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Research Article

Chemical and Phytochemical Properties of Fresh and Dried Moringa Oliferiea (PKM-1) Leaf Powder

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Abstract

The aim of the present study was to evaluate the chemical and phytochemical properties of fresh and dried M. oleifera (PKM-1) leaf powder. Dried moringa leaves powder was prepared using cabinet dryer at 60-70 ^{0}C for 6-8 hrs. and grind into fine powder. Proximate, mineral, phytochemical properties were carried out on the leaf samples. Fresh and dried moringa leaf powder exhibited moisture levels varying from 72.83 to 7.43%, ether extract from 4.59 to 9.53%, crude fibre from 5.75 to 22.03%, total minerals from 4.59 to 9.53%, crude protein from 5.29 to 20.42%, and carbohydrates from 10.57 to 50.16%. The predominant mineral elements in the fresh and dried moringa leaf powder were Ca, Mg, K, Fe, Cu, 475.33, 40.33, 328.33, 7.63, 0.15 and 20.32, 387.83, 1545.33, 26.69, 0.83 mg/100g respectably. The phytochemical properties revealed that the ascorbic acid and total phenols of fresh and dried moringa leaves ranged from (231.28 to 106.28) and (62.32 to 253.00) mg/100 g, respectively. Antioxidant activities were found to be best in dried moringa leaves 9489.80 % activity. We concluded that M. oleifera samples could be employed in edible and commercial applications.

Keywords: Moringa oleifera, chemical composition, micro nutrient, antioxidant activity, phenolic compounds and products

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Introduction

Moringaoleifera is the most widely cultivated species of a monogeneric family. The Moringa this is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan [1]. It had spread to most part of Asia, nearly the whole of Africa, South America, southern part of North America and some pockets in Europe [1, 2]. It is originated initially in the Northern part of India some 5000 years back and soon moved into the Southern parts as well. It is a sub-tropical species that is known by different regional names as benzolive, drumstick tree, kelor, marango, mulangay, nébéday, saijhan, mooringai and sajna. Presently, one of the most important trends in food and pharmaceutical industries is the growing demand for valuable natural sources of nutritional compounds. The leaves are also free of anti-nutritive factors such as phenols, tannins and saponins. It is a multipurpose and exceptionally nutritious vegetable tree with a variety of potential uses.

It has very high nutritional properties that would be useful as a food supplement, especially in those relegated communities. It is useful not only for human beings but also for animals and also in various industrial applications, it contains acetone which can be prepared into herbal formulation which is an effective anti-malaria bio agent [3]. Such trees have the potential to be a source of new drugs [4]. It is also an effective water clarifier using the seed, thus providing millions of people with clean drinking water [5]. The micro-nutrient content is even more in dried leaves; (ten times the vitamin A of carrots), (17 times the calcium of milk), (15 times the potassium of bananas), (25 times the iron of spinach) and (9 times the protein of yogurt) [6].

Moringaoleifera is not only an important source of naturally occurring antioxidant [7].It is also an important Indian medicinal plant and an important ingredient of the Indian cuisine. It contains high concentrations of ascorbic acid, estrogenic substances and beta-sitosterol, iron, calcium, phosphorus, copper, vitamins A, B and C, alpha-tocopherol, riboflavin, nicotinic acid, pyridoxine, beta-carotene, protein, and in particular essential amino acids such as methionine, cystine, tryptophan and lysine. vitamin C, which fights a host of illnesses including colds and flu; vitamin A, which acts as a shield against eye disease, skin disease, heart ailments, diarrhea, and many other diseases; Calcium, which builds strong bones and teeth and helps prevent osteoporosis; Potassium, which is essential for the functioning of the brain and nerves. Another important point is that Moringa leaves contain all of the essential amino acids in a good proportion, which are the building blocks of proteins. These leaves could be a great boon to people

who do not get protein from meat. Moringa even contains argenine and histidine two amino acids especially important for infants, who are unable to make enough protein for their growth requirements [8, 9]. The drumstick leaves an important dietary supplement [10]. It is also having antibacterial, anticancer and purgative effect [11, 12]. Crude extracts showed antioxidant properties as revealed by the following determinations: The Total Antioxidant Activity (TAA), 2,2-diphenyl-2-picryl hydrazyl (DPPH) radical scavenging activity and reducing power [13].

Therefore it is necessary to increase the utilization of Moringa leaves consumption by the different communities. It should be consumed either fresh or dry. Dried leaves can be stored for a long time and can be used regularly. Many companies across the world manufacturing various products of *Moringa* leaves such as *Moringa* Tea, *Moringa* Tablets, *Moringa* Capsules, *Moringa* leaf Powder, *Moringa* Soaps and *Moringa* Face wash. So it is necessary to hygienically drying and processing of *Moringa* leaves for further uses.

Materials and Methods

Raw material

Fresh moringa leaf (PKM-1) was procured from the department of Horticulture, Sam Higginbottom University of Agriculture Technology and Science (SHUATS), Allahabad. The fresh leaf was cleaned, dried (in cabinet dryer at 60-70^{0}C for 6-8 hrs.) and grind into fine powder. This powder was packaged in air tight container till further use. All the chemicals used in the present study were purchased from S.D. Fine Chemicals Ltd. Mumbai, India.

Proximate Composition

The methods of the Association of Official Analytical Chemists [14] were used for proximate analysis. A Moringa sample was used for determination of moisture content by weighing in crucible and drying in oven at 105^{0}C, until a constant weight was obtained. Determination of ash content was done by muffle Furness at 550^{0}C for 3h. The Kjeldah method was used to determine the protein content. The crude fiber content of the samples was determined by digestion method and the fat was done by Soxlhet extraction method. All determinations were done in triplicate.

Moringa fresh and powder sample was weighed into a clean ceramic crucible. A blank was prepared with empty crucible. The crucible was placed in a muffle furnace at 500 ^{0}C for 4 hr. The sample was allowed to cool down in the oven after which it was removed carefully. The ashed sample was poured into already labeled 50 ml centrifuge tube. The crucible was rinsed with 5 ml of distilled water into the centrifuge tube. The crucible was rinsed again with 5 ml of aquaregia. This was repeated to make a total volume of 20 ml. The sample was mixed properly and centrifuged (IEC Centra GP8) for 10 min at 301.86 g. The supernatant was decanted into clean vials for mineral determination. The absorbance was read on atomic absorption spectrophotometer at different wavelength for each mineral element (Zn-213.9 nm, Ca-422.7nm, Fe-248.3nm, Mg-285.2nm, Na-589nm and K-766.5 nm) [15].

Bioactive compounds

Ascorbic acid

The ascorbic acid content was estimated by visual titration method using 2,4-Dichloro-phenol-Indophenol dye method [14, 16]. Results were expressed as milligrams of ascorbic acid/100 g fresh weight.

$$\text{Ascorbic acid (mg/100gm)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made} \times 100}{\text{Aliquot taken} \times \text{sample weight}}$$

Total phenolic content

Total phenolics were estimated according to AOAC [14], by using photometric method with Folin reagent. The values were reported as mg of gallic acid equivalent (GAE) per 100 gram with reference to gallic acid standard curve.

$$\text{Total Phenols (mg/100 gm)} = \frac{\text{Conc.of phenols from graph} \times \text{Final volume} \times 100}{\text{Wt.of sample} \times \text{aliquate taken}}$$

Antioxidant activity

Antioxidant activity was determined according to the method described by [17, 18] as follows: Five grams of sample

was extracted by 100 ml. 80 % methanol. Different concentrations (0.5 to 1 ml) were used to determine the antioxidant activity using 2,2 – diphenyl – 1 – picryl hydroxyl (DPPH).

$$\text{Radical scavenging activity (\%)} = \frac{Absorbance\ of\ control\ (0\ minute) - Absorbance\ of\ sample\ (30\ minute)}{Absorbance\ of\ control\ (0\ minute)} \times 100$$

Statistical analysis

Statistical analysis all the experiments were conducted in triplicate and the mean and standard deviation were calculated using MS Excel software. The data were subjected to one-way analysis of variance (ANOVA).

Result and Discussion

Chemical Analysis

The proximate analyses of M. oleifera (PKM-1) play a crucial role in assessing its nutritional significance (<0.05). The chemical composition of fresh moringa leaves and dried moringa leaf powder for their moisture content, total minerals, crude protein, ether extract, total carbohydrates and crude fiber are shown in **Table 1**. The results of the proximate composition (Table 1) revealed that dried leaves contained high amounts of total minerals, crude protein, ether extract, total carbohydrates and crude fiber, 9.53%, 20.42%, 12.47%, 50.16% and 22.03% respectively and minimum amount of moistute content (7.43%) [10, 19, 20]. On the other hand, Fresh moringa leaves contained, lower contents than those reported for dried leaves recorded in the same aforementioned Table 1.

The percentages of proteins, moisture, fat, carbohydrates of fresh and dried leaves were 11.9, 73.9, 1.1 and 10.6 and 27.2, 5.9, 17.1 and 38.6%, respectively [21]. Finally, through data tabulated in Table 1, it could be clearly concluded that fresh Moringa leaves and dried moringa leaves powder are rich to great extent in many significant components such as protein and carbohydrates. Carbohydrates are the principal sources of energy. Other studies have reported variable protein contents ranging between 16, 22.42, 23.27, 27.4 and 40% [22-27].

Table 1 Chemical composition of fresh and dried moringa (M. oleifera PKM-1) leaf powder (n=3)

Perameters	FML	DMLP
Moisture (%)	72.83^{a} (1.36)	7.43^{b} (0.87)
Total minerals (%)	4.59^{a} (0.42)	9.53^{a} (0.51)
Crude Protein (%)	5.29^{a} (0.39)	20.42^{b} (1.01)
Ether extract (%)	6.72^{a} (0.31)	12.47^{a} (0.44)
Carbohydrates (%)	10.57^{a} (0.86)	50.16^{b} (1.66)
Crude fibre (%)	5.75^{a} (0.39)	22.03^{b} (0.42)

Mean values in the same column followed by different superscripts differ significantly (P < 0.05).
The values in brackets are the standard deviation from the mean values.
FML-Fresh Moringa Leaves
DMLP-Dry Moringa Leaves Powder

Elemental Analysis

Generally, the micro nutrient of any plant depends up on the Different physical parameter of the soils contain a particular of mineral elements qualities and quantities whose bioavailability depends on soil properties (pH, clay and humid complex and mineralogy) [28]. The elements were determined by atomic absorption spectrophotometer at different wavelength atomic absorption of wet digestion of the dried sample with concentrated nitric acid in closed PTFE vessels using a microwave oven. These values fall within the ranges reported (**Table 2**, reference column). The elemental analysis of our samples revealed that high contents of Ca (2032 mg/100 g), Mg (387 mg/100 g), K (1545 mg/100 g), Fe (26.69 mg/100g) and Cu (0.83 mg/100g) were found in dried moringa leaf powder (Table 2). These values of M. oleifera samples found in Mekelle agree with those found in Burkina Faso and India [29, 30]. Also noticed that the minerals contents for the (Ca, Mg, K, Fe, and Cu) were 847.1, 151.3, 549.6, 17.5, 1.3 and 0.21 and 2098.1, 406.0, 1922.0, 28.3, and 0.73 mg / 100 g (DWB) in the fresh and dried Moringa oleifera leaves, respectively [21]. This sample could be recommended as a source of essential elements.

The results indicated that the Moringa oleifera is an important crop, which has high concentrations in energy releasing nutrients such as lipids and proteins, besides important minerals (Ca, K, Mg, P, Fe and Zn). As it was

mentioned for other aforementioned components in Moringa oleifera leaves, it has been also proved through chemical analysis that crop (Moringa oleifera) is also rich in many important minerals.

Table 2 Measured concentration in (mg/100 g) of trace element in the fresh and dried moringa (M. oleifera PKM-1) leaf powder (n=3)

Perameters	FML	DMLP
Calcium (mg/100g)	475.33^{a} (40.47)	2032.83^{b} (118.14)
Magnesium (mg/100g)	40.33^{a} (11.09)	387.83^{b} (63.02)
Potassium (mg/100g)	328.33^{a} (64.32)	1545.33^{b} (219.79)
Iron (mg/100g)	7.63^{a} (1.11)	26.69^{b} (5.47)
Copper (mg/100g)	0.15^{a} (0.07)	0.83^{a} (0.19)

Mean values in the same column followed by different superscripts differ significantly ($P < 0.05$).
The values in brackets are the standard deviation from the mean values.
FML-Fresh Moringa Leaves
DMLP-Dry Moringa Leaves Powder

Natural antioxidants and antioxidant activities

Concentrations of two natural antioxidants (Total phenolics and antioxidant vitamin C) and total antioxidant activity in fresh moringa leaves and dried moringa leaf powder are shown in **Table 3**. The results shown in Table 3 revealed that the ascorbic acid and total phenols of fresh and dried moringa leaves ranged from (231.28 to 106.28), (62.32 to 253.00) mg/100 g, respectively. Antioxidant activities of fresh and dried moringa leaves as determined by DPPH radical scavenging method are presented in Table 3. Radical scavenging activity of methanolic extracts of fresh and dried moringa leaf samples were in the range of 6207.80-9489.80 % activity respectively.

It could be observed that the fresh and dried Moringa leaves are rich sources for natural antioxidants and total antioxidant activity (Table 3). These results are in agreement with these stated by Compaore *et al.* [31]. However, from the aforementioned obtained data, it could be clearly concluded that fresh and dried Moringa leaf contained considerable contents of components possessing the property of antioxidant activity. That means that, Moringa worth to be as we mentioned before promising crop which could play an important role as one of the most significant defiance lines of human body against different diseases.

Table 3 Phytochemical analysis of fresh and dried moringa (M. oleifera PKM-1) leaves n=3

Perameters	FML	DMLP
Ascorbic acid (mg/100g)	231.28^{a} (3.97)	106.72^{b} (5.20)
Total phenols (mg/100g)	62.32^{a} (1.20)	253.00^{b} (10.79)
$TEAC^{2}$, µmol TE (% activity)	6207.80^{a} (37.67)	9489.80^{b} (310.24)

Mean values in the same column followed by different superscripts differ significantly ($P < 0.05$).
The values in brackets are the standard deviation from the mean values.
TEAC: Trolox equivalent antioxidant capacity, an antioxidant assay using ABTS radicals; TE: trolox equivalent
FML-Fresh Moringa Leaves
DMLP-Dry Moringa Leaves Powder

Conclusion

Increased vegetable utilization and consumption are critical to alleviate world-wide incidence of nutritional deficiencies. Diets rich in micronutrients and antioxidants are strongly recommended to ameliorate the effects of HIV/AIDS.

Finally, through all data concerning different compounds existing in Moringa oleifera (PKM-1), it could be clearly concluded that Moringa leaf is very rich in many important nutrients to human health such as lipids and proteins, significant minerals which means that this crop worth to be studied or investigated. Through the same study, it has been proved that it could be practically to utilize moringa leaves in producing very important and palatable

economic products such as moringa powder and moringa juice It is also recommended to expand the area cultivated with moringa in future.

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