Guest Editorial

Moringa Oleifera: as a source of food, Nutraceuticals, anti-microbial, and an immunomodulating agent

Ayanthi N. Navaratne

Senior Professor in Chemistry, Department of Chemistry, Faculty of Science, University of Peradeniya

Introduction

Moringa oleifera, which belongs to the family Moringaceae, is a plant grown in almost all part of Sri Lanka although it is well grown in semi-arid areas. Everybody enjoys its pods, "Murunga" (Drumsticks) as a curry though little attention is paid to its leaves (Figure 1). Several Sri Lankan companies export mainly leaves / leaf - powder to different countries. However, Sri Lanka has never realized its full potential as an export agricultural crop which can bring foreign currency to the country. It grows widely in semi-arid, tropical and subtropical regions in the world and prefers to grow in neutral to slightly acidic (pH 6.3 to 7.0), sandy or loamy soil.

Moringa oleifera contains many important minerals and phytochemicals, such as zeatin, quercetin, beta-sitosterol, caffeoylquinic acid, kaempferol and catechins to name a few (Figure 2).

Figure 1: *Moringa oleifera* leaves
Source: https://www.ebay.com/itm/394353687070

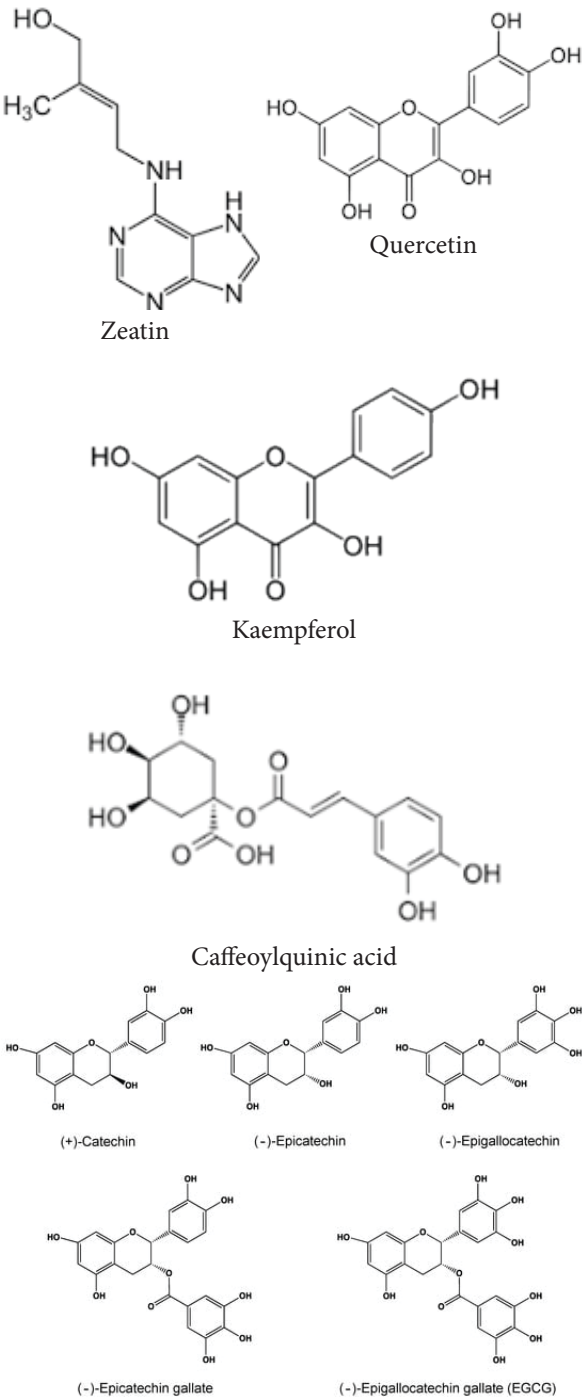

Figure 2: Health beneficial compound of *Moringa Oleifera*

The *in vitro* and *in vivo* studies have confirmed its various biological activities and important medical aspects such as antioxidant, anti-inflammatory, anti-diabetic, anti-cancer, cardioprotective, hypocholesterolemia, hepatoprotective, anti-asthmatic activities, immunomodulation, ant-viral and anti -bacterial besides its nutritional values.

Nutritional value of *Moringa oleifera*

Moringa oleifera is a nutrient-rich plant. Its leaves contain high amounts of minerals, Vitamins and beneficial organic compounds such as antioxidants. Minerals such as Ca, Na, Mg, Zn, Fe, Cu, Mn, Se, K, and P and Vitamins are A, E, and C and health-promoting phytochemicals: polyphenols, carotenoids, phytosterols and tocopherols, glucosinolates, folic acid, polyunsaturated fatty acids. According to the literature, there are more than 20 different pharmacologically active compounds found in Moringa Leaves.

Health benefits of *Moringa oleifera*

Dietary supplementation with *M. oleifera* leaves protect humans against iron deficiency and oxidative stress. Antioxidants, anticancer, antimicrobial, liver protectant, nerve protectant and liver metabolism are important phytochemicals found in these leaves.

Anti-microbial activity of *Moringa oleifera*

Use of antibiotics at large scale and in an irrational way have led to the emergence of antibiotic resistance in microbes. A wide range of plant extracts have been tested *in vitro* for their antimicrobial and antibacterial actions. For many years, herbal drugs have been prescribed for various ailments and in traditional medicines to cure varieties of infectious diseases. Herbal drugs are potent antibiotics and have potential to replace or reduce the load of synthetic antibiotics in the environment.

According to the studies conducted with the compounds, Thiocarbamate and Niaziminin which are isolated from the leaves of *M. oleifera* have been proven to have promising antiviral activity. Furthermore, the leaves of *M. oleifera* have shown potential to be used against HIV infections as the leaves immensely support the immunity of the patients.

Immunomodulation ability of leaf extract of Moringa

Moringa oleifera, a plant with various medicinal properties, exhibits immunomodulatory activity. Which means it can influence the body's immune system, potentially enhancing or modulating its responses.

The function of the immune system is to protect against infectious diseases and cancer. Many immunologists, oncologists, and other scientists have explored and elaborated and realized that the immune system as a target for developing therapeutic interventions. However, the immune system is highly regulated. As a result, there is a paradigm shift in the focus of many researchers on understanding the immune system's regulatory mechanisms and how these mechanisms can be modulated to target diseases.

Recently, interest in exploring the immunomodulatory effect of *Moringa oleifera* on the immune system becomes evident in scientific literature. For example, the anti-respiratory burst and anti-chemotactic properties of ethanol extract of *Moringa oleifera*'s Quercetin 3-O-glucoside, crypto-chlorogenic acid, and kaempferol 3-O-glucoside on neutrophils were reported. Therefore, Moringa oleifera leaves have a potential to be developed as immunomodulators that could cater for the general population, high-risk individuals and immunosuppressed patients.

Biodiesel /bioethanol production and water purification

M. oleifera seeds contain about 40% of oil potentially available for a wide range of applications, from food to cosmetics or biodiesel/bioethanol production.

Water extract of Moringa kernel has been shown to be useful for purification of water and wastewater, replacing coagulants for chemicals such as aluminum sulphate.

Furthermore, It has been proven that seeds of *Moringa oleifera* can remove heavy metal ions such as Pb and Cd at low concentrations, according to the studies conducted in Analytical laboratory of University of Peradeniya.

Toxicity studies of *Moringa Oleifera*

Moringa oleifera is generally considered safe when

consumed in food or used as a short-term medicine, but high doses or prolonged use could potentially cause liver and kidney damage, and the bark may cause uterine contractions. Therefore, eating large amounts of moringa might be dangerous.

The study conducted an acute toxicity analysis in rats and reported genotoxic effects at a dose of 3000 mg/kg for 14 days while 1000 mg/kg was observed to be safe. However, some research studies reports that the safe level as 2000 mg/K.

Conclusion

Murunga oleifera plant grow in sub topical areas and native to India, also called "Miracle Plant" and "Tree of Life". Some Sri Lankan companies already import different products of this tree but mainly leaves in the powder form. However, Sri Lanka has not realized its potential fully as an export commodity to get foreign currency. This valuable plant is growing every part of Sri Lanka although it grows very well in arid regions like Jaffna. However, not much attention is paid by public about the value of this plant. Once people understand its nutritional, therapeutic and food values, more attention will be drawn by people. Furthermore, finding a medication for HIV from this plant is not very far away.

References:

1. Yildirim, A., Mavi, A., Kara, A.A. (2001). Determination of antioxidant and antimicrobial activities of Rumex crispus L. extracts. Journal of Agricultural and Food Chemistry 49, 4083–4089.
2. Rigo, C., Castello, M. L., Ortola, M. D., Garcia-Mares, F. J., Desamparados Soriano, M. (2020). *Moringa oleifera*: An unknown crop in developed countries with great potential for industry and adapted to climate change. Foods, 10, 31.
3. Muhammad U. Adamu, Lawal H, Ramasamy R. review article: Immunomodulatory Functions of *Moringa oleifera* (Lam.) Mal. J. Med. Health Sci 17(SUPP10): 54-63, Dec 2021,
4. M.Sc. Thesis: Removal of Pb^{2+} and Cd^{2+} using *Moringa oleifera* seeds by L.S. Bandaranayake, 2019. (Supervisor: Prof. A.N. Navaratne).
5. Sanchooli N, et al. Growth promoting and immunomodulatory effects of dietary *Moringa oleifera* leaf powder in rainbow trout (*Oncorhynchus mykiss*). Aquaculture Reports. 2023; 30:101555.

Professor Ayanthi N. Navaratne *is currently serving as a Senior Professor in Chemistry at the University of Peradeniya. She obtained a B.Sc. (Honours) in Chemistry in 1984 from the University of Peradeniya. She obtained her MS degree in Inorganic Chemistry (Bioinorganic Chemistry and Ph.D. in Chemistry Analytical Chemistry (Bioelectroanalytical Chemistry) from University of Hawaii at Manoa, USA in 1989 and 1992 respectively. She obtained an excellence in Teaching Award from the American Chemical Society of Hawaii section in 1987 as a graduate Teaching Assistant. Furthermore, She is a recipient of Young Scientist award (2000), NSF Research Award (2010), Technology Award (2014) from the National Science Foundation. She is also a recipient of Presidential award for invention from Sri Lanka Inventor committee (2017) and several presidential awards and merit awards from National Research Council.*

Cover Page

Cover page shows a structure of perovskite-based solar cells. Perovskites hold promise for creating solar panels that could be easily deposited onto most surfaces, including flexible and textured ones. These materials would also be lightweight, cheap to produce, and as efficient as today's leading photovoltaic materials, which are mainly silicon. They're the subject of increasing research and investment, but companies looking to harness their potential do have to address some remaining hurdles before perovskite-based solar cells can be commercially competitive.

The term perovskite refers not to a specific material, like silicon or cadmium telluride, other leading contenders in the photovoltaic realm, but to a whole family of compounds. The perovskite family of solar materials is named for its structural similarity to a mineral called perovskite, which was discovered in 1839 and named after Russian mineralogist L.A. Perovski. For more details visit pages 32 - 35.

Cover photo from https://news.mit.edu/2022/perovskites-solar-cells-explained-0715.