Original article

Detecting and determining mineral elements content in *Moringa oleifera* leaves powder

Noor Elsham A. **Yousif** [1,*], Nafisa A. **Elgazali**[1], Shaza O. **Mustafa**[2], A. A. **Dafalla**[3]

1- Department of Chemistry, Faculty of Education, Shendi University, Shendi, Sudan,
[*]noorelsham76@gmail.com
2- Department of Biology, Faculty of Education, Nile Valley University, Atbara, Sudan
3- Department of Chemistry, Faculty of Science, Sudan University of Science and Technology, Khartoum, Sudan

Abstract

This study aims to detect and evaluate the concentrations of mineral elements in *Moringa oleifera* plant leaves powder. An inductively coupled plasma-mass spectrometry (ICP-MS) was used. 1.00g of ash sample digested with a nitric acid solution was analyzed. Likewise, 1.00g of the sample was transferred into the microwave digestion vessel and 10ml of 70% HNO_3 was added, then 1.0ml of 30% H_2O_2 was gently added and the compound was analyzed using ICP-MS. Results showed that *M. oleifera* leaves were rich in different mineral elements such as Ca, K, Cr, Fe and Zn. In conclusion, *M. oleifera* can be used as a vegetable and medicinal plant.

Keywords: *Moringa oleifera*, leaves powder, mineral elements.

Introduction

Plants are an important source of medicine; it has been estimated that up to 80% of people still rely primarily on traditional remedies such as herbs for their medicines [1]. *Moringa oleifera* leaves are highly nutritious; the young leaves are edible and are commonly cooked and eaten like spinach or used to make soups and salads. The most consuming part is the leaves because the needed nutrients are concentrated in the leaves [2]. The medicinal value of these plants is due to the presence of a variety of phytochemicals and their elemental composition. *M. oleifera* is used in practice in the treatment of various diseases and is available without a medical prescription, often in the form of an herbal infusion for everyday use. *M. oleifera* has nutritional potential because their leaves contain a high concentration of energy, nutrients, and minerals. Therefore, the therapeutic potential of this plant may be due to the presence of these constituents [3].

Previous studies indicated that *M. oleifera* leaves powder is rich with essential trace elements that have clinical property e.g. hyperglycemia may be associated with raised plasma chromium and increased urinary excretion, without reflecting tissue level. Chromium concentrations in urine, hair and other tissues or body fluids have also been reported not to reflect chromium status. The role of chromium supplementation was investigated in special subgroups of patients with diabetes [4]. Zinc plays an important role in the proliferation, differentiation, and metabolic function of mammalian cells. Mutations that activate H-Ras are oncogenic in most cells and lead to malignant transformation and this Ras

signaling pathway is inhibited by zinc [5]. Copper plays a very important role in metabolism largely because it allows many critical enzymes to function properly [6]. Iron is involved in the binding, transporting, and release of oxygen in higher animals [7]. Calcium is the most abundant mineral found in the human body. The majority is stored in the bones and teeth; the rest is stored in muscle tissue and blood. In addition to bone building and remodeling, calcium is also responsible for muscle contraction, central nervous function and hormone secretion. By providing abundant calcium, *M. oleifera* helps prevent: anemia, osteoporosis, bone weakness, muscle damage, Nerve damage and abnormal heartbeat and functioning [8]. *M. oleifera* leaves contain essential minerals elements. Examples of a few nutritional values of *M. oleifera*: 3 times the potassium of bananas, 4 times the calcium of milk [9]. When carefully dried, a gram of *M. oleifera* leaves contains 24 times the iron of spinach [10].

This study was conducted to detect and determine the concentrations of mineral elements in *M. oleifera* plant leaves powder purchased from Atbara market, River Nile State, Sudan.

Materials and methods

Moringa oleifera leaves were purchased from Atbara market, River Nile State, Sudan, and were air-dried and powdered. The material was protected from light until further analysis.

The method of the association of official analytical chemists [11] was used for proximate analysis. Whereas 5.00g of the plant leaves powder was used for the determination of moisture content by weighing in a crucible and drying in an oven at 105 ^{o}C until a constant weight was obtained. 1.00g of the powder was weighed into a clean ceramic crucible. A blank was prepared with an empty crucible. The crucible was placed in a muffle furnace at 500 ^{o}C for 4 hr. The sample was allowed to cool down in the oven after which it was removed carefully. The ashes sample was poured into an already labeled 50ml centrifuge tube. Ash was dissolved with 10.0 ml of HNO_3 0.1N solution, and deionized water was added to make the total volume of 50ml [12]. The supernatant was decanted into clean vials for mineral determination, using an inductively coupled plasma-mass spectrometry (ICP-MS).

Likewise, 1.00g (0.01g accuracy) of the plant leaves powder was transferred (20-mesh) into a microwave digestion vessel, and 10ml of 70% HNO_3 (specific gravity 1.42) was added. The vessel was gently swirled to allow tissues to contact the acid. The vessel was taken out of the microwave oven and carefully the cap under a fume hood was removed. Gently, 1.0ml of 30% H_2O_2 was added and let for about 5 minutes.

The vessel was rinsed three times to ensure that the material was quantitatively transferred to the funnel (making sure that it was filtered before the second and third additions), to make up to 100ml with deionized water. After thorough were mixed and were transferred an aliquot into a 60-ml Nalgene bottle for determination of calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), manganese (Mn), iron (Fe) and aluminum (Al) using inductively coupled plasma atomic emission spectrometry (ICP-AES). The weight and volume of each sample were entered and internal calibration and calculation were done with the blank subtracted [13].

Results and discussion

Results showed that *M. oleifera* leaves powder contains different mineral elements. When using the ICP, their concentrations (ppm) were decreased as Ca (46560), Mg (14140), K (12620), Al (1491), Fe (1401), Na (913), Si (526.00), Sr (113.30), Ti (71.65), Mn (61.69), Ba (14.78), Zn (13.76), Cu (13.43), Li (7.128), Mo (4.88), V (3.342), Cr (2.086), Ni (1.919), Pb (1.547) and Be (0.0207).

Likewise, when using the ICP with microwave digestion of plant tissue in an open vessel, the concentrations (ppm) of the mineral elements were decreased as Ca (54450), K (16370), Mg (16250), Al (14260), Si (1804), Fe (1402), Na (960.6), Sr (118.3), Mn (76.52), Ti (25.95), Zn (19.21), Ba (17.21), Cu (10.54), Pb (6.463), Mo (5.436), Li (4.190), V (3.022), Cr (2.484), Ni (2.081) and Be (0.0257).

Previous results concluded that *M. oleifera* could be employed in edible and commercial applications [3]. Heavy metals concentrations in this plant were found to be decreased; it is tea leaves had the highest average concentrations of As, Hg, Cr and Ni, while leaves capsules had the highest average concentrations of Cd, Pb, Cu, Fe, Al, and Mn. Moreover, the leaves powders had the highest average concentration of Zn [14]. A Neutron Activation Analysis (NAA) was used to determine the mineral content of this plant leaves found that it is rich in Ca, Mg, K, Zn, Fe and Cl. The plant also contains other minerals such as Cr, Br, Co and Al [15]. Results of the proximate and mineral analyses of the whole leaves extract revealed the presence of an appreciable amount of nutrients in the leaves of the plant, this is in line with some previous results [16,17]. This proves why leaves of this plant are used as a food supplement and essential for infants and nursing mothers [16,17]. Results indicate that *M. oleifera* leaves are a promising source of essential minerals [18]. The obtained results agreed with previous reports that the *Moringa* leaves are a very promising source for essential elements [18,19]. Leaves of the plant are rich in nutrients, and are very important for their medicinal value [20-22].

Compared with the results of existing studies, it shows that mineral composition in *M. oleifera* leaves varies depending on the location where the plant is grown.

In conclusion, the result showed that the *M. oleifera* leaves powder found in Atbara area, River Nile State has nutritional potentials because it is rich in essential mineral elements. Therefore, the therapeutic potential of this plant may be due to the presence of these constituents. The presence of macro and micro mineral elements in it is powder appears to be within permissible limits, this suggests that quality assurance of mineral elements are needed for plants intended for human consumption, which makes *M. oleifera* leaves a suitable food source to combat malnutrition.

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