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ELEMENTAL AND CHEMICAL COMPOSITION OF *Moringa oleifera* HUSK EXTRACTS

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ABSTRACT

Moringa oleifera is a well-known tropical plant with myriads medicinal and nutritional benefits. Its nutraceutical functions are due to the presence of mineral element and phytochemical components which necessitate their profiling. In this study, the elemental and chemical profiles of husk wastes from *Moringa oleifera* plants were elucidated using Liquid Chromatography equipped with an electrospray time-of-flight mass spectrometer (LCMS-QToF) and X-ray Fluorescence analyser. The confirmation of 493 bioactive compounds and two higher concentrations of micronutrients (calcium and potassium) indicated the potential of the *Moringa oleifera* extracts for medicinal and nutritional purposes. Also, the minimal presence of trace elements such as Cu, Si, Mo and Sr showed that they are non-toxic and can therefore be used as food supplement for both human and in animal feed. The result of this researchcould therefore provide lead for future investigation.

Keywords: *Moringa oleifera*; Maceration; LCMS-QToF; X-ray Fluorescence

1.0 INTRODUCTION

Moringa oleifera is an important fast-growing tree belonging to the family of *Moringaceae* and is commonly regarded as miracle tree due to its nutritional and medicinal benefits (Al_husnan & Alkahtani, 2016). There are thirteen (13) species of this tropical plant which widely grown in tropical many parts of Asia and sub-Sahara Africa (Chen *et al.*, 2017). Almost every part of *Moringa oleifera* can be used for food and as forage for livestock (Al husnan & Alkahtani, 2016). The leaves can be eaten fresh cooked or stored as dried powder for several months the pods, when young can be cooked; eaten like beans. Its oil and micronutrients have been reported to contain anti-tumour, antiepileptic, antidiuretic, anti-inflammatory and venomous bite characters (Anwar & Bhanger, 2003).

These functional properties of different parts of *Moringa oleifera* are due to the presence of bioactive compounds and mineral elements. The *Moringa oleifera* husk for example is generally known for its numerous benefits such as in the purification of water with their medicinal and nutritional properties (Ijarotimi *et al.*, 2017).However, several investigations have demonstrated that the bioactive and mineral elements from *Moringa oleifera* husk makes them a good candidate for nutraceutical applications (Salaheldeen *et al.*, 2015). These bioactive and elemental constituents are responsible for the different biological functions such as antioxidant and anti-microbial as reported by Salaheldeen *et al.* (2015).

Furthermore, as a result of the functional properties of *Moringa oleifera* husk to human health, it is imperative to determine an appropriate standard method characterization to produce high quality bio-products from this commodity crop. The minerals and chemical composition of *Moringa oleifera* plants and their bioavailability have been a subject of tremendous research but there are limited studies on the profiling and valorization of husk waste using state-of-the-art analytical techniques. The objective of this study was to investigate the mineral and chemical components of the *Moringa oleifera* husk extracts using the Liquid Chromatography equipped with an electrospray time-of-flight mass spectrometer (LCMS-QToF) and X-ray fluorescence analysis.

2.0 MATERIALS AND METHODS

2.1 Materials Preparation

The *Moringa oleifera* was carefully separated from its seeds was pulverized using a Grindomix grinder (GM-200 model, Germany). The powdered *Moringa oleifera* husk (without seeds) were stored in an airtight container. Ten grams (10 g) of the sample was sequentially macerated in 100 mL of analytical grade ethanol. The macerate was first filtered through a Whatmann No. 1 filter paper and concentrated using a rotary evaporator (R-200 model, Germany). The extracts were thereafter stored at –20 °C until analysis.

2.2 LCMS-QToF Analysis

The chemical profiling was conducted using a Liquid Chromatography equipped with an electrospray time-of-flight mass spectrometer (LCMS-QToF) detectors. The chromatographic separation was carried out using ACQUITY UPLCHSS T_3-column (2.1 x 100 mm, particle size 1.8 µm) (Waters, USA). The mobile phase was; A, 0.1% formic acid; B 0.1% formic acid in acetonitrile (Olalere *et al.*, 2018). The mass spectrometer was equipped with an electrospray ionization source operated in positive ion mode. The extracts were tentatively characterized in accordance with their ions' mass fragmentation.

2.3 XRF Analysis

The X-ray fluorescence analysis was employed to simultaneously measure and analyze the microelements and trace elements in the *Moringa oleifera* husk extracts. The atoms in the sample were excited using the monochromatic radiation emission from the X-ray tubing in an S8 Tiger Quant express analyzer. The analysis was conducted with the aid of a three-axial geometric configurations in order to mitigate the effect of noise emanating from polarization (Olalere *et al.*,2018).

3.0 RESULTS AND DISCUSSION

3.1 Identification of Bioactive Compounds in the Extracts

The bioactive composition of the *Moringa oleifera* husk extracts were identified and confirmed based on the mass-fragmentation and spectra chromatographs as illustrated in Figure 1. A total of 493 metabolites were identified and obtained by electron spray ionization mass spectrometry (ESI-MS/MS) with the corresponding confirmation of their spectra, retention times, molecular and ionic fragmentation of each chemical components. A combination of these bioactive compounds is largely responsible for the numerous medicinal and nutritional characteristics of *Moringa oleifera* husk as reported by Ijarotimi *et al.* (2017).

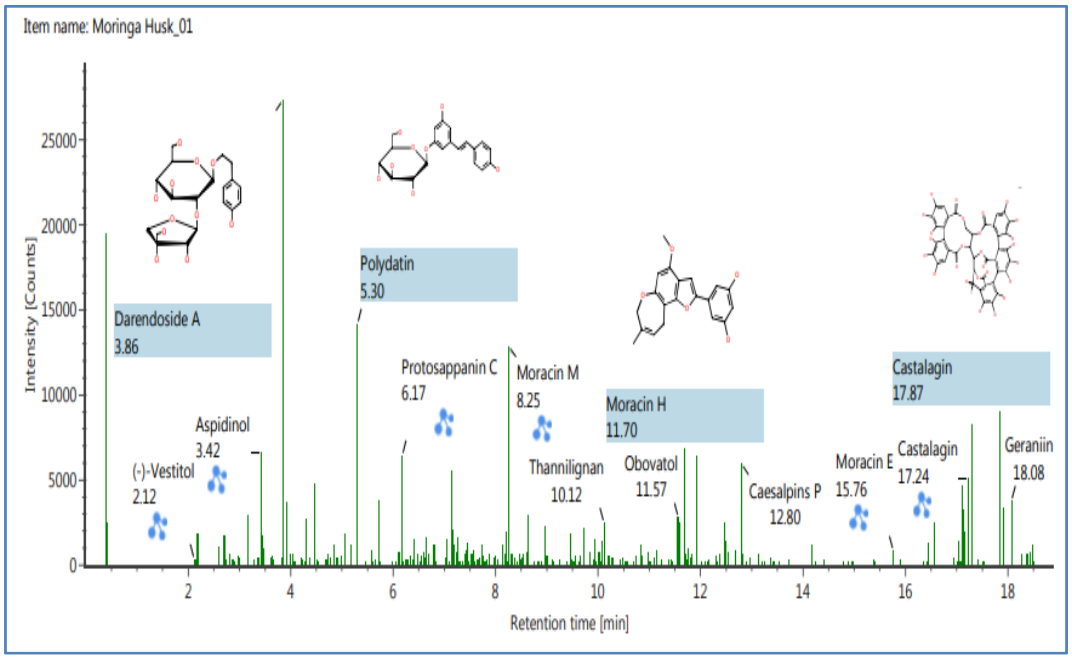

Figure 1: Chemical profiling of *Moringa oleifera* husk extracts by LC-MS-Q-ToF

3.2 Estimation of mineral element concentration

The XRF-mineral analysis was conducted to determine the micronutrients composition in the *M. oleifera* husk with the results obtained showed remarkable higher concentration in Ca, and K. Moreover, a weaker concentration was obtained for S, P, Cl, Fe and Mg, as presented in Table 1. However, the concentration of trace elements (Cu, Si, Mo, and Sr) were found to be negligible which indicated the edibility and non-toxic characteristics of the *M. oleifera* husk extracts as food fortifants as reported by Oyeyinka & Oyeyinka (2018).

Table 1: Mineral content of *M. oleifera* husk extracts obtained by X-ray fluorescence Banalysis

No	Parameter	Result (%)*
1	Calcium (Ca)	39.40±0.21
2	Potassium (K)	38.29±0.37
3	Sulphur (S)	8.29±0.09
4	Phosphorus (P)	4.98±0.23
5	Chlorine (Cl)	2.81±0.11
6	Iron (Fe)	2.78±0.43
7	Magnessium (Mg)	1.99±0.12
8	Zinc (Zn)	0.41±0.33
9	Copper (Cu)	0.33±0.17
10	Silicon (Si)	0.29±0.42
11	Molybdenum (Mo)	0.15
12	Strontium (Sr)	0.14

*Average ± Standard Deviation

4.0 CONCLUSIONS

The aim of this work is to access the elemental and phenolic profile in *M. oleifera* husk extracts using LC-QToF/MS and X-ray fluorescence analysers. The results of the mineral element and phytochemical screening showed the presence of 493 secondary metabolites, 7 micronutrients and 4 trace elements. The presence of lower concentration in the trace elements indicated that edibility of the husk extracts and its potential use in the food and/or pharmaceutical industries. Moreover, the cumulative bioactivities of these chemical and elemental constituents are responsible for the numerous therapeutic functions of *Moringa oleifera* husk as reported by many researchers. The result described in this investigation can therefore be used for further investigation into the other nutraceutical applications of *Moringa oleifera* husk extracts.

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REFERENCES

Al_husnan, L. A. andAlkahtani, M. D. F. (2016). Impact of moringa aqueous extract on pathogenic bacteria and fungi in vitro. *Annals of Agricultural Science*, *61*(2), 247–250.

Anwar, F. and M.I. Bhanger, (2003). Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. *Journal of Agriculture and Food Chemistry*, *51*, 6558–6563

Chen, C., Zhang, B., Huang, Q., Fu, X. and Liu, R. H. (2017). Microwave-assisted extraction of polysaccharides from *Moringa oleifera* Lam. leaves: Characterization and hypoglycemic activity. *Industrial Crops and Products*, *100*, 1–11.

Ijarotimi, O. S., Adeoti, O. A. andAriyo, O. (2017). Comparative study on nutrient composition, phytochemical, and functional characteristics of raw, germinated, and fermented Moringa oleifera seed flour. *Food Science & Nutrition*, *1*(6), 452–463

Salaheldeen, M., Aroua, M. K., Mariod, A. A., Chenge, S. F., Abdelrahman, M. A. and Atabani, A. E. (2015). Physicochemical characterization and thermal behaviour of biodiesel and biodiesel–diesel blends derived from crude *Moringa peregrina* seed oil. *Energy Conversion and Management*, *92*, 535–542

Oyeyinka, A. T. and Oyeyinka, S. A. (2018). *Moringa oleifera* as a food fortificant: Recent trends and prospects. *Journal of the Saudi Society of Agricultural Sciences,17*, 127–137.

Olalere, O.A., Abdurahman, N.H., Alara, O. R., and Habeeb,O.A. (2018). Chemical fingerprinting of biologically active compounds and morphological transformationduring microwave reflux extraction of black pepper. *Chemical Data Collection*, *17–18*, 339–344.

Olalere, O.A, Abdurahman, N. H., Yunus, R.M., and Alara, O. R. (2017). The effects of microwave heating on the extraction yield and elemental composition of black and white pepper (*Piper nigrum*) extracts. *Journal of Chemical Engineering & Industrial Biotechnology*, *V2*, 59–67.