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# *Moringa oleifera*: A Review of Pharmacological Benefits

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## Abstract

The chemical composition of a specific material, the structure that gives it its unique qualities, and indirectly the method of production all has an impact on the selection of an effective bioactive material for medical applications. Moringa is a type of medicinal plant with unique active ingredients that have been traditionally used to treat a variety of conditions. The species is also used to purify water and is recognized as a source of nutrients. The type consists of 13 species that have been extensively domesticated in Asia and Africa, M.O. one of them whose pharmacological values worried scientists to manage. The objective of this study is to provide updated and well-defined information on the traditional uses, biological characteristics, and therapeutic potential of *Moringa oleifera*. It will also evaluate upcoming research opportunities. PubMed, ScienceDirect, Google Scholar, and other journal articles published between 1994 and 2021 were used to gather the literature for this paper's review. The antioxidant, anti-inflammatory, anticancer, and other properties of *Moringa oleifera* are well known. Flavonoids, glucosides, and glucosinolates are present in significant concentrations, which activate the majority of its natural activity. We intend to shed light on this plant by outlining the traditional use and pharmacological properties of Moringa.

KEYWORDS
*Moringa oleifera*, Hepatoprotective, Renal-protective, Anticancer properties, Antioxidant activities

## INTRODUCTION

*Moringa oleifera* (M.O.) is an ever-popular multiuse tree of great financial significance and dietary virtues (Padayachee and Baijnath, 2020). M.O.'s leaves the part of the plant that is most useful and used is a rich source of proteins, amino acids, minerals, and vitamins (Abbas *et al*., 2018). The majority of the dried leaves contain 19 different amino acids as well as a variety of bioactive compounds, mostly antioxidants like proanthocyanidins, vitamin E, vitamin C, selenium, zinc, and beta-carotene. Other bioactive compounds include phenolic acids like gallic and chlorogenic acid, ellagic acid, and myricetin. These components are present in varied amounts in various plants, but M.O. is the only way to get them entirely in large amounts, and they have also been said to have stronger antioxidant potential than synthetic antioxidants like rutin and butylated hydroxytoluene (Saleem *et al*., 2020). It has many advantages over other plants used as an animal food source in tropical and subtropical regions, including the capacity to withstand both drought and cold conditions, the ability to be a multicast feedstuff with short cutting interval, the ease with which it can be modified and consumed by animals, and the ability to obtain high mineral (Ca and Fe) and protein substances, essential fatty acids, and negligible amounts of antinutritional elements (Olusanya *et al*., 2020).

## ETYMOLOGY AND DISTRIBUTION

Olson and Fahey (2011) reported that M.O. is one of the Moringaceae family that grows quickly and resists drought conditions. The plant is known by many other names, including miracle tree, horseradish tree, drumstick tree, and ben oil tree due to its behenic acid content and long, thin seedpods. The Western and Sub-Himalayan regions of Northwest India, Pakistan, and Afghanistan are home to the plant species *Moringa oleifera*. Africa, Southeast Asia, Arabia, South America, and the Caribbean Islands are all regions where this variety is frequently cultivated. M.O. Additionally, culture is being diffused throughout Brazil's semi-arid northeast (Thiago *et al*., 2019). Besides, Yadava's (1996) stated that M.O. due to its ability to withstand harsh surroundings like high temperatures and drought conditions, is one of the most common plants that can sustain a wide range of environmental circumstances. So, it grows in a variety of soil types, including semi-dry, desert, or tropical soils, as well as in places with rainfall. The plant can endure a wide range of pH values, from 5.0 to 9.0. However, it prefers soils with a neutral pH and good drainage. It thrives in temperatures between 25 to 40 °C, although during the coldest and hottest months, it can withstand temperature shocks of 1 to 3°C and 38 to 48°C, respectively.


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## POTENTIAL DESCRIPTION

*Appearance of Moringa oleifera plant*

The plant has heights up to 10-15 m long; width is 20-40 cm (Raja *et al*., 2016). The tree is deeply embedded, and the wood of the tree is soft (Thapa, 2019).

Leaves

The plant leaves are long up to 7-60 cm and the color of the leaves is dark green. The leaves of the plant are varying in shape and size with opposite pairs with elliptical shapes (Thapa, 2019).

Flower

The flower petals of the M.O. plant are yellowish white and long up to 1.0-1.5cm, 2.0cm broad. M.O. bearing fragrant flower these is bisexual and surrounded with five unequal petals bearing thinly veined (Raja *et al.*, 2016).

Fruits

Fruits of M.O. extended up to 90 cm and 12 mm wide (Thapa, 2019). They have a droopy kind of fruit in the plant and the fruit of *Moringa oleifera* has a spherical kernel that is 1cm in width (Raja *et al.*, 2016).

Bark

M.O. bark is smooth, and dark brown/yellowish green (Thapa, 2019).

*Chemical constituents*

Numerous bioactive substances are present in *Moringa oleifera*, including triterpenoids, moringyne, monopalmitic, di-oleic triglyceride, campesterol, stigmasterol, -sitosterol, avenasterol, and vitamin A. These include flavonoids and isothiocyanates (Kou *et al*., 2018), polyphenols, carotenoids, alkaloids, and terpenoids (Ma *et al*., 2020), as well as flavon (Bhattacharya *et al*., 2014). According to Gopalakrishnan *et al.* (2016) M.O. has strong phenolic and tannin underpinnings. In addition, it contains several vital nutrients, including minerals, carbs, protein, fatty acids, provitamin A, thiamine, riboflavin, pantothenic acid, niacin, folate, and vitamin C. (Fe, Ca, Mn, Mg, P, Na, K, and Zn). In addition to these, it contains Glycosides-carbamate, copper, -tocopherol, pyridoxine, and -carotene, as well as the important amino acids methionine, cystine, tryptophan, and lysine.

## MEDICINAL USE OF MORINGA OLEIFERA PARTS

The entire drumstick plant is valuable for several measures like therapeutic applications, and foodstuff preparations, also useful for the manufacture of biodiesel and water cleansing. They have plenty content of protein, minerals, vitamins, and some other phenolic compounds. The entire plant is utilized as leaves, stem, fruit, kernels, pod, and root discussed below:

*Leaves*

The leaves of the plant are utilized in several Medicinal applications to cure numerous illnesses and it is also utilized in the preparation of foodstuff, the plant leaves are rich in vitamins, minerals, phenolic composites such as quercetin and kaempferol and they have some other nutritional ingredients. they have potent antioxidant activity (Thapa, 2019). A 2009 Japanese study found that drumsticks have 10 times the amount of vitamin A found in carrots and have more vitamin C than oranges. They are also a rich source of calcium and protein, with more calcium than milk, more protein than yoghurt, 15 times the amount of potassium found in bananas, and 25 times the amount of iron found in spinach (Thapa, 2019).

Medicinal use of leaves

Purgative, help to cure eye and ear infection, juice of leaves is used to control glucose level in blood, scurvy and some other illness like bronchitis, catarrh (excessive discharge/Inflammation in the mucous membrane), headaches, fever, piles (Farooq, 2007).

*Root*

Several researchers revealed the root of M.O. is utilized to treat and cure gastric ulcers and gastric mucosal lesions. It is also used to decrease acidity, also it exhibits antiulcer activity (Thapa, 2019).

Medicinal use of root

It is used as an antilithic agent (prevent the formation of kidney stones), carminative, anti-inflammatory agent, used as a cardiac/circulatory tonic, abortifacient agent (an agent that induces abortion), useful in pain such as lower back pain or kidney pain and constipation (Farooq, 2007).

*Flower*

The drumstick flowers possess anti-inflammatory activity and antiarthritic activity and it also exhibit high medicinal value as a stimulant.

Medicinal Properties

Aphrodisiac, hysteria (uncontrollable emotion), hypercholesterolemia (Farooq, 2007).

*Pods*

Several investigations revealed that a drumstick pod is utilized to cure liver illnesses, diarrhea, and spleen disorders, and also utilized to relieve pain as joint pain (Daba, 2016).

*Stem bark*

The stem of the plant has high medicinal importance it has antitubercular properties and the extract of the root bark is utilized for earaches and utilized as an anesthetic for the dental cavity.

Medicinal use of stem bark

It treats eye sicknesses, cures delirious patients, inhibits spleen enlargement and development of tuberculous glands of the neck, and cancers, and prevents ulcer development (Farooq, 2007).

*Seed*

The seed of the drumstick plant has a variety of phytochemical composites, antioxidants include beta-carotene, vitamin C, vitamin A, beta-sitosterol, protein, phenolic compound, quercetin, kaempferol, and the plant has some bioactive ingredients as flavonoids, saponins, and trypsin inhibitor. The plant seed is not only valuable for its protein and nutrition; it is also valuable for the incidence of lipids and fibers (Saa, 2019).

Medicinal use of seed

Several investigations show that the complete grown seed of the drumstick plant is rich in oil and has 20 to 40% crude fat. Estimation of the seed oil chemical structure that revealed the oil has a higher quantity of monounsaturated fatty acid (MUFA) including oleic acid. The juice of M.O. seed has anti-malarial activity, and the seed juice is beneficial to inhibit inflammation through some mosquito vectors, seed extract is beneficial for pest control in crop fields and seed oil is also beneficial for the manufacture of biodiesel (Thapa, 2019).

It has anti-microbial, antibacterial, and anti-hypertensive activities (Farooq, 2007).

## PHARMACOLOGICAL USE OF MORINGA OLEIFERA

*Hepatoprotective activity*

The methanolic extract of leaves shows a hepatoprotective activity owing to the incidence of quercetin and the aqueous extract of flower also has hepatoprotective properties since it has a similar composite as quercetin (it is a flavonoid) and has a hepatoprotective effect (Farooq, 2007). *Moringa oleifera* leaves aid to decrease the level of plasma aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, and creatinine and is also beneficial for the decline of lipids and lipid peroxidation in the rat liver and several studies illustrate the administration of leaves extract of the plant in rats' consequence in inhibition of serum AST, ALT, ALP, creatinine. On the other hand, the administration of leaf extracts in guinea pigs' consequences prevents non-alcoholic fatty liver disorder (NAFD) (Jimenez, 2017).

*Reno-protective activity*

The reno-protective activity and anti-nephrotoxic characteristics of the watery extract of M.O. were assessed by Mansour *et al.* (2014) in rats. The authors produced liver and kidney damages by using radiation. Different biochemical parameters, including malondialdehyde, total nitrate/nitrite levels, superoxide dismutase, catalase, glutathione content, aminotransferase, and alanine aspartate aminotransferase, level of creatinine, and urea nitrogen in serum, underwent significant change after induction using such a method. biochemical parameters were recovered after treatment with M.O.. It was demonstrated that the reno-protective activity of free radical scavenging properties could be identified.

*Antioxidant activity*

*Moringa oleifera* possesses antioxidant properties, its extracts presented high activity in fighting oxidative stress (Pisoschi and Pop, 2015). The biological importance of the M.O. plant is due to the potent antioxidants (which are particles utilized against the free radicals with the capability to inhibit or neutralize free radicals before injuring the cells). There have been a lot of antioxidant systems which are synergistically occupying with each other for guarding the organs of the body besides the organ systems from free radical injuries (Younis *et al*., 2020), they are measured as external antioxidants and are a nutritional addition that participates with internal antioxidants in fighting free radicals that damage the cell. The extract also has several trace elements such as zinc, manganese, and magnesium that trigger several internal antioxidant enzymes that work inside the body (Pisoschi and Pop, 2015).

*Antidiabetic activity*

Aqueous extract of M.O. was found to have hypoglycemic properties, according to Adeeyo *et al*. (2013). According to an investigation, the aqueous extract of M.O. inhibited pancreatic malondialdehyde levels, raising glutathione and pancreatic superoxide dismutase levels, and regulating insulin levels to close to normal values all show that leaves are helpful in managing diabetes. In addition, much research have shown that M.O. may drop blood sugar levels by 13.5% on average, and fasting blood sugar levels by the same amount (Adeeyo *et al*., 2013; Kushwaha *et al*., 2014). Data indicated that M.O. inhibiting rate-limiting processes in liver gluconeogenesis, which increases insulin signaling and sensitivity directly or indirectly, is how extract applies its anti-obesity and anti-diabetic qualities. It is also an effective nutritive diet for the prevention of both conditions, and as anti-obesity and antidiabetic supplement (Waterman *et al*., 2015).

*Cholesterol-lowering activity*

The leaf extract of the M.O. plant performs an important role in decreasing cholesterol levels in the serum of a high-fat diet. The M.O. plant fruit shows activity like low cholesterol, phospholipids, triglycerides, low lipid density lipoprotein, and very low lipid density lipoprotein which demonstrates the plant is beneficial for reducing the lipid profile of the liver (Farooq, 2007). *Moringa oleifera* leaves extract has phytosterols as ß-sitosterol consequences in reduction of the intestinal uptake of dietary cholesterol outcomes in the reduction of plasma cholesterol and increase fecal cholesterol (Lin *et al*., 2010). Moringa leaves extract has potent diuretic constituents that can decrease the level of bad cholesterol in the blood and aid the body flush these dangerous elements more rapidly and simply (Dixit *et al*., 2016).

*Antihypertensive and diuretic activity*

Extract from M.O. leaves due to the presence of various composites that are advantageous for lowering blood pressure, such as nitrile, thiocarbamate glycosides, and mustard oil glycoside, has a stabilizing effect on blood pressure. The ethanol extract of *Moringa oleifera* leaves is thought to include a number of significant and naturally occurring compounds, including niazinin A, niazinin B, niazimicin, and niazinin A&B. In rats, these composites show hypotensive action, which lowers blood pressure. Another test revealed the blood pressure-lowering benefits of ethanol and an aqueous extract of whole pod sections. The study also revealed that pods frequently had a hypotensive impact. A calculation of the ethanol extract of *Moringa oleifera* pods shows that the pods contain the hypotensive compounds, thiocarbamate and isothiocyanate glycoside. On the other hand, the study also shows the pods of M.O. have some other composites such as methyl hydroxybenzoate, and sitosterol which also shows hy-

potensive activity. M.O. roots, leaves, and flowers have several chemical constituents which are beneficial for diuretic activity and the incidence of the diuretic element of the plant which show the main role in compound hypotensive activity (Farooq, 2007).

*Cardiovascular activity*

Cardioprotective effects are present in *Moringa oleifera*. A study found that its leaf extract has cardioprotective, which may be linked to its antioxidant properties, and myocardial protective properties (Nandave *et al*., 2009). N, L-rhamnopyranosyl vincosamide (VR), which was isolated from M.O. leaves have heart-protective qualities (Panda *et al*., 2013). M.O. extract in methanol in both normal and hyperdynamic heart measurements, leaves showed an increase in contraction force and cardiac output (Ganatra *et al*., 2012). According to reports, *Moringa oleifera* is used as a circulatory and cardiac tonic. Moringinine was discovered to be a heart tonic and a sympathetic nervous system stimulant (Dora *et al*., 2014).

*Anti-inflammatory effect*

Extract from *Moringa oleifera* leaves has been shown to regulate cellular and humeral immunity in rats and mice (Sudha *et al*., 2010). An ethyl acetate component of M.O. was organised by Kooltheat *et al*. (2014) which was derived from fresh leaves with high phenolic and antioxidant content. The scientists looked at the characteristics of M.O. because macrophages, TNF, and associated cytokines have a considerable pathophysiologic role in the lung damage caused by cigarette smoke. on human macrophage cytokine production induced by cigarette smoke extract. Various M.O. doses were pre-treated into human monocyte-derived macrophages (MDM). demonstrated that in response to LPS and cigarette smoke extract, the production of TNF, IL-6, and IL-8 was reduced. The decrease was noticeable at both the cytokine mRNA and protein levels. The extract also reduced the expression of *RelA*, a gene involved in NF-B p65 signaling in swollen cells. The outcomes show how capable M.O. is. to reduce cytokines (TNF, IL-6) that promote tissue damage and injury and IL-8 that promotes neutrophil migration into the lungs.

*Analgesic and Antipyretic activity*

As an average pyrexia model in Wistar albino rats, Bhattacharya *et al*. (2018) investigated the lowering fever property of ethanolic extracts of *Moringa oleifera* leaves at various doses. Pyrexia

Table 1. Some pharmacological activities of *Moringa oleifera* (M.O.)

| Activity | Description | References |
|---|---|---|
| Hepatoprotective activity | – *Moringa oleifera* leaves aid to decrease the level of plasma aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, and creatinine and is also beneficial for the decline of lipids and lipid peroxidation in the rat liver.<br>– The administration of leaf extracts in guinea pigs' consequences prevents non-alcoholic fatty liver disorder (NAFD). | Jimenez (2017) |
| Reno-protective activity | – Different biochemical parameters, including malondialdehyde, total nitrate/nitrite levels, superoxide dismutase, catalase, glutathione content, aminotransferase, and alanine aspartate aminotransferase, level of creatinine, and urea nitrogen in serum were recovered in rat's kidney after radiation-induced nephrotoxicity. | Mansour *et al*. (2014) |
| Antioxidant activity | – *Moringa oleifera* extract contains several trace elements such as zinc, manganese, and magnesium that trigger several internal antioxidant enzymes that work inside the body. | Pisoschi and Pop (2015) |
| Antidiabetic activity | – The aqueous extract of M.O. inhibited pancreatic malondialdehyde levels, raising glutathione and pancreatic superoxide dismutase levels, and regulating insulin levels to close to normal values all show that leaves are helpful in managing diabetes.<br>– M.O. may drop blood sugar levels by 13.5% on average, and fasting blood sugar levels by the same amount. | Adeeyo *et al*. (2013); Kushwaha *et al*. (2014). |
| Cholesterol-lowering activity | – Moringa leaves extract has potent diuretic constituents that can decrease the level of bad cholesterol in the blood and aid the body flush these dangerous elements more rapidly and simply. | Dixit *et al*. (2016) |
| Antihypertensive and diuretic activity | – M.O. have some other composites such as methyl hydroxybenzoate, and sitosterol which have hypotensive activity. M.O. roots, leaves, and flowers have several chemical constituents which are beneficial for diuretic activity and the incidence of the diuretic element of the plant which show the main role in compound hypotensive activity. | Farooq (2007). |
| Cardiovascular activity | – *Moringa oleifera* is used as a circulatory and cardiac tonic. Moringinine was discovered to be a heart tonic and a sympathetic nervous system stimulant. | Dora *et al*. (2014) |
| Anti-inflammatory effect | – Extract from *Moringa oleifera* leaves has been shown to regulate cellular and humeral immunity in rats and mice. | Sudha *et al*. (2010) |
| Analgesic and Antipyretic activity | – The M.O. extracts bark at a dose of 100 mg/kg significantly lowered body temperature in rabbits. | Ahmad *et al*. (2014) |
| Antispasmodic and Antiulcer activity | –Ethanolic extract of leaves of M.O. has antispasmodic and antiulcer properties. | Tiwari (2015) |
| Antitumor activity | – Studies have revealed that M.O. can be utilized as an anti-neuron proliferative element, medication decreasing the development of cancer cells. | Jung (2014) |
| Anti-microbial activity | – A significant response to the M.O. was demonstrated by establishment of increased antibody titers against Newcastle disease virus and infectious bronchitis (IB).<br>– M.O. extracts decrease several bacterial species such as *Bacillus subtilis, Escherichia coli, Micrococcus luteus, Enterococcus faecalis, Klebsiella pneumoniae, Pseudomonas aeruginosa, Bacillus cereus, Serratia marcescen, Staphylococcus epidermidis, Salmonella paratyphi, Staphylococcus aureus, and Salmonella typhi* | Khan *et al* (2021)<br>Patel and Mohan (2018) |

was induced in rats by administering 10 mL/kg of Brewer's yeast suspension subcutaneously in normal saline. When compared to the standard, the significant antipyretic property was found at dosage levels of 100, 200, and 400 mg/kg body weight. An analysis of the hydroalcoholic M.O. extract's relative antipyretic properties Paracetamol 50 mg/kg body weight was used as the standard medication in rabbits to treat E. coli-induced pyrexia at dosages of 25, 50, and 100 mg/kg. The M.O. extracts bark at a dose of 100 mg/kg significantly lowered body temperature (Ahmad *et al*., 2014).

*Antispasmodic and Antiulcer activity*

Ethanolic extract of leaves of M.O. has antispasmodic properties and the extract has an o-methyl thiocarbamate, because of the incidence of this composite it is utilized customarily in the cure of diarrhea. Moreover, the occurrence of dissimilar chemical composites they have an antispasmodic property, and the plant is also customarily beneficial in gastrointestinal motility diseases. The roots of the plant have antispasmodic properties. Several investigations revealed the methanolic extract of plant leaves demonstrates the anti-ulcer activities widely distributed in the plant (Gilani *et al*., 1994; Tiwari 2015).

The gastro-guard by M.O. extract may be because of the occurrence of phyto-apparatuses as flavonoids, tannins, terpenoids, sterols, alkaloids, and phenols, which have been described to exist in the leaves extract of M. O., which, when tested for antiulcer and gastroprotective properties, produced favorable results (Noemi *et al*., 2014). According to Kumar *et al*. (2013) the primary antiulcer dynamics of flavonoids include cytoprotection, cellular renewal, and advancement of wound healing. The flavonoids and phenols in M.O. have antioxidant effects. leaf extract might be connected to the antiulcer effect that was observed. Additionally, the *Moringa oleifera* leaf extract's antibacterial activities may suggest an alternative mechanism of antiulcer characteristics to slow the growth of *Helicobacter pylori* (Ijioma *et al*., 2018).

*Anti-epileptic*

Sections of the M.O. root, leaves, and fruits. were investigated, and the results suggested that the M.O. Due to its antiepileptic properties, it may obstruct sodium, chlorine, T type calcium channels, glutaminergic mechanisms, imitate GABA, decrease MAO enzyme activity, and produce less prostaglandins (Gupta *et al*., 1999; Joy *et al*., 2015; Quazi *et al*., 2016). Comparative research between M.O. was accomplished by Jay *et al*. (2011) using a maximum electroshock approach on male Wistar albino mice, a protective effect against seizures from root extract and oxcarbazepine was studied, along with pre- and post-treatment biogenic amine measurements. Comparing the root extract to the recommended antiepileptic dosage of 20 mg/kg, a considerable dosage-dependent reduction in numerous stages of epileptic episode was seen. Serotonin, dopamine, and nor-adrenaline levels in the forebrain area were significantly increased in the extract-cured animals, and the time needed to get over was much decreased in the experimental animals. M.O. has an anti-epileptic effect. Leaf extracts were tested on lab animals using the pilocarpine-induced seizure and maximum electroshock seizure pentylenetetrazole techniques. The observed effects showed that the extracts prevented rear limb extension caused by maximum electroshock, decreased the seizure period caused by pentylenetetrazole, and abolished convulsions caused by an epileptic state caused by pilocarpine (Joy *et al*., 2015).

*Antitumor activity*

According to Sharma *et al*. (2012) the M.O. repaid the property damage caused by the enzymes (glutathione and CAT). *Moringa oleifera* pod extract also revealed higher levels of the cytochrome p450 and cytochrome b5, which were discovered to operate as obstructive agents. These enzymes play the primary defense role against the impacts of carcinogens. According to a different study, consuming fruit and leaf extract could prevent mice from developing tumors (Purawal *et al*., 2010). Besides, Jung (2014) described that *Moringa oleifera* could be utilized as anticancer material because it is normal, dependable, and harmless at recognized meditations. Studies have revealed that M.O. can be utilized as an anti-neuron proliferative element, medication decreasing the development of cancer cells.

*Anti-bacterial and anti-fungal activity*

Patel and Mohan (2018) established that different M.O. extracts decrease several bacterial species in several manners. *Bacillus subtilis, Escherichia coli, Micrococcus luteus, Enterococcus faecalis, Klebsiella pneumoniae, Pseudomonas aeruginosa, Bacillus cereus, Serratia marcescen, Staphylococcus epidermidis, Salmonella paratyphi, Staphylococcus aureus*, and *Salmonella typhi* were among the strains investigated. The extract of M.O. roots extracts is described to have an active antibiotic pterygospermin which has potent bactericidal and fungicidal activities (Xianjuan *et al*., 2018).

*Antiviral activity*

Mohamed *et al*. (2017) investigated M.O.'s antiviral capacity. The plant's aqueous extract was tested for its ability to suppress herpes simplex virus types one and two, and the results showed that it has inhibitory properties of 43.2% and 21.4%, respectively. These findings show that *Moringa oleifera* can be used alone or in conjunction with antiviral medications to treat viral infections. *Moringa oleifera* treatment boosted antibody titers against infectious bronchitis illness and Newcastle disease in chickens, according to research by Mousa *et al*. (2017). A significant response to the M.O. was demonstrated by Khan *et al* (2021)'s establishment of increased antibody titers against Newcastle disease virus and infectious bronchitis (IB). The M.O.'s bioactive components may increase the amount of B lymphocytes, which are in charge of producing antibodies.

*Eye Diseases*

*Moringa oleifera* plant portions have a great number of vitamins and minerals and the leaves powder of M.O. show a great amount of vitamin A which is useful for eye illness such as night blindness. Another investigation revealed the usage of plant leaves with oil, these advance the vitamin A shortage consequences in reducing the danger of cataracts (Jimenez, 2017). Another research demonstrated that the M.O. seed has a variety of nutrients/ proteins that are necessary for skin and hair care medication. Some research has peptides of M.O. seed that are purist. It is beneficial to keep the skin from environmental dangers and M.O. seed extract shows the anti-contamination property, and hair-firming activity (Farooq, 2007).

*Immunomodulatory activity*

Deshmukh *et al*. (2015) described that both extracts of M.O.

(water and ethanolic) show immunostimulant activity by elevating the humoral antibody, hindered type hypersensitivity, and phagocytic index.

*Other Uses of Moringa oleifera*

Used as a skincare product

The seed oil of this plant contains various bioactive compound, which is essential for skin such as tannins, saponins, zeatin, flavonoids, etc. the compound exhibit various pharmacological activity which is useful for skin including anti-inflammatory activity, and antioxidant property and it also possesses antiseptic property (Muyibi and Evison, 1995; Shashank and Batra, 2014).

Seed oil of M.O. has several dietary composites; also has minerals that are necessary for hair products (Shashank and Batra, 2014; Tiwari and Talreja, 2020).

Used as a fertilizer

According to investigators' study revealed that plant seed oil extract has several/numerous chemical/nutrient composite that is utilized as a fertilizer for plant development as potassium, nitrogen, magnesium, copper, phosphorus, and calcium (Matic, 2018; Shashank and Batra, 2014).

Used in water purification

M.O. seed has been used for drinking water decontamination (Eman *et al*., 2014). M.O. seed presented coagulant properties as aluminum sulfate thus, M.O. seeds were utilized as a substitute natural element for wastewater treatment (Egbuikwem and Sangodoyin, 2013).

Used as a machine lubricant

Seed oil of this plant has a high kinematic viscosity. This is used as a lubricant in machines/engines (Dwarakanadha and Swarnalatha, 2016).

## CONCLUSION

Even though countless pieces of research have been focused on the estimation of the traditional significance of Moringa types and all the studies reinforced the long-standing declarations. Still, there are plenty of traditional benefits that have not been measured; especially in types save for *Moringa oleifera* which is known to be a promising strategy. Hence, more studies are essential to discover the various benefits of *Moringa oleifera* and other types.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest related.

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