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DRUMSTICK (*Moringa oleifera*)- A NATURAL GIFT (AN EXTENSIVE REVIEW)

***Bidisha Das[1] and Kazi Layla Khaled[2]**

Department of Home Science, University of Calcutta, 20B Judges Court Road, Kolkata-700027, India

***Corresponding Author Email: dasbidisha21@gmail.com**

ABSTRACT

Plants are able to cure different diseases from past time and are used in indigenous medicines. Among such trees one is Moringa oleifera, which provides us different health benefits. It is widely used in spices and cosmetic oils. Each part of this tree possesses significant amount of essential nutrients such as proteins, minerals, vitamins, some health promoting compounds such as zeatin, quercetin, β - sitosterol, caffeoylquinic acid and kaempferol. It has water purifying ability. The leaves, roots, seeds, barks, fruits, flowers and immature pods assist the functions of heart, also lowers blood cholesterol, protects us from Cardiovascular diseases. It reduces the risk of inflammation. Being a cheap source it is used in the treatment of different ailments. It can be cultivated easily and provides immense opportunities to be used as a viable medicinal and nutritional supplement. Its use is found in developing countries.

KEY WORDS

Cardiovascular diseases, Cholesterol, Indigenous, Inflammation, Pods.

I. INTRODUCTION

Moringa oleifera is a widely cultivated species of the genus *Moringa.*

- kingdom: Plantae
- Division: Magnoliphyta
- class: Magnoliopsida
- Order: Brassicales
- Family: Moringaceae
- Genus: *Moringa*
- Species: *M. oleifera*[1]

Moringa oleifera contains essential amino acids, carotenoids in leaves, and components with nutraceutical properties, supporting the idea of using this plant as a nutritional supplement or constituent in food preparation. Emphasis should be given on its cultivation [2].

Drumstick trees

The current review paper aims:

- To provide information on nutritive values of *Moringa oleifera* to people.
- To get idea regarding its medicinal and health promoting properties.
- To establish their applications in different aspects.
- To increase its production and exporting by considering both its positive and negative impact.
- To encourage people to enhance its production and applications.
- To create awareness among consumers that *Moringa oleifera* should be consumed not only because of their taste but also because of their health promoting properties.

II. DESCRIPTION

Moringa oleifera is able to resist drought. It is a native tree to the southern foothills of Himalayas in Northwestern India. It is widely cultivated in tropical and subtropical areas. Its young seed pods and leaves are used as vegetables that we keep in our daily diet. Other common names of Moringa are:

- Drumstick tree (from the long, slender, triangular seed-pods),
- Horseradish tree (from the taste of the roots, which resembles horseradish)
- ben oil tree or benzoil tree[3].

Drumstick flower Pods, leaves

Moringa oleifera can grow fast, It can reach the height of 10–12 m (32–40 ft) and trunk diameter of 45 cm (1.5 ft). The bark has a whitish-grey colour. The leaves build up a feathery foliage of tripinnate leaves.

2.1 Features of Flowers and Fruits

- The flowers are fragrant and asexual.
- The flowers are surrounded by five unequal, thinly veined, yellowish-white petals.
- The flowers are about 1.0-1.5 cm (1/2") long and 2.0 cm (3/4") broad. In seasonally cool regions, flowering only occurs once a year between April and June.
- The fruit is a hanging, three-sided brown capsule of 20–45 cm size which holds dark brown, globular seeds [4].

2.2 Production

India produces Moringa in a large amount (approximately with an annual production of 1.1 to 1.3 million tonnes of fruits from an area of 380 km²)[5]. It has earned its name as 'the miracle tree' due to its surprising healing abilities for various ailments and even some chronic diseases [6].

2.3 Cultivation

The Moringa tree is grown mainly in semiarid, tropical, and subtropical areas. It does not tolerate freezing or frost. Moringa can survive in dry regions, as it can be grown using rainwater without applying expensive irrigation techniques. It grows best at altitude between 0 to 2000m and in rainfall between 250-3000 mm. Irrigation is needed for leaf production if rainfall is less than 800 mm [5].

2.4 Cultivation practice

- **Soil preparations**: It needs loamy, sandy, or sandy-loamy soil. The soil needs to be shallow as possible. High planting densities needs plowing. It grows best between ph 5 to 9.
- **Propagation**: Propagation of Moringa occurs from seed. Moringa seeds can be germinated year-round in well-draining soil.
- **Planting**: For intensive leaf production the spacing of plants should be 15 x 15 cm or 20 x 10 cm, with conveniently spaced alleys (for example: every 4 m) to facilitate plantation management and harvests[7].

2.5 Uses of different parts

Many parts of moringa are edible. Regional uses of moringa vary widely:

- **Immature seed pods, called "drumsticks"**
- **Leaves**
- **Mature seeds**
- **Oil pressed from seeds**
- **Flowers**[8]

2.5.1 Immature seed pods/drumstick

The immature seed pods, called "drumsticks", are commonly consumed in South Asia. They are prepared by parboiling, and these are cooked in a curry until these become soft. The seed pods/fruits are cooked by boiling, heat is applied but these remain particularly high in vitamin C (which may be degraded variably by cooking) and are also a good source of dietary fibre, potassium, magnesium, and manganese[9].

Table no 1: Nutritive value of *Moringa oleifera,* raw (per 100 gm)

Energy	123±11kj
Carbohydrate	3.76±0.70gm
Dietary Fibre	6.83±0.22gm
Fat	0.12±0.01gm
Protein	2.62±0.22gm
Vitamins	
Vitamin A equivalent	17.28±1.85µg
Thiamin	0.04±0.002mg
Riboflavin	0.07±0.007 mg
Niacin	0.62±0.03 mg
Pantothenic acid	0.57±0.07 mg
Total Vitamin B_6	0.12±0.011 mg
Total Folate	62.75±6.71µg
Total Vitamin C	71.86±19.13mg
Minerals	
Calcium	33.30±5.54mg
Iron	0.73±0.18mg
Potassium	419±76.4 mg
Sodium	22.38±0.36 mg
Zinc	0.31±0.06mg
Phosphorus	52.87±8.72 mg
Moisture	85.39±0.64gm

Source: Indian Food Composition Tables 2017 NIN, ICMR

2.5.1.1 Medicinal values

- **Anti-inflammatory activity**

Different Bioactive compounds are present in the *Moringa oleifera* pods that possess anti-inflammatory activity. Due to this property they are able to improve the pathogenesis of inflammatory-associated chronic diseases. Phytochemicals such as flavonols, Phenolic acids present in pods are responsible for the anti-inflammatory activity[10].

- **Prevention of eye disease**

Vitamin A deficiency leads to blindness. Consumption of *Moringa oleifera* pods, rich source of vitamin A, can reduce the risk of night blindness and eye problems in children [10].

- **Regulation of Blood pressure**

Study conducted on the ethanol and aqueous extracts of whole pods and its parts, i.e. coat, pulp and seed revealed that the seed has the blood pressure lowering effect with comparable results in both ethanol and water extracts indicating that the activity is widely distributed. Activity-directed fractionation of the ethanol extract of pods of *M. oleifera* has led to the isolation of Thiocarbamate and Isothiocyanate glycosides which are known to be the hypotensive components. Methyl p-hydroxybenzoate and Beta-sitosterol, investigated in the pods of *M. oleifera* have also shown good hypotensive activity [11].

- **Dietary supplement**

Moringa leaves and pods contain the high concentrations of ascorbic acid, oestrogenic substances and Beta-sitosterol, Iron, Calcium, Phosphorus, Copper, Vitamins A, C, Alpha tocopherol, Riboflavin, Nicotinic acid, Folic acid, Pyridoxine, Beta-carotene, Protein, and in particular essential amino acids such as Methionine, Cystine, Tryptophan and lysine and make it an ideal dietary supplement[12].

Drumstick

2.5.2 Leaves

The leaves are the most nutritious part of the plant, being a good source of B vitamins, vitamin C, provitamin A as beta-carotene, vitamin K, manganese, and protein, among other essential nutrients [8,13].

- Calcium present in moringa leaves is present as crystals of calcium oxalate though at levels 1/25th to 1/45th of that found in spinach, which is a negligible amount. Leaves can be used fresh, cooked, or stored as dried powder for many months without refrigeration; the nutritive value is not lost. The leaves are cooked and used like spinach and are commonly dried and Crushed into powder used in soups and sauces[14].

Table no 1: Nutritive value of *Moringa oleifera* leaf, raw (per100 gm)

Energy	282±27 kj
Carbohydrate	5.62±1.44gm
Total Dietary Fibre	8.21±0.19gm
Total Fat	1.64±0.12 gm
Protein	6.41±0.35 gm
Vitamins	
Beta carotene	17542±1425µg
Thiamin	0.06±0.006 mg
Riboflavin	0.45±0.042mg
Niacin	0.82±0.09 mg

Pantothenic acid	0.39±0.04mg
Total Vitamin B_6	0.87±0.074mg
Total Folate	42.89±5.31 µg
Total Vitamin C	108±16.7µg
Minerals	
Calcium	314±71.0 mg
Iron	4.56±1.09 mg
Potassium	397±2.1 mg
Sodium	9.34±2.11 mg
Zinc	0.72±0.19mg
Phosphorus	109±20.7mg

Source: Indian Food Composition Tables 2017 NIN, ICMR

A report from Bureau of plant industry depicts that the vitamin C content of Moringa is almost seven times as compared to oranges, while its potassium is three times when compared to that of a banana, three times the spinach iron, four times the amount of vitamin A in carrots, and two times the protein in milk. Besides, the leaves of Moringa contains high amount of Ca, Mg, K, Mn, P, Zn, Na, Cu, and Fe [10].

2.5.2.1 Medicinal values

- **Anti-inflammatory activity**

Leaves of *Moringa oleifera* (Mo) plant have been shown to possess anti-inflammatory activity. The anti-inflammatory activity of the methanol leaf extract of *Moringa oleifera* was demonstrated by using carrageenan and histamine-induced tests [15].

- **Antioxidant activity**

Moringa leaves have been reported to be a rich source of Beta -carotene, protein, vitamin C, calcium and potassium. They also act as a good source of natural antioxidants. These are able to enhance the shelf-life of fat containing foods due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids. Later work has done to isolate hormones/growth promoters from the leaves of *M. oleifera*. Mo has antioxidant galore. Aqueous extracts of leaf of Mo act as an antioxidant. Methanol and ethanol extracts of Indian origin Mo were shown to have the highest antioxidant activity of 65.1% and 66.8%, respectively in a study on freeze dried Moringa leaves. Quercetin and Kaempferol have shown to possess good antioxidant activity on hepatocyte growth factor (HGF) induced Met cell migration [16].

- **Antimigrain activity**

The antimigraine potential of leaf juice alcoholic fraction of Mo, make it usable in the treatment of migraine. The fresh leaf juice and ethanolic extract of the leaves of *Moringa oleifera* were administered orally at varying doses in mice and were tested for antinociceptive activities using three models: writhing induced by Acetic acid, formalin induced paw licking and tail flick test using analgesiometer. Study showed a strong antinociceptive activity of *Moringa oleifera*[17].

- **Spasmolytic and antiulcerogenic effect**

Moringa leaves contain several compounds with Antispasmodic activity. In experimental rats gastric lesions induced by acetylsalicylic acid, serotonin and indomethacin, can be treated by Methanolic extract of Mo. It also enhances healing of chronic gastric lesions. Antiulcer effect on adult Holtzman albino rats is found in aqueous extract of Mo leaves[18].

- **Anticancer activity**

Mo has several bioactive compounds showing antitumor activity. Niazimicin, is a bioactive compound found in Mo leaves, has anticancer activity. Potential cytotoxic effects on human multiple myeloma cell has been executed by leaf extract of Mo [19].

- **Cardioprotective activity**

A study performing comparison of Mo leaf extract with antenolol (a selective ß1 receptor antagonist drug, used for cardiovascular diseases) reported Mo leaf extract as hypolipidimic, lowering body weight, serum triglyceride level and serum cholesterol level in experimental animals [20].

Antiatherosclerotic and hypolipidaemic effect of Mo leaves were also shown in another study keeping simvastatin as control [16].

Mo also produces cardioprotective role in isoproterenol (ISP)-induced myocardial infarction. It was reported that Mo treatment plays cardio protective effects in male Wistar albino rats on biochemical enzymatic parameters including, superoxide dismutase, catalase, glutathione peroxidase, lactate dehydrogenase, and creatine kinase-MB. Several bioactive compounds contained in Moringa leaves exert direct effect on blood pressure, and thus may be used for the stabilization or maintaining of normal blood pressure [11].

Moringa leaves contain Beta-sitosterol, a bioactive phytoconstituent, having cholesterol reducing effect. This compound has been shown to decrease cholesterol level in high fat diet fed rats[21].

- **Protection against eye diseases**

Vitamin A deficiency is a major cause of blindness. Consumption of Mo leaves, leaf powder, rich source of vitamin A, can prevent night blindness and eye problems in children. Consumption of drumstick leaves

with oils can improve vitamin A status and can delay the development of cataract[22].

Mo as a supplementary food was highly accepted for integrated child development scheme supplementary food (ICDS-SFP) because it is enriched in vitamin. It can be included in their daily meal as it reduces risk of eye diseases [23].

A Study showed retinoprotective effects of *Moringa oleifera* via anti-oxidant, anti-inflammatory, and anti-angiogenic mechanisms in streptozotocin-induced diabetic rats. Mo may be useful in preventing diabetes induced retinal dysfunction [10].

- **Antimicrobial and Antihelmintic effects**

Alcohol extracts of leaves showed the antimicrobial activity against E. coli, K. pneumoniae, Enterobacter species, Proteus mirabilis, P. aeruginosa, Salmonella typhiA, S. aureus, Streptococcus and Candida albicans. Mo aqueous extracts inhibits growth of many pathogens including Staphylococcus aureus, Bacillus subtilis, Escherichia coli, and Pseudomonas aeruginosain dose dependent [24].

Mo leaves are also capable of controlling parasitic infestation. Ethanolic extract of Mo leaves has also been reported to inhibit Indian earthworm Pheretima posthuma[10].

- **Antinociceptive activity**

The study showed that Moringa may be effectively used in the treatment and management of migraine. The fresh leaf juice and ethanolic extract of the leaves of *Moringa oleifera* were administered orally at varying doses in mice and were tested for antinociceptive activities using three models: writhing induced by Acetic acid, formalin induced paw licking and tail flick test using analgesiometer. Study showed a significant antinociceptive activity of Mo. *Moringa oleifera* Lam has been used to treat inflammatory diseases. The toxicological effects on mice of a naturally-occurring isothiocyanate from *M. oleifera* has been evaluated [25,26].

Drumstick leaves

- **Antihepatotoxic activity**

Various studies revealed that *Moringa oleifera* has hepatoprotective activity. Ethanolic extracts of Mo leaves showed protection against antitubercular induced drugs liver damage in rats. Hepatoprotective activity of Mo was found to be mediated by its effect on aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, and bilirubin levels in the serum; lipids, and lipid peroxidation levels in liver [27].

- **Antidiabetic activity**

Mo is able to reduce the chance of Type 2 Diabetes Mellitus. Leaves are potent source of polyphenols, which are responsible for hypoglycemic activity. The extract from Moringa leaf decreases sugar levels in the blood within 3 h after intake [28].

- **Central Nervous System depressant and cerebroprotective activity**

Cerebroprotective effect of *M. oleifera* leaves extract against brain damage and oxidative stress in animal model of focal ischemic stroke was studied. The study demonstrated that *Moringa oleifera* leaves extract is a potential neuroprotectant which is cheap and easy to approach. It also can reduce the chance of brain damage[29].

- **Blood Pressure and Cholesterol Lowering Effect**

Four pure compounds, niazinin A, niazinin B, niazimicin and niazinin A +B have been isolated form fractionation of the active ethanol extract of Moringa leaves which showed a blood pressure lowering effect in rats mediated possibly through a calcium antagonist effect. Moringa leaves contain bioactive phytoconstituent, i.e. Beta-sitosterol which shows cholesterol lowering action in the serum of high fat diet fed rats[21].

- **Other diverse activities**

Other diverse activities have been exhibited by *Moringa oleifera*. Hyperthyroidism can be treated by using aqueous leaf extracts as it regulates thyroid hormone. A methanol extract of *M. oleifera* leaves conferred significant radiation protection to the bone marrow chromosomes in mice. Moringa leaves have been used traditionally to treat constipation[25].

Moringa oleifera leaves is also rich in vitamin A and C. Vitamin C is important in the body as an antioxidant and its deficiency affects the cardiovascular system, immune system and collagen synthesis. Vitamin A also plays role in the body in vision, immune function, reproduction, bone metabolism, haematopoiesis etc [30].

Animal feed fortification

Moringa leaves added to cattle feed increased their daily weight gain by up to 32 percent. Cows were supplemented with 15-17kg of fresh Moringa leaves daily, and the milk production was increased by 43 percent [31].

Plant growth enhancer

Lab experimentation had shown that Moringa spray had a wide range of beneficial effects on plant crops. Young plants grow easily when Moringa spray is applied on it. This type of plant becomes more firmer, more resistant to pests and disease. This type of plant has longer life-span, heavier roots, stems and leaves, produce more fruit, larger fruit, yield increases to about 20-35%; If even a fraction of these results could be generated in the field, it could be a great help in increasing food supplies for millions of hungry people [31].

2.5.3 Seeds and Seed oil

The seeds are usually removed from more mature pods. The seeds contain high levels of vitamin C and moderate amounts of B vitamins and dietary minerals.38–40% edible oil is generated from mature seeds yield called ben oil which is clear and odourless, and resists rancidity. Its use is significantly found as a biofuel. The wild *M. oleifera* seed oil was found to contain oleic acid up to 73.22%, followed by palmitic, stearic, behenic and arachidic acids 6.45%, 5.50%, 6.16% and 4.08%, respectively and fell in the category of high-oleic oils. Ethanolic extract of *Moringa oleifera* seeds reduce risk of systemic and local anaphylaxis[32].

- **Moringa seeds as biosorbent**

Moringa seeds could be used as a less expensive biosorbent for the removal of cadmium (Cd) from aqueous media. The aqueous solution of Moringa seed is a heterogeneous complex mixture having various functional groups, most of them are low molecular weight organic acids (amino acids). These amino acids have been found to constitute a physiologically active group of binding agents, working even at a low concentration. These are able to interact with metal ions is likely to increase the sorption of metal ions. The proteineous amino acids have a variety of structurally related pH dependent properties, generating a negatively charged atmosphere and play an important role in the binding of heavy metals [33].

- **Moringa seeds as coagulant**

Moringa seeds are one of the best natural coagulants. Crushed seeds are a viable replacement of synthetic coagulants. In Sudan, Nile water is purified by seed crude extract. The rural women do not use alum to treat the highly turbid Nile water because of a traditional fear of alum causing gastrointestinal disturbances and Alzheimer's

Moringa seeds

disease. The Moringa seeds can also be used as an antiseptic in the treatment of drinking water. Many studies have also been conducted on the performance of Moringa seeds as an alternative coagulant, coagulant aid and in conjunction with alum for treating waste water. Therefore, it is important to identify the active constituents of Moringa seed for a better understanding of the coagulation mechanism [34].

2.5.4 Flowers

The flower of *Moringa oleifera* have high medicinal value. These act as a stimulant, aphrodisiac, abortifacient, cholagogue used to cure inflammation, muscle diseases, hysteria, tumors and enlargement of the spleen; These are able to lower the serum cholesterol to phospholipid ratio and atherogenic index; Extract of flower decrease lipid profile of liver, heart aorta in hypercholesterolaemic rabbits and increased the excretion of faecal cholesterol. It can be concluded that flowers of *Moringa oleifera* reduces risk of cardiovascular diseases.

Moringa Flowers

2.5.4.1. Pharmacological activities of *Moringa oleifera* flowers are

- Beside the cholesterol lowering effect Flowers of *Moringa oleifera* possess Antihypertensitive, diuretic activity. Quercetin, a well-known flavonoid isolated from the aqueous and alcohol extracts from *Moringa oleifera* flowers show significant hepatoprotective effect[35].
- The flowers also are considered to be of high medicinal value with antihelminthics property. The methanolic extract of flower buds showed antiulcerogenic activity against aspirin induced gastric ulcer at a dosage of 4 g/kg body weight [36].
- Antiplasmodic activity was shown by hot water infusions of flowers[37].
- Flowers of *Moringa oleifera* contain nine amino acids, sucrose, D- glucose, traces of alkaloids, wax, quercetin, isoquercetin, kaempferat, kaempherol and kaempferitrin. The ash is rich in potassium and calcium. The aqueous extract of the mature flowers contains free natural sugars, D-mannose and D-glucose in the ratio of 1:5 and two unidentified carbohydrate bearing materials along with proteins and ascorbic acid of the above materials with varying proportion. It also contains polysaccharides which on hydrolysis gives D-glucose, galactose and D-glucuronic acid in a molar ratio1:1.9:0.9[38].

2.5.4 Roots

The roots are shredded and used as a condiment with sharp flavor qualities, which develops due to presence of polyphenols. Diuretic activity of Moringa exists in its roots, leaves, flowers, gum and the aqueous infusion of seeds. Studies indicate that the root-wood of *M. oleifera* is having antiurolithiatic activity. Both the extracts significantly lowered the urinary excretion and kidney retention levels of oxalate, calcium and phosphate. This ultimately reduces the risk of development of kidney stones. Moringa roots protect liver from foreign particles. The root extract exhibited CNS depressant activity. Studies using root aqueous extract of MO on penicillin induced convulsion, locomotor behaviour, brain serotonine (5-HT), dopamine (DA) and norepineprine (NE) level was studied in rats. The extract improved the imbalance between 5HT, DA, and NE [10]

2.6 Phytochemistry[39,40]

Essential compounds present in *Moringa oleifera*	**Stem bark contains**	**Purified, whole-gum exudate from *M. oleifera* contains**	**Acetate phase of the ethanol extract of Moringa pods contains**	**Ethanol extract of the Moringa seed contains**
Simple sugar, Rhamnose, Glucosinolates and Isothiocyanates	Two alkaloids, namely Moringine and Moringinine. Vanillin, β -sitosterol, β-sitostenone, 4-hydroxymellin and octacosanoic	L-Arabinose, Galactose, Glucuronic acid, L-Rhamnose, Mannose and Xylose	Antihypertensive compounds Thiocarbamate and Isothiocyanate glycosides	A new O-ethyl-4-(α-L-rhamnosyloxy) benzyl carbamate together with seven known bioactive compounds, 4(α-L-rhamnosyloxy)-benzyl isothiocyanate, niazimicin, 3-O-(6'-O-oleoyl-β-D-glucopyranosyl)-β-sitosterol, β-sitosterol-3-O-β-D-glucopyranoside, niazirin, β-sitosterol and glycerol-1-(9-octadecanoate)

2.7 Medicinal Value

- The bark, sap, roots, leaves, seeds and flowers are used in traditional medicine. Research showed It can reduce risk of hypercholesterolemia [41,42].
- Extracts from leaves contain low contents of polyphenols which are under basic research for their potential properties [43, 44].
- The healing properties of Moringa oil, have been documented by ancient cultures. Moringa oil has been

used in skin diseases and preparation of ointments since Egyptian times.

PLANT PART	MEDICINAL USES
Root	• Antihelminthic, rubefacient, vesicant, carminative, antifertility, • Prevents inflammation • stimulant in paralytic afflictions. • act as acardiac/circulatory tonic, • used as a laxative, abortifacient, treating rheumatism, articular pains, lower back or kidney pain and constipation,
Leave	• Purgative, • used for piles, fevers, sore throat, bronchitis, eye and ear infections, scurvy and catarrh; • leaf juice is believed to control glucose levels, applied to reduce glandular swelling
Stem bark	• Rubefacient, vesicant and used to cure eye diseases and for the treatment of delirious patients, • prevent enlargement of the spleen and formation of tuberculous glands of the neck.
Seed	• Seed extract exerts its protective effect by decreasing liver lipid peroxides, • antihypertensive compounds thiocarbamate and isothiocyanate glycosids have been isolated from theacetate phase of the ethanolic extract of Moringa pods.

• Anti-asthmatic activity

Alkaloid isolated has been shown to have similarity with ephedrine in terms of its activity. Thus, it can be used in treatment of asthma. The kernels of *Mo* seed showed potential effect in the management of bronchial asthma [10].

• Antipyretic activity

Antipyretic effect of ethanol, petroleum ether, solvent ether and ethyl acetate extracts of *Mo* seeds was studied by yeast induced hyperpyrexia method in rats. Ethanol and ethyl acetate extracts of seeds had significant antipyretic activity[10].

• Wound healing properties

Wound healing capacity was exhibited by leaf extract of Mo. Phytosterols and phenolic compounds present in these extracts promote the wound healing activity [10].

• Antihyperglycaemic effect

Diabetes mellitus (DM) is a metabolic disorder throughout the world. This disorder could be treated with herbal plants. Medicinal plants have replaced for many drugs to treat various ailments. The drugs derived from the plants promote health, augmented the resistance of the body against disease. Plants such as *Moringa oleifera*, has hypoglycemic properties and other beneficial properties. The aqueous extract of these plants were assessed for their hypoglycemic and hypolipidemic effects. Presence of primary and secondary metabolites was also screened. The level of glucose, glycosylated haemoglobin, total cholesterol, triglyceride, LDL- cholesterol was reduced to 23%, 12.5%, 40%, 18% and HDL- cholesterol was increased to 20% on treatment with *Moringa oleifera*. Hypoglycemic activity is exhibited by presence of primary and secondary metabolites. The preliminary screening results indicated that the plants possess various constituents like tannins, phenols, alkaloids, flavonoids and carotenoids[45].

2.8 Miscellaneous

The anti-arthritic effect of methanolic extract of *Moringa oleifera* stem bark could be observed in acute (Turpentine oil and Formaldehyde induced arthritis) and chronic (Freund's complete adjuvant induced polyarthritis in rat) model of inflammation. Rheumatoid arthritis is treated by methanolic extract of *Moringa oleifera.* The aqueous leaf extract of *Moringa oleifera* was evaluated for its ameliorative effect in the regulation of thyroidism in rat model**.** The results of this study suggest that the extract may have beneficial effect on serum cholesterol concentration and a stimulant to thyroid functions [46].

Water purification: Powdered seed act as a natural flocculent, able to clarify even the most turbid water. Seed powder can be used as a quick and simple method for cleaning dirty water. This treatment also removes 90-99% of bacteria contained in water. Using *Moringa* to purify water replaces chemicals such as aluminium sulphate, which are dangerous to people and the environment, and are expensive [47,48]

2.9 Future Prospects

Numerous studies have been conducted on different parts of *M. oleifera* so far, but there is an absolute need to isolate and identify new compounds from different

parts of the tree, which have possible antitumor promoters as well as inhibitory properties. More unidentified bioactive compound needs to be isolated from seeds and leaves, which will be helpful in different ailments. The clinical studies with human subjects should be taken to investigate:

- nutrient bio-availability and bio-toxicity
- Positive effects on the immune system in fighting diseases, such as: malnutrition, HIV/AIDS, and sexually transmitted infections etc.
- Antioxidant properties in fighting diseases, such as: heart disease, cancer and Alzheimer's disease.
- More research needs to be done to find out its more health promoting effects.

III. CONCLUSION

Moringa oleifera plant is the most inexpensive and credible alternative not only to provide good nutrition, but also to reduce risk of a lot of diseases. Emphasis should be made for commercial production of food product, supplement, neutraceuticals, *Moringa* oil, fortified feed for cattle, biogas, and plant fertilizer. The plants for water purification by moringa should be designed. Moringa truely appears to be a "Miracle" plant having countless significant benefits for humanity and thus should be taken as a high quality gift of nature at very low price. Properties of *Moringa oleifera* are multidimensional and thus, have varied economic applications. Its easy cultivation within unfavourable environmental condition and wide availability makes it an excellent potential for growth in economy and health & nutrition sector in a developing country like India. Various parts of this plant give maximum yield and various constituents could be achieved to derive supplements and therapeutics of multifarious nature for human consumption.

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***Corresponding Author:**
Bidisha Das*
Email: dasbidisha21@gmail.com