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Original article

Comparative studies of mineral composition of some wild vegetables of the Federal Capital Territory, Abuja

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ABSTRACT

Micronutrient deficiency is the lack of essential vitamins and minerals that are required in small amounts by the body for proper growth and development. Deficiencies in these micronutrients are an important global health issue, they can result in poor physical and mental development in children, vulnerability or exacerbation of diseases, mental retardation, blindness and general losses in productivity and potential. However, fruits and vegetables have been linked to the management of anaemia because fruits and vegetables are rich in vitamins and minerals. These wild fruits and wild vegetables could be integrated in the food-based and medicinal approach for fighting health problems and micronutrient deficiency in Abuja and Nigeria. Hence, the aim of the study is to evaluate the nutrients and important elements present in lesser-known wild vegetables and fruits consumed in the Federal Capital Territory (Abuja). The wild fruits and vegetables were collected from forests in two different communities and were identified in each of the six area councils of the Federal Capital Territory. There nutrient contents of these wild vegetables were analyzed using atomic absorption spectrophotometry (AAS). A total of seventeen (17) species were collected and grouped into twelve (12) families. Amaranthaceae (4) species was the most common family seen, followed by Asteraceae two (2) species, Solanaceae two (2) species, Amplidaceae (1) species, Annonaceae one (1) specie, Apocynaceae one (1) species, Lamiaceae one (1) species, Fabaceae one (1) species, Cleomaceae one (1) species, Cyatheaceae one (1) species, Nyctaginaceae one (1) species and Portulacaceae one (1) species. These wild vegetables contain nutrients in varying composition which include Sodium, Potassium, Iron, Calcium, Lead, Cadmium, Chromium, Copper, Manganese, Magnesium, Nickel, Cobalt, Vitamin A and Vitamin C. In conclusion, there are micro and macro nutrients present in wild vegetables that can serve to supplement nutrients in our diet.

Keywords: Wild Vegetables, Micronutrient, Deficiency, Nigeria, Global Health

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INTRODUCTION

Fruits and vegetables are an important part of a healthy diet, variety is as important as quantity, no single fruit or vegetable provides all the nutrients you need for good health. A diet rich in vegetables and fruits can lower blood pressure, reduce the risk of heart disease and stroke, prevent some types of cancer, lower risk of eye and digestive problems and have a positive effect upon blood sugar which can help keep appetite in check. Consumption of non-starchy vegetables and fruits like apples, pears and green leafy vegetables may even promote weight loss [1].

Micronutrient deficiency is defined as lack of essential vitamins and minerals that are required in small amounts by the body for proper growth and development deficiencies in these micronutrients are an important global health issue, they can result in poor physical and mental development in children, vulnerability or exacerbation of diseases, mental retardation, blindness and general losses in productivity and potential [2]. Unlike energy-protein undernourishment, the health impact of micronutrient deficiency is therefore sometimes termed 'hidden hunger', and these two terms are often used interchangeably. Micronutrients deficiency still poses a public health problem in Nigeria despite the effort that has been made to eliminate it. The World Health Organization [3] reported that about 30% of the population in developing countries suffer currently from one or more multiple nutritional deficiencies, especially that of micronutrients.

[4] Kiani *et al.* in 2022 observed that in most developing countries three micronutrient deficiencies are common. These are vitamin A deficiency, iron deficiency anaemia and iodine deficiency disease.

Micronutrient deficiency have been an enduring problem in Nigeria. The prevalence of vitamin A deficiency is estimated at 30% and 70% for children that are anaemic. Previously micronutrient deficiency control (MNDC) efforts were limited [6]. Nutrition is more complex than simply having enough to eat, it is a critical part of staying healthy at all life stages.

Fruits and vegetables have been linked to the management of anaemia because fruits and vegetables are rich in vitamins and minerals. Some of these vitamins are not directly involved in red blood cell production but they promote the absorption of other important minerals, for example ascorbic acid promotes the absorption of iron from the small intestine [7]. In the Federal Capital Territory (FCT), most staple foods are consumed without vegetables due to scarcity and high prices yet there are many lesser known wild vegetables and fruits wasting in the forest rich in micronutrients, such vegetables as *Amarantus spinosus (*Efo tete*), Celosia isertii (*Sokoyokoto*), Cyathula Prostrata (*Sawere pepe*), Annona Senegalensis (*Shap-shap*), Acanthospermum hispidum (*Egun arugbo*), Vitex Doniana (*Oori nla*)* grow wild. There are many wild fruits and tender leaves of the wild vegetables that are readily available in the forest and farmlands, they could be utilized to provide protein and micronutrient needs of the populace.

In the Six Area Council of the FCT, many leafy vegetables and fruits are grown wildly and there has been little or no work on their nutrient composition. Documentation of the nutrient potentials of these wild fruits and vegetables would

be valuable in the food-based approach to eliminating micronutrient deficiencies.

Many lesser-known wild fruits and vegetables in the Federal Capital Territory, can be collected freely without restrictions and consumed by the populace to increase nutrient intake, many of these wild fruits and vegetables have comparative nutritional values with that of the common ones or everyday fruits and vegetables. Some of the wild vegetables and fruits are available even when many domestic fruits and vegetables are scarce and very expensive, thus they could fill the gap experienced in fruit and vegetable consumption in rural communities and urban areas. Despite abundance of these fruits and vegetables in the wild, there is still problem of micronutrient deficiency in Abuja and Nigeria at large. The inadequate intake of these essential nutrients can result in major health complications such as poor health, blindness, stunted growth, mental retardation and learning disabilities [8]. There is need to identify and evaluate the nutrients and elemental constituents of these vegetables. These wild fruits and wild vegetables could be integrated in the food-based and medicinal approach for fighting health problems and micronutrient deficiency in Abuja and Nigeria. Hence, the aim of the study is to evaluate the nutrients and important elements present in lesser-known wild vegetables and fruits consumed in the Federal Capital Territory (Abuja)

MATERIALS AND METHODS

Study Area

The study was conducted in the rural communities of the six Area Council of the FCT namely (Abuja Municipal, Abaji, Bwari, Gwagwalada, Kuje, Kwali). The Federal Capital Territory (FCT) is in central Nigeria also known as the capital of Nigeria, lies between latitudes 80° 25' and 9° 25' North of the equator and longitude 6°45' and 7° 45' East of the Greenwich Meridian. It is bordered by four States: Kaduna in the North, Kogi in the South, Niger in the West and Nasarawa in the East. It covers a land mass of 8,000 square kilometers (km^2) which is equivalent to 0.8% of Nigeria land mass.

Sampling Collection and Identification

The wild fruits and vegetables were collected from forests in two different communities and were identified alongside their local names, each in the six area councils of the Federal Capital Territory, namely: (Abuja Municipal, Abaji, Bwari, Gwagwalada, Kuje, Kwali), sampling of materials was run side by side with the laboratory work. Samples of these fruits and vegetables were taken to the Department of Biological Sciences University of Abuja Herbarium for identification and sampling by a taxonomist. The samples identified were matched to a known taxon, using various methods, for characterization and identification of their botanical names. A total seventeen (17) wild vegetables and thirteen (13) wild fruits given a total thirty (30) specimen were collected from the six-area council of the Federal Capital Territory.

Preparation of Materials

Polyethylene bags were used for collection and storing samples to avoid contamination. The leaves were picked to remove unwanted materials. The vegetables and fruits were washed with iodized water and excessive water was blotted dry. The moisture content of the samples was determined by weighing two grams of each sample in different ranges of temperature between 100°C and 102°C [8] the dried matter obtained was grounded

and stored at 5°C in airtight containers prior to further analysis.

Elemental components of the samples were analyse using atomic absorption spectrophotometry (AAS) which is one of the most effective methods for conducting multi-elemental analyses following protocol used [9]. Briefly, elements are detected in either liquid or solid samples through the application of characteristics wavelength of electromagnetic radiation from a light source. Individual element absorbs wavelengths differently and this absorbance is measured against standards. Analytes are introduced into the atomizer as a fine mist mixed with combustion gases in the case of FAAS, or directly as a liquid drop in Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS). The atomizer will convert these complex molecules into unexcited gaseous atoms. This was typically achieved using thermal heat sources [10]. [11] wet digestion procedure will be used in estimating iron (Fe), iodine, (12), copper, calcium, zinc and phosphorus.

Five milliliters (5ml) of chloric acid and 10ml of nitric acid were heated under fume chamber until the solution turns colorless and free of nitrogen. One (1g) gramme of the sample was weighed into a 100ml round bottom flask and diluted into a known volume before been used for absorption spectrophotometer. A spectrometric atomic absorption spectrophotometer was used on a general principle that minerals are absorbed at different wavelengths, Fe (248.30), Cu (324.70), Zn (213.90), Ca (230.0) and P (470). Readings were obtained against standard for each mineral and distilled water was used to zero the spectrophotometer after each reading. Calibration curves are constructed for each mineral and used to calculate its concentration.

Data Analysis

Data was presented in the form of frequency distribution tables and chart to show degree of association using the Statistical Package for Social Sciences (SPSS) version 20.0. Statistically significant values of $p<0.05$ were used. The charts were designed using Microsoft excel version 2021.

RESULTS

Table 1 documents a checklist of wild vegetables encountered during the study which shows the distribution according to Family and Table 2, documents the global positioning system (GPS) coordinates of wild vegetables collection spot.

A total of seventeen (17) species were collected and grouped into twelve (12) families. Amaranthaceae (4) was the most common family seen, followed by Asteraceae two (2), Solanaceae two (2), Amplidaceae (1), Annonaceae one (1), Apocynaceae one (1), Lamiaceae one (1), Fabaceae one (1), Cleomaceae one (1), Cyatheaceae one (1), Nyctaginaceae one (1) and Portulacaceae one (1).

Most of the wild vegetables were herbs (8) followed by shrubs (5), climbers (2) and trees (2) showing their diversity. These wild vegetables are rich in vitamins, fiber content and minerals, they play an important role in finding solutions towards nutritional supplements associated with different ailments. There is rarely known documentation about wild vegetables in the Federal Capital Territory Abuja (Figure 1).

Table 1: Distribution of Wild Vegetables Collected According to their Family

S/N	Family	No. of distribution of wild vegetable
1	Amaranthaceae	4
2	Amplidaceae	1
3	Annonaceae	1
4	Apocynaceae	1
5	Asteraceae	2
6	Cleomaceae	1
7	Cyatheaceae	1
8	Fabaceae	1
9	Lamiaceae	1
10	Nyctaginaceae	1
11	Portulacaceae	1
12	Solanaceae	2

TABLE 2: Global Positioning System (GPS) Coordinates of Wild Vegetables Collection Spot

S/N	Wild Vegetables (Botanical Names)	GPS (Latitude)	GPS (Longitude)
1	Acanthospermum hispidium (DC)	N09.02666	E007.43136
2	Amaranthus spinosus (Linn)	N09.02606	E007.43136
3	Amaranthus viridis (Linn)	N09.00562	E007.40584
4	Annona Senegalensis (Persoon)	N09.02596	E007.43063
5	Biden pilosa (Linn)	N09.02835	E007.43149
6	Boerhavia diffusa (L)	N09.02523	E007.43148
7	Calotropis procera (Ait.) R.Br	N09.02666	E007.43136
8	Celosia Isertii (C.C.Towns)	N09.02538	E007.43091
9	Cleome Gyandra (Linn)	N09.00466	E007.40499
10	Cyathea postiato (J.E Smith)	N09.00562	E007.40564
11	Cyathula prostrata (L.)Blume	N09.88449	E007.40304
12	Cissus populnea (Guill. & Perr)	N09.00594	E007.40605
13	Daniellia Oliveri (Rolfe)	N09.02641	E007.43114
14	Physalis angulate (Linn)	N09.02589	E007.45061
15	Portulaca oleracea (L)	N09.02596	E007.43226
16	Solanum dulcamara (Linn)	N09.02650	E007.43241
17	Vitex doniana (Sweet)	N09.02546	E007.43236

Each coordinate pair in decimal degrees aids the coordinates to work with google map; N Represents-Latitude(north-south); E Represents-Longitude(east-west); the collection areas for each wild vegetable were recorded.

Wild Vegetables Identified in the Six Area Council of the Federal Capital Territory

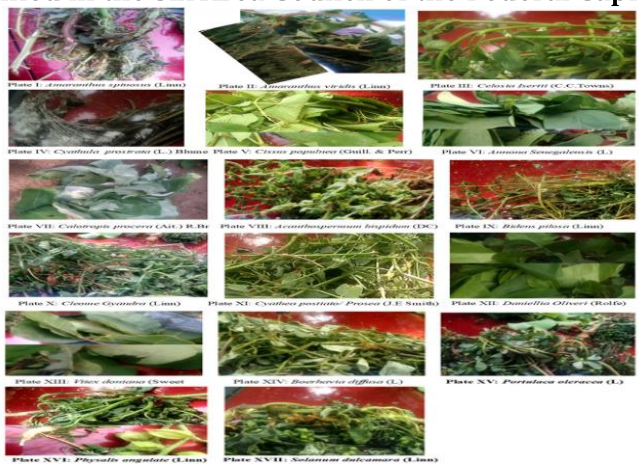

Figure 1: Wild Vegetables Identified in the Six Area Council of the Federal Capital Territory

Elemental analysis is carried out by determining the ratio of elements from within the sample and working out chemical formula that fits with those results. There are two types of analysis, qualitative and quantitative analysis. Qualitative analysis focuses on determining what elements are in the sample, while quantitative analysis measures the amount of each element in the sample (Table 3).

Table 3: Elemental Analysis of Wild Vegetables – Concentration (mg/g)

S/N	BOTANICAL NAME	SODIUM (Na)	POTASSIUM (K)	IRON (Fe)	CALCIUM (Ca)	LEAD (Pb)	CADMIUM (Cd)	CHROMIUM (Cr)	COPPER (Cu)	MANGANESE (Mn)	MAGNESIUM (mg)	NICKEL (Ni)	COBALT (Co)
1	Acanthospermum hispidium (DC)	0	161.40	53.62	8322.01	0	3.16	19.65	39.74	3482.44	0	3.06	0
2	Amaranthus spinosus (Linn)	269.04	4942.33	294.88	13470.27	1.72	0.44	19.69	70.84	562.2	1718.11	1.46	0
3	Amaranthus viridis (Linn)	236.77	4878.93	574.69	18401.84	0	0.11	21.40	58.39	1175.81	2007.53	4.34	0
4	Annona Senegalensis (Persoon)	421.23	745.19	230.45	15,978.09	2.28	0.24	19.24	70.94	7808.99	105.53	33.7	0
5	Biden pilosa (Linn)	0	1081.33	168.15	9,699.56	2.26	0.48	16.26	3.81	319.94	7.74	0	0
6	Boerhavia diffusa (L)	576.73	10.67	994.16	0	0	0.28	17.98	212.84	639.91	0	0	0
7	Calotropis procera (Ait.) R.Br	1014.04	5181.66	189.07	8322.01	0	0.19	19.26	55.21	2054.93	3667.83	3.85	0
8	Celosia Isertii (C.C.Towns)	0.0386	40.45	3.00	0	0	0.13	14.69	0	29.25	36.64	0	0
9	Cleome Gyandra (Linn)	1062.91	4629.59	986.90	0	0	0	13.13	65.96	2121.54	290.58	2.24	0
10	Cyathea postiato (J.E Smith)	374.26	4165.10	274.62	11,927.97	0	0.24	18.78	119.29	5528.03	296.56	8.91	0
11	Cyathula prostrata	190.25	427.62	77.08	78,448.06	0	0.44	18.11	53.61	497.33	78.26	0	0

	(L.) Blume												
12	Cissus populnea (Guill. & Perr)	156.37	0	418.58	10,925.37	0	0.07	18.22	21.14	325.41	0	2.15	0
13	Daniellia Oliveri (Rolfe)	200.57	2987.03	106.49	2,215.52	0	0	18.41	59.18	676.51	0	4.60	0
14	Physalis angulate (Linn)	2.614	4379.16	211.75	8,605.54	0	0.59	18.70	106.83	3598.83	0	6.86	0
15	Portulaca oleracea (L)	2185.61	5145.65	834.17	18,740.0	0.96	0.58	17.91	157.4	2150.21	0	4.22	0
16	Solanum dulcamara (Linn)	0	2195.22	80.86	12,673.24	1.32	0.24	18.39	126.23	992.02	0	2.20	0
17	Vitex doniana (Sweet)	232.07	3374.31	209.29	12,672.03	0	0	18.68	23.06	3698.88	383.03	6.44	0

Mean $\pm$ value of three determinations

Elemental Analysis of All Seventeen Wild Vegetables

The horizontal bars portray the composition and comparison of several variables across different categories, this is also a data visualization technique. The length of these bars is proportional to the value they represent. The X axis is horizontal and the Y axis is vertical, the data array contains the X value for each implicit Y. The data type indicates this is a horizontal plot (Figure 2).

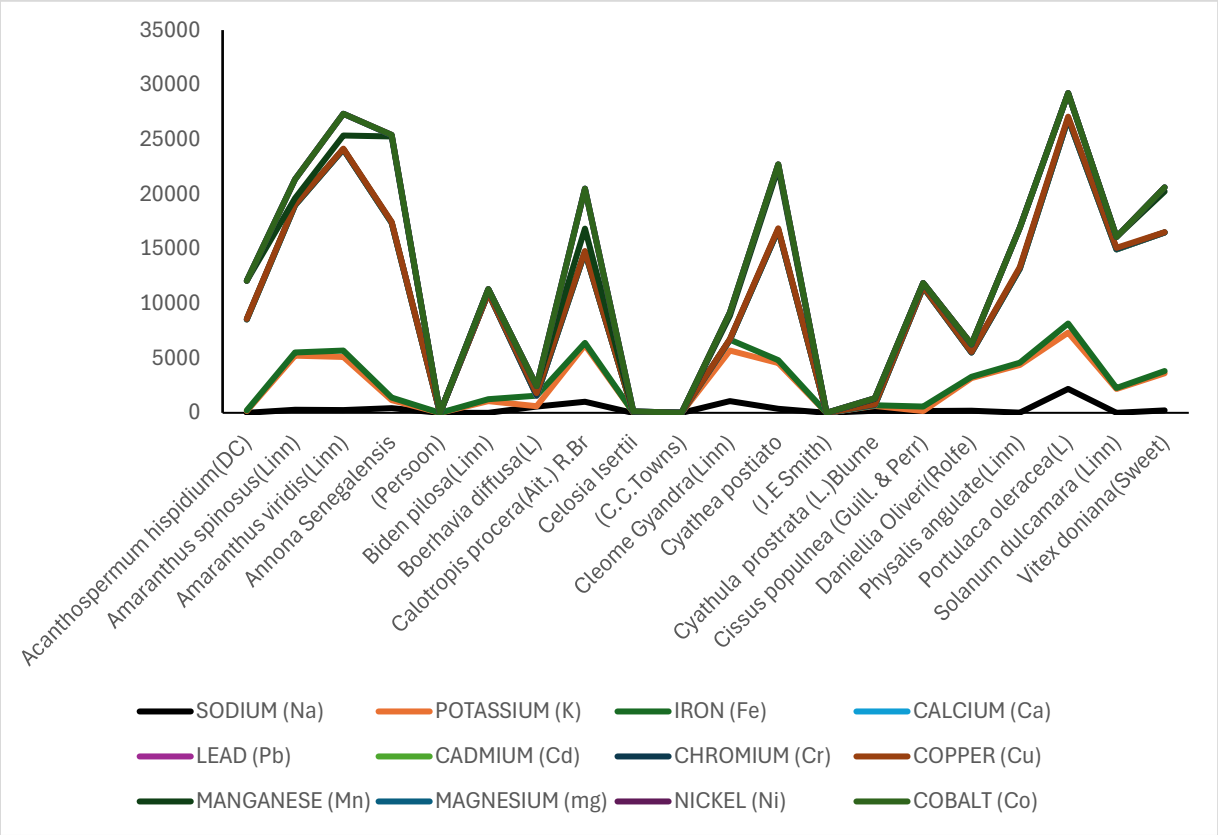

Figure 2: Elemental Analysis of All Seventeen Wild Vegetables

Determination of Titre Value, Vitamin A, Vitamin C of Wild Vegetables Collected

The comparative analysis and significant difference in Vitamin A content was determined, *Cyathea postiato*(J.E Smith) has the highest number **(1.95);** *Amaranthus spinosus*(Linn) has the lowest number **(1.00);** in Vitamin C, *Cyathea postiato*(J.E Smith) has the highest value of **(0.7738)**; *Amaranthus spinosus*(Linn) has the lowest value (Table 4)

Table 4: The titre value, Vitamin A and Vitamin C composition of wild vegetables

S/N	Botanical Name	Titre Value	Vitamin A(mg/100g)	Vitamin C(mg/100g)
1	*Acanthospermum hispidium (DC)*	1.50	2.5148	0.5952
2	*Amaranthus spinosus (Linn)*	1.00	1.6563	0.3968
3	*Amaranthus viridis (Linn)*	1.40	0.8632	0.5556
4	*Annona Senegalensis (Persoon)*	1.15	0.2441	0.4563
5	*Biden pilosa(Linn)*	1.20	0.2572	0.4762
6	*Boerhavia diffusa (L)*	1.35	0.1948	0.5357
7	*Calotropis procera (Ait.) R.Br*	1.75	2.3832	0.6944
8	*Celosia Isertii (C.C.Towns)*	1.40	0.2025	0.5556
9	*Cleome Gyandra (Linn)*	1.85	0.1833	0.7341
10	*Cyathea postiato (J.E Smith)*	1.95	0.4181	0.7738
11	*Cyathula prostrata (L.)Blume*	1.65	2.6434	0.6548
12	*Cissus populnea (Guill. & Perr)*	1.45	1.2582	0.5754
13	*Daniellia Oliveri(Rolfe)*	1.50	0.5806	0.5952
14	*Physalis angulate(Linn)*	1.30	0.4181	0.5159
15	*Portulaca oleracea(L)*	1.25	0.5814	0.4960
16	*Solanum dulcamara(Linn)*	1.45	0.0816	0.5754
17	*Vitex doniana(Sweet)*	1.50	0.2025	0.5952

Mean ± value of three determinations

The line graph shows that each data point is plotted and connected by a line that visually shows the changes in the values of data of the Titre value, Vitamin A and Vitamin C. Titre Value shows that *Amaranthus spinosus*(Linn) has the lowest value of 1.0 and the highest value of 1.95; Vitamin A shows that *Solanum dulcamara*(Linn) has the lowest value of 0.0816 and *Cyathula prostrata* (L.)Blume has the highest value of 2.6434; Vitamin C shows that *Amaranthus spinosus*(Linn) has the lowest value of 0.3968 and *Cyathea postiato*(J.E Smith) has the highest value of 0.7738

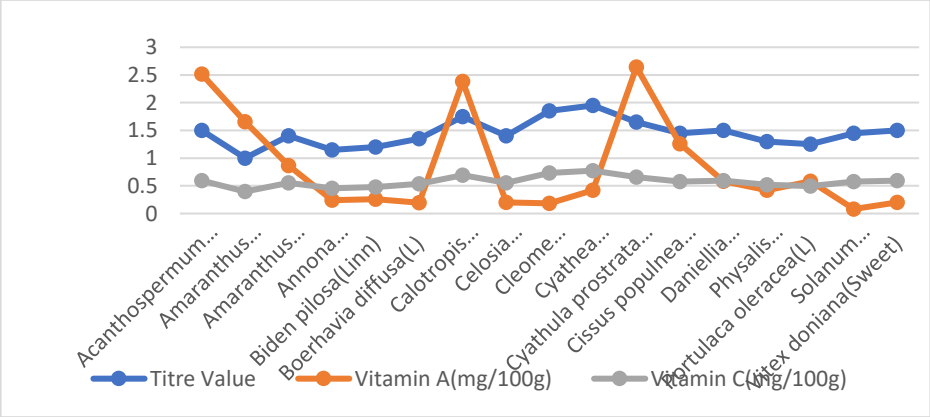

Figure 3: Line Graph Showing Wild Vegetable Titre Value, Vitamin A and Vitamin C

Table 5: Segregation of Element by Category

S/N	Element Tested (12)	Beneficial Element (6)	Non-Essential Element (4)	Trace Element (6)	Macro- Element (4)
1	Sodium	Sodium	Cadmium	Copper	Sodium
2	Potassium	Cobalt	Lead	Manganese	Potassium
3	Iron	Copper	Chromium	Lead	Calcium
4	Calcium	Iron	Nickel	Chromium	Magnesium
5	Lead	Manganese		Cobalt	
6	Cadmium	Nickel		Cadmium	
7	Chromium				
8	Copper				
9	Manganese				
10	Magnesium				
11	Nickel				
12	Cobalt				

Segregation is the enrichment of atoms, ions or molecules at a microscopic region in a materials system [5]. Segregations produces a permanent non-uniform distribution of "minority" atoms in solid phases. It happens whenever there is a phase transformation. Twelve elements were tested namely, Sodium, Potassium, Iron, Calcium, Lead, Cadmium, Chromium, Copper, Manganese, Magnesium, Nickel, Cobalt; 6 were beneficial elements, 4 non-essential, 6 trace and 4 macronutrients.

DISCUSSION

The Amaranthaceae family is the most prevalent of the 12 families and 17 wild vegetable species found in the survey. Abuja's abundance of wild vegetables offers substantial health advantages and vital nutritional supplements. These vegetables, which are high in vitamins, minerals, and fibre, can help alleviate stomach problems and anaemia [13]. [14] also emphasizes the potential of locally available wild fruits to remedy nutritional inadequacies by highlighting their micronutrient richness. According to [13], incorporating wild plants into the diet can help close the nutritional gap and enhance general health outcomes.

Recent studies that emphasis the variety and nutritional worth of Nigerian wild vegetables corroborate the results of the survey carried out in Abuja. [13, 14] highlights the potential of locally available wild fruits to address nutritional inadequacies by highlighting their micronutrient richness, [15] It is challenging to completely comprehend the range, abundance, and ecological roles of wild vegetable species due to a lack of thorough recording. This is partially because people are unaware of their nutritional worth and possible health advantages [16].

[16] argues for increased awareness and the inclusion of these species in food security programs by discussing the ethno-nutritional uses of wild edible vegetables in rural Nigerian communities. Enhancing nutrition and promoting biodiversity conservation can be achieved by educating people about the advantages of eating wild vegetables. The use of wild vegetables should be encouraged through community-based projects, educational campaigns, and the creation of laws that support their conservation and sustainable usage [17]. Furthermore, it's important to consider the ecological advantages of wild veggies. These plants are crucial for preserving biodiversity and environmental equilibrium. They sustain the health of soil, give different animal species food and habitat, and help natural ecosystems work.

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