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COMPARATIVE STUDIES OF SOME SELECTED TROPICAL LEAVES EXTRACTS

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Abstract

Natural products have been an integral part of traditional phytomedicine systems. The objective of the study was to investigate the phytochemicals, proximate and mineral compositions of *Moringa oleifera*, *Manihot esculenta*, *Anacardium occidentale L.*, *Vernonia amygdalina* and *Talinum triangulare* leaves extracts. The phytochemicals, proximate and mineral compositions of the leaves extracts were conducted using standard methods. The qualitative phytochemical screening of the extracts indicated the presence of saponin, tannin, terpenoids, flavonoids, and cardiac glycoside. Quantitatively, cardiac glycoside was found to be the abundant constituent in *Moringa oleifera* (24.8%), *Manihot esculenta* (21.8%), *Anacardium occidentale L.* (15.8%), *Vernonia amygdalina* (19.6%), when compared with other phytochemicals in the extracts. However, saponin was found to be the most abundant phytochemical in *Talinum triangulare* leaf extract making about 24.0%. The qualitative proximate analysis of the extracts in g/100g showed that the extracts contained carbohydrate, protein, fats, fibre, moisture and ash. Quantitatively, carbohydrate was revealed as the highest nutrient in *Manihot esculenta* making about (62.15%), followed by *Vernonia amygdalina* extract (60.81%), *Moringa oleifera* (54.35%), and *Talinum triangulare* leaf extract (50.32%) respectively when compared with other proximate compositions in the extracts. The mineral composition analysis indicates the presence of sodium, calcium, potassium, magnesium, zinc, iron and manganese. *Vernonia amygdalina* has the highest calcium concentration (30.40ppm). Also, calcium was found to be the highest mineral when compared with other minerals in the extracts. The presence of nutrients in these leaves extracts were evidences that, the five tropical leaves can be used as food supplement.

Keywords: Phytochemicals, Proximate, Minerals, ppm.

Introduction

Natural products have been an integral part of ancient traditional medicine systems (Sharman *et al.*, 2019). Over the years, medicinal plants have assumed a very central stage in modern civilization as natural source of therapy as well as amongst scientists in search for alternative sources of drugs (Van and Wink, 2018). According to the World Health, a medicinal plant is any plant in which any of its parts including the leaves, rhizomes, flowers, stems, barks, roots, fruits or seeds contain substances that can be used for therapeutic purposes, or which have the potential for chemo-pharmaceutical semi synthesis (Van and Wink, 2018; Ahad *et al.*, 2021). Such plants will have its parts employed in the

control or treatment of a disease condition and they often contain chemical components known as phytochemicals/bio-active materials that are of significant medicinal values (Musundire, 2014; Chhikara *et al.*, 2020). Some of these bio-active materials are the plants' secondary metabolites because the metabolites conferred a great protection on them against several viruses and bacteria (Alvarado *et al.*, 2019). Phytochemicals are chemicals of plant origin such as, tannin, saponin, flavonoids, and cardiac glycosides (Awotedu *et al.*, 2020).

Traditional medicine has been used since time immemorial with great contributions made by practitioners to human health, particularly as primary health care providers at the community level (Sridhar and Senthilvel, 2018). Countries in Africa, Asia, and Latin America use traditional medicine to help meet some of their primary healthcare needs (Carrera *et al.*, 2019). In Nigeria, for example, herbal medicine is the first line of treatment for 60% of children with high fever from malaria, while 85 % of Nigerians use traditional medicine for health care, social and psychological benefits (Owumi *et al.*, 2016). Interestingly, demand for medicinal plants is progressively rising in industrialized nations as it is in developing countries (Lokko *et al.*, 2018). Medicinal plants have enormous therapeutic potentials with little or no side effects (Falade *et al.*, 2021). Africa is endowed with rich biodiversity and indigenous knowledge system about bioactive plants whose beneficial values have not been fully explored in tropical medicine and agriculture (Agulanna, 2020).

Moringa oleifera is a fast growing, perennial angiosperm tree that may grow as high as 7 to 15 m and reach a diameter of 20 to 40 cm at chest height (Tesfaye, 2021). It belongs to the Moringaceae family and is generally regarded as a vegetable, a medicinal plant, and a source of cooking oil in the developing world (El-Hamidi and Zaher, 2018). It is indigenous to Africa especially Nigeria, the sub-Himalayan tracts of India, Pakistan, Bangladesh, and Afghanistan where it is known by various regional names (Fahey, 2019). Recently, it has gathered medical and socioeconomic attention in the tropics and subtropics such as in Western, Eastern, and Southern Africa, tropical Asia, Latin America, the Caribbean and the Pacific Islands where it is now being widely cultivated and has naturalized (Fahey, 2019). It is an easily cultivated tree, famous for its low demand for soil nutrients and water thereby capable of withstanding destitute soils and drought (Alegbeleye, 2018). A wide variety of nutritional, prophylactic, and therapeutic virtues have been attributed to its roots, bark, leaves, flowers, sap, fruits and seeds (Fahey, 2019; Hussein and El-Anssary, 2019).

Manihot esculenta is widely grown in tropical and subtropical countries of Africa, Asia and Latin America, with 276.7 million tons estimated production (Tao *et al.*, 2019). In the past 30 years, the area under cultivation has doubled and is expected to increase further (Mombo *et al.*, 2017). It is grown in 105 countries and ranks as world's fourth most important crop and a staple food for nearly one billion people (Scott, 2021). *Manihot esculenta* is a crop which may support food security in low rainfall and marginal soil regions. *Manihot esculenta* has become a favored crop for both small scale farmers and large-scale plantation as it requires low input of time, labor and money (Cramb *et al.*, 2017). It is mainly grown for starchy roots however; the stem, leaves and petioles of *Manihot esculenta* are also edible and are widely used as food in Africa (Ndam *et al.*, 2019). *Manihot esculenta* leaves are an important vegetable and are available throughout the year (Parmar *et al.*, 2017). *Manihot esculenta*

leaves form a major part of the diet in some countries, but there are many countries where they are not generally consumed, even though cassava is widely grown and readily available (Ucheckukwu-Agua *et al.*, 2015). It deserves more attention as a source of protein and nutrients for human nutrition and should get as much attention as the roots, which are low in protein (Chisenga *et al.*, 2019).

The *Anacardium occidentale L.* has a native from Brazil, Mexico and United States of America (USA). It is one of the exotic crops in Thailand (Liangpanth and Tongdeesoontorn, 2018). The characteristics of cashew fruit are a bell shape, greenish-gray color, fleshy and swollen (Liangpanth and Tongdeesoontorn, 2018). Actually, *Anacardium occidentale L.* plant can separate into two parts as are edible part and medicinal part (Liangpanth and Tongdeesoontorn, 2018). The edible part consists of seed, fruit, and leaf which contains many nutrients, fat, protein carbohydrate (Ranasinghe *et al.*, 2019). It can be consumed as fresh and processed products (Dimoso *et al.*, 2020). The *Anacardium occidentale L.* plant can be used as one of the traditions of the medicinal plant with many parts of the plant (seed, leaf, flower, and bark) (Upasani *et al.*, 2017). Its leaf contains the antimicrobial compound, such as phenolic compounds, tannin, vitamin C, carotenoids, and organic acids (Salehi *et al.*, 2019).

Vernonia amygdalina leaf occurs naturally along rivers and lakes, in forests margins, woodland and grassland up to 2800 m altitude, in regions where mean annual rainfall is 750-2000 mm (Kaur *et al.*, 2019). *Vernonia amygdalina* can be commonly found along drainage lines and in natural forests or at home and commercial plantations (Alara and Abdurahman, 2021). It requires full sunlight and prefers humid environment. It grows on all soil types but prefers humus-rich soils (Ciju *et al.*, 2019). *Vernonia amygdalina* belongs to the family Asteraceae (Danladi *et al.*, 2018). The leaves are dark green colored with a characteristic odour and a bitter taste (Oboh *et al.*, 2021). Flower heads thistle like, small, creamy white, 10 mm long, grouped in dense heads, axillary and terminal, forming large flat clusters, 15 cm in diameter, sweetly scented (Awang *et al.*, 2020).

Talinum triangulare is an erect perennial herbs plant with swallow roots, obtuse angular, hairless and succulent stems which can grow up to 100 cm – 300 cm tall (Raven, 2020). The branches on the stems have two laterals and basal buds (Okoye *et al.*, 2017). The leaves are arranged spirally almost nearly opposite, often crowded at the top of the stem and indistinctly or short petiole (Chowdhury, 2015). The leaf-blades are usually spoon-shaped, with a size of measure about 3-25 cm long and 1-6 cm wide, entire and succulent, obtuse to round and occasionally at the apex. Waterleaf also has been found to possess useful medicinal potentials such as laxative, purgative, treatment of diarrhea, gastro-intestinal diseases as well as in the management of cardiovascular diseases such as: stroke and obesity (Tiamiyu *et al.*, 2019).

Materials and Methods

Collection and preparation of plant samples

Moringa oleifera, *Manihot esculenta*, *Anacardium occidentale L*, *Vernonia amygdalina* and *Talinum triangulare* leaves were harvested fresh from a forest in Akure, Akure South Local Government, Ondo State. Identification and authentication of the plants material was done at the Environmental Biology Unit of Science Laboratory Technology Department, Rufus Giwa Polytechnic, Owo. The leaves were washed thoroughly with distilled water and air-dried for four weeks. Thereafter, the dried

samples were then grinded into powder with the aid of a mechanical grinder and were stored in clean air-tight containers, and kept in a cool, dry place until required for use

Preparation of extracts

One hundred gram (100 g) portion of each of the powdered samples was soaked in 1000 mL of distilled water for 48 hrs with intermittent stirring using sterile spatula. Thereafter, extracts were filtered through filter paper into sterile containers and then dried using rotary evaporator at 50^{0}C.

Phytochemical screening

The phytochemical screening of each of the extracts for various phytochemical constituents such as terpenoids, flavonoids, alkaloids, steroid, phlobatannins, cardiac glycoside, anthraquinones, saponin and tannin were conducted using standard methods as described by the Association of Official Analytical Chemist (AOAC), 2000.

Quantitative phytochemical analysis

Different methods were used in evaluating the quantity of phytochemical constituents of the five plant materials used. Spectrophotometric method was used to determine saponin, terpenoids, tannins, steroids, anthraquinones, and cardiac glycosides while colorimetric method was used to determine flavonoids and alkaloids content according to method described by Bao, 2005.

Proximate analysis

Proximate analysis of the samples were conducted to determine the moisture content, ash content; crude protein, crude fibre, crude lipid and carbohydrate using methods described by the Association of Official Analytical Chemist (AOAC), 2000. The proximate parameters were expressed in percentage (%).

Mineral analysis

The mineral composition of the extracts including sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), iron (Fe) and manganese (Mn) were determined using spectrophotometric method (AAS BUCK SCIENTIFIC $_{211}$ VGP) as described by the Association of Official Analytical Chemist (AOAC), 2000. The mineral compositions were expressed in part per millions (ppm).

Results

Table 1: Qualitative phytochemical screening of *Moringa oleifera, Manihot esculenta, Anacardium occidentale L., Vernonia amygdalina* and *Talinum triangulare r leaves* extracts

Phytochemicals	*Moringa oleifera*	*Manihot esculenta*	*Anacardium occidentale L.*	*Vernonia amygdalina*	*Talinum triangulare*
Saponin	+	+	+	+	+
Tannin	+	+	+	+	+
Alkaloid	-	-	-	-	-
Flavonoids	+	+	+	+	+
Terpenoid	+	+	+	+	+
Steroid	-	-	-	-	-
Phlobatanin	-	-	-	-	-
Anthraquinone	-	-	-	-	-
Cardiac glycosides	+	+	+	+	+

Present: (+), Absent: (-)

The qualitative phytochemical screening of *Moringa oleifera, Manihot esculenta, Anacardium occidentale L., Vernonia amygdalina* and *Talinum triangulare leaves* extracts are presented in Table 1. The phytochemicals; tannins, saponins, flavonoids, terpenoids and cardiac glycosides were present while phlobatannins, anthraquinones, alkaloid and steroids were absent in the extracts.

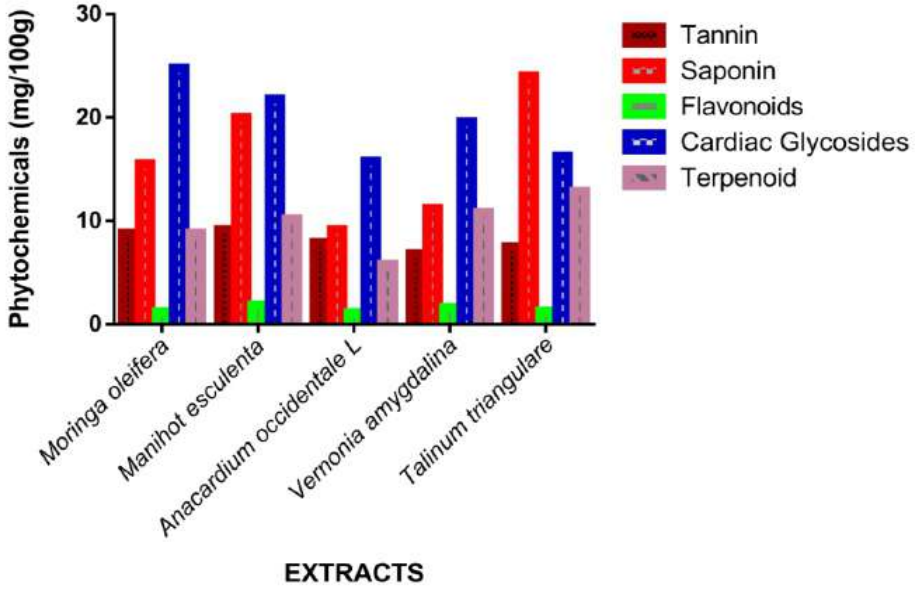

Figure 1: Quantitative phytochemical screening of *Moringa oleifera, Manihot esculenta, Anacardium occidentale L., Vernonia amygdalina* and *Talinum triangulare leaves* extracts

Quantitatively, cardiac glycosides was found to be the most abundant phytochemical in the extracts as shown in Figure 1 except *Talinum triangulare* leaf extract which has saponins as the most abundant phytochemicals.

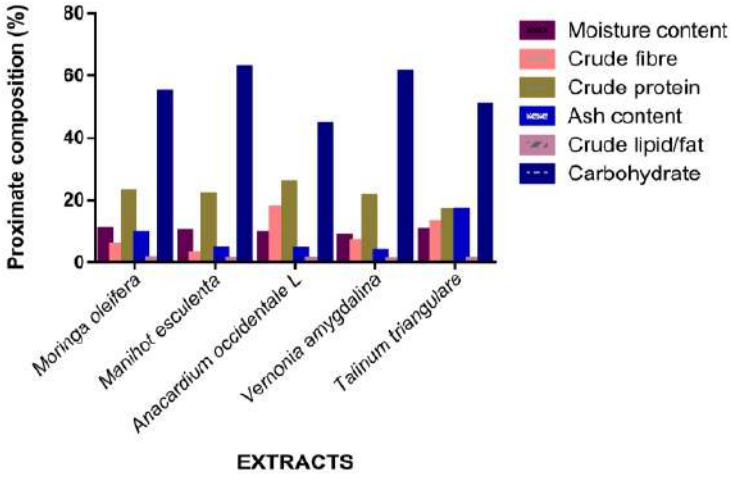

Figure 2: Quantitative proximate analysis of *Moringa oleifera, Manihot esculenta, Anacardium occidentale L., Vernonia amygdalina* and *Talinum triangulare leaves* extracts

Figure 2 shows the result of the quantitative proximate composition of the extracts. The extracts revealed the presence of moisture, protein, ash, lipid and carbohydrate. However, the quantitative analysis of the extracts revealed carbohydrate proteins and crude fibre as the most abundant nutrients, whereas, the study indicated a low fat content in the extracts.

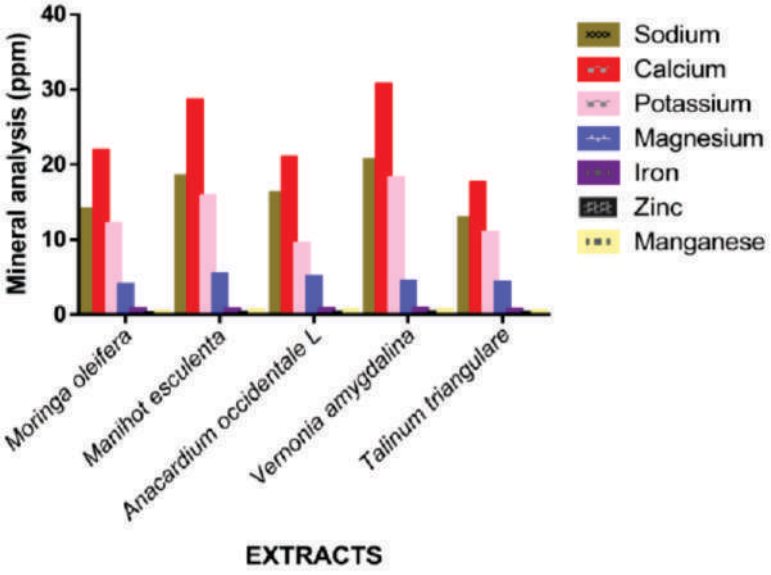

Figure 3: The mineral analysis of *Moringa oleifera, Manihot esculenta, Anacardium occidentale L., Vernonia amygdalina* and *Talinum triangulare leaves* extracts

The extracts contained some important minerals such as, sodium, calcium, potassium, magnesium, zinc, iron and manganese as shown in Figure 3. Quantitatively, sodium, potassium and calcium were found to be the most abundant minerals in the extracts.

Discussion

The study revealed that several phytochemicals are present in *Moringa oleifera, Manihot esculenta, Anacardium occidentale L., Vernonia amygdalina* and *Talinum triangulare leaves* extracts. Phytochemicals give plants their unique flavours, smell, colour and are part of plants' natural defense system that protect them against viruses, fungi, parasites and pathogens (Wani *et al.*, 2020). The phytochemicals tannins, saponins, flavonoids, terpenoids and cardiac glycosides were present while phlobatannins, anthraquinones, alkaloids and steroids were absent in the extracts. Quantitatively, the phytochemical contents of the extract of *Moringa oleifera* revealed cardiac glycosides as the most abundant phytochemical (21.89%), followed by terpenoids (10.24%), tannins (9.22%), saponins (9.20%), and flavonoid constituting (1.87%). Cardiac glycosides was also found to be the most abundant constituent making about (21.8%), followed by saponins (20.0%), terpenoids (10.2%), tannins (9.2%) and flavonoids constituting 1.9% for *Manihot esculenta* leaves extract. The same trend was observed in *Anacardium occidentale L.* leaf extracts with cardiac glycosides making about (15.8%), followed by saponins (9.2%), tannins (7.9%),

terpenoids (5.8%), and flavonoids constituting (1.1%) respectively. Cardiac glycosides was found to be the abundant constituent making about (19.6%), followed by saponins (11.2%), terpenoids (10.8%), tannins (6.8%) and flavonoids constituting (1.6%) in *Vernonia amygdalina* leaf extract. However, saponins was the most abundant constituent in *Talinum triangulare* leaf extract making about (24.0%), followed by cardiac glycosides (16.3%), terpenoids (12.9%), tannins (7.5%), and flavonoids constituting (1.3%) respectively.

Based on these findings, cardiac glycosides was the most abundant phytoconstituent in the extracts except *Vernonia amygdalina* extract. Cardiac glycosides are important class of naturally occurring drugs whose actions help in the treatment of congestive heart failure (Triana-Martínez *et al.*, 2019). Terpenoids are chemically reactive compounds (Lichman *et al.*, 2019). The presence of terpenoids in medicinal plants was previously reported (Bisi-Johnson *et al.*, 2017). They are important due to their relationship with essential compounds such as vitamin A and could be of immense medical applications (Stephave *et al.*, 2020). Terpenoids are effective hydrogen donors; hence they have potentials as antioxidants (Quan *et al.*, 2019). Terpenoids have been found to be useful in the prevention and therapy of several diseases, including cancer (Jain *et al.*, 2016). Medicinal plants containing tannins are used for the treatment of intestinal disorders such as diarrhoea and dysentery (Seebaluck *et al.*, 2015). Saponins have the property of precipitating and coagulating red blood cells and have an expectorant action useful for upper respiratory tract infections (Bishnoi, 2017). The saponins content may also help in the liver functions, concerning the metabolite of cholesterol (Romano *et al.*, 2020). Flavonoids are also present in the extracts as a potent water-soluble antioxidant and free radical scavenger, which prevent oxidative cell damage and also have strong anticancer activity (Yarley *et al.*, 2021). It also helps in managing diabetes-induced oxidative stress (Cheng *et al.*, 2020).

The result of the present study indicates that the qualitative proximate composition of *Moringa oleifera, Manihot esculenta*, *Anacardium occidentale L.*, *Vernonia amygdalina* and *Talinum triangulare* leaves aqueous extracts contain moisture, protein, ash, lipid and carbohydrate while the quantitative analysis result was presented as carbohydrate (54.35%), protein (22.58%), fats (0.98%), crude fibre (5.05%), moisture content (10.19%) and ash content 8.86% respectively for *Moringa oleifera* extracts. There was carbohydrate (62.15%), protein (21.23%), fats (0.74%), crude fibre (2.45%), moisture content (9.50%) and ash content (3.93%) respectively for *Manihot esculenta* extracts. The result also revealed the presence of carbohydrate (44.11%), protein (25.22%), fats (0.81%), crude fibre (17.20%), moisture content (8.81%) and ash content 3.85% respectively for *Anacardium occidentale L.* leaves extracts. *Vernonia amygdalina* extract revealed carbohydrate (60.81%), protein (20.77%), fats (0.66%), crude fibre (6.40%), moisture content (8.13%) and ash content (3.23%) respectively. The following were found to be true for *Talinum triangulare* leaf extract, carbohydrate (50.32%), protein (16.19%), fats (0.79%), crude fibre (12.55%), moisture content (9.91%) and ash content (10.24%). This indicated the higher content of carbohydrate particularly in *Manihot esculenta* and *Vernonia amygdalina* leaves when compared with others. The higher carbohydrate content in these extracts is a clear indication that the extracts are good sources of energy for the body with *Manihot esculenta* having the

highest carbohydrate content, hence a source of exogenous energy to the body (Rashwan *et al.*, 2021). The presence of moisture, ash, lipid and protein in in the extracts suggest that they may be useful for body building, prevention of ageing while the high dietary crude fibre contents will help in bowel movement (Ogidi *et al.*, 2019). These important nutrients composition in the extracts provide a justification that *Moringa oleifera, Manihot esculenta*, *Anacardium occidentale L.*, *Vernonia amygdalina* and *Talinum triangulare* leaves extracts could be used as food supplements. Findings of this study indicated low fat content in the extracts, and low fat foods are known to reduce cholesterol levels (Utami *et al.*, 2018). These results are in tandem with available previous reports.

The mineral analysis of *Moringa oleifera, Manihot esculenta*, *Anacardium occidentale L.*, *Vernonia amygdalina* and *Talinum triangulare* leaves extracts contained some important minerals such as, sodium, calcium, potassium, magnesium, zinc, iron and manganese. The metal/mineral composition analysis of *Moringa oleifera* indicates the presence of sodium (13.70ppm), calcium (25.50ppm), potassium (11.80ppm), magnesium (3.60ppm), zinc (0.24ppm), iron (0.42ppm), and manganese (0.19ppm). The following metals/minerals, sodium (18.10ppm), calcium (28.30ppm), potassium (15.50ppm), magnesium (5.13ppm), zinc (0.30ppm), iron (0.38ppm), and manganese (0.27ppm) were also present in *Manihot esculenta* extracts. *Anacardium occidentale L.* leaves extracts also revealed the presence of sodium (15.90ppm), calcium (20.60ppm), potassium (9.20ppm), magnesium (4.72ppm), zinc (0.34ppm), iron (0.44ppm), and manganese (0.31ppm) respectively. The metal composition analysis of *Vernonia amygdalina* leaf extract indicates the presence of sodium (20.30ppm), calcium (30.40ppm), potassium (17.90ppm), magnesium (4.13ppm), zinc (0.38ppm), iron (0.52ppm), and manganese (0.36ppm). *Talinum triangulare* leaf extract also revealed the presence of sodium (12.50ppm), calcium (17.20ppm), potassium (10.60ppm), magnesium (3.95ppm), zinc (0.29ppm), iron (0.31ppm), and manganese (0.22ppm). The presence of these essential minerals in the extracts could be utilized as nutritionally valuable and healthy ingredients for food (Ogbe and Affiku, 2021). These elements are very important in human nutrition (Huang *et al.*, 2020). Sodium, potassium, calcium and magnesium play a central role in the normal regulation of blood pressure (Van der Wijst *et al.*, 2018). They could also be valuable in improving immune system and in preventing malnutrition-related diseases (Farhadi and Ovchinnikov, 2018). Mineral elements are required for normal growth, activities of muscles and skeletal development such as calcium, cellular activity and transport of oxygen (copper and iron), chemical reaction in the body and intestinal absorption (magnesium), fluid balance and nerve transmission (sodium and potassium), as well as regulation of acid-base balance homeostasis (Ogbe and Affiku, 2021). Iron is useful in prevention of anemia and other related diseases (Cappellini *et al.*, 2020). Manganese plays a role in energy production and in supporting the immune system while zinc is useful for protein synthesis, normal body development and recovery from illness (Ali *et al*, 2019; Ogbe and Affiku, 2021).

Conclusion

The results obtained from the present study are evidence that the leaves extracts can be used as food supplement for man and for pharmaceutical preparation.

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