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A COMPREHENSIVE REVIEW OF GENERAL INFORMATION AND PHYTOCHEMICAL COMPOSITION OF: GENUS MORINGA

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ABSTRACT

The pandemic has increased people's preference for plant-based and herbal medications, which has highlighted the relevance use. Natural medicines have good nutritional value and has a great nutritional value. Medicinal plants has a variety of biological activities that are used in the indigenous medical system to treat a variety of illnesses. These activities include antitumor, antipyretic, antiepileptic, anti-inflammatory, antiulcer, antispasmodic, diuretic, antihypertensive, cholesterol lowering, antioxidant, hepatoprotective, antibacterial, cardiac, and antifungal. Medicinal plants are still very important in today's medical research. Most species in the Moringa Genus are important to pharmacology and have excellent therapeutic qualities. This study focuses on the ethnomedicinal, pharmalogical, phytochemical and anti-bacterical characteristics of five species in the genus Moringa: Moringa oleifera Lam, Moringa peregrina, Moringa concanensis Nimmo, Moringa stenopetala, Moringa rivae.

Keywords: Medicinal plants, pharmacological activities, anti-oxidant, anti-microbial, Phytochemicals.

I. INTRODUCTION

The very nutritious and adaptable vegetable tree Moringa oleifera Lam has several potential applications. It is the Moringaceae family's most commonly grown species (Patel et al.,2010). Common names for this plant include "West Indian Ben," "drumstick tree," and "horse radish tree." M. oleifera Lam is a drought-resistant, medium-sized plant that grows quickly in any condition. It is present in the sub-Himalayan tracts of northern India (Bareilly, Pilibhith, Shahjahanpur, Bahraich, Gorakhpur, and surrounding area), the tarai tract of Uttarakhand, the foothills of Himachal Pradesh, Sikkim, and sections of northern Uttar Pradesh (Pandey et al.,2011). It is believed that the drumstick tree (Moringa oleifera Lam.), a tree with rich evergreen leaves that grows to a height of three to five feet, originated in the Himalayan region of northwest India (Rufai et al.,2013). Moringa oleifera Lam, also known as Sajna or drumstick, is a significant perennial vegetable crop internationally. Plants of the moringa genus can survive in a variety of climatic and environmental conditions. The tree is said to be able to survive temperatures as high as 480°C, as well as minor frosts, shade, and slightly alkaline soils up to pH 9 (Akter & Rahman.,).

Moringaceae family is the drumstick. There are around 13 species in Moringa genus , out of this two species are found in India: M. oleifera Lam. (syn. M.pterygosperma Gaertn.) and M. concanensis Nimmo. M. oleifera Lam. is widely dispersed, and naturally occurring species in the monogeneric former (Tak et al.,2015].

Morton (1991) reported that the most common species are M.stenopetala Cufod, M. borziana Mattel, M. longituba Engl, M. concanensis Nimmo, M. ovalifolia Dinter and A. Berger, M. drouhardii, and M. hildebrantii. Alternatives for these species are M. aptera Gaertns, M. arabica (Lam.) Pens., M. zeylanica Sieb, Balanus myrepsica Blackm (Morton 1991 Moringa oleifera Lam is cultivated throughout Africa, usually as a universal medicinal plant, and is widely cultivated for its unripe fruits and leafy vegetables, stems, roots, pods, and seeds(Popoola et al.,2016). A significant food item that has received a lot of attention as the "natural nutrition of the tropics" is the drumstick. Moringa possesses numerous medicinal properties. Nearly every element, including the root, bark, gum, leaf, fruit (pod), flower, seed, and seed oil, has been used to treat a variety of infectious and inflammatory illnesses as well as liver disease., gastrointestinal, cardiovascular, and haematological condition [Tak& Mayara.,2015]. Drum stick

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is known as a highly nutritious vegetable tree because its leaves and immature pods are rich in minerals and vitamins A, B, and C (Drisya Ravi et al.,2021)

India is the world's greatest producer of delicate fruit, producing between 1.1 and 1.3 million tonnes per year. Dried powdered of Moringa oleifera Lam leaves are effectively use for adding flavor to food and make nutritious porridge diets for people of all ages group, including expectant mothers, nursing mothers, newborns, and small children. (Dunkwal et al.,2017).

Taxonomical classification of Moringa Oleifera Lam:

Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Order : Brassicales
Family : Moringaceae
Genus : Moringa
Species : oleifera

II. GENERAL INFORMATION ABOUT SOME SPECIES OF MORINGA SPECIES

1.Moringa oleifera Lam:

Moringa oleifera Lam is a fast-growing softwood tree found in the sub-Himalayan highlands of northern India. Among the 13 species belonging to the same genus, it has the widest distribution at elevations of up to 2000 metres in tropical and subtropical areas (Leone et al.,2016).

Members of the Moringaceae family, M. oleifera is known as "zogale" in Hausa, Nigeria, and generally as "drumstick tree" or horseradish tree. Although it originated in north India, M. oleifera Lam is now popular all across the tropics. It is also referred to as the drumstick tree, the horse radish tree, and the mother's greatest buddy. It grows quickly and can go as tall as 12 metres. There are spots of grey bark that resemble cork peeling (Bashir et al.,2016). It is not severely affected by drought and can survive poor soil conditions. It also thrives in hot, dry areas and the rainy tropics .With estimated minimum and maximum yearly rainfall requirements of 250 and more than 3000 mm, respectively, and a pH range of 5.0 to 9.03, it can tolerate a substantial rainfall. (Toma & Deyno.,2014).

The perennial softwood tree (Moringa oleifera) is well-known for its industrial and traditional applications. It is widely farmed in West, East, and South Africa, Tropical Asia, Latin America, the Caribbean, Florida, and Pacific Islands. It is a significant crop in India, Ethiopia, the Philippines, and Sudan (Tesfay et al.,2011).

Humans use Moringa oleifera Lam in a variety of ways, consuming all of its components. Moringa leaves are a highly digestible source of nutrients that may be consumed raw, boiled, or preserved as a powder. In many underdeveloped nations across the world, moringa leaves are recommended for use in medicine and nutrition. Moringa has a lot of potential for helping strengthen animal and poultry immune systems and improve nutrition. You can consume green or dried seeds(Abd El-Hack.,2018).

2.Moringa peregrina:

The subtropical and tropical regions of Asia and Africa are home to some of the most useful plants, including varieties of moringa. Moringa peregrina is native to the region north of Somalia, southern Arabia, and the Dead Sea. These are the most often planted plants and are members of the Moringaceae family (Al Ameri et al.,2014).

M. peregrina is a deciduous tree of the Moringaceae family. Among the other Moringa species, it grows the quickest, reaching a height of 3 to 10 metres and having greyish green bark that is suited for extreme aridity. The leaves are deciduous, oblong, alternating, and 30 to 40 centimetres long. The pentamerous, hermaphrodite, 10–15 mm long flowers have white sepals and are pinkish white in colour. M. peregrina is becoming increasingly well-known these days because of its traditional, nutritional, industrial, and therapeutic uses. Over the past few decades, this plant has been tested for a variety of pharmacological properties due to its vast range of medical applications(Senthilkumar et al.,2018). Up to now, the majority of these research contributions have been

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concentrated on M. peregrina applications for food and medicinal production, cultivation techniques, innovative crop management, and evaluation of M.peregrina drought stress adaption(Moradi et al.,2021).

3.Moringa Concanensis Nimmo: M.Concanensis Nimmo grow in India. In India's untamed regions (Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, Goa, Andhra Pradesh, and Tamil Nadu), M. concanensis, a tiny tree that resembles M. oleifera, thrives. This little-known species may be separate from the former by its taller, bipinnately complex leaves and yellow blooms with pink or red splotches(Vijayarajan & Pandain.,2016).

The plant known as Moringa concanensis is a member of the Moringaceae family. In India's arid tropical areas, this plant is grown. It is mostly grown in India's western and southern areas. Due to its bitter flavour, this plant cannot be eaten, but because of its chemical makeup, it has many other use. The trunks of M.concanensis are thin(Patil & Dodiya.,2022).

On arid terrain, Moringa concanensis is extensively found. M. concanensis is an eight-foot-tall evergreen tree with a spreading crown.The obovate, caducous, bipinnate leaves alternate .Large, white, hermaphrodite, irregular flowers in panicles along the axilla.Calyx thinly tomentose,long,segments white,oblong,reflexed.Petals are golden, oval, and red-veined.5 viable stamens and staminodes(Balamurugan&Balakrishnana.,2013).

4.Moringa stenopetala: There are around fourteen species in the genus Moringa of the family Moringaceae, which includes Moringa stenopetala. This tropical deciduous plant is extensively found in Ethiopia's southern regions, with an elevation range of around 1100–1600 metres(Chekesa & Mekonnen.,2015).

M. stenopetala, sometimes known as the "cabbage tree," is a widely grown native vegetable in southwest Ethiopia that is used for food. The tree M. stenopetala is 6–12 m tall, 60 cm in diameter, and has a smooth bark. It may grow between 400 and 2,100 metres above sea level, with annual temperatures between 24 and 30 degrees Celsius and 500 and 1400 millimetres of rainfall(Seifu.,2015).

Ethiopian people eat the leaves as a vegetable, especially during the dry season. The plant grows in semi-arid environments. The leaves and fruits are eaten as vegetables since they are high in nutrients(Kekuda et al.,2016).

With around five pairs of pinnae and three to nine elliptic or ovate leaflets on each pinna, the leaves are either bipinnate or tripinnate. The creamy-pink sepals, white or yellow petals, and white stamens adorn the fragrant blooms. Long, crimson pods with a greyish bloom are the fruits (Abiyu et al.,2018).

5.Moringa rivae : The plant, known locally as Swanjhero, is Moringa rivae, a member of the Moringaceae family. It is a short, thin shrub or tree with sticky bark. It is indigenous to Asia and Africa. There are 33 species in the single genus Moringa that make up the Moringaceae family. Just a small number of the Moringaceae family's plants have undergone scientific investigation (Saleem et al.,2020)

The leaflets are glabrous, oblong to elliptic, and the leaves are alternating and pinnate. The fruits are 9-ribbed pendulous pods that are 30 to 45 cm long, tomentose when young, and have a yellowish or reddish smell. The blossoms are fragrant with honey. The three angled, winged, spherical, and blackish seeds are lodged in the valve pits. M. rivae inhabits rocky hillsides covered with dense undergrowth (Padayahee &Baijnath.,2012).

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1.Moringa oleifera Lam
2.Moringa peregrina
3.Moringa concanensis Nimmo
4.Moringa stenopetala
5.Moringa rivea

Table :1 Species Name with their Origin:

Species	Origin
1.Moringa oleifera Lam	India
2.Moringa peregrina	Africa
3.Moringa concanensis Nimmo	India
4.Moringa stenopetala	Kenya
5.Moringa Rivea	Kenya

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Table 2: The geographical distribution and uses of Moringa species

Moringa species	Geographical distribution	Growth From	Use	References
Moringa oleifera Lam	Most Southern Asia	Tree	Food supply, coagulant for water, oil, medicinal plant, fodder, decorative, and firewood.	Jahn et al.,1986
Moringa peregrina	Most Middle East	Shrub or tree	Water coagulant, ornamental plants, oil	Jahn et al.,1986
	India	Tree	Oil and therapeutic plant	Anbazhakan et al.,2007
Moringa stenopetala	Kenya	Tree	Oil, vegetable, feed, and decorative	Hamza et al.,2017
Moringa rivea	Kenya	Shrub or tree	Medicinal plant	Hamza et al.,2017

Phytochemicals Found In Different Species Of Genus Moringa

The different extracts of various species of genus Moringa are analysed for the presence of various phytochemicals such as phenolic acids, flavonoids, tannins, saponins, alkaloids ,glycosides, protein fixed oil and fats etc.

Moringa oleifera Lam: Numerous phytoconstituents, including glucosinolates, flavonoids, terpenes, alkaloids, saponins, tannins, steroids, and phenolic acids, are found in moringa species. The genus's wide range of pharmacological applications is facilitated by the variety of these phytochemicals. M. oleifera, with the majority of research concentrating on the plant's leaves (Adb Rani et al.,2018).

Moringa peregrina: Numerous bioactive substances, including glucosinolates, caffeoylquinic acid, ascorbic acid, amino acids, carotenoids, alkaloids, moringine, phytoestrogens, and moringinine, are available from different species of moringa plants. According to reports, M. peregrina has the biggest fatty acid makeup (Abdalla et al.,2022).

Moringa concanensis Nimmo: In order to determine the presence of alkaloids, fatty acids, emodins, flavonoids, steroidsterpenoids, anthracene glycosides, phenolics, saponins, tannins, xanthoprotein, carbohydrates, cardiac glycosides, amino acids, volatile oils, and reducing sugar (Balamurugan & Balakrishnan.,2013).

Moringa stenopetala: Glucosinolates and phenolics (flavonoids, anthocyanins proanthocyanidins, and cinnamates) from a single source of M. stenopetala were examined. Both 4-(α-l-rhamnopyranosyloxy)-benzylglucosinolate and benzyl glucosinolate were present in considerable proportions in M. stenopetala. Four-(α-l-rhamnopyranosyloxy)-benzylglucosinolate and its three monoacetyl isomers were found in the leaves of both species (Bennett et al.,2003).

Moringa rivea: tannins, lignans, phenolic acids, and flavonoids, with flavonoids being the main component.

III. ANTI-OXIDANT ACITIVITY OF DIFFERENT SPECIES OF GENUS MORINGA

Unstable atoms known as free radicals are produced spontaneously by metabolism or exposure to toxins in the environment. Free radicals can produce oxidative stress, accelerate ageing, damage cells, and cause illnesses. As a result, the antioxidant potential of the plant extracts is assessed. One antioxidant test used to measure this potential is the DPPH assay, which depends on the antioxidants' ability to scavenge it.

Moringa oleifera Lam:

Researchers looked at the phytochemical contents of an ethanol extract made from both young and mature Moringa oleifera leaves, including total phenolic, flavonoid, and tannin content. Conversely, research was also

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done on antioxidant activity tests, which included ferrous ion chelating capacity, ABTS free radical scavenging activity lowering power, and total antioxidant activity (Ahmed et al.,).

The evaluation of M. oleifera's potential for anti-inflammatory, anti-arthritic, and antioxidant effects has not been the subject of any scientific research. As a result, the current work examined the anti-inflammatory, anti-arthritic, and antioxidant properties of several M. oleifera (wild type) extracts (Saleem et al.,2020).

M. ovalifolia's leaves and flowers decreased the DPPH by about 20%, whereas the bark and seed only had a 12% reduction (Ananias.,2015).

Moringa peregrina:

With a DPPH radical scavenging activity of 5.3±0.2µg/ml, the leaves methanol (LM) extract had the greatest level of activity. The leaves ethylacetate extract (LE) and seeds methanolic extract (SM) had IC50 values of 7.1±0.2 and 7.2±0.4µg/ml, respectively, after that. With an IC50 value of 49.1±2.7µg/ml, LE extract exhibited the highest ABTS radical scavenging activity, while LM and SM extracts demonstrated the highest hydroxyl radical inhibition activity, with IC50 values of 76.9±0.8 and 77.5±1.2µg/ml, respectively. The extracts of LM, LE, and SM exhibited the highest overall antioxidant activity, with 294.3, 244.5, and 231.6µg ascorbic acid equivalent per milligramme of extract, respectively (Al-Dabbas .,2017).

Moringa concanensis Nimmo: The DPPH activity, superoxide anion radicals, hydroxyl radicals, and reducing power were all decreased by M. concanensis leaves. The extract had a higher hydroxyl radical inhibition (IC50: 45.3 µg/mL) than ascorbic acid (IC50: 58.2 µg/mL).

Methanol crude extracts of M. concanensis root bark reduced the mitochondrial membrane potential of the cells while controlling caspase 9 and caspase 3, which in turn prevented the growth of hepatocellular carcinoma (Hep-G2) cells via intrinsic pathways (Abd Rani et al .,2018).

Moringa stenopetala:

The total phenolic content of the bought Moringa leaf powder and the powdered M. stenopetala leaves was determined to be 75.5 ± 2.28 and 92.8 ± 1.01 mg gallic acid equivalent per 100 g of dry weight of sample, respectively. In the FRAP experiment, the antioxidant capacity of the bought Moringa powder and powdered Moringa stenopetala leaf was determined to be 442.0±10.58 and 291.3±15.52 mg of ascorbic acid equivalent per 100 g of dry weight of plant sample, respectively.

In the DPPH experiment, the equivalent ascorbic acid content of the powdered Moringa stenopetala leaf and the bought Moringa powder were determined to be, respectively, 144.0±0.53 and 138.8±1.05 mg per 100 g of dry weight of the sample. These two samples' varying total phenolic contents can be used to explain the variation in their antioxidant ability (Tebeka & libsu.,2014).

IV. PHARMACOLOGICAL APPLICATIONS OF DIFERENT SPECIES OF GENUS MORINGA

Different plants of genus Moringa exhibit great importance as they contain ethnomedicinal, pharmacological and antimicrobial applications.Tables below illustrate various applications of selected five species of genus Moringa.

Moringa oleifera Lam:

Pharmacological activity	Plant Part	Result	References
Ethnomedicinal uses	Leaf	diarrhoea, vomiting, colitis, ulcers, skin infection, anaemia, rashes, cuts, and ageing signs	Mohanty et al.,2021
	Flowers	tumour, inflammation, hysteria, splenic enlargement, muscular disorders, and aphrodisiacs	Mohanty et al.,2021.
	Roots	antioxidant, antidiabetic, hepatoprotective, antitumor, antipyretic, antiepileptic, antiinflammatory, antiulcer, antispasmodic,	Anwar et al.,2007

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		diuretic, antihypertensive, cholesterol lowering,	
	Leaves	Treatments for high blood pressure, decreasing blood sugar, treating common colds, curing male impotence, and treating skin infections and illnesses were among the applications mentioned by the respondents	Stevens et al.,2013
Anti-microbial activity	Flower&leaves	In vitro tests were conducted on M. oleifera leaves, flowers, and seeds against fungi and gram-positive and gram-negative bacteria.	Nepolean et al.,2009
Anti-inflammatory activity	Bark	according to the results of this investigation, extracts from the stem bark of Moringa oleifera have the ability to reduce pain and inflammation. The outcomes provide experimental support for its traditional usage in treating a range of inflammatory and pain-related disorders.	Kumbhare & Sivakumar (2011)

2: Moringa peregrina:

Pharmocological activity	Plant part	Result	References
Ethnomedicinal uses	Plant	Diabetes, wound healing, disinfection, fever, constipation, muscular aches, slimness, burns, labour pain, hypertension, malaria, stomach disorders, asthma, skin issues, and the removal of a retained placenta are among the conditions for which human health care is needed.	Senthilkumar et al.,2018
	Leaves & roots	The seeds are used to treat stomach ache, while the leaves are used to heal wounds. When combined with water, the roots and leaves of M. peregrina are used to cure a variety of conditions, including diabetes, asthma, malaria, hypertension, stomach issues, and retained placentas..	Karuvantevida, N. (2018).
Anti-microbial activity	Flower& leaves	Using the Bauer-Kirby diffusion technique, the antibacterial activities of the extracted oil were ascertained by measuring the Minimal Inhibitory Concentration (MIC), which was expressed as mg/mL, against four Gramme negative bacteria two Gramme positive bacteria and three human pathogenic fungi (Candida albicans, Candida tropicalis, and Candida glabrata.	Lalas et al.,2019
Anti-inflammatory activity	Leaves	Anti-inflammatory properties of M. peregrina leaves and seed oil can be strengthened in a beneficial way. Furthermore, there are notable anti-inflammatory and anti-arthritic properties in M. peregrina oil. To determine the exact active ingredients in M.	Shamlan et al.,2021

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		peregrina oil and leaves that provide their anti-inflammatory and anti-arthritic properties, more research is necessary.	

3. Moringa concanensis Nimmo:

Pharmocological activity	Plant part	Result	References
Ethnomedicinal uses	Plant	Usually, medicinal preparations make use of all components of the plant, including the roots, seeds, fruits, flowers, bark, and leaves, whether they are fresh or dried	Hamza & Azmach (2017)
	Leaves	Its leaves have several medicinal qualities that may be used to treat a wide range of conditions, including skin tumours, gastrointestinal issues, diabetes, exhaustion, burn wounds from fires, jaundice, and a host of other conditions.	Christian & Maitreya, (2022)
Anti-Microbial activity		The extracts of ethanol, chloroform, and water exhibited significant efficacy against Salmonella typhi. When it came to combating Salmonella typhii, the ethanol extract outperformed the standard.	Balamurugan, V., & Balakrishnan, V. (2013).
Anti-inflammatory activity	Seed	The current experiment sought to determine the anti-inflammatory properties of Moringa concanensis seed oil and quantify lupeol and β-sitosterol using high performance liquid chromatography. Rat paw edoema caused by carrageenan and granuloma development generated by cotton pellets were used to assess the anti-inflammatory efficacy. At 1 ml/kg, seed oil showed a moderate decrease in granuloma development and a stronger impact on the latter stages of swelling.	Wijayasiriwardena et al.,(2009).

4. Moringa stenopetala:

Pharmocological activity	Plant part	Result	References
Ethenomedicines uses	Plant	often used to treat a variety of conditions, including wounds, liver and pancreatic illnesses, malaria, high blood pressure, asthma, diabetes, stomach discomfort, diarrhoea, vomiting, digestive issues, rheumatism, cold troubles.	Tesfaye et al., (2022)
	Roots	The roots of M. stenopetala are used to heal wounds, stomach issues, diabetes, hypertension, asthma, malaria, and to remove retained placentas.	Hadis et al., (2020).

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	Leves & roots	The leaves were used medicinally to cure ear infections, decrease blood pressure, and treat diabetes mellitus by reducing blood sugar. There has been proof that the roots and stem of Moringa trees have traditional medical uses.	Stevens et al.,2013
Anti-microbial activity	Leaves	Among the organisms were: the microorganisms that are Gram-negative Salmonella Typhimurium, Klebsiella pneumoniae subsp. pneumoniae, and Escherichia coli the microorganisms that are Gram-positive Aureus Staphylococcus	Seleshe & Kang. (2019).
Anti-inflammatory activity	Leaves	Using mice that had their paws edematously caused by carrageenan, the anti-inflammatory activity was assessed using a slightly modified version of the Winter technique	Tamrat et al., (2017).

V. CONCLUSION

Numerous plant species in the Genus Moringa have significant medicinal and pharmacological value, as the overview above shows. different phytochemicals and biomolecules found in the different Moringa plant species. As a result, this Genus of plants has been utilised for ages for its decorative qualities as well as for their recognised ethnomedicinal and pharmacological uses. However, a lot more study is required to determine these plants' full potential. Furthermore, the pharmaceutical and medical companies will be able to employ more plant materials and improve the applications of medications derived from plants as a result of these discoveries.

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