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A Systematic Review of the Anti-Inflammatory Activities of *Moringa oleifera*

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ABSTRACT:

Moringa oleifera, a widely used medicinal plant in traditional health systems, has gained increasing scientific attention for its potent anti-inflammatory properties. This review synthesizes current evidence on the phytochemical constituents, molecular mechanisms, and therapeutic potential of Moringa as an anti-inflammatory agent. Bioactive compounds— including flavonoids, phenolic acids, glucosinolates, and isothiocyanates—demonstrate significant modulation of inflammatory pathways. Experimental studies show that extracts of Moringa leaves, seeds, and pods inhibit key mediators such as NF-κB, COX-2, iNOS, TNF-α,

IL-1β, and IL-6, while enhancing antioxidant defenses through Nrf2 activation. Animal models and limited clinical investigations further support Moringa's capacity to reduce inflammation associated with metabolic disorders, arthritis, and cardiovascular conditions. Despite promising findings, variations in extraction methods, dosage, bioavailability, and study design limit direct comparability across studies. More standardized clinical trials are needed to validate safety, therapeutic efficacy, and optimal formulations. Overall, Moringa oleifera represents a promising natural anti-inflammatory resource with broad therapeutic potential, warranting deeper mechanistic and clinical exploration.

INTRODUCTION

Numerous remedies are used in the Indian medical system. Both herbal and mineral-based pharmaceuticals have been promoted a variety of illnesses and other topics. Varied undesirable circumstances for people. One of the ancient systems of Ayurveda is The practice of medicine in India and Sri Lanka is able to Ayurvedic remedies may be traced back to 6000 B.C. are mostly derived from herbal and herbomineral sources preparations and have particular diagnostic and therapeutic principles(1). The application of medicinal components is acknowledged to be the most prevalent variety of traditional medication. It is believed that it is the only species in the whole flora. that between 35,000 and 70,000 species have been utilized for medical use. There are about 5,000 of these. researched biomedical topics. in the process of creating Herbal remedies continue to be used in nations throughout the world. a key component of primary health care, particularly where health service coverage is restricted(2) .The seeds of Moringa oleifera lam (MOL), commonly called drumsticks, belongs to the family (Moringaceae). are advised in illness at liver(3), spleen, paralysis and tetanus. The seeds are packed with minerals, a drug made up of vitamins and mucilages(4).adjuvant(5) as well as ascorbic acid oxidase. Additionally, they are employed in the therapy of ascites and rheumantism(6). A tree that is either little or medium in size. 10 meters high, with thick, soft, corky, and deeply fissured bark inflammatory condition of the bark and tomentose branches.(7) is one of the most prevalent and oldest illnesses afflicting both humans and animals. Despite notable advancements in understanding and treating diseases, humans and animals continue to be afflicted. Improvements in our understanding of inflammation, the Plant is still far from being the perfect anti-inflammatory treatment. On www.ijprd.com, it may be found online. Medicines with a base have already supplied stringent cures for certain illnesses condition. With medication, such as digitalis and morphine.atropine, etc. Therefore, it makes sense to Look for the perfect anti-inflammatory medication from the the plant kingdom(8).

Keywords: Moringa oleifera , anti-inflammatory activity , medicinal plant ,Nutritional Composition

Overview of moringa production areas

Six of South Africa's nine provinces—the Limpopo, Gauteng, Mpumalanga, KwaZulu-Natal, Free State, and North West—produce moringa.(9,10) 5 Of these provinces, the Limpopo Province is where farmers and households grow it the most.(11) The Moringa Development Association of South Africa (MDASA) was established in 2013 with the goal of advancing moringa cultivation, use, and commercialization. By working with organizations and research institutes to share new information and advancements, MDASA acted as a central point for moringa farmers, product developers, and customers. In certain regions of South Africa, the number of farmers cultivating moringa has grown since its inception. Per a survey carried out by Mabapa et al. All five districts of the province of Limpopo (Capricorn, Mopani, Sekhukhune, Vhembe, and Waterberg Districts) had moringa farmers. With seed yields of 50–100 kg/ha, moringa was grown on an area larger than 0.25 ha. Additionally, it was predicted that the sale of moringa leaves would generate USD 13,000 in enterprise income annually, with a USD 6000 gross margin.(12)

Use of different parts of Moringa Oleifera:

Nearly every component of the plant, including the seed, bark, root, and more, is included. petals, pods, seed oil, leaves, resin have possible food applications.agricultural and industrial applications. It has a wide range of uses, including:water purification, medication, nutraceuticals, and functional meals attributes, making it the most valuable in the world plant [13]. The tree is called by a different name in different regions of the globe. mother's best friend since it's known to be eaten improving milk output and treating anemia, which is prevalent among nursing mothers [14].

Leaves: The leaves of the drumstick tree are nutritious and are completely safe to eat. They contain a high concentration of Protein, carbs, fiber, beta carotene, and other nutrients calcium, potassium, iron, and vitamin C, among other minerals phosphorus [15]. The quantity of protein in dried Moringa.The protein content of oleifera leaf powder is comparable to that of a few pulses, such as kidney beans, soybeans, and moth beans,that are utilized in food since they contain (22-24%) protein.Leaves contain vital amino acids, including methionine.As a result, lysine, tryptophan, and cysteine are excellent for daily use.diet [16]. There are several different kinds of antioxidants found in the leaves.substances like flavonoids, ascorbic acid, and phenolic carotenoids and compounds that behave as a natural antioxidant [17].

Fig.No 1 *leaf of moringa plant*

Flowers: The flowers are bisexual and 2.5 cm in width and pleasantly fragrant. They are either white or cream-colored with yellow dots at the base [18]. Flowers are a great nectar source for honey production. They may be consumed raw with salads or used to create tea, which may be consumed after blanching, etc

Fig.no 2 Flower of moringa plant

Seeds: Approximately 15,000 to 25,000 seeds are made from just one tree each year. The seeds are semi-brownish. are spherical in form and have a permeable seed coat. Seeds have average quantity of vitamin A and E. The seed contains polypeptides, which behave like coagulants and are hence utilized to treat river water with suspended solids and groundwater

[19] and as an oil source for biodiesel manufacturing [20]. Seeds are sold commercially to make oil known as "ben oil." Its aroma is sweet and it has the ability to Oil's ability to absorb and hold volatile components makes it so. used in hair care and fragrance products. Seeds include between 30% and 42% oil, which is a vibrant yellow hue, and the press cake that is produced as a byproduct of the oil.

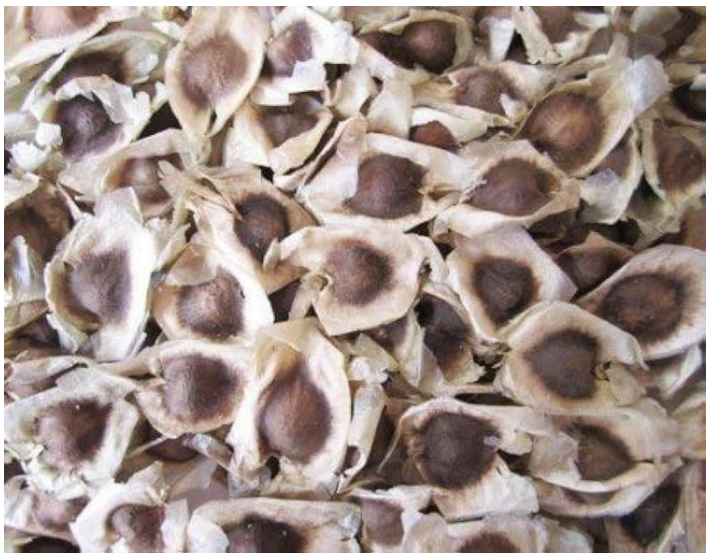

Fig.no 3 Seeds of moringa plant

Nutritional Composition

A plant's nutritional value is crucial to its therapeutic, nutritional, and medicinsal qualities.(21). Moringa leaves are thought to be a rich source of protein, potassium, and vitamin C. It functions as a potent natural antioxidant source. Moringa can prolong the shelf life of foods high in lipids because it contains a variety of antioxidant compounds, including flavonoids, ascorbic acid, carotenoids, and phenolics.(22) Additionally, it was discovered that every component of the Moringa tree under study—fruits, seeds, leaves, flowers, bark, and roots—led to the identification of at least one, or in the majority of cases, several, advantageous nutrients.Furthermore, it was discovered that the Moringa has a class of special chemicals called sugar and rhamnose, which are rare sugar-modified glucosinolates.(23) According to reports, these substances exhibit some chemopreventive effect by triggering apoptosis.(24)

1. Anti-inflamtory effect
2. Anti-fibrotic/ulcer
3. Anti-oxidant propery of moringa
4. Anti-microbial property of moringa
5. Anti-hyperglycemic of oringa
6. Anti-cancer of moringa
7. Anti-tumer properties of moringa
8. Anti-clastogenic properties of moringa

MATERIAL AND METHODS

Collection of Plant Material

The Seeds of Moringa oleifera getaway were collected from original areas of Chopda Maharashtra and authenticated by Department of Botany, Agharkar Research Institute, pune, The Voucher no. is F- 164. The seeds were dried in shade and reduced to coarse power using mechanical grinder and passed through a sieve No. 40 to gain about greasepaint of asked flyspeck size.

Preparation of Crude Extraction

Preparation of Crude birth The dried greasepaint(1 Kg) was uprooted with petroleum ether, chloroform, ethanol in soxhlet extractor and another batch of greasepaint(1 Kg) was soddened with distilled water for 24 hours. The excerpts were concentrated in rotary flash evaporator under vacuum.

Successive Solvent Extraction

Consecutive Detergent birth The dried greasepaint(1 Kg) was uprooted with colorful detergents having different opposition like petroleum ether(40-600C), chloroform and ethanol in race. Each excerpt was concentrated in rotary flash evaporator under vacuum.

CONCLUSION:

Moringa oleifera demonstrates significant anti-inflammatory potential supported by a growing body of preclinical and emerging clinical evidence. Its bioactive constituents— including isothiocyanates, flavonoids (quercetin, kaempferol), phenolic acids, and vitamins— modulate key inflammatory pathways such as NF-κB, COX-2, and pro-inflammatory cytokines (TNF-α, IL-6, IL-1β). Both leaf and seed extracts consistently reduce inflammatory markers in in vitro and animal models, showing effects comparable to standard anti- inflammatory drugs, but with a more favorable safety profile.

While early human studies suggest benefits for metabolic and inflammatory disorders, the current clinical evidence remains limited by small sample sizes, variability in extract preparation, and inconsistent dosing. Standardization of moringa preparations, rigorous randomized controlled trials, and long-term safety assessments are needed before definitive therapeutic recommendations can be made.

Overall, Moringa oleifera holds strong promise as a natural anti-inflammatory agent, with potential applications in chronic inflammatory diseases, metabolic disorders, and nutraceutical formulations. Further well-designed human studies will be crucial to validating its efficacy and optimizing its clinical use.

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