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Moringa oleifera: A review on nutritive importance and its medicinal application

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Abstract

Moringa oleifera, native to India, grows in the tropical and subtropical regions of the world. It is commonly known as 'drumstick tree' or 'horseradish tree'. Moringa can withstand both severe drought and mild frost conditions and hence widely cultivated across the world. With its high nutritive values, every part of the tree is suitable for either nutritional or commercial purposes. The leaves are rich in minerals, vitamins and other essential phytochemicals. Extracts from the leaves are used to treat malnutrition, augment breast milk in lactating mothers. It is used as potential antioxidant, anticancer, anti-inflammatory, antidiabetic and antimicrobial agent. *M. oleifera* seed, a natural coagulant is extensively used in water treatment. The scientific effort of this research provides insights on the use of moringa as a cure for diabetes and cancer and fortification of moringa in commercial products. This review explores the use of moringa across disciplines for its medicinal value and deals with cultivation, nutrition, commercial and prominent pharmacological properties of this "Miracle Tree".

Keywords: *Moringa oleifera*; Miracle Tree; Antidiabetic; Anticancer; Coagulant

1. Introduction

Moringa oleifera belonging to the family of Moringaceae is an effective remedy for malnutrition. Moringa is rich in nutrition owing to the presence of a variety of essential phytochemicals present in its leaves, pods and seeds. In fact, moringa is said to provide 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach [1]. The fact that moringa is easily cultivable makes it a sustainable remedy for malnutrition. Countries like Senegal and Benin treat children with moringa [2]. Children deprived of breast milk tend to show symptoms of malnutrition. Lactogogues are generally prescribed to lactating mothers to augment milk production. The lactogogue, made of phytosterols, acts as a precursor for hormones required for reproductive growth. Moringa is rich in phytosterols like stigmasterol, sitosterol and kampesterol which are precursors for hormones. These compounds increase the estrogen production, which in turn stimulates the proliferation of the mammary gland ducts to produce milk. It is used to treat malnutrition in children younger than 3 years [3]. About 6 spoonfuls of leaf powder can meet a woman's daily iron and calcium requirements, during pregnancy. This study provides an overview on the cultivation, nutritional values, medicinal properties for commercial use and pharmacological properties of moringa. There are no elaborate reports on treatment of diabetes and cancer using moringa. This study aims to bridge the gap.

Abbreviations: AGE, advanced glycated end products; ATP, adenosine triphosphate; BITC, benzyl isothiocyanate; RAGE, receptor for advanced glycated end products; ROS, reactive oxygen species; STZ, streptozotocin.

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2. Plantation and soil conditions

M. oleifera can be grown in any tropical and subtropical regions of the world with a temperature around 25–35 °C. It requires sandy or loamy soil with a slightly acidic to slightly alkaline pH and a net rainfall of 250–3000 mm [4]. The direct seeding method is followed as it has high germination rates. Since moringa seeds are expected to germinate within 5–12 days after seeding and can be implanted at a depth of 2 cm in the soil. Moringa can also be propagated using containers. The saplings are placed in plastic bags containing sandy or loamy soil. After it grows to about 30 cm, it can be transplanted. However, utmost care has to be taken while transplanting as the tap roots are tender and tend to get affected. The tree can also be cultivated from cuttings with 1 m length and 4–5 cm in diameter, but these plants may not have a good deep root system. Such plants tend to be sensitive to drought and winds. For commercial purposes large scale intensive and semi-intensive plantation of moringa may be followed. In commercial cultivation, spacing is important as it helps in plant management and harvest. *M. oleifera* differs in nutrient composition at different locations [5]. The tree grown in India has slightly different nutritional components than a tree grown in Nigeria. Asante et al. [6] studied the nutritional differences in the leaves from two ecological locations semi-deciduous and Savannah regions. It showed that the latter was less nutritious than the former and attributed this to high temperatures at the Savannah regions. At higher temperature, proteins and enzymes get denatured and this could be the cause for the difference in nutrient content.

Soil is an important factor that defines nutrient content and strength of the plant. Dania et al. [7] showed that fertilizers when applied solely or in combination with others resulted in different nutrient compositions on plant parts. NPK fertilizer, poultry manure and organic base fertilizer was provided to study the effect on the nutrient content and found that poultry manure gave the best results than phosphorous, potassium, sodium and manganese. Likewise the stem girth and vegetative growth of moringa increased on application of poultry manure. The overall nutrient attributes of the plant remains same albeit nutrient variability. This makes moringa viable as a potential nutraceutical anywhere in the world.

3. Nutritive properties

Every part of *M. oleifera* is a storehouse of important nutrients and antinutrients. The leaves of *M. oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper [2]. Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in *M. oleifera* [8]. Phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugar present along with anti-cancerous agents like glucosinolates, isothiocyanates, glycoside compounds and glycerol-1-9-octadecanoate [9]. Moringa leaves also have a low calorific value and can be used in the diet of the obese. The pods are fibrous and are valuable to treat digestive problems and thwart colon cancer [10,62]. A research shows that immature pods contain around 46.78% fiber and around 20.66% protein content. Pods have 30% of amino acid content, the leaves have 44% and flowers have 31%. The immature pods and flowers showed similar amounts of palmitic, linolenic, linoleic and oleic acids [11].

Moringa has lot of minerals that are essential for growth and development among which, calcium is considered as one of the important minerals for human growth. While 8 ounces of milk can provide 300–400 mg, moringa leaves can provide 1000 mg and moringa powder can provide more than 4000 mg. Moringa powder can be used as a substitute for iron tablets, hence as a treatment for anemia. Beef has only 2 mg of iron while moringa leaf powder has 28 mg of iron. It has been reported that moringa contains more iron than spinach [12]. A good dietary intake of zinc is essential for proper growth of sperm cells and is also necessary for the synthesis of DNA and RNA. *M. oleifera* leaves show around 25.5–31.03 mg of zinc/kg, which is the daily requirement of zinc in the diet [13].

PUFAs are linoleic acid, linolenic acid and oleic acid; these PUFAs have the ability to control cholesterol. Research show that moringa seed oil contains around 76% PUFA, making it ideal for use as a substitute for olive oil [14]. A point to note is that the nutrient composition varies depending on the location. Fuglie [12] revealed that seasons influence the nutrient content. It was shown that vitamin A was found abundantly in the hot-wet season, while vitamin C and iron were more in the cool-dry season [15]. The difference in results can be attributed to the fact that the location, climate and the environmental factors significantly influence nutrient content of the tree [16]. A complete list of nutrients available in leaves, pods and seeds are shown in Table 1.

4. Processing of moringa

Most plants lose their nutritive properties when processed. When compared, the nutritive content of raw, germinated and fermented moringa seed flour, it was found that phytochemicals were higher in raw seed flour and amino acid content was at its peak in fermented and germinated seed flour [17,59]. This can be a result of the biochemical activities during germination and microbial activity during fermentation. However, a study reviewed the effect of boiling, simmering and blanching to see the retention of nutrient content of moringa leaves. Interestingly, boiling was the most effective of all the techniques as it reduced the cyanide, oxalate and phytate contents, more significantly than the other two methods. The presence of phytate and other anti-nutrients can reduce the bioavailability of certain nutrients and processing can hence be done for maximum utilization of required nutrients from the seeds and leaves [18,63]. Yang et al. [15] reported that boiling increased the availability of iron and antioxidant content. Hence, the processed moringa seed flour can be used to treat malnutrition problems. However, some studies have shown that children refuse to take in moringa due to its slight bitter taste [70]. Kiranawati et al. [19] designed moringa noodles by three methods of cooking noodles, sautéing, steaming and boiling. These noodles were tested on rats and the effects on mammary glands were studied. Interestingly, the sautéed

Table 1
The nutrient compositions[a] of leaves, leaf powder, seeds and pods.

Nutrients	Fresh leaves	Dry leaves	Leaf powder	Seed	Pods
Calories (cal)	92	329	205	–	26
Protein (g)	6.7	29.4	27.1	35.97 ± 0.19	2.5
Fat (g)	1.7	5.2	2.3	38.67 ± 0.03	0.1
Carbohydrate (g)	12.5	41.2	38.2	8.67 ± 0.12	3.7
Fibre (g)	0.9	12.5	19.2	2.87 ± 0.03	4.8
Vitamin B1 (mg)	0.06	2.02	2.64	0.05	0.05
Vitamin B2 (mg)	0.05	21.3	20.5	0.06	0.07
Vitamin B3 (mg)	0.8	7.6	8.2	0.2	0.2
Vitamin C (mg)	220	15.8	17.3	4.5 ± 0.17	120
Vitamin E (mg)	448	10.8	113	751.67 ± 4.41	–
Calcium (mg)	440	2185	2003	45	30
Magnesium (mg)	42	448	368	635 ± 8.66	24
Phosphorus (mg)	70	252	204	75	110
Potassium (mg)	259	1236	1324	–	259
Copper (mg)	0.07	0.49	0.57	5.20 ± 0.15	3.1
Iron (mg)	0.85	25.6	28.2	–	5.3
Sulphur (mg)	–	–	870	0.05	137

[a] All values are in 100 g per plant material [12,52,60].

noodles had a better effect on the mammary glands of rats and improved milk production. The effect of sautéing on the noodles improved lactogogum values, because the oil used was rich in sterols. *M. oleifera* have also been incorporated into chocolates. A recent report tested different percentages of moringa in the chocolate fortification and found that, 20% moringa incorporation in cocoa powder was ideal. Similarly, moringa incorporation in halawa tahinia also increased the nutrient value of the delicacy. Such studies have shown the potential for developing protein and minerals-rich chocolate and halawa tahinia [20]. Several such moringa fortifications are possible to ensure intake of adequate amounts of nutrients in children.

4.1. Preservation methods

Moringa can also be preserved for a long time without loss of nutrients. Drying or freezing can be done to store the leaves. A report by Yang et al. [15] shows that a low temperature oven used to dehydrate the leaves retained more nutrients except vitamin C than freeze-dried leaves. Hence, drying can be done using economical household appliance like stove to retain a continuous supply of nutrients in the leaves. Preservation by dehydration improves the shelf life of Moringa without change in nutritional value

An overdose of moringa may cause high accumulation of iron. High iron can cause gastrointestinal distress and hemochromatosis. Hence, a daily dose of 70 g of moringa is suggested to be good and prevents over accumulation of nutrients [21].

5. Medicinal properties

M. oleifera is often referred as a panacea and can be used to cure more than 300 diseases. Moringa has long been used in herbal medicine by Indians and Africans. The presence of phytochemicals makes it a good medicinal agent. In this section, the effect of moringa on diseases like diabetes and cancer are reviewed.

5.1. Anti-diabetic properties

Moringa has been shown to cure both Type 1 and Type 2 diabetes. Type 1 diabetes is one where the patients suffer from non-production of insulin, which is a hormone that maintains the blood glucose level at the required normal value. Type 2 diabetes is one associated with insulin resistance. Type 2 diabetes might also be due to Beta cell dysfunction, which fails to sense glucose levels, hence reduces the signaling to insulin, resulting in high blood glucose levels [22]. Several studies have shown that, moringa can act as an anti-diabetic agent. A study has shown that the aqueous extracts of *M. oleifera* can cure streptozotocin-induced Type 1 diabetes and also insulin resistant Type 2 diabetes in rats [23]. In another study, the researchers fed the STZ-induced diabetes rats with Moringa seed powder and noticed that the fasting blood glucose dropped [50]. Also, when the rats were treated with about 500 mg of moringa seed powder/kg body weight, the antioxidant enzymes increased in the serum. This shows that the antioxidants present in moringa can bring down the ROS caused in the Beta-cells due to the STZ induction [8]. STZ causes ATP dephosphorylation reactions and helps xanthine oxidase in the formation of superoxides and reactive oxygen species (ROS) in Beta cells [24]. In hyperglycemic patients, the beta cells get destructed (Fig. 1). Therefore, high glucose enters the mitochondria and releases reactive oxygen species. Since beta cells have low number of antioxidants, this in turn causes apoptosis of the beta cells [25,26]. This reduces insulin secretion leading to hyperglycemia and in turn diabetes mellitus Type-2. The flavonoids like quercitin and phenolics have been attributed as antioxidants that bring about a scavenging effect on ROS. It can be hypothesized that the flavonoids in Moringa scavenge the ROS released from mitochondria, thereby protecting the beta cells and in turn keeping hyperglycemia under control [27,50].

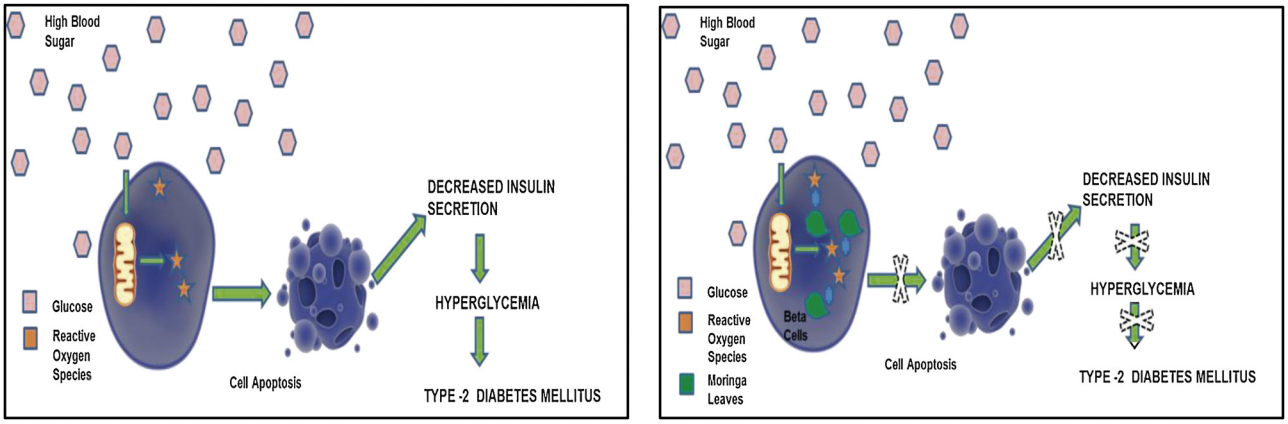

Fig. 1. Mechanism of high glucose leading to diabetes and the effect of moringa on progression of diabetes. The high glucose in blood enters glycolysis in the mitochondria of beta cells and forms reactive oxygen species. This then causes apoptosis of beta cells which in turn leads to decreased insulin secretion, hyperglycemia and finally Type-2 diabetes. However, the cell apoptosis of beta cells can be averted by the use of moringa. Moringa has antioxidants which combine with the reactive oxygen species and prevent cell damage and further consequences [8,22,25,50].

Diabetes leads to several complications such as retinopathy, nephropathy and atherosclerosis etc. Moringa can be used to prevent such ailments. When there is hyperglycemia, the blood glucose reacts with proteins and causes advanced glycated end products (AGEs). These AGEs bind to RAGE which gets expressed on the surface of immune cells. This interaction leads to increased transcription of cytokines like interleukin-6 and interferons. At the same time, the cell adhesion molecules are expressed on the surface endothelium of arteries [28]. This facilitates transendothelial migration which causes inflammation in the arteries and leads to atherosclerosis (Fig. 2). Moringa is used as an anti-atherosclerotic agent [29]. The anti-atherogenic nature can be accounted for by the antioxidant properties of moringa.

5.2. *Anticancer properties*

Cancer is a common disease and one in seven deaths is attributed due to improper medication. Around 2.4 million cases are prevalent in India, while there are no specific reasons for cancer to develop. Several factors like smoking, lack of exercise and radiation exposure can lead to the disease [69]. Cancer treatments like surgery, chemotherapy and radiation are expensive and have side effects. *M. oleifera* can be used as an anticancer agent as it is natural, reliable and safe, at established concentrations. Studies have shown that moringa can be used as an anti-neoproliferative agent, thereby inhibiting the growth of cancer cells. Soluble and solvent extracts of leaves have been proven effective as anticancer agents. Furthermore, research papers suggest that the anti-proliferative effect of cancer may be due to its ability to induce reactive oxygen species in the cancer cells. Researchs show that the reactive oxygen species induced in the cells leads to apoptosis. This is further proved by the up regulation of caspase 3 and caspase 9, which are part of the apoptotic pathway [30,31,64]. Moreover, the ROS production by moringa is specific and targets only cancer cells, making it an ideal anticancer agent. Tiloke et al. [30] also showed that the extracts increased the expression of glutathione-S-transferase, which inhibits the express of antioxidants.

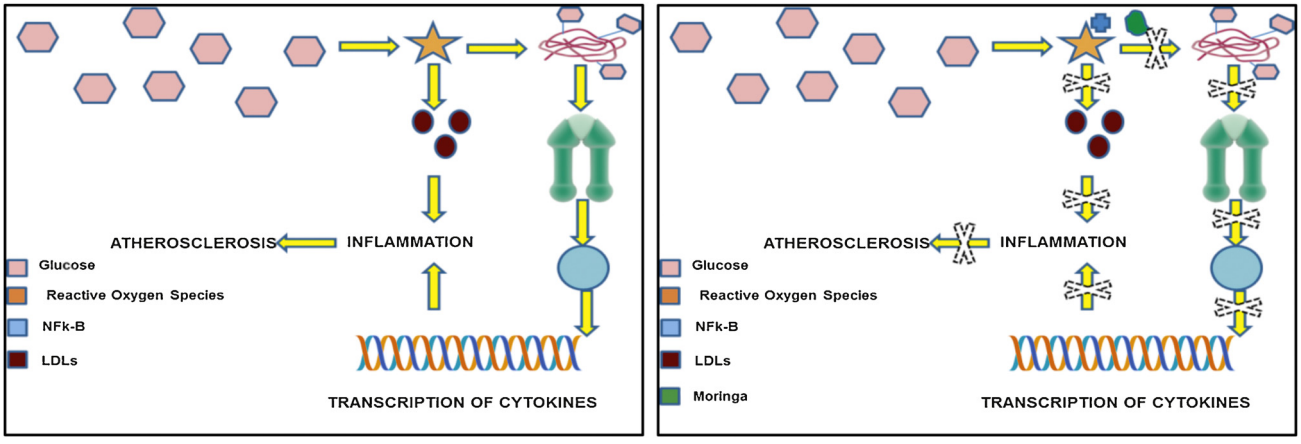

Fig. 2. Mechanism of diabetes leading to atherosclerosis and effect of moringa on the progression of atherosclerosis. High blood glucose due to glycolysis releases ROS, which then forms AGEs and LDLs. The LDLs can directly lead to inflammation, while the AGE when combined to RAGE expressed on cell surface, can cause expression of NFk-B. This can further lead to transcription of other cytokines and in turn inflammation. Inflammation causes transendothelial migration of immune cells and LDLs, leading to atherosclerosis. Moringa can prevent atherosclerosis by scavenging ROS and preventing the formation of AGE and LDL, thereby acting as an anti-atherosclerotic agent [8,24,28,29].

Table 2
Nutritional compositions and medicinal uses of different parts of Moringa.

Part of tree	Medicinal uses	Nutritive properties	Suggestion	References
Leaves	Moringa leaves treat asthma, hyperglycemia, Dyslipidemia, flu, heart burn, syphilis, malaria, pneumonia, diarrhea, headaches, scurvy, skin diseases, bronchitis, eye and ear infections. Also reduces, blood pressure and cholesterol and acts as an anticancer, antimicrobial, Antioxidant, antidiabetic and anti-atherosclerotic agents, neuroprotectant	Moringa leaves contain fiber, fat proteins and minerals like Ca, Mg, P, K, Cu, Fe, and S. Vitamins like Vitamin-A (Beta-carotene), vitamin B-choline, vitamin B1-thiamine, riboflavin, nicotinic acid and ascorbic acid are present. Various amino acids like Arg, His, Lys, Trp, Phe, Thr, Leu, Met, Ile, Val are present. Phytochemicals like tannins, sterols, saponins, trepenoids, phenolics, alkaloids and flavanoids like quercitin, isoquercitin, kaemfericitin, isothiocyanates and glycoside compounds are present	The presence of flavanoids gives leaves the antidiabetic and antioxidant properties. The isothiocyanates are anticancer agents. Flavanoids like quercitin and others are known for anti-proliferative, anticancer agent. The presence of minerals and vitamins help in boosting the immune system and cure a myriad of diseases	[1,8,12,17,31,40]
Seeds	Seeds of moringa help in treating hyperthyroidism, Chrohn's disease, antiherpes-simplex virus arthritis, rheumatism, gout, cramp, epilepsy and sexually transmitted diseases, can act as antimicrobial and anti-inflammatory agents	Contains oleic acid (Ben oil), antibiotic called pterygospermin, and fatty acids like Linoleic acid, linolenic acid, behenic acid, Phytochemicals like tannins, saponin, phenolics, phytate, flavanoids, terpenoids and lectins. Apart from these, fats, fiber, proteins, minerals, vitamins like A, B, C and amino acids	The presence of flavanoids gives its anti-inflammatory property. The antibiotic pterygospermin is responsible for antimicrobial properties. The other phyto-chemicals help in treating various diseases	[1,2,4,38,61]
Root Bark	Root bark acts as a cardiac stimulant, anti-ulcer and anti-inflammatory agent	Alkaloids like morphine, moriginine, minerals like calcium, magnesium and sodium	The alkaloid helps the bark to be antiulcer, a cardiac stimulant and helps to relax the muscles	[39,41]
Flower	Moringa flowers act as hypocholesterolemic, anti-arthritic agents can cure urinary problems and cold	It contains calcium and potassium and amino acids. They also contain nectar	The presence of nectar makes them viable for use by beekeepers.	[12,38]
Pods	Moringa pods treat diarrhea, liver and spleen problems, and joint pain	Rich in fiber, lipids, non-structural carbohydrates, protein and ash. Fatty acids like oleic acid, linoleic acid, palmitic acid and linolenic acid are also present	The presence of PUFA in the pods can be used in the diet of obese	[12]

Anticancer agents targeting cancer using ROS induction are common, but these substances should also be able to attack the antioxidant enzymes [32]. However, Moringa leaf extracts have been shown to be antioxidants and anticancer agents which induce ROS. The exact behavior of the two contrary attributes of the leaves is yet to be explored. The compounds of the leaves that are held responsible for the anticancer activities are glucosinolates, niazimicin and benzyl isothiocyanate [33]. Benzyl isothiocyanate has been shown to be linked with cancer. Research shows that BITC causes intracellular ROS, which leads to cell death. This could be one of the reasons for moringa to be a good anticancer agent [34,35,65].

5.3. Other diseases

Moringa can be used as a potent neuroprotectant. Cerebral ischemia is caused due to obstruction of blood flow to the brain. This leads to reperfusion and lipid peroxidation, which in turn results in reactive oxygen species. Moringa with its antioxidants can reduce the reactive oxygen species, thereby protecting the brain [36,37]. *M. oleifera* is used to treat dementia, as it has been shown to be a promoter of spatial memory. The leaf extracts have shown to decrease the acetylcholine esterase activity, thereby improving cholinergic function and memory [38]. Adeyemi et al. [39] showed that moringa in diet of rats, can increase protein content and decrease levels of urea and creatinine in blood, preventing renal dysfunction. Moringa decreased acidity in gastric ulcers by a percentage of 86.15% and 85.13% at doses of 500 mg and 350 mg, respectively and therefore can be used as an antiulcer agent [40]. Moringa is prescribed by herbal practitioners for patients with AIDS. Moringa is suggested to be included in the diet, with the view of boosting the immune system of HIV positive individuals. However, more research is essential to validate the effect of moringa on anti-retroviral drugs [41]. The hydro-alcoholic extract of moringa flowers reduced the levels of rheumatoid factor, TNF-alpha and IL-1 in arthritic rats. This proves that moringa can be a potent therapy for arthritis [42]. Microbial diseases are widespread and there is a need for antimicrobial agents, *M. oleifera* has been proven as a good antimicrobial agent [66]. A study by Viera et al. [43] has shown that the extracts of *M. oleifera* can act against bacteria like *Bacillus subtilis*, *Staphylococcus aureus* and *Vibrio cholera*. The antibacterial effects of the seeds were accounted for by the presence of pterygospermin, moringine and benzyl isothiocyanate [67]. Table 2 presents nutritional composition and medicinal uses of different parts of Moringa.

6. Commercial applications

Moringa seeds are used to extract oil called the Ben oil. This oil is rich in oleic acid, tocopherols and sterols. It can also withstand oxidative rancidity. The oil can be used in cooking as a substitute for olive oil, as perfumes and also for lubrication [14,44]. The pods can absorb organic pollutants and pesticides. Moringa seeds also have great coagulant properties and can precipitate organics and mineral particulates out of a solution [1,53]. Chemical coagulants such as aluminum sulfate (Alum) and ferric sulfate or polymers removes suspended particles in waste water by neutralizing the electrical charges of particles in the water to form flocs making particles filterable. *M. oleifera* seed is a natural coagulant, containing a cationic protein that can clarify turbid water. This property of *M. oleifera* seeds is attracting much research as other coagulants such as alum, activated carbon and ferric chloride are expensive and rare [58]. Suhartini et al. [45] developed a two-stage clarifier for the treatment of tapioca starch waste water by placing coconut fiber followed by a layer of sand media mixed with powdered *M. oleifera*, this lead to improvement on physical and chemical characteristics, stabilizing pH value. Moringa seed extract has the ability to eliminate heavy metals (such as lead, copper, cadmium, chromium and arsenic) from water [46]. *M. oleifera* functionalized with magnetic nanoparticles such as iron oxide were found beneficial in surface water treatment by lowering settling time [55]. Seed extracts have antimicrobial properties that inhibit bacterial growth, which implies preventing waterborne diseases. These properties of *M. oleifera* seeds have wide applicability in averting diseases and can enhance the quality of life in rural communities as it is highly abundant.

Moringa seeds can be used in cosmetics and are sources of biodiesel while the seedcakes, can be used as a green manure or a fertilizer. The flowers of moringa are used to make tea with hypocholesterolemic properties. Moringa flowers are said to taste like mushrooms when fried [68]. The moringa flowers are great sources of nectar and are used by beekeepers. The root bark has medicinal values and is used for dyspepsia, eye diseases and heart complaints [51]. The tap root of Moringa is used as a spice. The gum from the tree can be used in calicoprinting. The gum and roots also have antibacterial, antifungal and anti-inflammatory properties [54]. The growth hormone from the leaves, called Zeatin is an excellent foliar and can increase the crop yield by 25%–30% [12]. Incorporation and fortification of moringa can be significant to tackle nutrient deficiencies and malnutrition. Studies have tried fortifying moringa in snacks. Aluko et al. [47] did a sensory evaluation on cookies made from a mix of maize flour and moringa seed flour. The flour was mixed with different percentages of the two flours and the best acceptance was for 92.5% maize and 7.5% moringa seed flour combination. This was well accepted due to its crispness, aroma, taste and color. Cereal gruels have also been fortified by moringa leaves in order to improve the protein content and energy. The cereal gruel with 65% popcorn and 35% moringa leaves was blanched and fermented. The fermented ones showed higher protein and energy while the blanched cereal had higher mineral content [48]. Owusu et al. [49] also used moringa as a fortificant and produced cream and butter crackers with moringa and *Ipomoea batatas* as fortificants, with the hope of adding additional nutrients to snacks. The sensory evaluation proved the cream crackers to be widely accepted. *M. oleifera* leaves can be incorporated in the diet of hens and layers thereby providing excellent protein source, substituting other expensive ingredients such as soybean meal and ground nut cake [56,57].

Considering the views of several such fortifications, it is suggested that such addition can be done to other snacks as well. Addition of moringa to the snacks can add nutritive value to the snacks. Most snacks are made up of corn meal and several studies demonstrated that a little addition of moringa to maize flour can add nutritive value to the snack in terms of protein, energy and minerals. However, further studies on moringa as a fortified Indian snack is required before bringing commercialized moringa to the market.

7. Conclusion and future prospects

The research on *M. oleifera* is yet to gain importance in India. It is essential that the nutrients of this wonder tree are exploited for a variety of purposes. *M. oleifera* has great anti-diabetic and anti-cancer properties. However, double blind researches are less prevalent to further substantiate these properties of moringa. More studies are needed to corroborate the primary mechanisms of moringa as antidiabetic and anticancer agents. Several puzzling questions are unanswered. Research on the antioxidant nature of aqueous extracts on cancer cells needs further inquiry. Studies have proven that moringa causes ROS in cancer cells that leads to apoptosis or necrosis. However, the aqueous extracts also have antioxidants present in them. The exact mechanism of this irony is yet to be explored. The effect of environmental factors affecting the nutrient levels of leaves and other parts of *M. oleifera* grown across the globe require further analysis.

Further research to isolate endophytic fungi and identify the enzymes or proteins from *M. oleifera* that are accountable for the anticancer and antidiabetic activity may lead to development of novel therapeutic compounds. Yet another focal area is to evaluate the commercial use of *M. oleifera* as a bio-coagulant. It might be a viable alternative for water purification. The demand for snacks in the market is huge. Hence Moringa fortification in snacks to eradicate malnutrition has a twin advantage. The tree as a native to India can become a great source of income for the nation if this potential for highly nutritional food is exploited by the industries and researchers by undertaking further research to corroborate earlier studies.

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