Parkia roxburghii - A Potential Solution for Global Food Security and Beyond

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Various plant species that have been neglected and underutilized, yet are rich in nutrients and well-suited for low-input agriculture, hold significant potential in bolstering global food security (Dansi et al., 2012). These underutilized resources boast higher nutritional content compared to commonly produced and consumed species or varieties on a global scale (Ebert, 2014). By harnessing the potential of such species, there is a possibility to improve nutrition and combat hidden hunger. *Parkia roxburghii* G. Don, also known as tree bean, is a swiftly growing leguminous plant found across Southeast Asia and the Pacific region. It is prevalent in India's Northeastern states, where it is referred to by various vernacular names such as Manipur-Urohi, Khorial in Assamese, Manipuri seems in Bengali, Zawngtah in Mizo, Yongchak in Manipuri, Aoelgap in Garo, Unkamn-pinching in Naga, and Bairethai in Dimasa (Firake et al., 2013).

This medium-sized tree, ranging from 10 to 20 meters in height, is commonly cultivated in home gardens, jhum fallows, and marginal lands alongside roads in northeastern India (Angami et al., 2018). Its flowers, tender pods, and seeds are edible and offer a rich source of carbohydrates, vitamins, minerals, and proteins compared to other legumes (Seal, 2011). Considered an underutilized plant with diverse utility and benefits, this species holds significant potential (Firake et al., 2013). While *P. roxburghii* has garnered attention for its nutritional value and biological properties (Singh et al., 2020), there remains a dearth of information regarding its role in environmental management. Hence, this article seeks to present updated insights into the diversity, distribution, traditional uses, and its significance in food security.

Diversity, Distribution and botanical description

Parkia, a genus widely distributed across the tropics, encompasses approximately 35 species, predominantly found in tropical America, notably within the Amazon basin. Among these, the African locust bean plant (*Parkia biglobosa*) stands out as a significant species of South Africa, representing one of the 34 recognized species within the Parkia genus (Amusa et al., 2014). Across Asia, Parkia's presence extends from northeastern India and Bangladesh eastward through Southeast Asia, with additional species occurring in Micronesia and Fiji (Hopkins, 1994). Detailed taxonomic descriptions of Parkia species from both the New and Old World have been meticulously documented (Hopkins, 1994). Notably, *Parkia roxburghii* G. Don. (Syn. *Parkia timoriana* (DC.) Merr.) emerges as the most widely distributed species across the Indo-Pacific region (Hopkins, 1994). In India, this species is observed in various regions including Arunachal Pradesh, Cachar hills of Southern Assam, Garo and Khasi Hills of Meghalaya, Lushai Hills, Kolasib–Bukpui, and Sialsuk road in upper Thenzawl area of Mizoram, Imphal, Kangpokpi, and Pachao of Manipur (Angami et al., 2018). It is also documented in Chittagong and Sylhet of Bangladesh, Myanmar, and the Malay Peninsula.

Parkia trees typically reach medium size, featuring grayish-brown bark and reaching heights of 15–25 meters. Flowering occurs from September to October, with fruits maturing approximately four months after flowering, available for harvest from January to March. Pods develop in clusters of 10–15, suspended on elongated stalks measuring 25–40 cm in length and 2–4 cm in width. Leaves are compound bipinnate, spirally arranged or alternating, hosting anywhere from 500 to 3500 leaflets per leaf. Inflorescence is terminal, arranged in a racemose fashion, with flowers clustered at the end of a peduncle up to 45 cm long. Flowers are white and yellow, measuring approximately 1 cm in length. *Parkia roxburghii* follows an annual phenological cycle, marked by a brief period of leaflessness succeeded by the emergence of new, light green, shiny leaves (Thangjam et al., 2020). Notably, *P. roxburghii* exhibits remarkable complexity within the genus, with only 9-17 fruits produced from its numerous fertile flowers in a capitulum (Hopkins, 1994).

Nutritional Status

The green pods serve as a valuable reservoir of crude proteins and energy (Rocky et al., 2004).

Notably, the tender pods exhibit elevated levels of diverse minerals such as Na, Ca, K, and P, whereas the mature pods are characterized by a higher concentration of Mg, Fe, Mn, and Cu (Table 1). The mineral distribution within the pods follows the sequence of pulp > testa > cotyledon (Salam et al., 2009). Furthermore, the protein fractionation analysis of the seeds reveals a lower globulin to albumin ratio (1.6), suggesting improved protein digestibility and nutritional value when utilized as a vegetable (Salam et al., 2009). Moreover, the seeds contain relatively lower levels of anti-nutritive and toxic components such as phytate, phosphorus, trypsin inhibitors, and saponins, which can be effectively eliminated through conventional processing and cooking methods (Salam et al., 2010). Given the challenges of achieving sustainable development in countries like India, where feeding a population of 1.3 billion remains a pressing concern despite economic growth, the nutritional profile of this species emerges as a crucial asset for enhancing food security (Salam et al., 2010).

Table 1: Nutritional variation in tender pod, mature pod and mature kernel of *Parkia roxburghii*

Nutritional Parameters	Tender Pod	Mature Pod	Mature Kernel
Moisture (%)	8.4	6.7	10.0
Protein (%)	12.1	18.8	28.8
Fat (%)	1.0	15.5	33.5
Ash (%)	7.4	6.1	5.7
Carbohydrate and Fabre (%)	71.1	52.9	22.0
Energy (kcal)	342	426	505
Phosphorus (mg/ 100 g)	320	298	270
Magnesium (mg/ 100 g)	520	480	420
Calcium (mg /100 g)	176	172	180
Iron (mg/100 g)	8.8	9.1	13.3
Manganese (mg/ 100 g)	2.8	2.4	2.9
Zinc (mg/ 100 g)	3.1	3.3	5.6
Copper (mg/ 100 g)	0.6	0.6	0.7
Chromium (µg /100 g)	74.0	71.0	79.0

Source: Roy et al., 2016

Role in food and nutritional security

Parkia, a significant edible legume in South Asian countries, plays a crucial role in ensuring food security, ecosystem maintenance, and supporting farmers. With low fat and high fiber content, it offers health benefits (Roy et al., 2016). Parkia pods are available in markets annually from December to March, with consumption ranging from tender light green pods, approximately 30 cm in length, to maturity. These pods are consumed fresh, raw, or sundried during off-seasons, serving as a supplementary food source (Longvah & Deosthale, 1998). This multifunctional crop not only enhances food and livestock provision but also serves as a dependable income source for growers and users. Parkia's mature seeds boast high-quality proteins with no limitations in essential and semi-essential amino acids, distinguishing it among legumes (Longvah and Deosthale, 1998). Furthermore, chemical analysis by revealed that mature kernels have notable moisture (10.0%), protein (28.8%), fat (33.5%), energy (505 kcal), iron (13.3mg/100g), manganese (2.9 mg/100g), zinc (5.6 mg/100g), and chromium (7.9 µg/100g) content compared to tender and immature pods. However, tender pods exhibit higher carbohydrate and fiber (71.15%) content (Roy et al., 2016).

Tribal communities have a diverse array of culinary uses for tree beans. These beans, marketed as vegetables, feature prominently in various dishes. In Manipur, for instance, they're a key ingredient in 'Singju,' a traditional salad. Additionally, the scraped and sliced skins are combined with fish to prepare 'eromba,' a distinctive curry. Pickling the pods is a popular method of consumption, while tribes like Garo, Khasi, Reang, Naga, and Mizos incorporate them into their cuisine as well. Furthermore, both the flowers and mature seeds find their way into tribal diets, either raw or cooked alongside meat. Though bitter, the seeds become palatable after roasting or boiling. Notably, the characteristic pungency of Parkia derives from thioproline, a cyclic sulfur-containing amino acid, with demonstrated anticancer properties. This species enjoys culinary and medicinal use across India and beyond, particularly in Northeastern states like Manipur, Mizoram, and Nagaland, where various

tribal communities utilize different parts of the plant in salads, curries, and even diabetes treatment through bark decoction. Moreover, minor tribes such as Kacharis, Dimasa, Mikir, and Garos employ bark paste as a remedy for eczema (Rathi et al., 2012).

Application in traditional Medicine

The medicinal properties of the bark of *P. roxburghii* have been well-documented. It serves as a lotion for treating cancer and various skin ailments (Angami et al., 2018). Additionally, even the dry seeds of the plant are utilized in non-seasonal culinary dishes. Traditional healers utilize tender pods and bark from sacred groves to address intestinal disorders such as piles, dysentery, and diarrhea (Khumbongmayum et al., 2005). Moreover, a decoction made from the bark, fruit skin, and leaves is employed to manage diarrhea and dysentery. In Northeast India, the Dimasa and Kachari tribes apply a paste made from the bark as a plaster for eczema treatment. Not only does the bark contain antioxidants, but it also possesses therapeutic properties that enhance children's cognitive abilities (Angami et al., 2018). Furthermore, a lotion crafted from the bark and leaves is utilized for treating skin diseases and ulcers. Ethnobotanical studies have highlighted the effectiveness of seeds and pods from *P. roxburghii* in alleviating stomach disorders and regulating liver functions (Roy et al. 2016). In some practices, pods are crushed in water and used for facial and scalp cleansing.

Conclusion

Exploration of neglected and underutilized plant species, particularly *Parkia roxburghii* G. Don, underscores a significant opportunity in addressing global food security challenges. Despite being an underutilized resource, *P. roxburghii* offers a rich source of nutrients and holds immense potential for low-input agriculture. Its widespread distribution across Southeast Asia and the Pacific region, coupled with its nutritional richness, makes it a valuable asset in combating hidden hunger and improving nutrition. Furthermore, the multifunctional nature of *P. roxburghii* extends beyond its role in food security to encompass environmental management, traditional medicine, and income generation for local communities. The study of *P. roxburghii* exemplifies the untapped potential of underutilized plant species in addressing multifaceted challenges, including food security, nutrition, and health. Further research and investment in harnessing the capabilities of such species are essential for promoting sustainable agriculture, improving livelihoods, and enhancing human well-being on a global scale.

References

Amusa, O., Adosoye, A., Ogunkamni, A., Omoche, O., Olowe, O., Akinyosoye, S., Omodele, O. (2014). Genetic diversity of Parkia biglobosa from different agroecological zones of Nigeria using RAPD markers. Int. J. Biodiver. doi:10.1155/2014/457309

Angami, T., Bhagawati, R., Touthang, L., Makdoh, B., Khatri, N., Singson, L., Bharati, A.K., Silambarsan, R., Ayyanar, M. (2018). Traditional uses, phytochemistry and biological activities of Parkia timoriana (DC.) Merr., an underutilized multipurpose tree bean: a review. Genet. Resour. Crop. Evol. doi:10.1007/s10722-017-0595-0.

Dansi, A., Vodouhe, R., Azokpota, P., Yedomonhan, H., Assogba, P., Adjatin, A., Loko, I.Y., Dossou-Aminon, I., Akpagana, K. (2012). Diversity of the neglected and underutilized crop species of importance in Benin. Sci. World J. doi:10.1100/2012/932947

Ebert, A.W. (2014). Potential of underutilized traditional vegetables and legume crops to contribute to food and nutritional security, income and more sustainable production. Sustainability 6, 319–335.

Firake, M.D., Venkatesh, A., Firake, D.P., Behere, T.G., Thakur, A.S.N. (2013). Parkia rox burghii: an underutilized but multipurpose tree species for reclamation of Jhum Land. Curr. Sci. 104 (12).

Hopkins, H.C.F. (1994). The Indo-Pacific species of Parkia (Leguminosae: Mimosoidae). Kew Bull. 49, 181–234.

Khumbongmayum, A.D., Khan, M.L., Tripathi, R.S. (2005). Sacred groves of Manipur, northeast

India: biodiversity value, status and strategies for their conservation. Bio divers. Conserv. 14, 1541–1582.

Longvah, T., Deosthale, Y.G. (1998). Nutrient composition and food potential of Parkia roxburghii a lesser-known tree legume from north east India. Food Chem. 62, 477–481.

Rathi, R.S., Misra, A.K., Roy, S., Verma, S.K., Singh, S.K. (2012). Potential of a lesser-known tree species Parkia roxburghii G. Don of North East India. Ind. For. 138 (5), 476–479.

Rocky, P., Sahoo, U.K., Thapa, H.S. (2004). Livelihood generation through tree bean (Parkia roxburghii G. Don) in Imphal West District of Manipur. J. non-Timber Forest. Products 11, 135–139.

Roy, S.S., Kumar, S., Sharma, K.S., Devi, R.A., Singh, A.N., Prakash, N., Ngachan, V.S. (2016). Tree bean (Parkia roxburghii): a potential multipurpose tree legume of Northeast India. Nat. Symposium Veg. Legum. Soil Human Health. Safi initiative, Agri Manipur. 1, 1.

Salam, J.S., Singh, P.K., Dutta, B.K., Sahoo, U.K. (2009). Chemical composition and nutritive indices in Parkia roxburghii, a leguminous plant of India. Ind. J. Agr. Biochem. 22 (2), 87–93.

Salam, J.S., Singh, P.K., Dutta, B.K., Sahoo, U.K. (2010). Effect of processing and cooking methods on some anti-nutritive toxic components and nutritional composition in Parkia roxburghii G. Don seeds. Ind. J. Agric. Biochem. 23 (2), 97–102.

Seal, T. (2011). Nutritional composition of wild edible fruits in Meghalaya state of India and their ethno-botanical importance. Res. J. Botany 6 (2), 58–67.

Singh, K.M., Borpujari, P., Dutta, A. (2020). Studies on Parkia timoriana (DC.) Merr: an endemic and economically important tree species of north east India. Int. J. Chem. Stud. 8 (6), 2043–2047.

Thangjam, U., Sahoo, U.K., Thong, P. (2020). Characterization of morphometric, reproductive and seedling traits of Parkia timoriana in northeast India. Silva Fenn. 54 (1). doi:10.14214/sf/10163.

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