

Moringa oleifera Leaves Possible uses as environmentally Friendly Material: A REVIEW

Eman N. Ali

Abstract— *New uses of Moringa oleifera* leaves have been found by many researchers for the last two decades which introduced new material in pharmaceutical and water treatment industry. *Moringa oleifera* leaves can be used as a medicine for many diseases, as antibacterial, antioxidant, anticancer. In addition it can be used as a protein supplement for human being and animals due to high protein content. *Moringa oleifera* leaves are unique because of their tremendous amounts of minerals but lower amounts of harmful compounds and it can be considered as safe supplement because besides that it is not toxic. In addition, it was found that it can work as a biosorbent for heavy metals in water treatment. Therefore, it can be considered as a natural product and environmentally friendly material.

Keywords—antibacterial, antioxidant, biosorbent *Moringa oleifera*, protein supplement.

I. INTRODUCTION

MORINGA oleifera is member of the *Moringaceae* family which is a single genus family of shrubs [1], [2]. All *Moringa* species are native to India, from where they have been introduced into many warm countries, such as Malaysia and other tropical countries around the world. It is a fast growing tree and can tolerate draught, sandy soil, bacteria and fungi, and thrives in subtropical to tropical dry to moist climates, tolerating rainfall from 25 to 300 plus cm annually with temperatures ranging from 19 to 28 °C [3]. It is generally used in a number of developing countries as a vegetable, a medical plant, and a source of vegetable oil. It can be propagated from seeds or cuttings even in poor soil requiring minimum attention and it can survive long periods of drought. Most of the tree parts are useful for many purposes; the leaves particularly have many applications. This paper presents the most uses of *Moringa oleifera* leaves (Figure, 1) in many fields.



Fig. 1. *Moringa oleifera* leaves.

II. MORINGA OLEIFERA USES

A. *Moringa oleifera* leaves composition

It was found that *Moringa oleifera* leaves are unique because of their tremendous amounts of minerals but lower amounts of harmful compounds. In *Moringa oleifera* leaves, tannins and phytates are 12 and 21 g/ kg on dry basis, respectively [4]. The chemical composition of *Moringa oleifera* leaves contains: 27.2% protein, 5.9% moisture, 17.1% fat, and 38.6% carbohydrate on dry basis. The mineral composition expressed in mg for 100 gm of dry extracted leaves is 2098 calcium, 406 magnesium, 1922 potassium, 28.3 iron, 5.4 zinc, and 351.1 phosphor [5]. It contain around 0.58-0.73 g protein/ g leaves dry weight [6] and this what make it a good protein supplement. HPLC analysis indicated the presence of phenolic acids (gallic, chlorogenic, ellagic and ferulic acid) and flavonoids (kaempferol, quercetin and rutin) [7]. *Moringa oleifera* leaves are a rich source of vitamins [8].

B. Protein Supplement

It was recommended by [5] that *Moringa oleifera* leaves extract is a balanced nutrition for population. In Thailand, *Moringa oleifera* leaves are considered a very good daily basis supplement [9]. The extracts of moringa leaves contain amounts of saponins ranging between 4.7 and 5 g /kg on dry basis, and so they can be consumed by livestock and human beings without any adverse effects [4].

Moringa oleifera leaves can be used as a very high protein supplement for high producing cows, it contains much higher protein than those for various conventional protein supplements like seed meal of coconut, cotton seeds, ground nut, sesame, sunflower [8], [10]. It was reported by [11] that *Moringa oleifera* leaves extract have a high potential as

alternative to soybean meal and rapeseed meal as protein source for its high total fatty acid content. The inclusion of *Moringa* as a protein supplement to low quality diets improved dry matter intake and digestibility of the diet and increased milk production without affecting the milk composition as concluded by [12]. It was deduced by [13] that *Moringa oleifera* leaves meal at inclusion level that is not detrimental to the bird's performance, may be promising source of natural antioxidants for broiler meat, and concluded by [14] that supplement from *Moringa oleifera* leaves meal up to 25 g / kg of feed enhanced the birds' genetic potential for growth performance.

It was suggested by [15] that *Moringa oleifera* leaves meal can be used to substitute up to 10% of dietary protein in Nile tilapia without significant reduction in growth, and it was recommended by [16] that *Moringa* should be promoted for greater consumption to improve nutrition and strengthen immune functions.

In conclusion, it has been found that *Moringa oleifera* leaves meal are good feed sources for livestock, fish, rabbits, laying hens, broiler chickens, growing sheep, and cross-bred cows [17], [18], [19], [20], [21], [22].

C. Medicine

Moringa oleifera is known for long time as an important nutritional supplement with a variety of medicinal properties. It is proved by research work that *Moringa oleifera* leaves extract is good to regulate the hyperthyroidism [23], antineoplastic agent to treat Sickle cell disease [24]. It works as hypocholesterolemic agent in obese patients [25], antiproliferation and induction of apoptosis on human cancer cell [26] and was supported the study of [27] which provided evidence that *Moringa oleifera* leaves possess cytotoxic and chemopreventive properties. Therefore, it might be beneficial as a medicinal plant for alternative novel anticancer drugs and nutraceutical products. *Moringa oleifera* leaves as ethnomedicine to treat diabetes mellitus [28], in addition the experimental findings by [29], [30] have indicated the potential benefits of using the aqueous extract of *Moringa oleifera* leaves as a potent antidiabetic treatment.

It works as anti fungal beside the use of its essential oil for anti-skin disease agent [31]. *Moringa oleifera* can be prescribed as food appendage for coronary artery disease patients along with their regular medicines [32]. The findings of [33] suggested that the cardio-protective potential of the isolated alkaloid from *Moringa oleifera* leaves and possibly the beneficial action is mediated through its free radical scavenging property. It was demonstrated by [34] that pretreatment with the methanolic leaf extract of *Moringa oleifera* confers significant radiation protection to the bone marrow chromosomes in mice and this may lead to the higher 30 day survival after lethal whole body irradiation. The study by [35] has justified the traditional use of the *Moringa oleifera* leaves extract for the treatment of epilepsy. The leaves possess adose-dependent CNS depressant (sedative-hypnotic, anticonvulsant) effect possibly mediated via positive modulation of GABA. It is reported by [36] that *Moringa oleifera* leaves are having bio enhancer for drugs and nutrients

(Niaziridin & Niazirin), which add another advantage for *Moringa oleifera* leaves use in pharmaceutical industry.

It can be concluded that *Moringa oleifera* leaves extract possesses therapeutic potential for pharmaceutical product development but, it should be kept in a cold place to prevent significant changes in chemical, physical and biological properties as recommended by [37].

D. Antioxidant

Moringa oleifera leaves works as antioxidant [27], [38], [39], [40], [41], [42] and the results of [43] has support d the potent antioxidant activity of aqueous and ethanolic extract of *Moringa oleifera*, which adds one more positive attribute to its known pharmacological importance. Ref. [7], [44] concluded that the extract of *Moringa oleifera* possess high phenolic content and potent antioxidant properties. It was found by [45] that the best extraction of antioxidant compounds from *Moringa oleifera* leaves were by using methanol (80%) and ethanol (70%).

E. Antibacterial

For antibacterial activity, it was found that different extracts of *Moringa oleifera* leaves are active against bacteria such as: *E. Coli*, *S. Arous*, *P. Aeruginosa*, and *B. Cereus*, as these organisms range from pathogenic and toxigenic organism liable to cause food borne illnesses, and food spoilage due to bacteria presence. It was reported by [46], [47] that possession of alkaloids, tannins and flavonoids is enhancing anti-bacterial properties of plant. In addition, the anti-bacterial activity of *Moringa oleifera* leaves for different species of bacteria has been highlighted by many authors [16], [48], [49], [50], [51]. It can be used as valuable drug in the treatment of infections caused by *E. coli*, *S. typhi*, And *P. aeruginosa* [52].

It was confirmed as antibacterial by [42], [53]. Aqueous extract of *Moringa oleifera* leaves posses significant antimicrobial activity against gram positive and negative fungal species. It is active against *E coli*, *S. Aureus* and *B. Subtilis* [54]. It was suggested by [55] that the extracts and juice of *Moringa oleifera* Lam. can be used to discover antibacterial agent for developing new pharmaceuticals to control studied human pathogenic bacteria responsible for severe illness.

F. Biosorbent

In addition to the possibility of using *Moringa oleifera* leaves in pharmaceutical industry, it is good in water treatment industry as well. It was found that *Moringa oleifera* leaves extract is a good sorbent for Pb(II) from aqueous solutions [56]. Chemically Modified *Moringa oleifera* leaves powder was used by [57] for optimization of Cd(II), Cu(II) and Ni(II) biosorption. Removing of Cd(II) from waste water was achieved using fresh leaves as biosorbent [58].

G. Other uses

It was found that the bean seed soaking in *Moringa oleifera* leaves extract can overcome NaCl stress and its effect on growth of the bean and increase the production yield [59].

The crude extract isolated from the mature *Moringa oleifera* leaves can work as protease inhibitor with potential for use as therapeutic drug and as seafood preservative [60].

The aqueous extract of *Moringa oleifera* leaves was found by [61] to demonstrate a strong potential for synthesis of silver nanoparticles by rapid reduction of silver ions.

H. Toxicity

The popularity of using *Moringa oleifera* as a nutritional supplement raises the question of possible toxicity at supra-supplementation levels. The results of [62], concluded that hepatonephro-toxicity was nil with no abnormal haematology results. It was supported by [63] findings that aqueous leaf extracts is relatively safe when administered orally.

III. CONCLUSION

As a conclusion, more attention need to be paid to the uses of *Moringa oleifera* leaves in a large scale in countries like Malaysia and other countries where the *Moringa oleifera* tree can be grown to produce more natural products and environmentally friendly materials.

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EMAN N. ALI. Born in Baghdad / IRAQ on 29th January 1958. BSc. Petroleum & Mining / Baghdad University / IRAQ (1980). MSc. Chemical Engineering / UKM/ Malaysia (2000). Ph.D Biotechnology Engineering/ IIUM/ Malaysia (2010). Engineering

The work Experience, 8 years working in chemical factories in IRAQ, 8 years research and development in IRAQ, 3 years teaching as a senior lecturer at Universiti Malaysia Pahang, Malaysia (current job)..