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PROMOTING BREEDING OF INDIGENOUS VEGETABLES TO PRESERVE BIODIVERSITY AND CULTURAL HERITAGE OF INDIA

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ABSTRACT

India is a land of rich biodiversity and cultural heritage, with a vast array of indigenous vegetable varieties that have been cultivated for centuries. These traditional crops have played a crucial role in sustaining local communities, providing food security, and preserving cultural traditions. However, many of these indigenous vegetable varieties are facing the threat of genetic erosion due to the widespread adoption of modern, high-yielding varieties and the changing dietary patterns of urban populations. This review explores the importance of promoting the breeding and cultivation of indigenous vegetables in India to preserve biodiversity, cultural heritage, and ensure food security for future generations. It examines the current status of indigenous vegetable diversity, the challenges faced in their conservation and promotion, and the potential strategies for their sustainable utilization and improvement through breeding programs. The review also highlights the nutritional and therapeutic benefits of many indigenous vegetables, as well as their role in maintaining traditional culinary practices and cultural identity. By promoting the breeding and cultivation of these valuable genetic resources, India can not only safeguard its rich biodiversity and cultural heritage but also contribute to achieving global goals of sustainable development and food security.

***Keywords*:** Genetic resources, crop improvement, agrobiodiversity, genetic diversity.

Introduction

India is a country blessed with a rich diversity of plant genetic resources, including a vast array of indigenous vegetables that have been cultivated for centuries. These traditional crops, often referred to as "neglected and underutilized species" (NUS), have played a vital role in sustaining local communities, providing food security, and preserving cultural traditions. However, many of these indigenous vegetable varieties are facing the threat of genetic erosion due to the widespread adoption of modern, high-yielding varieties and the changing dietary patterns of urban populations (Padulosi *et al*., 2002).

The conservation and promotion of indigenous vegetables in India are essential for several reasons. Firstly, these crops represent a valuable source of genetic diversity, which is crucial for developing new crop varieties that are resilient to climate change, pests, and diseases (Jarvis *et al*., 2011). Secondly, many indigenous vegetables are highly nutritious and possess therapeutic properties, making them valuable contributors to food and nutritional security (Gopalan *et al*., 2004). Thirdly, these traditional crops are deeply rooted in the cultural heritage and culinary traditions of various ethnic communities, and their loss would diminish the rich tapestry of India's cultural diversity (Kuhnlein *et al*., 2013)

This article aims to explore the importance of promoting the breeding and cultivation of indigenous vegetables in India to preserve biodiversity, cultural heritage, and ensure food security for future generations. It examines the current status of indigenous vegetable diversity, the challenges faced in their conservation and promotion, and the potential strategies for their sustainable utilization and improvement through breeding programs.

Table 1: Nutritional Composition of Some Indigenous Indian Vegetables (per 100g edible portion)

Vegetable	Protein (g)	Fiber (g)	Vitamin C (mg)	Iron (mg)	Reference
Amaranth Leaves	3.8	4.2	89	5.2	(Gopalan *et al*., 2004)
Brinjal	1.4	3.4	12	0.8	(Anonymous, 2019)
Okra	2.0	3.2	16.3	0.7	(Anonymous, 2019)
Pointed Gourd	0.7	1.6	15	1.1	(Gopalan *et al*., 2004)
Taro Leaves	4.0	2.4	81	1.9	(Gopalan *et al*., 2004)

Table 2: Traditional Uses and Therapeutic Properties of Some Indigenous Indian Vegetables

Vegetable	Traditional Uses/Therapeutic Properties	Reference
Bitter Gourd	Anti-diabetic, anti-cancer, anti-inflammatory	(Leung *et al*., 2009)
Fenugreek	Hypoglycemic, hypocholesterolemic, anti-inflammatory	(Srinivasan, 2018)
Turmeric (*Curcuma longa*)	Anti-oxidant, anti-inflammatory, anti-cancer	(Prasad *et al*., 2011)
Drumstick (*Moringa oleifera*)	Anti-bacterial, anti-fungal, anti-inflammatory	(Abdull Razis *et al.,* 2014)
Curry Leaves (*Murraya koenigii*)	Anti-diabetic, anti-oxidant, anti-microbial	(Ningappa *et al*., 2008)

Biodiversity of Indigenous Vegetables in India

India is home to a staggering diversity of indigenous vegetables, with estimates suggesting the existence of over 800 cultivated species (Arora *et al*., 1984). These traditional crops are adapted to local agro-climatic conditions and have been grown by various ethnic communities across the country for generations. The diversity of indigenous vegetables in India can be attributed to the country's vast geographical expanse, diverse agro-ecological zones, and rich cultural heritage.

Some of the major indigenous vegetable groups found in India include:

1. **Cucurbitaceous vegetable*s:*** Cucumber, pumpkin, ash gourd, ridge gourd, bitter gourd, and snake gourd (Behera *et al*., 2008).
2. **Leafy vegetables*:*** Amaranth, chenopods, basella, and various traditional greens (Shukla *et al*., 2006).
3. **Solanaceous vegetables*:*** Brinjal, chili, and various cultivated and wild species of Solanum (Daunay *et al*., 1991).
4. **Leguminous vegetables*:*** Cowpea, cluster bean, and various cultivated and wild species of Vigna and Dolichos (Lawn *et al*., 2003).
5. **Tuber crops*:*** Colocasia, Dioscorea, and various cultivated and wild species of Aroids (Govaerts *et al*., 2007).

These indigenous vegetables are not only rich sources of essential nutrients but also possess unique phytochemicals with potential therapeutic properties (Seal, 2011). For example, amaranth leaves are rich in proteins, minerals, and antioxidants, while bitter gourd has been traditionally used for its anti-diabetic and anti-cancer properties (Palada *et al*., 2003; Kemper *et al*., 1999).

Table 3: Major Vegetable Crops Originated in India

Vegetable Crop	Botanical Name	Family
Brinjal/Eggplant	*Solanum melongena*	Solanaceae
Okra/Lady's Finger	*Abelmoschus esculentus*	Malvaceae
Cucumber	*Cucumis sativus*	Cucurbitaceae
Amaranth	*Amaranthus* spp.	Amaranthaceae
Taro/Aroids	*Colocasia* spp., *Alocasia* spp.	Araceae
Pointed Gourd/Parwal	*Trichosanthes dioica*	Cucurbitaceae
Yam	*Dioscorea* spp.	Dioscoreaceae
Fenugreek	*Trigonella foenum-graecum*	Fabaceae

Challenges in Conservation and Promotion of Indigenous Vegetables

Despite the immense value of indigenous vegetables, their conservation and promotion face several challenges. One of the primary challenges is the increasing threat of genetic erosion due to urbanization, changing dietary preferences, and the widespread adoption of modern, high-yielding varieties

(Brush, 1995). Many traditional varieties are being replaced by improved cultivars, leading to a loss of genetic diversity and the associated traditional knowledge.

Another significant challenge is the lack of organized breeding programs and seed systems for indigenous vegetables. Unlike major crops, these traditional varieties have received limited attention from formal plant breeding and seed production efforts, resulting in a lack of improved varieties and limited access to quality seeds (Padulosi *et al*., 2002).

Additionally, the cultivation of indigenous vegetables often faces challenges related to low yields, susceptibility to pests and diseases, and limited market demand, particularly in urban areas (Chadha *et al*., 2003). Farmers may be reluctant to cultivate these traditional crops due to perceived lower economic returns compared to commercially viable crops.

Furthermore, the erosion of traditional knowledge systems and culinary practices associated with indigenous vegetables poses a threat to their cultural significance and continued use (Erkul *et al*., 2021). As younger generations embrace more westernized diets, the traditional knowledge and appreciation for these crops may be lost.

Strategies for Promoting Breeding and Cultivation of Indigenous Vegetables

To address the challenges faced by indigenous vegetables and ensure their conservation and sustainable utilization, a multifaceted approach is required. This section outlines potential strategies for promoting the breeding and cultivation of these valuable genetic resources.

1. **Germplasm Collection and Characterization:** The first step towards effective conservation and utilization of indigenous vegetables is the systematic collection and characterization of their germplasm. Extensive field surveys and explorations should be undertaken to collect and document the existing diversity of these crops from various agro-ecological regions and ethnic communities (Hammer *et al*., 1996). Characterization of the collected germplasm based on morphological, agronomic, and molecular traits can provide valuable insights into the genetic diversity and potential usefulness of these resources for breeding programs.
2. **Establishment of Gene Banks and Community Seed Banks:** The establishment of gene banks and community seed banks is crucial for the ex-situ conservation of indigenous vegetable germplasm. National and regional gene banks can serve as repositories for the long-term storage and maintenance of seed collections, while community seed banks can play a vital role in promoting on-farm conservation and enabling access to local varieties for farmers (Vernooy *et al*., 2012). These seed banks can also facilitate the exchange of germplasm among researchers, breeders, and farmers, fostering collaborative efforts in crop improvement.
3. **Participatory Plant Breeding and Farmer-Led Initiatives:** Involving farmers and local communities in the breeding and conservation efforts of indigenous vegetables is essential for ensuring their successful adoption and long-term sustainability. Participatory plant breeding approaches, which integrate farmers' knowledge and preferences into the breeding process, can lead to the development of improved varieties that are better adapted to local conditions and meet the needs of farmers and consumers (Ceccarelli and Grando, 2007). Farmer-led initiatives, such as community seed banks and seed exchange networks, can also play a crucial role in promoting the cultivation and conservation of indigenous vegetables.
4. **Value Addition and Market Promotion:** Enhancing the market demand for indigenous vegetables can provide an economic incentive for farmers to cultivate these crops. Value addition strategies, such as developing processed products, promoting their nutritional and therapeutic properties, and creating niche markets for specialized products, can increase their commercial viability (Siemonsma and Piluek, 1994). Initiatives like branding, labeling, and promoting indigenous vegetables as speciality crops can also help in creating consumer awareness and demand.
5. **Strengthening Research and Development:** Increased investment in research and development programs focused on indigenous vegetables is critical for their sustainable utilization and improvement. Research efforts should encompass areas such as genetic diversity characterization, breeding for improved yields and stress tolerance, developing improved cultivation practices, and exploring value-addition opportunities (Mal *et al*., 2010). Collaboration between research institutions, universities, and local communities can facilitate the integration of traditional knowledge with

modern scientific approaches, leading to more efficient and sustainable breeding programs.

6. **Policy Support and Awareness Campaigns:** Supportive policies and awareness campaigns play a crucial role in promoting the cultivation and conservation of indigenous vegetables. Governments and policymakers can provide incentives and subsidies to encourage farmers to cultivate these crops, establish markets and value chains, and promote their nutritional and cultural significance (Padulosi *et al.*, 2022). Awareness campaigns targeting urban populations can help in creating demand and appreciation for these traditional crops, thereby supporting their continued cultivation and preservation.
7. **Integration with Traditional Knowledge Systems:** The traditional knowledge systems associated with indigenous vegetables are invaluable resources that should be integrated into conservation and breeding efforts. These knowledge systems encompass diverse aspects, including cultivation practices, seed selection, and culinary traditions, and can provide valuable insights for developing sustainable and culturally relevant strategies (Thrupp, 2000). Documenting and preserving this knowledge through participatory approaches and community engagement can ensure its transmission to future generations and support the continued use and appreciation of these crops.

Conclusion

The promotion of breeding and cultivation of indigenous vegetables in India is essential for preserving biodiversity, safeguarding cultural heritage, and ensuring food and nutritional security for future generations. These traditional crops represent a wealth of genetic diversity, nutritional value, and cultural significance that must be protected and leveraged for sustainable development.

By adopting a holistic approach that integrates germplasm conservation, participatory breeding, market promotion, research and development, policy support, and the integration of traditional knowledge systems, India can effectively address the challenges faced by indigenous vegetables and unlock their full potential.

The study highlights the urgency and significance of promoting indigenous vegetables in India, emphasizing the need for concerted efforts to conserve and utilize these invaluable genetic resources. By prioritizing the preservation and improvement of these traditional crops, India can pave the way for a more sustainable and culturally rich future, where biodiversity and cultural heritage are cherished and celebrated.

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