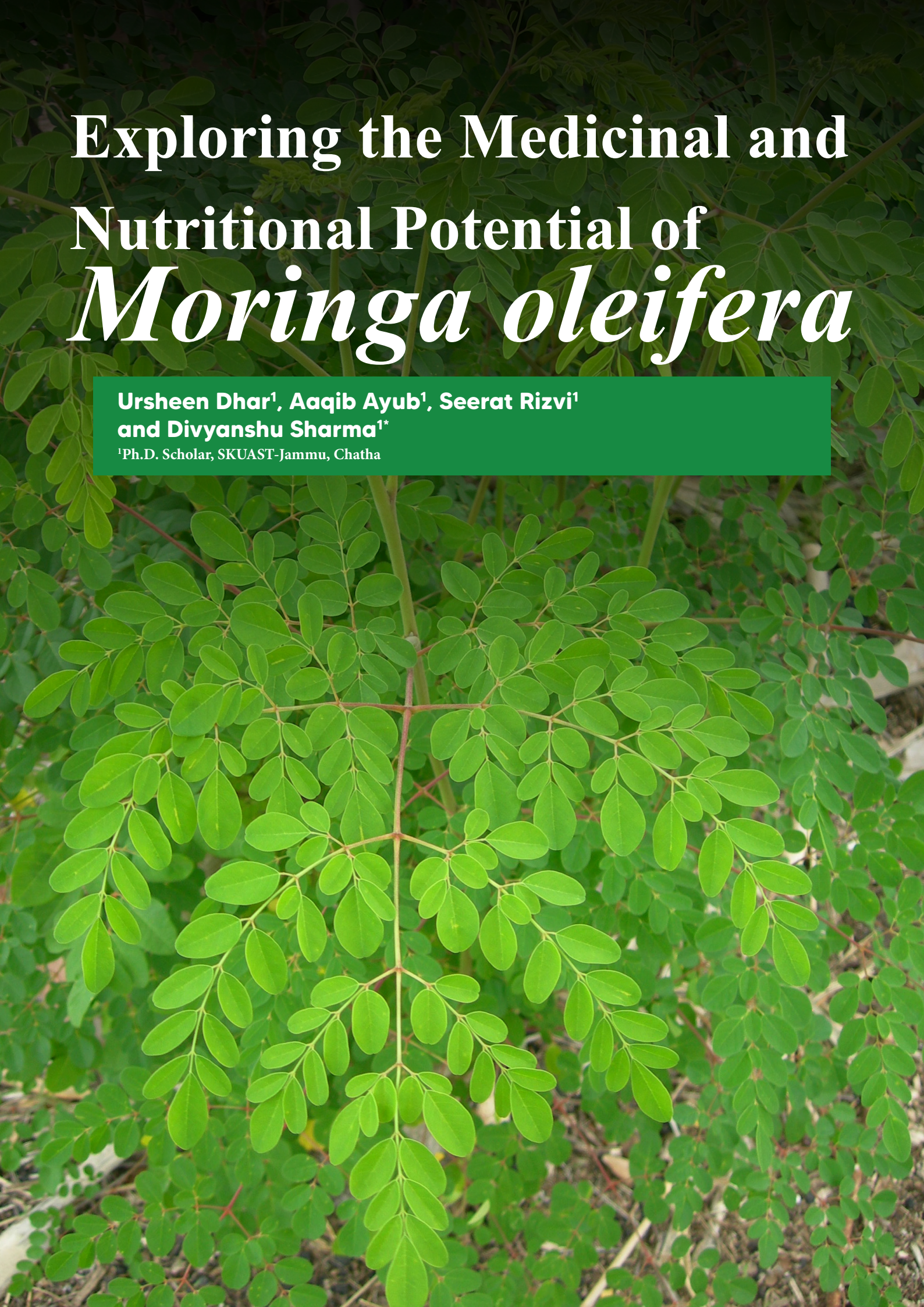


Exploring the Medicinal and Nutritional Potential of *Moringa oleifera*

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INTRODUCTION:

Moringa oleifera, also known as drumstick, is a fast-growing, drought-resistant plant native to the sub-Himalayan regions of India, Pakistan, Bangladesh, and Afghanistan. It is a diploid with a chromosome number of $2n = 2x = 28$. It belongs to the family Moringaceae and is widely cultivated in tropical and subtropical regions worldwide for its nutritional and medicinal properties. Beside its English name, Drumstick, other names for it include Horseradish, Sanskrit: Subhanjana, Ayurvedic: Haritashaaka or Akshiva, Hindi: Sainjna or Saguna, Kannada: Nuggokayee, Malayalam: Muringa, Tamil: Murungai Maram, and Telugu: Munagachettu. India is reported to be the largest producer of drumstick. It accounts for an annual production of 1.2 million tonnes of fruit

under 380 km² of a total area. Various parts of the *M. oleifera* tree, including leaves, seeds, pods, and roots, have been utilized for centuries in traditional medicine systems for the treatment of various ailments. Since it is widely utilized as a nutritive herb with a high nutritional content and a dietary supplement to combat child malnutrition, it is known as the “miracle tree” or “tree of life”.

The use of herbal medicine has increased dramatically in recent years. Developing nations mostly rely on medicinal plants to meet their needs for well-being. Therefore, moringa leaves are a good choice for developing countries searching for affordable, high-quality healthcare in areas inaccessible to western medicine.



BOTANY

Drumstick is a perennial vegetable tree that grows quickly up to 10–12 m in height. The tree is characterized by its thick and erect stems with grayish-white bark. The tripinnate leaves (30–60 cm long) on the drooping tree branches have elliptic leaflets. The seeds within the long, pendulous pods are triangular in shape and have wings on the angles. The pods are dark green, smooth-skinned, and long, resembling drumstick. The tree has bisexual, creamy white, yellowish-white blooms with five sepals and five petals that grow on thin, hairy stalks. In regions with seasonal differences, the tree flowers in the spring.



TRADITIONAL USES AND CULTURAL SIGNIFICANCE

The use of drumstick in traditional medicine dates back thousands of years, with documented references in ancient Ayurvedic texts and traditional healing practices in regions where the plant is indigenous. In many cultures, it holds significant cultural and religious symbolism and is revered for its purported healing properties. The leaves, seeds, and roots of the drumstick are commonly used in traditional remedies for conditions such as inflammation, digestive disorders, infections, and malnutrition.

Culinary traditions have also embraced the drumstick plant, with its green pods, being incorporated into a wide range of recipes in Indian cuisine to add unique flavors and textures to dishes like curries, lentils, and soups. Moreover, the drumstick plant plays a central role in religious and cultural ceremonies worldwide. For instance, in South India during the festival of Makara Sankranti, young girls offer the first harvested

drumstick to deities as a symbol of prosperity and good fortune. Additionally, the its flower is used in Thailand to make garlands offered in Buddhist temples as a symbol of purity and reverence.

In certain African cultures, its leaves are used to alleviate malnourishment, especially in children due to their remarkable nutritional value. The drumstick plant not only holds cultural significance but also offers environmental benefits by preventing soil erosion with its deep-rooted system and contributing to creating sustainable ecosystems by attracting pollinators and providing shade. This multifaceted plant continues to be cherished for its versatility and nourishing properties across diverse cultures worldwide.

PHYTOCHEMICAL COMPOSITION

Moringa oleifera is renowned for its rich phytochemical profile, which includes a wide array of bioactive compounds such as phenolic acids, flavonoids, alkaloids, glycosides, terpenoids, and vitamins. The leaves of drumstick are particularly rich in nutrients, containing high levels of vitamin C, vitamin A, vitamin E, beta-carotene, calcium, iron, and essential amino acids.

Additionally, the seeds are a rich source of bioactive compounds, including phenolic glycosides, alkaloids, and fatty acids. On a dry weight basis, the crude protein content of leaves ranged from 10.74% to 30.29%, the carbohydrate content from 13.41 to 63.11%, the fat content from 6.50 to 20%, the crude fibre content from 7.09 to 35%, and the mineral matter from 7.64 to 10.71%. Moringa leaves have the highest concentration of unsaturated fatty acids in their fatty acid profile, with α -Linolenic acid being the most abundant. Hot water extraction has been utilized to isolate a novel polysaccharide called MOP-2 from moringa leaves, and several chromatographic methods were employed to purify it. Several functional meals may contain this MOP-2 as an immunoregulatory ingredient. Additionally abundant in polyunsaturated fatty acids like omega-3 and omega-6, moringa leaves are crucial for a variety of cardiovascular processes as well as body vigour. Furthermore, it has a high concentration of monounsaturated fatty acids and fewer saturated fatty acids. It is rich in minerals like potassium, zinc, magnesium, iron, and copper as well.



PHARMACOLOGICAL ACTIVITIES

Extensive scientific research has demonstrated the diverse pharmacological activities of *M. oleifera* extracts and isolated bioactive compounds. These include crypto-chlorogenic acid, isoquercetin, and astragalin, which possess antioxidant and anti-inflammatory, anti-microbial, anti-cancer, anti-diabetic, hepatoprotective, and immunomodulatory properties beneficial for health. The bioactive compounds present in it exert their therapeutic effects through various mechanisms, including scavenging free radicals, modulating inflammatory pathways, inhibiting microbial growth, and regulating metabolic processes.

HEALTH AND NUTRITIONAL BENEFITS

Consumption of drumstick have been associated with numerous nutritional benefits. The leaves are recognized as a valuable source of micronutrients and antioxidants, making them an excellent dietary supplement for addressing nutrient deficiencies and promoting overall health. It offer a wide array of health benefits such as boosting immunity, aiding digestion by regulating bowel movements and promoting gut health, improving heart health by regulating blood pressure, and supporting liver health by protecting against toxins and boosting antioxidant production. It is also beneficial for regulating blood sugar levels, promoting good vision with vitamins A and C, accelerating weight loss due to their low-calorie content and high fiber, improving bone strength with calcium and potassium content, and promoting healthy skin by supporting collagen production. Moreover, it has been found to support kidney health by reducing the development of kidney stones and clearing toxins from

the body. They also play a role in reducing the risk of cancer due to the presence of ample amounts of vitamins and nutrients. Additionally, drumsticks promote good eye health by providing antioxidants that help treat dry eyes and cataracts. They also aid in delaying signs of aging by reducing wrinkles and acne while improving skin tone and elasticity. Pregnant women can benefit from drumstick as they contain folic acid to prevent birth defects and iron to prevent anaemia. Pregnant women can benefit by its consumption as it contains folic acid to prevent birth defects and iron to prevent anaemia.

Additionally, the seeds and oil have garnered attention for their potential therapeutic applications in managing conditions such as hyperlipidemia, diabetes, and cardiovascular disease. It's important to consume drumstick in moderation as excessive intake may lead to side effects like lower blood pressure or interactions with certain medications.



CLIMATE AND SOIL REQUIREMENTS

The tree thrives in tropical and subtropical climates. A temperature range of 25°C to 35°C is ideal for lush plant growth. The tree can experience frost, and when the daytime temperature rises over 40°C, blossoms begin to shed. Because it can be cultivated with rainwater without the need for costly irrigation methods, moringa is a sun- and heat-loving plant that is especially well suited for arid climates. It doesn't matter what kind of soil the plant grows in. Ideal soil conditions are well-drained sandy loam soils with a pH of 6.0–7.0; red soils are advised because of the high vigor of seedlings that have been seen.

VALUE-ADDED PRODUCTS

The leaves, twigs, stalks, and seeds all have a high protein content along with pro-vitamin A, vitamins B and C, minerals especially iron, and sulfur-containing amino acids i.e., methionine and cysteine. According to popular belief, drumstick leaves have protein qualities comparable to those of milk and eggs and more vitamin A than carrots, calcium than milk, iron than spinach, vitamin C than oranges, and potassium than bananas. Nonetheless, it is known that a significant portion of the calcium in leaves and stem is tied up in calcium oxalate crystals. Value-added products can be made from several components of drumstick tree to optimize the utilization of its available nutrients like,

- ✓ Leaf powder
- ✓ Pickles
- ✓ Juice
- ✓ Drumstick oil: Drumstick oil's low viscosity makes it a useful lubricant in the precision industry, particularly in Western European nations
- ✓ Cake with drumstick pods



CONCLUSION:

The growing body of scientific evidence supporting the medicinal and nutritional benefits of drumstick underscores its potential as a valuable resource for health promotion and prevention. Further research is warranted to elucidate the underlying mechanisms of action of *M. oleifera* bioactive compounds and to explore their therapeutic applications in clinical settings. Incorporating *M. oleifera* into dietary and healthcare practices has the potential to contribute significantly to global efforts aimed at combating malnutrition, improving public health, and promoting sustainable agriculture.