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# Nutritional Potentials of *Moringa olifera* Leaves in Uttar Pradesh, India

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## ABSTRACT

*Moringa olifera* or the horseradish tree, also known as saijhan, sajna, benzolive, drumstick tree, kelor or marango, is a large tree indigenous to the India and neighbouring countries like Bangladesh, Afghanistan and Pakistan. It is known as one of the world's most useful trees. Its leaves are used in Indian foods fresh as salads, cooked or stored as dried powder for long periods with minimum loss of nutrients. Leaves of *Moringa olifera* are also used for treatment of inflammatory conditions, paralysis, hypertension, athlete's foot and tinea. It acts as galactogogue, rubefacient, an antidote, antiscorbutic, stimulant and diuretic. The study was undertaken to evaluate the proximate and elemental analysis of the leaves of *Moringa olifera*. The proximate analyses viz., crude protein, crude fibre, total ash, nitrogen free extract, cellulose, hemicelluloses and lignin etc were carried out using standard protocol while mineral analysis was done using Atomic Absorption Spectrophotometer (AAS). The proximate analysis of the leaves of *Moringa olifera* showed that it contained moisture 72.39%, ether extract 2.525%, crude protein 14.125%, crude fibre 23.09%, total ash 9.15%, nitrogen free extract 51.11%, cellulose 11.00%, hemicellulose 10.24% and lignin 2.41%. The mineral analysis of the leaves showed that they contain the following essential minerals; calcium (199.23 ppm), phosphorous (34.81 ppm), iron (111.058 ppm), copper (8.733 ppm), zinc (69.342 ppm) and manganese (72.242 ppm). The study revealed that *Moringa olifera* leaves to be a potential source of essential nutrients and minerals especially calcium and iron for man as well as animals and could be utilized to improve growth performance and health benefits.

**Key words:** Proximate analysis, mineral analysis, moringa olifera, health

## INTRODUCTION

Since a long time, man and animals depend on nature in terms of food, feed and nutrients, shelter as well as medicines (Mahima *et al*., 2012). Inspite of development of modern medicine, rural or poor people are still mainly depends on herbal or ayurvedic medicines (Cui *et al*., 2013). The uses of herbal plants as health promoters are gaining increasing attention in both man as well as animals (Upadhya *et al*., 2012; Hashemi and Davoodi, 2012; Mosihuzzaman, 2012; Mahima *et al*., 2013a). Out of 21,000 medicinal plants listed by the World Health Organization (WHO), 2500 plant species are native to India, thus called as 'medicinal garden of the world'

(Mahima *et al*., 2012, 2014; Dhama *et al*., 2013). Herbal medicine may be obtained from any part of plant but commonly from leaves, roots, bark, flowers and seeds. Phytomedicine plays a key role in traditional medicines for safeguarding livestock health and production (Dhama *et al*., 2013; Rahal *et al*., 2014). Therefore, their recognition in terms of clinical, pharmaceutical and economic value is rapidly growing (WHO, 2005). *Moringa olifera* or the horseradish tree also known as saijhan, sajna, benzolive, drumstick tree, kelor or marango, is a large tree indigenous to the India and neighbouring countries like Bangladesh, Afghanistan and Pakistan. It is known as one of the world's most useful trees. Its leaves are used in Indian foods fresh as salads, cooked, or stored as dried powder for long periods with minimum loss of nutrients. Leaves of *Moringa olifera* are also used for treatment of inflammatory conditions, paralysis, hypertension, athlete's foot and tinea. It acts as galactogogue, rubefacient, an antidote, antiscorbutic, stimulant and diuretic. In order to contribute to this growing knowledge on this ethano-veterinary medicine, the present study was conducted to analyze the proximate and mineral constituents of leaves of *Moringa olifera*.

## MATERIALS AND METHODS

**Plant materials:** Fresh samples of leaves from healthy plants (Fig. 1) were plucked from *Moringa* tree growing in the premises of Uttar Pradesh Pandit Deen Dayal Upadhayay Pashu Chikitsa Vigyan Vishvidhyalaya Evum Go-Anusandhan Sansthan (DUVASU), Mathura, India. The leaves were confirmed and identified a plant taxonomist. All the plants were packed in kraft paper and prepared a herbarium. The leaves were washed and air dried in the laboratory for two weeks and then grounded with mixer grinder and sieved with a mesh of size 0.5 mm and stored in clean air tight containers at room temperature for further analysis. Table 1 present the various details viz., local names, parts used, active principles and status of *Moringa olifera* plant.

Table 1: Plant collected for the study and pattern of local use

| Species name | Family name | Local name | Part used | Active principles | Status |
|---|---|---|---|---|---|
| *Moringa olifera* | Moringaceae | Saijhan, Shajmah, Shajna, Segra, Sanjna, Saijna, Shajna | Fruits and leaves | Pterygospermin, moringine, moringinine spirochin, behenic acid, moringic acid, niazinin A and B, niazimicin, campesterol, stigmasterol, beta sitosterol and amino acids | Wild/cultivated |


Fig. 1(a-b): *Moringa olifera* plant

**Proximate analyses:** Proximate analyses including moisture contents, Crude Protein (CP), Crude Fibre (CF), Ether Extract (EE), Nitrogen Free Extract (NFE), total ash and acid insoluble ash contents of *Moringa olifera* leaves of were determined as per the standard protocols (AOAC, 1996), while fibre fractions such as Nutrient Detergent Fibre (NDF), Acid Detergent Fibre (ADF), Acid Detergent Lignin (ADL), hemicellulose and cellulose were conducted as per the protocol given by Van Soest *et al.* (1991).

**Moisture content (moisture percentage):** Moisture contents of leaves of *Moringa olifera* were determined by hot air oven method. The percentage of dry matter was measured using electronic balances and calculations of moisture content were performed with the following equation:

$$\text{Moisture (\%)} = \frac{\text{Weight of sample before drying} - \text{Weight of sample after drying}}{\text{Weight of sample before drying}} \times 100$$

**Ash content:** It was also determined by oven method. About 10 g of the sample were added to a preweighed crucible and placed in a muffle furnace at 550°C for 4 h, cooled in desiccators and reweighed. The ash content was calculated with the following equation:

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

**Acid Insoluble Ash (AIA):** AIA was estimated by dissolving inorganic portion of total ash mainly represent sand and silica.

$$\text{AIA (\%)} = \frac{\text{Weight of acid insoluble ash}}{\text{Weight of sample}} \times 100$$

**Fat content (ether extract):** For determination of fat contents, Soxhlet method was used. About 150 mL of petroleum ether was poured over 5 g of plant extracts in an extraction thimble. The thimble was placed in an extractor covering anti-bumping cotton, fixed the extractor to a preweighed oil flask and placed in the soxhlet for 8 h after which the oil flask was dried in an oven, cooled and reweighed. The fat content of each sample was calculated as below:

$$\text{Crude fat (\%)} = \frac{\text{(Weight of dried oil flask + fat) - (Weight of dried oil flask + granules)}}{\text{Weight of sample}} \times 100$$

**Protein Content (CP):** Kjeldahl method was used for crude protein estimation. Nitrogen content was calculated as follows:

$$\text{CP (\%)} = \frac{\text{Volume (mL) made out of digested sample} \times (\text{titrant of N/7 } H_2SO_4 \text{ for sample (mL)} - \text{titrant for blank (mL)}) \times 0.002 \times 6.25}{\text{Aliquot taken for distillation (\%)} \times \text{Weight of sample}} \times 100$$

The crude protein content of samples were calculated as follows:

$$\text{Protein (\%)} = \text{N} \times 6{:}25 \text{ (protein factor specific to sample)}$$

**Crude Fibre (CF):** Fat free samples were used for determination of Crude fiber by using the following equation:

$$CF\ (\%) = \frac{(\text{Crucible + Residue weight left after acid and alkali digestion}) - (\text{Crucible + Ash weight})}{\text{Sample weight}} \times 100$$

**Nitrogen Free Extract (NFE):** It was calculated by difference between actual sample weight and sum of weight of moisture, EE, CP, CF and ash.

$$NFE\ (\%) = 100 - CP\ (\%) + EE\ (\%) + CF\ (\%) + \text{Total ash}\ (\%) + \text{Moisture}\ (\%)$$

**Fibre fractions:** About 1 g air dried sample was taken into a beaker of the refluxing apparatus and refluxed with neutral detergent solution for 60 min, then filtered in preweighed sintered glass crucibles, dried and reweighed.

$$NDF\ (\%) = \frac{(\text{Crucible + cell wall constituents}) - (\text{Crucible weight})}{\text{Sample weight}} \times 100$$

For the estimation of ADF, procedure was same as NDF but the solution used was acid detergent solution. Hemicellulose content was calculated by difference of NDF and ADF. The ADF residue was treated with 72% $H_2SO_4$ and ashing of the residue determined the crude lignin (ADL).

$$ADL\ (\%) = \frac{(\text{Crucible +lignin}) - (\text{Crucible + ash weight})}{\text{Sample weight}}$$

Cellulose was calculated by the difference of ADF and ADL.

**Mineral analysis:** Mineral analysis of calcium, iron, zinc, copper and manganese were performed as per the method described by Association of Official Analytical Chemists methods (AOAC, 1990) using the flame system of the Atomic Absorption Spectrophotometry (AAS), (Perkin elmer). Moringa leaves were ashed at 550°C overnight and the ash 2 g was dissolved in 10 mL of a mixture of nitric acid, sulphuric and perchloric acid (4:1:1 v/v) until a clear solution was obtained. The digest was allowed to cool and then transferred into a 100 mL volumetric flask and made up to mark with de ionized water. Phosphorous content was estimated by titremetric method (Chen *et al.*, 1956).

**Statistical analysis:** The study was repeated three times and data obtained were presented with their mean±standard error using Microsoft excel software.

## RESULTS AND DISCUSSION

The proximate analysis data of *Moringa olifera* leaves were given in Table 2. From the Table 2, it can be seen that the leaves of *Moringa olifera* contained moisture 72.39%, ether extract 2.525%, crude protein 14.125%, crude fibre 23.09%, total ash 9.15%, nitrogen free extract 51.11%, cellulose 11.00%, hemicellulose 10.24% and lignin 2.41%.

In the present study, the crude protein was found 14.125%. Similar to our study, Ogbe and Affiku (2012) reported the crude protein value of *Moringa olifera* leaves as 17.01% while the other previous studies conducted by Olugbemi *et al.* (2010) and Mutayoba *et al.* (2011) reported

Table 2: Proximate analysis of *Moringa olifera* leaves

| Parameters | Percentage (%) (w/w) |
|---|---|
| Moisture | 72.390±5.316 |
| Ether extract | 2.525±0.046 |
| Crude protein | 14.125±1.428 |
| Total ash | 9.150±1.042 |
| Crude fibre | 23.090±1.824 |
| Nitrogen free extract | 51.110±3.124 |
| Hemicellulose | 10.240±0.472 |
| Cellulose | 11.000±0.272 |
| Lignin | 2.410±0.084 |

All values are expressed on dry matter basis except moisture

Table 3: Concentration of macro and micro nutrients of *Moringa olifera* leaves

| Constituents | Parts per million (ppm) |
|---|---|
| Calcium | 199.230±8.458 |
| Phosphorous | 34.810±4.248 |
| Iron | 111.058±9.547 |
| Copper | 8.733±1.068 |
| Zinc | 69.342±5.012 |
| Manganese | 72.242±6.812 |

Values are expressed as mean±SE

the higher value of crude protein i.e., 27.44 and 30.65% in leaves of *Moringa olifera*. Similarly, other contents like crude fibre, Ether extract and ash contents were also higher in the studies conducted by Olugbemi *et al.* (2010) and Mutayoba *et al.* (2011). These differences might be due to geographical variations and developmental stage of *Moringa olifera* plant.

The mineral analysis of the *Moringa olifera* leaves were shown in Table 3. From the Table 3, it can be seen that leaves of *Moringa olifera* contained calcium (199.23 ppm), phosphorous (34.81 ppm), iron (111.058 ppm), copper (8.733 ppm), zinc (69.342 ppm) and manganese (72.242 ppm).

In the present study, mineral contents of *Moringa olifera* leaves were quite comparable with the previous studies. The present study showed that higher value of copper (8.733), zinc (69.342) and manganese (72.242) than the previous reports Mutayoba *et al.* (2011), who reported 5.73, 21.70 and 57.34 ppm values of copper, zinc and manganese, respectively in leaves of *Moringa olifera* plant. Contrary to the findings of present study, Mutayoba *et al.* (2011) reported higher value of calcium, phosphorous and iron. These differences in the mineral composition of *Moringa olifera* leaves might be due to difference in geographical locality, stage of plant at the time of plucking of leaves, etc (Ogbe and Affiku, 2012).

Minerals are very much required for maintaining the routine activities of body such as muscular growth and activity, bone development, cellular and biochemical activities, immunological protection from pathogens etc. (Mahima *et al.*, 2013b; Rahal *et al.*, 2014). Similar to our findings, previous studies also recorded that proximate and minral analyses of *Moringa olifera* leaves showed that leaves has good amount of nutrients and can be used for supplementation in diet of man and animals (Oduro *et al.*, 2008; Fuglie, 2001). However, these nutrients are exclusively having medicinal property but may be helpful in prevention of diseases particularly related to malnutrition or deficiency diseases. The presence of essential nutrients and minerals implies *Moringa oleifera*

leaves could be utilized as a nutritionally valuable and healthy ingredient for animals. These nutrients may not be strictly medicinal but could be valuable in preventing diseases that are related to malnutrition.

## CONCLUSION

The present study has provided some useful information on the proximate and elemental analysis of *Moringa leaves* grown in western parts of Uttar Pradesh, India. There are indications that these are good sources of nutrients. Since, it is a potential leaf source of food that is suitable for fortification of foods and their use as nutritional supplements is highly promising. Furthermore, a thorough research would be helpful to further investigate the anti-nutritive, enzymatic and molecular effect on animal health of this plant.

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