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Moringa oleifera: a new perspective for the synthesis of natural products

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Abstract: Moringa oleifera Lam. is a plant native from India, but its distribution extends to all continents. Its leaves, flowers, pods and seeds are commonly used for food, mainly in Africa, due to its high nutritional value. With regard to medicine, M. oleifera demonstrates immeasurable potential in view of the various biological activities which are reported from its secondary compounds, such as alkaloids, tannins, flavonols, steroids, saponins, coumarins, quinones, resins, lectins among others. Based on this assumption, this review aims to expose the potential of Moringa oleifera in the period 2016-2018, in the use of its compounds for the synthesis of natural products due to its diverse biological activities. The results showed that the several parts of the plant may have different biological activities. The seeds have antibacterial activity with dental importance; activity in the prevention and deceleration of the amyotrophic lateral sclerosis disease (ALS); anti-hypertrophic and anti-fibrotic effect, being beneficial for cardiac structure and function in hypertensive mice; anticancer activity; anti-inflammatory; and protection of neural cells. For the leaves were reported Antitumor activities; therapeutic efficacy against neurotoxicity; for insulin expression and decrease in the degree of insulitis; antimicrobial activity; reduction of myocardial damage and oxidative stress; treatment in atopic dermatitis; gastroprotective activity and improvement of mucus; hypocholesterolemic effect; and ability to prevent chromatolysis, distortion of cerebellar cortical cells and neurobehavioral deficit. For the other parts of the plant similar activities are described, however in less quantity. Thus, Moringa oleifera presents a new perspective on the synthesis of natural products, considering the range of biological activities described for a species, as well as the ease of obtaining and using its compounds.

Keywords: Biological activity; moringa; secondary compounds.

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1. Introduction

Moringa oleifera Lam. is a species of plant belonging to the family Moringaceae, being native to Asia, but cultivated in tropical and subtropical regions around the world [1]. This plant is commonly used in the food, in order that all parts are edible and nutritional, with a large source of protein, vitamins and minerals [2]. Stohs and Hartman [3] demonstrated that *M. oleifera* is completely safe to be consumed by humans and other animals.

This species is known as “the miracle tree”, because it presents incredible results in the cure of various diseases. As a result of their activities, some research began to isolate bioactive compounds from different parts of the plant to test their applications [4].

In traditional medicine, moringa is mainly used for the treatment of skin diseases, anemia, cholera, headaches, antihypertensive, regulator of thyroid hormones, laxatives and as antibiotic [1,5-7].

In addition to nutritional and medicinal potential, *M. oleifera* is also used in the production of cosmetics, such as body hydrating, moisturizing and hair conditioner. The oil of this species was used by the Egyptians for the treatment of the skin. As a result of so many activities, *M. oleifera* was titled "the most rich plant in nutrient discovered” [8]

Based on this assumption, this review aims to expose the potential of Moringa oleifera in the period 2016-2018, in the use of its compounds for the synthesis of natural products due to its diverse biological activities.

2. Results and Discussion

For didactic purposes, we divided the biological activities found in *M. oleifera* according to the plant anatomy.

The seeds of *M. oleifera* present a source as therapeutic potential. Cells of neurons pretreated with the compound glucomoringin-isothiocyanate (GMG-ITC), showed resistance to apoptotic cell death induced by H2O2, the GMG-ITC confers protection to the cytoskeleton and cytoplasmic inclusion, as well as preservation of the morphological characteristics and general integrity of the neural cells [9]. The same compound GMG-ITC, It was administered to mice with amyotrophic lateral sclerosis (ALS) and showed interference in the pathophysiological mechanisms of the development of ALS, acting in the deceleration or prevention of the disease [10]. GMG-ITC also showed the ability to inhibit signaling pathways that are commonly upregulated in cancer and immune disorders such as JAK/STAT, demonstrating a potential prevention of diseases such as cancer, inflammatory diseases and immunological disorders [11]. The seed powder used in the feeding of hypertensive rats had an anti-hypertrophic and antifibrotic effect, reduction in the level of cardiac triglycerides and increase of plasma prostacyclins, showing beneficial effect of *M. OIeifera* on the structure and cardiac function of hypertensive mice [12]. The essential oil of seeds from *Moringa oleífera* showed a potent cytotoxic activity, with reduction of cell viability of the cancer cell lines HeLa, HepG2, MCF-7, CACO-2 and L929 [13]. Microbial assays using seeds showed inhibition of the growth of the pathogenic bacteria *Staphylococcus aureus* e *Streptococcus mutans* [14].

Leaf extracts of *M. oleifera* presented a positive result for the treatment of atopic dermatitis, with the reduction of serum level of IgE and the clinical characteristics [15]. The aqueous extract of the leaf, with phytochemical compounds, was an important target in neural studies, with action of nicotine, the authors revealed that the aqueous extract was able to prevent chromatolysis, distortion of cerebellar cortical cells and neurobehavioral deficit, in mice treated with nicotine [16]. The hydroethanolic extract of the leaves showed antioxidant activity [17]. Hani, *et al.* [18] found that the leaf extract of MO, with secondary metabolites, maintained its antioxidant activity after encapsulation and that it is safe for oral consumption. The ethanoic extract from the leaves was tested for gastroprotective activity *in vivo*, the results were positive, the extract may contain active agents with gastroprotective activity and improvement of the mucus, this result aims at the use as agents of safe and potent treatments for ulcer [19]. I*n vivo* study was done through an induced diet with leaf

powder, the results demonstrate a hypocholesterolemic effect, with use of 400mg/Kg of the extract prevented cholesterol elevation, triglycerides, low density lipoprotein cholesterol, malondialdehyde and the activities of alanine aminotransferase and serum aspartate aminotransferase [20]. studies have demonstrated efficacy of the ethanolic extract of leaves of MO against nephrotoxicity induced by N-Acetyl-p-Aminophenol (APAP), also known as acetaminophen, a common use of medication, it was seen the increase of the endogenous antioxidant system/enzymatic level to neutralize the oxidative stress environment (ROS), In addition presented a modulating effect on specific inflammatory cytokines in renal tissues [21]. The crude aqueous extract from the leaves of OM has antiproliferative effects against cancerous esophageal cell line, due to increased lipid peroxidation, DNA fragmentation and induction of apoptosis in these cells [22]. A toothpaste was developed from the ethanoic extract of the leaves of OM that showed a potential effect against the growth of *Staphylococcus aureus, Streptococcus mutans,* and *Candida albicans* [14], *Vibrio cholerae, Vibrio mimicus* and *Escherichia coli* [23]. Leaf extracts tested against the cancer cell lines MDA-MB-231 and HCT-8, of breast and colorectal cancer, respectively, showed a significant decrease in the cellular population of both cell lines, due to increase induction of apoptosis [24].

Using the MO flowers, was administered the ethanoic extract to diabetic rats induced by streptozotocin. The results showed hypo and normoglycemic properties, as well as antioxidant properties, maintaining glucose homeostasis, and metabolic and enzymatic functions of the liver [25]. The flower extract of *M. oleifera* tested in macrophages induced by LPS suppressed the secretion and expression of NO, NF-κB, iNOS, COX-2, and of the proinflammatory cytokines TNF-α, IL-1β, IL-6, PGE2, besides increasing the production of anti-inflammatory cytokines IL-10 and IκB-α [26]. Flower extracts also demonstrated antimicrobial potential against *V. cholerae* and *E. coli* [23].

Antimicrobial tests with root extracts showed an antibacterial effect against the growth of *Staphylococcus aureus* and *Streptococcus mutans* [14], and from the pods inhibited *Vibrio. vulnificus V. cholerae, V. mimicus* and *E. coli* [23]. The barks of MO presented a reduction in the cell population of the cancer cell lines MDA-MB-231 and HCT-8 [24].

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4. Conclusions

Thus, Moringa oleifera presents a new perspective on the synthesis of natural products, considering the range of biological activities described for a species, as well as the ease of obtaining and using its compounds.

Conflicts of Interest

The authors declare no conflict of interest.

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