nutrients, including vitamins, minerals, and antioxidants, which contribute to its status as a super-food. The vegetable is high in vitamins A and C, both crucial for maintaining healthy skin, vision, and immune function. It also provides significant amounts of minerals such as calcium, iron, and potassium, which are essential for bone health, oxygen transport, and fluid balance. In addition to its nutritional benefits, the Spine Gourd is celebrated for its medicinal properties. Traditional medicine systems, particularly those practiced by tribal communities, have long recognized the vegetable for its therapeutic effects. It is believed to possess anti-inflammatory and antimicrobial properties, making it beneficial in treating various ailments and infections. Its consumption is also thought to aid digestion and enhance overall gastrointestinal health (Salvi & Katewa, 2015). The vegetable's use in traditional remedies and home treatments highlights its integration into local healthcare practices.

Cultivating Spine Gourd is relatively straightforward but requires specific conditions to thrive. The plant prefers warm, tropical climates and well-drained, fertile soils. It is typically grown during the monsoon season, which provides the necessary moisture for optimal growth. Farmers and cultivators in the regions where the Spine Gourd is grown often use traditional agricultural practices, including organic fertilizers and natural pest control methods (Anjana, et al., 2020). This sustainable approach helps maintain the vegetable's quality and supports local farming communities. Despite its potential, the Spine Gourd remains underutilized and has not achieved widespread commercialization. However, growing interest in the vegetable's benefits presents an opportunity to expand its availability and promote its use. Increased awareness of the Spine Gourd's nutritional and medicinal advantages could lead to greater adoption and demand, providing economic opportunities for farmers and contributing to its integration into mainstream food systems.

Efforts to enhance the cultivation and marketing of Spine Gourd could include improving post-harvest handling, developing value-added products, and exploring export opportunities. Investment in research and development can help stakeholders better understand the vegetable's potential and identify strategies for increasing its market presence. Educational campaigns can also play a crucial role in helping consumers recognize the benefits of incorporating Spine Gourd into their diets, further driving demand (Sandilya. et al., 2019). However, the Spine Gourd (Momordica dioica Roxb.) is a unique and valuable vegetable with a rich cultural heritage and significant health benefits. Its origins in the Indo-Malayan region and widespread distribution across Asia underscore its importance in traditional diets and practices (Bharathi, et al., 2010). The recent resurgence in popularity highlights the vegetable's nutritional and medicinal potential. By addressing commercialization challenges and promoting its benefits, the Spine Gourd has the opportunity to make a meaningful impact on global food systems and public health. The taxonomic classification of the spine gourd is given in Table 1

Table – 1: Taxonomic classification of *Momordica dioica Roxb.*

Kingdom	Plantae
Clade	Tracheophytes
Clade	Angiosperms
Clade	Eudicots
Clade	Rosids
Order	Cucubitales
Family	Cucurbitaceae
Genus	*Mimordica*
Species	*Dioica*
Botanical name	*Mimordica dioica*

Spine Gourd has substantial demand in local markets but remains under-exploited due to its dioecious nature and reliance on vegetative propagation. Despite these challenges, it holds significant potential to become a commercially valuable crop, offering opportunities to enhance the income of farming communities. Key to successful cultivation is managing the male-to-female ratio to ensure maximum fruit set. In India, various local varieties of Spine Gourd are grown, reflecting regional preferences and adaptations. Additionally, some widely recognized varieties include Indira Kankad–I, developed by Indira Gandhi Agricultural University, Raipur, Chhattisgarh, and Arka Neelachal Sree, which was developed through clonal selection at CHES, Bhubaneswar. These improved varieties are designed to address specific cultivation challenges and maximize yield, paving the way for broader commercialization and increased benefits to farmers (Jha, et al., 2017).

2. Botanical description

Momordica dioica, widely known as the Spine Gourd, is a perennial climbing plant with a chromosome number of 2n=28. This unique vegetable features a flowering period from June to July and a fruiting phase starting in September, extending through the season. As a dioecious plant, it requires separate male and female individuals for reproduction, which can pose challenges for fruit set. Research shows that under typical environmental conditions, fruit set is around 22%, but with hand-pollination, it can reach up to 100%.

Male buds appear in the second week of August and persist until early October, while female flowers are present from the first to the second week of September and remain open until late October (Nawarathna, et al., 2020). Male flowers are light yellow with oblong petals and a floral structure consisting of five calyces, five corollas, and three stamens. Female flowers are characterized by small yellow bracts with three nectar glands (Bawara et al., 2010). The ideal time for hand pollination is between 5:00 am and 6:00 am.

The Spine Gourd produces relatively small fruits, ranging from 2 cm to 3 cm in diameter and weighing between 3 g and 5 g. The fruits are short-beaked with a soft exocarp, covered in distinct spines or green hairs (Jha et al., 2017). Immature fruits are green, transitioning to yellow and light green as they mature (Ponnusamy, J. and Balusamy, 2019). Inside the fruit, ovules are arranged along a central column, with seeds protected by a tough, hard endocarp. This durable endocarp helps the fruit withstand pests such as caterpillars, gall flies, and root-knot nematodes enhancing its overall resilience and viability as a crop.

3. Nutritional value

Spine Gourd is a remarkably nutritious vegetable that stands out for its high content of essential nutrients and fibres while remaining low in calories. This rhizomatous vegetable is not only a dietary staple in various cultures but

also a powerhouse of beneficial biomolecules and compounds. The fruits of the Spine Gourd are typically prepared by cooking with spices or pan-frying, enhancing their flavour and nutritional value (Salvi & Katewa, 2015).

Per 100 grams of edible fruit, *Momordica dioica* provides approximately 84.1% moisture, making it a hydrating food choice. It contains 7.7 grams of carbohydrates, 3.1 grams of protein, 3.1 grams of fat, 3.0 grams of dietary fiber, and 1.1 grams of minerals. These components contribute to its role in promoting digestive health, supporting metabolic functions, and providing energy. Additionally, the Spine Gourd offers small but significant amounts of essential vitamins, including ascorbic acid (vitamin C), carotene (vitamin A precursor), thiamine (vitamin B_1), riboflavin (vitamin B_2), and niacin (vitamin B_3). These vitamins play crucial roles in immune function, vision, energy metabolism, and overall well-being (Salvi & Katewa, 2015). Due to its impressive nutritional profile, Momordica dioica serves as a valuable addition to a balanced diet, offering both health benefits and culinary versatility. The nutritional compositions of spine gourd fruit are mentioned in Table–2.

Table–2: Nutritional composition of spine gourd fruits (per 100g on dry weight basis)

Mineral	**Nutrient composition**
Carbohydrate (g)	47.92
Crude Protein (g)	19.38
Crude Lipid (g)	4.70
Crude Fiber (g)	21.30
Calcium (mg)	33.00
Phosphorous (mg)	42.00
Iron (mg)	4.60
Riboflavin (mg)	0.18
Thiamine (mg)	0.05
Calorific Value (kcal)	311.50

4. Medicinal properties

Immature tender green fruits of Momordica dioica are cooked as vegetables, providing a unique flavour and texture to various dishes. The young leaves, flowers, and tuberous roots of this plant are also consumed, adding diversity and nutritional value to culinary applications. Studies have confirmed that M. dioica is not only a nutritious vegetable but also a staple in folk medicine, offering a range of health benefits (Salvi and Katewa, 2015; Nawarathna, et al., 2020). Rich in vitamins, minerals, and antioxidants, this plant contributes significantly to overall health and wellness, making it a valuable addition to any diet.

Additionally, compounds extracted from M. dioica, such as hexane, have demonstrated an anti-feeding effect on Spodoptera litura, a common agricultural pest. This finding highlights the potential of M. dioica in pest management, providing a natural alternative to chemical pesticides. The tuberous gourd is abundant in phyto-

constituents and bioactive compounds, extensively utilized in Western medicine for their therapeutic properties. These include anti-inflammatory, anti-diabetic, and anti-cancer activities, making M. dioica a valuable resource in medical research and treatment (Talukdar & Hossain, 2014).

The phytochemicals listed in the table below can be extracted from various parts of the spine gourd, each offering a broad spectrum of medicinal properties and applications. This multifaceted vegetable plays a significant role in both nutrition and health, illustrating its importance beyond mere dietary inclusion. Its versatility and health benefits make it a noteworthy component of a balanced diet and a potential asset in medical and agricultural fields. With its rich nutritional profile and medicinal potential, M. dioica stands out as an exceptional plant that supports health and combats disease, while also contributing to sustainable agriculture practices (Jha et al., 2017).

5. Pharmaceutical Importance and Health Benefits

5.1. Anticancer activity: The root extracts of Momordica dioica exhibit significant anticancer activity, containing constituents that show promising anti-cancerous properties. Among these, Aspinasterol-3-o-β-D-glucopyranoside has been particularly noted for its effect on cancer cells (Jha et al., 2017; Talukdar et al., 2014). These findings highlight the potential of M. dioica as a source of natural compounds for cancer treatment, contributing to on-going research in developing effective anticancer therapies.

5.2. Antioxidant Activity: Spine gourd is rich in antioxidants such as flavonoids, phenolic compounds, and carotenoids. These antioxidants help neutralize harmful free radicals in the body, reducing oxidative stress and inflammation, which can contribute to overall health and longevity. Fruit extracts of spine gourd possess diuretic, laxative, hepatoprotective, and antivenom properties. It is used in traditional medicine to treat asthma, leprosy, and excessive salivation (Bawara et al., 2010). Additionally, spine gourd helps prevent inflammation caused by lizard and snake bites, fever, mental and digestive disorders, and heart problems (Talukdar et al., 2014). This broad range of therapeutic properties underscores the importance of spine gourd in both dietary and medicinal contexts, highlighting its potential benefits for health and wellness.

5.3. Ayurvedic properties: In Ayurvedic practice, spine gourd is highly valued for its versatility and therapeutic properties. Consumed as a vegetable or incorporated into herbal formulations, spine gourd addresses various aspects of health and well-being. It is particularly noted for its cooling properties, making it an effective remedy for balancing excess Pitta dosha in the body. Pitta dosha, which governs digestion, metabolism, and body heat, can cause issues like acidity and inflammation when in excess. Spine gourd's cooling nature helps to calm these symptoms, providing relief from digestive discomfort and inflammatory conditions. Additionally, spine gourd is believed to possess detoxifying properties, aiding in the elimination of toxins (ama) from the body. This supports the overall purification process, promoting better health and enhancing the body's natural healing abilities. The holistic benefits of spine gourd in Ayurveda underscore its importance in maintaining balance and harmony within the body.

5.4. Improves digestive health: The high fiber content in spine gourd plays a crucial role in promoting healthy digestion. It supports the growth of beneficial gut bacteria, which are essential for maintaining a balanced microbiome and overall digestive well-being. This dietary fiber adds bulk to stools, which helps to facilitate regular bowel movements and prevent constipation. By enhancing digestive health, spine gourd not only aids in smoother and more efficient elimination but also improves nutrient absorption from food. This contributes to overall digestive comfort

and well-being, making spine gourd a valuable addition to a balanced diet. Regular consumption can help maintain digestive regularity, support gut health, and contribute to a healthier lifestyle.

5.5. Diabetes Management: Momordica dioica contains bioactive compounds such as Charantin and Momordin, which have been studied for their potential hypoglycaemic effects. These compounds may help regulate blood sugar levels by enhancing glucose utilization and promoting insulin secretion. Research suggests that these effects could be beneficial for individuals with diabetes or those at risk of developing the condition. By improving the body's ability to manage glucose, spine gourd may offer a natural approach to blood sugar control, supporting overall metabolic health and potentially aiding in the management of diabetes.

5.6. Immune Support: The spine gourd's high vitamin content, particularly vitamin C, along with its antioxidants, plays a significant role in maintaining a healthy immune system. Vitamin C is well-known for its ability to strengthen immune defenses, enhancing the body's ability to fend off infections. Antioxidants in spine gourd further support immune function by neutralizing free radicals, which can otherwise cause oxidative stress and damage to immune cells. Together, these nutrients help to bolster the immune system, improve resilience against illnesses, and promote quicker recovery from infections, contributing to overall health and well-being (Thiruvengadam & Chung, 2011).

5.7. Anti-inflammatory Effects: Certain compounds in spine gourd, particularly some antioxidants, exhibit notable anti-inflammatory properties. Chronic inflammation is a contributing factor to a range of health conditions, including cardiovascular disease, arthritis, and certain cancers. By reducing inflammation, spine gourd may help mitigate these risks, promoting better overall health. Incorporating spine gourd into the diet may therefore offer protective benefits against chronic inflammatory conditions and contribute to a healthier, more balanced lifestyle.

5.8. Weight Management: Spine gourd, being low in calories and high in fiber, is beneficial for weight management. Its high fiber content promotes satiety, helping to control appetite and reduce overall calorie intake. This makes it a valuable addition to a weight-conscious diet. Additionally, spine gourd is nutrient-dense, providing essential vitamins and minerals necessary for health without adding excess calories. This combination of low calorie content and high nutritional value supports a balanced diet and contributes to effective weight management while ensuring adequate intake of vital nutrients.

5.9. Skin Health: Traditionally, spine gourd has been utilized to enhance skin health due to its potent antioxidant and anti-inflammatory properties. These properties aid in treating various skin conditions, including acne, by combating oxidative stress and reducing inflammation, leading to clearer and healthier skin. Additionally, the roasted seeds of ripe spine gourd fruits are known to be beneficial for managing skin conditions like eczema. Ingesting these seeds can provide therapeutic effects, helping to soothe and heal affected skin areas. Overall, spine gourd offers natural support for maintaining and improving skin health through its unique combination of beneficial compounds.

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