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Concentrations of (Fe, Ni , Zn, Mn , Cr) in Moringa Oleifera collected from River Nile state

HASHIM GAD ELSEED
MOHAMMED HASHIM ALBASHIR
Department of Physics
Faculty of Education, Nile Valley University
Sudan
MUBARAK DIRAR
Department of Physics
Faculty of Science, Sudan University of Science and Technology
Sudan

Abstract:

The aim of the study was to assess the content of Fe, Ni , Zn, Mn, Cr in Moringa oleifera leaves collected from Ad-Damir , Atbarah, Shendi, Berber and Abu Hamed from River Nile State by X-ray fluorescence (EDXRF) spectrometer. The study showed that some metal content, the concentrations of Fe, Ni, Zn, Mn, Cr in M. oleifera leaves were found within permissible limits and normal ranges. Moriga samples might be safe for Fe, Ni , Zn, Mn, Cr.

Key words: Moringa oleifera , XRF, River Nile, Heavy metals.

1- INTRODUCTION

Moringa oleifera is the most widely cultivated species of a monogeneric family, the Moringaceae, that is, native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan[1].There are 13 known species in the Moringaceae

family and M. oleifera is the most widely studied and cultivated as a multi-purpose tree[2]. Moringa oleifera is among plants that can be used as a cheap protein supplement to improve digestibility of other Diets[3].As well as medicinal plant, Moringa oleifera Lam. also can be used as an absorbent and coagulation. The seeds also have antimicrobial activity and are utilized for wastewater treatment. In some developing countries, the powdered seeds of Moringa oleifera are traditionally utilized as a natural coagulant for water purification because of their strong coagulating properties for sedimentation of suspended undesired particles. The seed extract contains very interesting behaviour in removing anionic surfactants from surface water[4]. Medicinal uses stem from the fact that the entire plant has high protein, vitamins, mineral, and carbohydrate content. It is, thus, of high nutritional value for both humans and livestock. Moringa leaves are rich in minerals such as iron, potassium, and calcium as well as vitamins, essential amino acids, and a number of glycosides[5].In the Sudan, dry Moringa oleifera seeds are used in place of alum by rural women to treat highly turbid Nile water. [6] various parts of M. oleifera such as leaves, roots, seeds, barks, fruits, flowers and immature pods act as antipyretic, antiepileptic, anti-inflammatory, antiulcer, antispasmodic, diuretic, antihypertensive, cholesterol lowering, antioxidant, antidiabetic, hepatoprotective, antibacterial and antifungal activities M.oleifera leaves are a good source of ß-carotenes, amino acids, phenolic compounds, vitamins, and minerals, especially calcium and iron[7].

Different elements have many functions in plant growth and development. Metal ions, including iron, zinc and copper, are required for catalytic and structural properties of many proteins and are therefore essential for growth and development of all organisms. Essential elements also play a major role in nerve transmission, blood circulation, cellular integrity, energy production and muscle contraction[8]. Human

exposure to heavy metals by consuming heavy metal contaminated plants makes it necessary to monitor these metals in edible plants [9-11].The popular uses of leaves and seeds from M. oleifera raise the question about safety and health of their products, especially due to the heavy metal concentrations. Daily exposure to heavy metals above the permissible limits has been associated with mental retardation, cancer, neuropathy, hepatic dysfunction and renal failure [12].XRF technology was used to evaluate the soil pollution with heavy metals like Ti, Cr, Mn, Fe, Cu, Zr [3]. XRF is one of the non-destructive methods in the elemental analysis of solid or liquid samples for major and minor constituents. Most of the elements in the periodic table, both metals and non metals, respond to this technique. Detection limit is between 10 to 100 ppm [5].

2- METHOD

River Nile state 18°27′N 33°23′E is one of the 18 (wilayat) or states of Sudan. It has an area of 122,123 km² (47,152 mi²) and an estimated population of 1,027,534 (2006). It consists of 6 localities (according to the latest political mapping) Ad-Damir is the capital city of the state. Slightly north of Ad-Damir is the important rail junction town of Atbarah; the other towns (localities) are Shendi, Berber and Abu Hamed.

Leaves of Moringa oleifera plant samples were collected from River Nile state ,Sudan. Leaves were sun dried to evaporate water content from it, after then it was grinded in mixture and with the help of palette leaves sample were prepared and were used for further elemental analysis in X-ray Fluorescence instrument[2].

XRF spectrometry low detection limits down to the parts-per-million (ppm) range for analyzing heavy metals. This allows the instrument to deliver accuracy that rivals lab analysis results. X-MET5000 Series handheld XRF analyser, a

supplier of analytical instruments for optical emission and XRF spectrometry, X-MET5000 handheld energy dispersive X-ray fluorescence (EDXRF) spectrometer a lightweight instrument It is designed especially for high-throughput elemental testing and spectro-chemical analysis of a wide range of metals and other materials.

3. RESULTS

X-ray fluorescence (XRF) is a non-destructive analytical technique used to determine the elemental composition of materials. XRF analyzers determine the chemistry of a sample by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a primary X-ray source. Each of the elements present in a sample produces a set of characteristic fluorescent X-rays ("a fingerprint") that is unique for that specific element, which is why XRF spectroscopy is an excellent technology for qualitative and quantitative analysis of material composition. The X-ray fluorescence process A solid or a liquid sample is irradiated with high energy X-rays from a controlled X-ray tube. When an atom in the sample is struck with an X-ray of sufficient energy (greater than the atom's K or L shell binding energy), an electron from one of the atom's inner orbital shells is dislodged. The atom regains stability, filling the vacancy left in the inner orbital shell with an electron from one of the atom's higher energy orbital shells. The electron drops to the lower energy state by releasing a fluorescent X-ray. The energy of this X-ray is equal to the specific difference in energy between two quantum states of the electron. The measurement of this energy is the basis of XRF analysis. XRF Technology Interpretation of XRF spectra Most atoms have several electron orbital's (K shell, L shell, M shell, for example). When x-ray energy causes electrons to transfer in and out of these shell levels, XRF peaks with varying intensities are created and will be present in the spectrum, a

graphical representation of X-ray intensity peaks as a function of energy peaks. The peak energy identifies the element, and the peak height/intensity is generally indicative of its concentration.

Determination of minerals and trace elements is important in enhancing production efficiency in plants and foods[5,13]. Heavy metals are considered potential carcinogens and are associated with various diseases, such as cardiovascular disease, bone disease, kidney disease, gastrointestinal diseases, reduced general intellectual capacity, and cancer [1].elements: (Mn, Cr, Zn, Ni, Fe) were present in Leaf of M. olifira .The concentrations of elements in Moringa are shown in Table 1. Serious health problems can occur as a result of excessive accumulation of heavy metals from eating contaminated herbal plants. Due to the toxicity of heavy metals in herbal plants, permissible limits of various heavy metals have been set. The data about heavy metal concentrations in M. oleifera leaves used as traditional medicines and food is very important for evaluation the risk to human health. Zinc and Mn content in the Moringa sample ranges from 1.0 the concentrations of Zn and Mn respectively. WHO's recommended limit of zinc in plants is 50 mg/kg .and 200 mg/kg of Mn Table.1.

Table -1: Concentrations mg/kg of elements present in Moringa oleifera by X-ray Fluorescence

Sample	Fe	Ni	Zn	Cr	Mn
Atbara	4.8±0.03	1.2±0.02	1±0.01	0.2±0.02	1±0.02
Ad-Damir	3.4±0.01	1.3±0.01	1±0.01	0.3±0.01	ND
Shendi	3±0.02	1.0±0.01	1±0.01	0.2±0.03	1±0.02
Abu Hamad	2.6±0.01	1.0±0.01	1±0.01	0.3±0.01	1±0.03
Berber	3.2±0.01	1.5±0.02	ND	0.4±0.02	ND

The level of Fe in Moringa ranges from 3 to 4.8 mg/kg. Some of the trace elements, which include iron, are essential micronutrients with a variety of biochemical functions in all living organism. Fe deficiency is probably the most common

nutritional deficiency disorder in the world though it performs the most vital functions in the body. An estimate based on WHO criteria indicated that around 600–700 million people worldwide have marked iron deficiency anaemia, and the bulk of these people live in developing countries[1].the Concentrations of Fe in Moringa are shown in Fig 1. The WHO recommended level of iron in plants is 20 mg/kg[12-14]

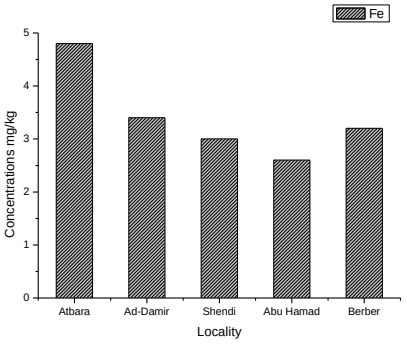

Fig -1: Concentrations of Fe in Moringa oleifera

The concentrations of Ni in Moringa are shown in Fig 2. Nickel in Moringa sample ranges from 1 to 1.5 mg/kg Ni is essential for the catalytic activity of some plant and bacterial enzymes. Humans exposed to highly nickel-polluted environments are at higher risk to etiological and pathological effects as it is known to cause lungs and nasal cancers [13] The permissible limit of Nickel in plants recommended by WHO is 10mg/kg[15].

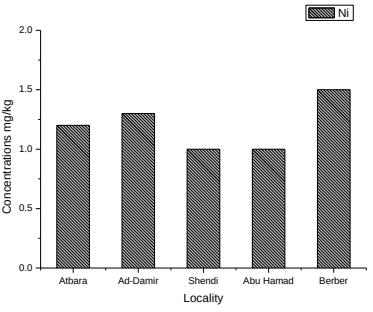

Fig -2: Concentrations of Ni in Moringa oleifera

The concentrations of Cr Fig 3. Cr might cause adverse effects such as lung cancer and liver damage Chronic exposure to high level might cause damage to brain, kidney, and lung. Therefore, the herbal Moringa samples might be safe for Cr. The permissible limit of Chromium for plants is 1.30mg/kg recommended by WHO[12].

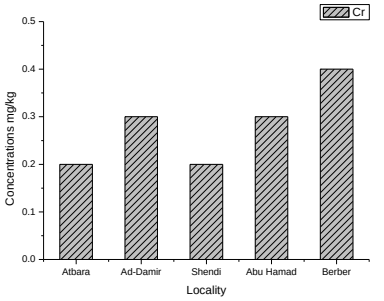

Fig -3: Concentrations of Cr in Moringa oleifera

4. CONCLUSION

From this study, the concentrations of Fe, Ni, Zn, Mn, Cr in Moringa within the permissible limits. Moringa samples might be safe for Fe, Ni , Zn, Mn, Cr. Moringa are a good source of important minerals and needs to be explored further for use as a supplement and ready source of dietary minerals in animal and human food .The XRF method is a powerful tool for the analysis of different elemental analysis.

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