



POTENTIALS OF UNDERUTILIZED FRUIT CROPS

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Abstract

Underutilized fruit crops, often referred to as minor, neglected, or underexploited fruits, represent a rich reservoir of biodiversity with immense potential for nutritional security, sustainable agriculture, and climate resilience. Despite their adaptability to marginal environments and resistance to biotic and abiotic stresses, these crops remain largely overlooked in mainstream cultivation, research, and commercialization. Fruits like bael (*Aegle marmelos*), wood apple (*Feronia limonia*), jamun (*Syzygium cumini*), cape gooseberry (*Physalis peruviana* L.), karonda (*Carissa carandas*), and others are nutritionally dense, offering high levels of vitamins, antioxidants, dietary fiber, and bioactive compounds with therapeutic properties. They have traditionally played significant roles in indigenous diets and medicine but are yet to realize their commercial and economic potential. With increasing awareness of functional foods and sustainable farming, underutilized fruits are gaining recognition for their value in diversifying food systems, enhancing farmers' livelihoods, and conserving agrobiodiversity. Integrating these crops into formal value chains, research systems, and policy frameworks can address nutritional deficiencies, promote climate-smart agriculture, and provide alternative income sources for rural communities. This review explores the significance, nutritional richness, health benefits, and commercial prospects of underutilized fruit crops, highlighting the need for focused attention through research, extension, and market linkage development.

Introduction

Underutilized fruit crops, also known as neglected or minor fruits, represent a vast yet overlooked segment of global biodiversity. These

fruits are often native or semi-domesticated species that have been traditionally cultivated and consumed in specific regions but have not received adequate attention in terms of scientific research, commercial exploitation, or policy support (Padulosi *et al.*, 2013). Examples include bael (*Aegle marmelos*), jamun (*Syzygium cumini*), wood apple (*Feronia limonia*), cape gooseberry (*Physalis peruviana* L.), karonda (*Carissa carandas*), tamarind (*Tamarindus indica*), and custard apple (*Annona squamosa*), among others. Despite their remarkable nutritional, medicinal, and ecological attributes, these crops remain underrepresented in mainstream agriculture. Underutilized fruits are often rich in vitamins (A, C, and B-complex), minerals (iron, calcium, potassium), dietary fiber, antioxidants, and bioactive compounds with therapeutic potential (Kumar *et al.*, 2019). Their traditional use in local medicine and diets attests to their health-promoting properties, including anti-diabetic, anti-inflammatory, anti-microbial, and hepatoprotective effects. Furthermore, many of these crops exhibit high adaptability to arid, semi-arid, and degraded lands, requiring minimal external inputs, making them ideal candidates for climate-resilient and sustainable agriculture (Hammer *et al.*, 2001).

The revival and promotion of underutilized fruits align well with current global priorities such as nutrition-sensitive agriculture, climate-smart farming, biodiversity conservation, and livelihood enhancement. However, their limited commercialization, lack of improved varieties, weak supply chains, and low consumer awareness continue to impede their potential. This article aims to explore the untapped potential of underutilized fruit crops in terms of nutritional and medicinal value, environmental

sustainability, and rural economic empowerment. By identifying research gaps, success stories, and future prospects, this review seeks to promote the integration of these crops into national horticultural development strategies and global food systems.

Nutritional and Medicinal Properties

Macronutrient and Micronutrient Profile

Underutilized fruit crops are often nutritionally superior to their mainstream counterparts. They are rich in essential macronutrients such as carbohydrates, dietary fiber, and natural sugars, as well as micronutrients including vitamins (A, C, B-complex) and minerals (iron, calcium, potassium, and magnesium). For instance, bael (*Aegle marmelos*) is an excellent source of vitamin C and fiber, while jamun (*Syzygium cumini*) is known for its high iron and anthocyanin content. Cape gooseberry (*Physalis peruviana* L.) offers abundant carotenoids, vitamin B12 analogs, and potassium. These fruits help combat hidden hunger (micronutrient malnutrition), particularly in low-income and rural populations that lack access to fortified foods or supplements (Arora *et al.*, 2019; Lim, 2012).

Bioactive Compounds and Health Benefits

Many underutilized fruits are naturally rich in bioactive compounds such as flavonoids, tannins, polyphenols, alkaloids, and terpenoids. These phytochemicals exhibit antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, and antimicrobial activities. For example, wood apple (*Feronia limonia*) pulp and seeds are known to reduce cholesterol and improve gut health due to their polyphenol content. Similarly, jamun seed extract has been reported to exhibit potent antihyperglycemic effects, while karonda (*Carissa carandas*) contains high levels of anthocyanins beneficial for heart and eye health (Yadav *et al.*, 2020; Kundu *et al.*, 2021).

Role in Traditional Medicine Systems

In India and other tropical countries, underutilized fruits have been integral to traditional medicine systems like Ayurveda, Siddha, and Unani for centuries. Bael is revered in Ayurveda as a digestive aid and remedy for

gastrointestinal disorders. Jamun is widely used in the treatment of diabetes and oral health problems. Amla (*Phyllanthus emblica*), although now commercialized, has long been a cornerstone of immune-boosting formulations. These uses demonstrate the therapeutic potential of these fruits, warranting further scientific validation and development into nutraceuticals (Sharma *et al.*, 2018; Baliga *et al.*, 2011).

Agro-Ecological Advantages and Adaptability

Drought and Salinity Tolerance

Underutilized fruit crops are often resilient to adverse environmental conditions, making them ideal for cultivation in drought-prone, rainfed, or saline regions. For example, bael and ber (*Ziziphus mauritiana*) trees can thrive with minimal water, while tamarind (*Tamarindus indica*) and wood apple tolerate arid and semi-arid climates. This inherent hardiness reduces the need for irrigation and agrochemical inputs, supporting resource-conserving agriculture and sustainability in climate-vulnerable areas (Padulosi *et al.*, 2013).

Suitability for Marginal Lands

These crops are well-suited for cultivation on marginal or degraded lands where commercial fruit crops fail to thrive. Their deep root systems, low input requirements, and adaptability to diverse soil types enable farmers to convert unproductive areas into economically viable orchards. This makes them valuable for land reclamation programs and inclusive agricultural development (Mayes *et al.*, 2012; Ray *et al.*, 2020).

Biodiversity Conservation

Cultivation and conservation of underutilized fruits play a crucial role in preserving agrobiodiversity. Many of these species are endemic, genetically diverse, and under threat from land-use changes and monoculture practices. By promoting their cultivation, especially through community seed banks and on-farm conservation, genetic resources are protected, contributing to climate resilience and food system stability (Hammer *et al.*, 2003).

Socio-Economic Importance

Role in Food and Nutritional Security

Underutilized fruits provide a valuable source of nutrition, especially during seasonal food shortages or in subsistence farming systems. Their consumption can mitigate malnutrition and enhance dietary diversity among rural and tribal communities. For example, tribal populations in India rely heavily on wild fruits like jamun, mahua, and chironji during food-scarce periods (Narayanan, 2021). Including these fruits in local diets can significantly contribute to meeting Sustainable Development Goal 2 (Zero Hunger).

Livelihood Support for Tribal and Rural Communities

These crops serve as a crucial source of income for small and marginal farmers, especially women and tribal groups. Wild harvesting, seasonal sales in local markets, and small-scale processing into products like jams, beverages, and dried fruit provide employment and cash flow. Initiatives like value chain development and training in postharvest handling can further increase the profitability and sustainability of these livelihoods (Jaenicke & Höschle-Zeledon, 2006; Nair *et al.*, 2017).

Gender Roles in Cultivation and Value Addition

Women often play a central role in the collection, cultivation, processing, and marketing of underutilized fruits. Empowering them through training, cooperative development, and access to credit and technology can enhance household food security and income. In many regions, women-led self-help groups (SHGs) have successfully developed value-added products like bael squash, jamun vinegar, and amla candy, turning traditional knowledge into economic opportunity (Mittal *et al.*, 2021).

Future Prospects and Strategies

Underutilized fruit crops hold immense potential for integration into climate-smart agriculture due to their resilience to drought, salinity, and poor soils, making them ideal for sustainable farming under changing climatic conditions. To unlock their full potential, these

crops should be mainstreamed into national horticultural development programs, with targeted support for varietal improvement, extension services, and infrastructure. Additionally, promoting their nutritional and medicinal value through public health campaigns, school feeding programs, and Farmer Producer Organizations (FPOs) can enhance consumer awareness, drive demand, and create inclusive market opportunities, especially for smallholders and tribal communities.

Conclusion

It represents a valuable yet largely untapped resource for achieving nutritional security, sustainable agriculture, and rural empowerment. Rich in essential nutrients and bioactive compounds, these fruits not only address micronutrient deficiencies but also offer significant health benefits and medicinal applications. Their adaptability to marginal environments, drought resilience, and low-input requirements make them ideal candidates for climate-resilient farming. Furthermore, they support biodiversity conservation and provide critical livelihood opportunities for tribal and rural populations, especially women. By integrating these crops into mainstream horticultural programs, promoting value addition, and enhancing market access through Farmer Producer Organizations and policy support, their full potential can be realized. A strategic, multidisciplinary approach is essential to reposition underutilized fruits as functional, profitable, and sustainable components of modern food systems.

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