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A Sustainable Natural Resource (*Moringa oleifera*) in Tropical and Subtropical Areas: An Intensive Literature Review

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Abstract

Moringa oleifera (*M. oleifera*) is a species of the Moringaceae family and mostly available in the tropical and subtropical areas including Bangladesh, Nepal, India, Pakistan, Afghanistan, Latin America and some African countries. It is widely contributing to sustainable food, agriculture and medicine development as well as sustainable aquaculture. *M. oleifera* is a promising natural food source in the tropics because of its availability even in the end of dry season when other foods are typically scarce. Furthermore, the *M. oleifera* trees have been advocated by the Educational Concerns for Hunger Organization as a “natural nutrition for the tropics”, especially among infants and nursing mothers. This literature review research has been conducted with more than 30 internationally published research articles. It has been already proven that the *M. oleifera* tree is one of the most underutilized tropical crops because of lack of awareness, although it has multidimensional applications and functionalities including antioxidant, anti-diabetics and antibacterial activities. Apart from that, *M. oleifera* leaves extract shows the better results in a comparison study of the antimicrobial activities of sea fish preservation compared to brine solution. On the other hand, the entire *M. oleifera* trees (e.g. leaf, shoot, flower, pod, seed and root) are using in numerous applications including traditional diets. Also, the dried *M. oleifera* leaves can be preserved for a longer period without any preservative and adverse nutritional losses. Hence, drying can be done using the economical household appliance as well as commercial drying techniques. Above scientific evidence gives an indication that the *M. oleifera* grown for economic purposes as well as on a commercial scale, also the creation of employment, reduction of poverty and the rural development. This review research work would deliver the key indications and background for the future research.

Keywords: Economic and sustainable development, *Moringa oleifera*, natural resource

Introduction

M. oleifera is belongs to the family of Moringaceae, it is native to the Himalaya region but it is commercially grown in many tropical and subtropical countries world wide (Bashir *et al.*, 2016). It known as a vegetable and called “Sajina” in Bangladesh. Entire part of *M. oleifera* have been consumed by human but in some subtropical countries only pods are consumed as vegetable (e.g. Bangladesh). *M. oleifera* has less nutritional demand to grow, it can also be grown in dry and sandy

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soil although the yield depends on irrigation and fertilization (Foidl *et al.*, 2001). However, the literature demonstrates that the *M. oleifera* leaves have been included in the diets of Roman, Greek, Egyptian and Indian societies for the long time (Mahmood *et al.*, 2010) to maintain mental attentiveness and healthy skin (Dhakar *et al.*, 2011). The significant nutritional research on the *M. oleifera* plant has been conducted since of 1970s. The World Health Organization (WHO) has been promoted *M. oleifera* as a food supplement against malnutrition in developing countries (Rweyemamu *et al.*, 2015). It has been already recognized that the *M. oleifera* tree is one of the most underutilized tropical and subtropical crops although it has multidimensional application possibilities and functionalities as food, feed and medicine as well as fertilizer in the agriculture (Bashir *et al.*, 2016; Melo *et al.*, 2013). Furthermore, the *M. oleifera* tree has been advocated by the “Education Concerns for Hunger Organization” as a natural nutrition for the tropics, especially among infants and nursing mothers (Dixit *et al.*, 2016). The *M. oleifera* is highly nutritional (Agbankpe *et al.*, 2015) and the leaves of the Bangladeshi grown plants are especially rich in nutrients compared to other Asian countries (Foidl *et al.*, 2001). According to the Food and Agriculture Organization of the UN (FAO) and WHO the *M. oleifera* contain essential amino acids which are recommended for the children between the ages of two and five years (Foidl *et al.*, 2001; Barta, 2011). Dried *M. oleifera* leaf powder provides an average amount of (19.2mg/100g) fibre content, high calcium level and is low in fat (Siyanbola *et al.*, 2015). Also, contain higher amounts of vitamins A and C, minerals (e.g. calcium, sodium, potassium) and protein compared to other available foods (Mahmood *et al.*, 2010).

All about *M. oleifera*

There are different parts of *M. oleifera* available which are rich in nutritional content and various functionalities for diverse applications (Mune *et al.*, 2016).

Leaves: *M. oleifera* leaves are highly nutritious and it contains different minerals, vitamins, proteins & antioxidant etc. as well as various functionalities including anti-oxidant, anti-diabetics, anti-cancer and anti-microbial activities.

Flowers: *M. oleifera* flowers act as anti-arthritic agents and Hypocholesterolemic agent. It also contains amino acids, minerals, fiber etc. *M. oleifera* flowers are used as traditional vegetables and tea; it also can be applied in food fortification (Oyeyinka *et al.*, 2016).

Pods: *M. oleifera* pods act against diarrhea and liver problems etc. *Moringa* pods are contains ash, protein, fiber and fatty acids etc. It also is being used as traditional vegetables.






Seeds: *M. oleifera* seeds are acting as coagulating, anti-bacterial and anti-inflammatory agents. It can also have applied in water purification also as fertilizer in agriculture.

Root: *M. oleifera* root is acting as anti-ulcer, anti-bacterial, anti-inflammatory agents and organic piscicide. Root extracts can be used as preservative and condiments. It can also apply in sustainable aquaculture (Kamble *et al.*, 2014).

Nutritional Content

M. oleifera has nutritional potential because the leaves contain high amounts of energy, nutrients, phenolic constituents and flavonoids, which represent a good source of natural antioxidants (Masurekar *et al.*, 2015). Furthermore, the *M. oleifera* is full of nutrients (Table 1), for example the leaves (minerals, vitamins, protein, fibre and

Table 1: Comparison of dried *M. oleifera* leaf and foods

Foods	100gm dried <i>M. Oleifera</i> Leaf
	10 times than the Vitamin A of Carrot
	12 times than the Vitamin C of Orange
	17 times than the Calcium of Milk
	15 times than the Potassium of Banana
	25 times than the Iron of Spinach

antioxidants), flowers (amino acids, vitamins and protein), pods (protein, fibre, ash and fatty acids), seeds (vitamin, minerals, protein, amino acids and antioxidants), and finally roots (minerals and alkaloids) contain adequate amount of nutrients respectively (Mune *et al.*, 2016).

Functionalities and Applications

Entire parts of *M. oleifera* has diverse functionalities (Table 2) including antibacterial, antimicrobial, antioxidant, anti-diabetic and anti-inflammatory as well as numerous applications in food process industries also in traditional consumption since 19th century in different territory of the globe (Dixit *et al.*, 2016).

Table 2: Functionalities and application of entire *M. oleifera* tree

Parts of <i>M. oleifera</i>	Functionalities	Applications
Leaves	Anti-microbial Anti-diabetic Anti-oxidant	Food supplement Animal feed Fertilizer (green)
Flowers	Act as: Anti-arthritis agents Hypocholesterolemic	Food fortification Use as traditional food (vegetable) Tea
Pods	Act against: Diarrhea Liver problems	Use as traditional food (vegetable)
Seeds	Coagulation Anti-bacterial Anti-inflammatory	Water purification Fertilizer (oil cake) Oil used in cosmetics
Root	Anti-Ulcer Anti-inflammatory	Preservative Condiments Used in aquaculture

Table 3: Availability of entire elements of *M. oleifera* tree in tropics

Parts of <i>M. oleifera</i>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leaves	X	X	X	X	X	X	X	X	X	X	X	X
Flowers				X	X	X	X	X				
Pods	X	X	X	X	X	X	X	X	X	X	X	X
Seeds	X	X	X	X					X	X	X	X

Availability

Some elements of the *M. oleifera* trees are available entire years in tropical and subtropical countries (Melo *et al.*, 2013). For example, leaves and pods are available whole year, flowers in spring and summer and seeds in autumn and winter (Table 3).

Conclusions

The *M. oleifera* has been scientifically recognized as a super food for its multidimensional activities, especially in the tropical and subtropical region. On the other hand, *M. oleifera* being mostly discussed topic as an underutilized plant, although it has various functionalities. This review research delivers the key indications and a justified background for the future agricultural research which could lead the sustainable economic development.

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