

## ***Moringa oleifera* - nutritional and antimicrobial properties. A review**

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### **Abstract**

*Moringa oleifera* is a tree native to southern Asia. Phytochemical characteristics have led to its cultivation in other parts of the globe. There are attempts to acclimatize even in Romania. The richness in minerals, vitamins, amino acids, sugars far exceeds the content of some agri-food products, and the content in unsaturated fatty acids of the seeds recommends it as a promoter of human health. In this review we presented the nutritional and antimicrobial properties of this plant from which everything can be capitalized, from the root to the seeds. The paper is based on extensive documentation and selection of essential results. The benefits of this miraculous tree are many and the compounds it contains can make up for the nutritional deficiencies in the diets of people in many countries. The range of bioactive compounds is an argument of antimicrobial activity and the possibilities of their use in pharmacological formulas.

**Keywords:** God's tree, phytochemicals, antimicrobial potential, nutritional properties

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### **1. Introduction**

*Moringa oleifera* is part of the *Moringaceae* family, along with 12 other botanical species [35]. It is popularly known as the tree of God, the miraculous tree, the drumstick tree or the moringa. The etymology of the name "Moringa" is in latin, where "tamil" means "twisted pod" and "oleifera" which consists of "oleum" - "oil" and "iron" - "bear" [43]. It is native to southern Asia, although today it is found in other parts of the globe [37].

According to Paliwal et al., [27], *M. oleifera* is a cheap nutritional, medical and industrial alternative. This is a motivation for its cultivation in many regions of the world. From this tree all the component parts are used: wood, leaves, flowers, gum, seeds. Its young pods, seeds and leaves are rich in compounds with nutritional and medical value such as minerals, vitamins, amino acids and antioxidants [10].

Various parts of the plant are used as animal feed (leaves, industrial residues) [35], foliar fertilizer, biopesticide, paint (wood), etc. It can also be used as an ornamental plant, honey plant and green fence [1,19,29].

Although it has many economic advantages, it is appreciated and promoted in some projects, there are still many unknowns related to the factors that prevent its use at maximum levels [13,28], the implications of chemical compounds, their antimicrobial action and the mechanisms of action against some diseases. This review focuses on the nutritional properties and antimicrobial activity of *Moringa oleifera* L.

### **2. Taxonomic classification and spread**

*Moringa oleifera* is a fast-growing, drought-resistant tree native to India, but found in large areas of Asia, Arabia, and Africa (figure 1) [11,39].

Its beneficial properties determined the Vegetable Research Station in Buzau, Romania to try its acclimatization and cultivation.

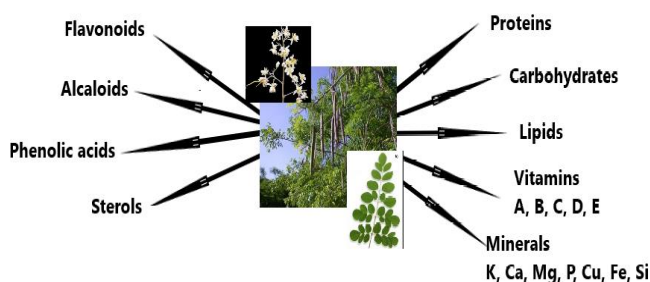
*Moringa oleifera* L is included in:

Kingdom: *Plantae*  
 Phylum: *Tracheophyta*  
 Clasa: *Magnoliopsida*  
 Ordinul: *Brasicales*  
 Familia *Moringaceae*  
 Genus: *Moringa* [44].



**Figure 1.** Different areas of the globe where species of the genus *Moringa* are found [7]

The main species found in various parts of the globe: *Moringa oleifera*, *Moringa arborea* (Kenya), *Moringa drouhardii* (Madagascar), *Moringa peregrina* (Arabia), *Moringa ovalifolia* (Namibia, Angola), *Moringa ruspoliana* (Etiopia, Kenya, Somalia), *Moringa pygmaea* (Etiopia, Kenya), *Moringa rivae* (Somalia), *Moringa longituba* (Kenya, Somalia), *Moringa stenopetala* (Etiopia, Kenya), etc. [13,25].



**Figure 2.** Chemical composition of *M. oleifera* [14,19,20,34,45]

Mbikay [20] highlighted in mineral leaves (calcium, potassium, zinc, magnesium, iron and copper) and vitamins (A, B, C, D, E). The complete picture with the nutritional values of the powder from the dried leaves of moringa (100 g) is as follows: fiber 19.2 g, protein 27.1 g, fat 2.3 g, carbohydrates 38.2 g, phosphorus 204 mg, potassium 1,324 mg, iron 28.2 mg, sodium 870 mg, calcium 2,003 mg, magnesium

368 mg), vitamin A 16.3 mg, vitamin B1 - thiamine 2.64 mg, vitamin B2 20.5 mg, vitamin B3 8.2 mg, vitamin C 17.3 mg, vitamin E 113 mg) and amino acids (g 16-1 g N) (eg arginine 1.33, histidine 0.61, lysine 1.32, tryptophan 0.43, phenylalanine 1.39, methionine 0.35, threonine 1.19, leucine 1, 95, Isoleucine 0.83, valine 1.06) and other substances [13,16,42] he pointed out,

*Moringa* has a high content of phytosterols, especially stigmasterol, sitosterol and kampesterol [17], which stimulate lactation. According to Gharsallah et al., [14]  $\beta$ -sitosterol dominates in moringa seeds (47.24%). Berkovich et al., [19] also mention the presence of tannins, terpenoids, saponins, alkaloids, glucosinolates, etc. According to Brisibe, [8] the chemical composition is influenced by area, season, environmental factors, but also by cultivation methods and the species [40].

#### 4. Nutritional properties

*Moringa* is considered an inexhaustible source of nutrients. It is believed that moringa powder can supplement the minerals and vitamins needed by the human body. These things are possible because many authors have shown that most compounds in moringa outnumber those present in agri-food products. *Moringa* has a lot of minerals essential for growth, being considered a good remedy for malnutrition in children [22]. Calcium is important for the proper functioning of the nervous system, for the growth of bones, teeth, prevention of osteoporosis. Studies show that this element exceeds the amount in milk and protein in yogurt. In addition, moringa can supply zinc [5] and iron, the latter being 28 mg higher than spinach [12].

Eating bananas is recommended due to its high potassium content, but it should be noted that moringa has 15 times more potassium. Vitamin C is essential for iron absorption [3]. According to studies conducted by Rockwood et al., [31], moringa contains 7 times more vitamin C than some citrus fruits, and in terms of vitamin A the differences are 10 times higher than carrots. *Moringa oleifera* leaves contain a higher amount of polyunsaturated fatty acids compared to saturated acids. Unsaturated acids are recommended for health promotion [40]. According to studies, the daily caloric intake of carbohydrates should be 50%, the requirement met by moringa leaves [26].

Moringa seed oil can replace olive oil. Lalas, [18] showed that moringa seeds contain linoleic acid, linolenic acid and oleic acid (76%). There are also studies showing that seed extract has the ability to remove heavy metals (lead, copper, cadmium, chromium and arsenic) from water [33]. Moringa root is considered a valuable spice [36].

### 5. Antimicrobial activity and medicinal uses

Inhibiting the growth of pathogenic bacterial species and fungi, especially those that produce toxins, is an advantage for the food and medical fields. The richness in bioactive compounds recommends moringa as a good antibacterial and antifungal. According to some authors, each component part of the plant contains a substance with antimicrobial activity. Compounds with antimicrobial effect include: alkaloids, amino acids, cardiglycosides, flavonoids, saponins, steroids, terpenoids and tannins [29].

Ruckmani et al., [32] demonstrated the antimicrobial effect of pterygospermine, a compound with antibiotic action isolated from flowers by Das et al, [9]. Many authors have observed the antibacterial and antifungal action of extracts obtained from moringa root [23]. For example, petroleum ether extracts obtained from the root negatively influenced the growth of *E. coli*, *P. aeruginosa* and *S. aureus* bacteria [29].

Rahman et al., [30] demonstrated that the juice and hydroalcoholic extracts of fresh *M. oleifera* leaves have antimicrobial potential against Gram-negative bacteria (*Shigella shinga*, *Pseudomonas aeruginosa*, *Shigella sonnei* and *Pseudomonas spp.*) and Gram-positive bacteria (*Staphylococcus aureus*, *Streptococcus-B-haemolytica*, *Bacillus subtilis*, *Sarcina lutea* and *Bacillus megaterium*). The areas of inhibition were much larger when the juice from the fresh leaves was tested (15.23-42.3 mm), compared to those produced by the alcoholic extract (16.25-21.5 mm). Aqueous and alcoholic extracts also have an inhibitory effect on *Salmonella* species [10,41]. Acetone (0.5 mg / ml) extracts (0.5 mg / ml) also had good results against bacteria (*Escherichia coli*, *Enterobacter cloacae*, *Proteus vulgaris*, *Staphylococcus aureus*, *Micrococcus kristinae*) [21].

The growth of fungal species is inhibited by the use of various moringa extracts. *Penicillium* and *Mucor* were inhibited in petroleum ether extracts at a concentration of 15 mg / ml, respectively in

alcoholic extracts. Alcoholic extracts also showed biological activity against *Candida albicans* [29]. Methanolic extracts had a high inhibitory effect (70-80%) on the growth of *Aspergillus flavus* fungi Shukla et al., [38] and *Trichoderma harzianum* [15].

Moringa contains compounds with anticancer properties, isothiocyanate glucosinolates, glycosidic compounds and glycerol-1-9-octadecanoate are considered anti-carcinogenic agents [6]. Pods are high in fiber (approximately 46.78%) and prevent colon cancer [24]. Moringa powder can be used to treat anemia [12]. There is research showing that it can control cholesterol [18].

Seed extracts, gum and roots have anti-inflammatory and antimicrobial properties [36]. Moringa flowers are used in the preparation of tea with hypocholesterolemic properties [4]. The root and bark have medicinal value and are used for eye and heart conditions [2].

### Conclusions

Although moringa is considered a miracle plant, studies must be continued to decipher the importance of all chemical compounds, the mechanisms of action of bioactive compounds, as antimicrobial, antidiabetic and anticancer agents.

In addition, current knowledge can be used to develop new pharmacological products, to obtain and preserve food enriched with moringa extracts, to control microbial agents in the medical and food fields, and even to obtain natural antiseptic solution.

**Compliance with Ethics Requirements.** Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human or animal subjects (if exist) respect the specific regulation and standards.

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