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Explorer Article

Flowers of *Moringa oleifera*: a nutraceutical of Bihar, Odisha, Bengal, Jharkhand and Himachal Pradesh, India

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Abstract: *Moringa oleifera* Lam., popularly known as the "miracle tree", is widely recognized for its nutritional and medicinal importance. While extensive research exists on its leaves and seeds, the flowers remain comparatively underexplored, particularly in eastern India. The present paper compiles and synthesizes botanical, nutraceutical, phytochemical and ethnomedicinal data on *M. oleifera* flowers collected from Bihar, Odisha, West Bengal, Jharkhand and Himachal Pradesh. The flowers are traditionally consumed as food and medicine, especially for lactation support, inflammation, liver disorders and gastrointestinal ailments. Phytochemical investigations reveal the presence of flavonoids, phenolic acids, glucosinolates, sterols, fatty acids and volatile compounds responsible for antioxidant, anti-inflammatory, antimicrobial and metabolic regulatory activities. The study highlights the nutraceutical potential of *M. oleifera* flowers and emphasizes their role in food security, traditional healthcare and functional food development in eastern India.

Keywords: *Moringa oleifera*, flowers, nutraceutical, phytochemicals, ethnomedicine, eastern India

Introduction

India harbours a rich diversity of edible and medicinal plants that contribute significantly to traditional healthcare systems and nutritional security (Kala et al., 2006). Among these, *Moringa oleifera* Lam. (Moringaceae) occupies a unique position due to its exceptional nutritional density and therapeutic versatility (Pareek et al., (2023). Native to the Indian subcontinent, the species is extensively cultivated across tropical and subtropical regions. Although the leaves and pods of *M. oleifera* have been widely studied (Islam et al., 2021; Soto et al., 2025; Panova et al., 2025), flowers are an important, yet less documented plant part, particularly in the context of eastern Indian states such as Bihar, Odisha, West Bengal, Jharkhand and Himachal Pradesh in Western Himalaya. In these regions, flowers are seasonally consumed as vegetables, fritters and medicinal preparations by rural and tribal communities. In Bihar and Bengal, it is prepared with poppy seeds in the form of curry.

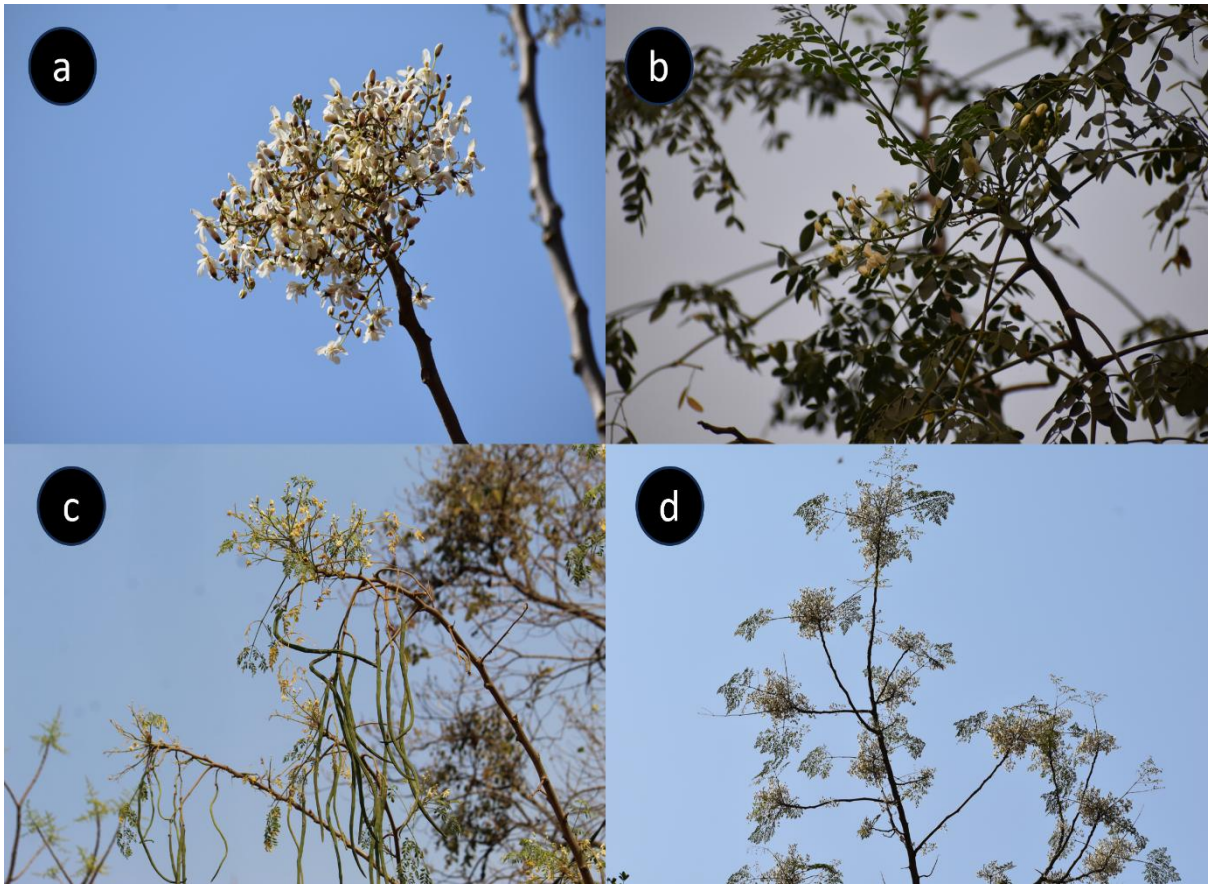

Figure 1 Plant parts of *Moringa oleifera*, a) Flower, b) Leaves, c) Fruits, d) Whole plant

The flowers are boiled in water twice before cooking to get rid of the bitterness. Given the growing interest in plant-based nutraceuticals, a comprehensive documentation of the botanical description, nutritional value, phytochemical composition and medicinal relevance of *M. oleifera* flowers is essential. The present study aims to consolidate existing scientific evidence and ethnomedicinal knowledge, thereby highlighting the potential of *M. oleifera* flowers as a functional food and nutraceutical resource. *Moringa oleifera* is a small to medium-sized deciduous tree with corky, grey or whitish bark. The twigs are mostly lenticellate. Leaves are 25–50 cm long, 2–4 pinnate, with a slender rachis thickened and

articulated at the base. Pinnae and pinnules are opposite, with articulated stalks bearing glands at the articulations. Leaflets are elliptic to ovate or obovate, entire, pale beneath, pubescent when young, and measure 5–22 mm in length. Inflorescences are axillary panicles, 15–22 cm long with branched axes. Flowers are creamy white, fragrant, bisexual and approximately 1.5 cm long. Sepals are linear-lanceolate and puberulous externally, while petals are spathulate to oblanceolate. The fruit is a pendulous capsule measuring 22–45 cm in length (Kharoliwal and Shrivastava, 2024; Figure 1).

Materials and methods

The present paper is based on a critical analysis of published literature, ethnobotanical reports and phytochemical studies related to *Moringa oleifera* flowers. Primary information was collected through field survey in Bihar, Odisha, West Bengal, Jharkhand and Himachal Pradesh during January 2025-January 2026 (Pradhan et al., 2025; Jena et al., 2025). Additional data were compiled from peer-reviewed journals, review articles and pharmacological studies (Kumar et al., 2025; Sahu et al., 2026). Special emphasis was given to reports originating from or relevant to eastern Indian states (Bihar, Odisha, West Bengal, Jharkhand and Himachal Pradesh). Botanical descriptions were verified using standard floras and taxonomic literature, while medicinal and nutritional information was cross-referenced with ethnomedicinal and pharmacological sources.

Figure 2: Flowers collected for food at Jawalamukhi, Himachal Pradesh, India

Results and discussion

During the survey period, it was observed that local people from Bihar, Odisha, West Bengal, Jharkhand, and Himachal Pradesh (Figure 2) commonly consume the flowers as food. It was also noted that rural and tribal communities sell these flowers in their local weekly and daily markets.

Nutritional value: *Moringa oleifera* flowers are nutritionally rich, containing proteins, essential amino acids, carbohydrates and beneficial lipids. They are a good source of vitamins such as vitamin C, vitamin A (β-carotene precursor) and B-complex vitamins. The flowers also provide essential minerals, including calcium, iron, potassium, magnesium and phosphorus, making them valuable in combating micronutrient deficiencies.

Medicinal uses: Traditionally, the flowers are consumed to enhance lactation in nursing mothers and are used in the treatment of inflammation, joint pain, ulcers, gastric disturbances and diabetes. Decoctions are employed to manage common cold, cough and throat irritation. Modern pharmacological studies support these traditional claims, reporting anti-inflammatory, antioxidant, antimicrobial, hepatoprotective, hypocholesterolemic and metabolic regulatory activities.

Table 1: Medicinal and nutritive values of *Moringa oleifera* flowers

Medicinal and nutritional values	**Source(s)**
Flowers are traditionally consumed to promote milk secretion in lactating mothers	Madhumitha and Prabha, (2019); Khobragade et al., (2024)
It is used to reduce inflammation in conditions such as joint pain and swelling	Khobragade et al., (2024); Shil, (2021)
It shows anti-inflammatory activity	Alhakmani et al., (2013); Fahmy et al., (2024); Pareek et al., (2023); Khobragade et al., (2024)
It exhibits antibacterial and antifungal activities	Muhammad et al., (2020); Shil, (2021); Ghosh et al., (2023); Shital et al., (2021)
Decoctions of the flowers are used to manage common colds, cough and throat irritation	Shital et al., (2021)
It supports liver function and helps protect against liver disorders	Khobragade et al., (2024); Sivakumar, (2024); Pareek et al., (2023); Divya et al., (2024)
It enhances vitality and reproductive health	Khobragade et al., (2024)
It helps to neutralize free radicals	Alhakmani et al., (2013); Pareek et al., (2023); Fahmy et al., (2024); Divya et al., (2024)

It helps to reduce blood cholesterol levels	Pareek et al., (2023); Divya et al., (2024)
Powder of flowers useful in diabetes.	Bhatti et al., (2023)
It could correlate with therapeutic potential in neuroprotective or metabolic pathways	Fahmy et al., (2024)
It contains macronutrients such as proteins, essential amino acids, carbohydrates and fats	Madhumita and Prabha, (2020); Sreeja et al., (2021); Ghosh et al., (2023); Sivakumar, (2024); Divya et al., (2024)
It contains Vitamin C, Vitamin A (β-carotene precursor), B-complex vitamins	Madhumita and Prabha, (2020); Sreeja et al., (2021); Saini et al., (2016); Divya et al., (2024)
It contains minerals such as calcium, iron, potassium, magnesium and phosphorous	Madhumita and Prabha, (2020); Sreeja et al., (2021); Ghosh et al., (2023); Sivakumar (2024); Divya et al., (2024)
It is used for ulcers and gastric disturbances	Khobragade et al., (2024); Madhumita and Prabha, (2020)

Phytochemical composition: Phytochemical investigations reveal that *M. oleifera* flowers contain a wide spectrum of bioactive compounds. Major constituents include flavonoids (quercetin, kaempferol, rutin), phenolic acids (gallic acid, chlorogenic acid and caffeic acid), glucosinolates (glucomoringin), sterols (β-sitosterol, stigmasterol), fatty acids and volatile aromatic compounds. Qualitative screening also confirms the presence of alkaloids, tannins, saponins, terpenoids and cardiac glycosides. These compounds collectively contribute to the plant's antioxidant, anti-inflammatory, antimicrobial and enzyme inhibitory properties, supporting its role as a nutraceutical and therapeutic agent**.**

Table 2: Phytochemical compounds present in *Moringa oleifera* flowers

Phytochemical class	**Phytochemical compounds**	**Source(s)**
Flavonoids and Flavonoid Glycosides	Quercetin, Kaempferol, Rutin, Kaempferol-3-O-rutinoside and Isorhamnetin	Madhumita et Prabha (2020); Ghosh et al. (2023); Sivakumar (2024); Sreeja et al. (2021); Pareek et al. (2023); Shital et al. (2021); Saini et al. (2016); Divya et al. (2024); Alhakmani et al. (2013)

Phenolic Acids and Related Compounds	Gallic acid, Chlorogenic acid, Caffeic acid, Ferulic acid, p-Coumaric acid, Vanillin and 4-Hydroxy mellein	Saini et al., (2016); Pareek et al., (2023); Divya et al., (2024); Fahmy et al., (2024)
Glucosinolates and Isothiocyanates	Glucomoringin (4-O-(α-L-rhamnopyranosyloxy)-benzyl glucosinolate), Benzyl isothiocyanate	Saini et al., (2016); Pareek et al., (2023); Shil (2021); Sivakumar (2024); Divya et al., (2024)
Sterols and Phytosterols	β-Sitosterol Stigmasterol Campesterol	Saini et al., (2016); Pareek et al., (2023); Sivakumar (2024); Divya et al., (2024)
Alkaloids	Qualitative detection	Don-Lawson and Okah (2019); Suryawanshi and Umate (2018); Shital et al., (2021); Ghosh et al., (2023)
Tannins	Qualitative detection	Don-Lawson and Okah (2019); Suryawanshi and Umate (2018); Shil (2021); Ghosh et al., (2023)
Saponins	Qualitative detection	Don-Lawson and Okah (2019); Suryawanshi and Umate (2018); Shital et al., (2021)
Fatty Acids	Palmitic acid, Stearic acid, Oleic acid, Linoleic acid, Linolenic acid, Decanoic acid	Saini et al., (2016); Pareek et al., (2023); Fahmy et al., (2024)
Volatile and Aromatic Compounds	Dodecanal, cis-9-Octadecen-1-ol, 9-Octadecen-1-ol, Octacosanoic acid	Fahmy et al., (2024)
Terpenoids Steroids Glycosides Cardiac glycosides	Qualitative detection	Suryawanshi and Umate (2018); Don-Lawson and Okah (2019); Shital et al., (2021); Ghosh et al., (2023)

The compiled data clearly demonstrate that *M. oleifera* flowers possess dual significance as food and medicine. Their high nutrient content supports dietary supplementation, while the presence of diverse phytochemicals explains their broad pharmacological spectrum. The convergence of traditional knowledge and modern scientific validation strengthens the case for incorporating *M. oleifera* flowers into functional foods, herbal formulations and community nutrition programs. In eastern India, where malnutrition and limited access to healthcare persist in rural areas, *M. oleifera* flowers offer a locally available, affordable and culturally accepted nutraceutical resource. Further region-specific studies on bioavailability, clinical efficacy and product development are warranted.

Conclusion

Moringa oleifera flowers represent a valuable yet underutilized nutraceutical resource in Bihar, Odisha, West Bengal, Jharkhand and Himachal Pradesh. Rich in nutrients and bioactive phytochemicals, they exhibit significant medicinal properties validated by both traditional use and scientific studies. Promoting their consumption and integrating them into nutraceutical and functional food systems can contribute to nutritional security, preventive healthcare and sustainable utilization of plant biodiversity.

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