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SHORT COMMUNICATION

Moringa oleifera L. – An underutilized tree with macronutrients for human health

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Abstract

Moringa oleifera Lam (Moringaceae) is a highly valued plant, distributed in many countries of the tropics and subtropics. Many parts of the *Moringa* are edible. Regional uses of the *Moringa* as food vary widely, and include: the immature seed pods, called "drumsticks", popular in Asia and Africa, leaves, particularly in South India and Africa, mature seeds, oil pressed from the mature seeds and roots. The objective of this study was to evaluate the potential of different morphological parts of this tree as food or feed. *Moringa* leaves, flowers, seedpods and seeds were collected from Michoacán State, Mexico and analyzed according for mineral contents. The leaves of *M. oleifera* and the residue obtained after the recovery of oil from seeds can be good sources of proteins for human and animal feeds.

Key words: Human health, *Moringa oleifera*, Products, Nutrition

Introduction

A large amount of people live in poverty, hence they do not have an adequate food supply. This situation results in a high index of malnutrition and other nutritional disabilities, a possible measure to overcome the malnutrition problem faced by population would be the cultivation of natural sources utilized in some countries and underutilized, in others, which could provide valuable nutrients, available to a large extent of population.

Moringa oleifera L. tree is one of the 14 species of the Moringaceae family which belong to the genus called *Moringa* the most widely known and utilized specie grown worldwide in the tropics and subtropics, native from the sub Himalayan region of North-West India, Pakistan, Bangladesh and Afghanistan, is also indigenous to other countries where is referred as the “drumstick tree” by describing the shape of its pods, or the “horseradish tree” due to the flavor of its root. *M. oleifera* is a small to medium sized tree of 7 to 12 m high, grows fast, drought resistant, not very demanding to climate or soil, with thick grey bark, edible green leaves and fragrant white flowers on spring season, tender pods, with 10 to12 seeds in each and roots, (Manzoor et al., 2007; Anwar and Bhanger, 2003). *M. oleifera* tree products, leaves, flowers, and immature pods represent a good option with balance amounts of macronutrients request for a good human health.

M. oleifera tree species is naturalized in other places worldwide; this multipurpose plant nowadays has been introduced as a potential orchard for tropical or arid regions. This tree is being described in many reports as ornamental, medical, therapeutic or with healing properties (Sánchez Machado et al., 2010). *M. oleifera* can be used as feedstuff for cattle, goats and lambs (Manzor et al., 2007). The fat from the seeds is used as vegetable oil, for cooking which possess resistance to oxidative degradation, the anti-fungal activity of the extract, and the protective action to the toxic effects of arsenic element have been investigated as well, also cosmetic uses of the oil extracted from the seeds are reported (Sánchez Machado et al., 2010). As a foodstuff to cook in different dishes is common in India but their nutritional value is not considered due to lack of information (Chuang et al., 2007; Gupta et al., 2007; Reyes et al., 2006; Ben Salem and Makkar, 2009).

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Most of the research on the chemical characteristics of the *M. oleifera* tree, are mainly focused on the oil from the seeds due to the antioxidant properties but very little is associated to the nutritional value of other edible products of the plant as a traditional important food commodity to improve economic and health condition of population (Ogbunugafor et al., 2011; Fugile, 2001, FAO, 2002). Although leaves, fruit, flowers and immature pods of the tree are used as a nutritional vegetable in some places like India, Pakistan and Philippines countries, where the tree is native (Anwar et al., 2005).

The objective of this research was to determine the chemical composition of macronutrients in leaves, flowers, pods, and seeds from *M. oleifera* tree.

Material and Methods

Sampling

The experimental trials were conducted in a *M. oleifera* cultivar of 18 ha at the San Jeronimo Riva Palacio locality of the San Lucas municipality in the subtropical central west region of the Michoacán State in Mexico where it is also known as "perla" Figure 1. Average rainfall 906.5 mm per year and temperature ranged from 20.2°C to 35.3°C (e-local 2012).

Samples were manually collected from 10 different trees randomly selected during the year of 2011. Tender green leaves and pods on March, June, October and December; flowers on April; seeds on March, May, September and December were harvested for analysis. Samples were harvested at the beginning mid-point and at the end of each month mentioned to ensure the reliability of data, leaves, flowers, pods and seeds (Figure 2). Seeds removed from pods and with the other sun dried samples were transported in plastic bags and kept under cool dry storage conditions until analyzed (Greenfield and Southgate, 2003).

Chemical analysis

Products were washed under running tap water and rinsed with distilled water, to proceed with the analytical performance of the samples according AOAC (1995) techniques.

Moisture was determined, by oven-dried at 60°C for 24 h; sample was ground to a fine powder and pass through a 60 meshes sieve to proceed with the other analysis. Ash was obtained by incinerating at 650°C in a muffle furnace for 6 h to a constant weight. Lipids determined by the semi continuous solvent extraction process with petroleum ether at boiling point for 6 h using a soxhlet extractor for 10 hs. Petroleum ether was removed by evaporation. Crude fiber determined by acid hydrolysis followed by alkaline hydrolysis. Total carbohydrates were calculated by difference [100-(Protein+lipids+ash+crudefibre)]. Protein content was determined according to the kjeldahl method, multiplying the total nitrogen obtained by 6.25. All determinations were done in triplicate (AOAC, 1995).

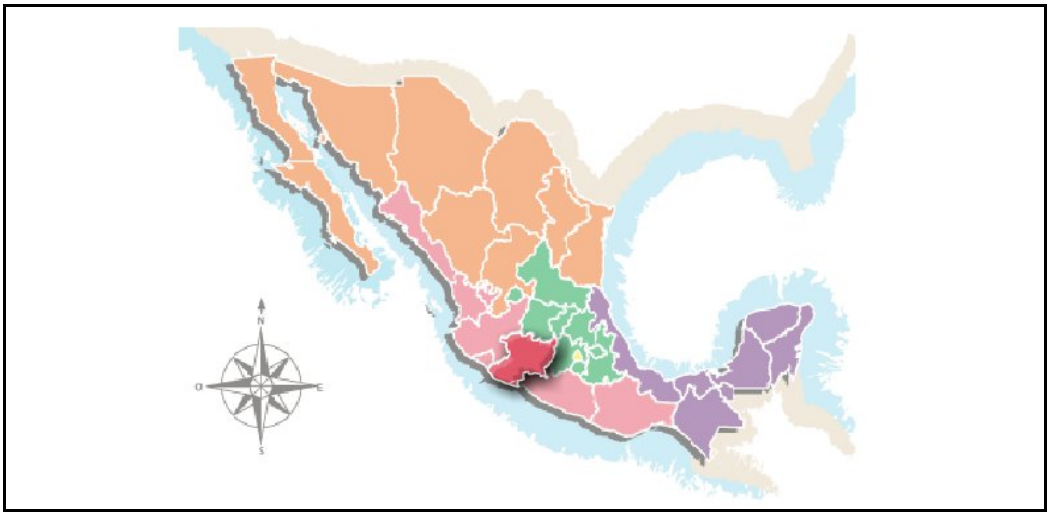

Figure 1. Map of México, red color Michoacan state (e-local 2012).

Figure 2. Images of *Moringaoleifera*products A)leaves, C) flowers, B) pods and D) seeds.

Results and Discussion

M. oleifera tree wild plant in many countries all over the world, is in some places underutilized however cultivars are important to be used in nutritional programs to combat malnutrition and to improve alimentary security of the rural population in different regions of the world. This research focused to analyse the macronutrients and nutritional value of the leaves, flowers, tender pods, edible as vegetables, and seeds rich in oil. There is a little information regarding nutritional composition of edible parts of the plant therefore this study will provide information to be used for population daily diets.

Leaves and pods are available all year round, flowers in spring and summer and seeds in autumn and winter (Table 1).

Table 1. Year availability of *Moringa oleifera* L. products

Products	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

X=month availability

Table 2. Moisture content of *Moringaoleifera* L. products %.

	Leaves	Flowers	Pods	Seeds
Water	5.99 ±0.5	6.98 ±0.4	90.86 ±0.9	3.11 ±0.2
Dry matter	94.01	93.02	9.14	96.89

Dry matter obtained by difference

Table3. Chemical composition of the edible products of *Moringa oleifera* L., g/100g dry basis.

Stems	Proteins	Lipids	Minerals	Fiber	Soluble Carbohydrates
Leaves	22.75± 1.2	4.65±0.3	13.02±0.9	7.92±1.0	51.66
Flowers	24.53±1.1	6.01±0.3	6.21±0.7	5.07±0.4	58.08
Pods	12.36±0.3	0.94±0.1	13.40±0.2	22.57±1.2	50.73
Seeds	32.19±1.3	32.40±1.2	5.58±0.5	15.87±0.3	15.96

M± S.D. mean ± standard deviation,

Crude protein=N(%) X 6.25,

Carbohydrate obtained by difference

The moisture of the edible parts of *M. oleifera* plant are shown in Table 2, water content is high in pods, in leaves and flowers is similar, seeds present the lowest value.

The macronutrients sources of products of *M. oleifera* plant in dry basis are mention in Table 3; protein found in cells and tissues involved in metabolic processes and essential for human nutrition is the high, in seeds, follow by flowers and leaves but low in pods. Regarding lipids, classified as essential due to the presence of double bonds which humans do not possess enzymes able to synthesize in n-3 and n-6 fatty acids, seeds are much higher in fat but in the other products are similar. Proteins in seeds are higher than human requested, nevertheless excess of amino acids from proteins by deamination are used as energy resource Pods are low in proteins, almost without lipids but rich in minerals not identify individual fiber and nonstructural carbohydrates source of energy.

M. oleifera macronutrient composition from edible parts of the plant might vary according biotic and abiotic conditions of the environment as well as maturity of them. The data obtained in this study could not coincide with others reported before due to difference in soil, weather and maturity of the plant (Sanchez–Machado et al., 2010). The chemical composition of plant edible parts represents a good source of macronutrients essential for human nutrition with a well balance of underutilized nutrients. Profile of amino acids, fatty acids and minerals will be done in future. Production and consumption of all the parts of the plant could have social and economic benefits for the population of countries where this tree is cultivated due to the fast growth and high tolerance to environment conditions (Hsu, 2006).

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