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DETERMINATION OF SOME MINERAL ELEMENTS LEVEL IN VEGETABLES SOLD IN YANKABA MARKET KANO STATE, NIGERIA

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ABSTRACT

This study was conducted to analyze the levels of some mineral element contents of broccoli, cauliflower, curly kale, red cabbage, and lentils sold in Yankaba Market of Kano State, Nigeria. Samples of these vegetables were obtained from the market and analyzed for some mineral elements (calcium, Cobalt, Copper, iron, potassium, magnesium, manganese, sodium, and zinc) contents using standard methods. The mineral elements analysis showed that the samples had calcium ranging from 43.09 to 76.67 mg/kg, cobalt 0.04 to 2.33 mg/kg, Copper 0.89 to 7.20 mg/kg, iron 0.71 to 9.88 mg/kg, Potassium 12.83 to 69.09 mg/kg, magnesium 15.63 to 86.63 mg/kg, Manganese 0.51 to 1.77 mg/kg, Sodium 8.65 to 37.36 mg/kg, and Zinc 0.7-11.88 mg/kg. atomic absorption spectroscopy (AAS) method was used to determine the level of these elements. The results for the analysis of variance (ANOVA) indicated that (P>0.05) in all samples, this shows that there was no significant difference among the samples analyzed. The study revealed that the vegetables from the Yankaba market contain some appreciable amount of essential nutrients and mineral elements needed to maintain good nutritional status that will benefit consumers.

Keywords: Yankaba market, broccoli, cauliflower, curly AAS

INTRODUCTION

There is a very high incidence of malnutrition, especially of protein deficiency in developing countries and Vegetables are one of the world's greatest resources of nutritious food. Consumption of vegetables as food is reported to be the most rapid and simple means of providing adequate supplies of vitamins, minerals and fibre among other components of food (Akan *et al.*, 2009). They are the edible parts of plants that are consumed wholly or in parts, raw or cooked as part of a main dish or salad. A vegetable includes leaves, stems, roots, flowers, seeds, fruits, bulbs, tubers and fungi (Uwaegbule, 1989; Uzo, 1989). Vegetables are rich in protein, minerals, and vitamins, and they contain an abundance of essential amino acids. Therefore, vegetables can be a good supplement to cereals (Lațo *et al.*, 2012). Onunogbu, (2002) reported that vegetable fats and oil lower blood lipids thereby reducing the occurrence of disease associated with damage to the coronary artery.

The Quality and safety of these vegetables are highly affected by metal contaminations, and it is fast becoming a source of concern to many researchers. This is primarily due to the negative health implications they pose when ingested either directly or indirectly (Dan *et al.*, 2013a). It has been reported that the major sources of these toxic metals are anthropogenic (e.g. addition of manure, sewage sludge, fertilizers and pesticides) (Yusuf and Osibanjo, 2006). The rate of uptake and accumulation by plants varies with the morpho-physiological nature of the vegetables, although natural processes like direct atmospheric metal deposition on leaf surfaces by rain, air and dust are also possible. Many reports on the occurrence of heavy metal accumulations in vegetables are available in the literature. (Akan *et al.*, 2009; Sobukola *et al.*, 2007; Ali and Al-Qahtani, 2012; Lenka *et al.*, (2018); Naz *et al.*, 2018).

Pulses play an important role in meeting global food and nutrition needs. In developing countries, pulses are also termed a "poor man's meat" because of their high protein content. They are excellent sources of protein and also rich in important vitamins, minerals, and soluble and insoluble dietary fiber (Chidananda *et al.*, 2014).

Leafy vegetables in Africa

Leafy vegetables are important items of diet in many Nigerian homes. Apart from the variety which they add to the menu (Mepba *et al.*, 2007; Sobukola *et al.*, 2007) they are valuable sources of nutrients especially in rural areas where they contributes substantially to protein, minerals, vitamins, fibers and other nutrients which are usually in short supply in daily diets (Mohammed and Sharif, 2011). There has been an increasing trend in recent times for taking more green leafy vegetables portion in the human diet. However, many people are apprehensive about vegetables as a food and nutritional source. Among various green leafy vegetables available for human consumption, some are confined to a specific region and few are available in many parts of the world (Satheesh and Workneh Fanta, 2020). Many rural communities in Africa rely on food that is harvested from plants growing in the wild or which occur as volunteer crops, by self-sowing themselves in household gardens and fields as seasonal volunteer crops. Depending on one's perspective some of these plants are actively cultivated. Many of these plants are indigenous to Africa while others originated in the other parts of the world but given their suitability to local, social and environmental conditions they have been "naturalized" and internalized as important elements of local food culture and livelihood resources. The different parts of the plant that are used as foodstuffs include roots, tubers, stems, leaves, flowers, fruits, nuts, gums, berrier, cereals and legumes. Generally, at least two parts of the plant can be eaten of which the leaves are almost always eaten (Sharif, 2012).a group of vegetables including cabbage, broccoli, cauliflower and Brussels sprouts recently have gained increased attention due to their high content of health promoting phytochemicals.

MATERIALS AND METHODS

Sampling

Five (5) different leafy vegetables were selected (viz.; broccoli, cauliflower, red cabbage, curly kale and lentils). The vegetables were purchased from Yankaba market in Kano city, Nigeria.

Sample Preparation

The collected plant leaves were washed under running water, and then rinsed with distilled water. The samples were then cut into small pieces using a knife and spread on an already cleaned laboratory bench for two weeks in the Analytical Chemistry laboratory of Bayero University, Kano. The dried leaves were later pounded into powder with laboratory ceramic mortar and pestle. The powdered sample was then kept for determination of the various parameters.

Reagents

2% Boric Acid Solution

Exactly 20.00g of boric acid crystal was dissolved first in 40cm3 of boiling water then cooled and was diluted to the mark in a 250Cm^3 volumetric flask.

1.25% H_2SO_4 Solution

Exactly 1.25cm^3 of concentrated sulphuric acid (S.G 1.84; 98%w/v) was diluted to 100cm^3 with distilled water.

1.25%NaOH

Exactly 1.25g NaOH pellet was dissolved in 80cm^3 of water on cooling, the solution was transferred in to a 100cm^3 volumetric flask, and the volume was made to the mark with water.

40% NaOH

Exactly 40.00g of NaOH pellets were dissolved in a 50cm^3 beaker containing 30cm^3 of water, on cooling, the solution was transferred in to a 100cm^3 volumetric flask, and the volume was made to the mark with water.

0.1M HCl

Exactly 8.6cm^3 of concentrated hydrochloric acid (S.G 1.84; 98%w/v) was dissolved in 500cm^3 of water in a beaker and the solution on cooling was transferred in to a 1dm^3 volumetric flask and was diluted to the mark with water.

10% H_2SO_4

100cm^3 of concentrated sulphuric acid was disolved in 500cm^3 of water in a 500cm^3 beaker and the solution on cooling was transferd in to a 1dm^3 volumetric flask and was diluted to the mark with water.

0.008M KMnO4

1.333g of KMnO4 was dissolved in 100cm^3 of water and made up to the mark in 1dm^3 volumetric flask.

1% KOH

1g of potassium hydroxide was dissolved in 20cm^3 of water on cooling the solution was transferred in to a 100cm^3 volumetric flask and was made up to mark.

Mixed Indicator

0.5g of methyl red-bromocresol green and 0.1g of methyl red was dissolved in 100cm^3 of 95% ehanol.

Kjeldahl Catalyst

500g of potassium sulphate (K_2SO_4), 50g of anhydrous copper sulphate (CuSO4) and 0.5g of selenium powder. These reagents were mixed and ground to fine powder.

Indigo Solution

6g of sodium indigotin disulfonate was dissolved in 500cm^3 of water and heated, on cooling 50cm^3 of sulphuric acid was added, diluted to 1dm^3 with water and filtered.

Preparation of Standard Solutions

10% (v/w) Nitric Acid

10cm^3 of concentrated nitric acid was transferred into water in a 50cm^3 beaker and was allowed to cool before transferring it in to a 100cm^3 volumetric flask and diluted to mark with water.

1000mg/dm^3 Copper Solution

2.511g of copper sulphate $CuSO_2$ was dissolved in 10cm^3 nitric acid 10% the resultant solution was made up to mark with distilled water in a litre volumetric flask. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

1000mg/dm^3 Sodium Solution

6.178g of sodium sulphate was dissolved in 10cm^3 nitric acid 10% the resultant solution was made up to mark with distilled water in a litre volumetric flask. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

1000mg/dm^3 Potassium Solution

1.434g of potassium hydroxide (KOH) was dissolved in 10cm3 nitric acid 10% the resultant solution was made up to mark with distilled water in a litre volumetric flask. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

1000mg/dm^3 Manganese

2.290g of manganese chloride ($MnCl_2$) was dissolved in 10cm^3 nitric acid 10% the resultant solution was made up to mark with distilled water in a litre volumetric flask. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

1000mg/dm^3 Calcium Stock Solution

2.769g of calcium chloride ($CaCl_2$) was dissolved in 10cm^3 nitric acid 10% the resultant solution was made up to mark with distilled water in a litre volumetric flask. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

1000mg/dm^3 Iron Stock Solution

2.269g of iron ll chloride ($FeCl_2$) was dissolved in 10cm^3 nitric acid 10% the resultant solution was made up to mark with distilled water in a litre volumetric flask. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

1000mg/dm^3 Magnesium Stock Solution

4.952g of magnesium sulphate $MgSO_4$ was dissolved in 10cm^3 nitric acid 10% the resultant solution was made up to mark with distilled water in a litre volumetric flask. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

1000mg/dm^3 Cobalt Stock Solution

2.5858g of cobalt chloride $CoCl_2$ was dissolved in 10cm^3 nitric acid 10% the resultant solution was made up to mark with distilled water in a litre volumetric flask. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

Zinc Stock Solution

1.000g of zinc metal was weighed and diluted in a covered 250cm^3 beaker with 40cm^3 nitric acid. Then 100cm^3 distilled water was added. Their solution was boiled to expel nitrous fumes cooled transferred to 1000cm^3 volumetric flask and fill to the mark with distilled water. The working standard solutions were prepared by diluting different portions of the stock solutions initially prepared, to give standard solutions with concentration range of 2-10mg/dm^3.

Sample Digestion

The procedure according to Awofolu (2005) was used for digestion of plant samples. 5g of sieved samples were then weighed into 100cm^3 beaker. A mixture of 5cm^3 concentrated HNO_3 and 2cm^3 $HClO_4$ were added to dissolve the sample. The beaker was heated at moderate temperature of 110°C on a hot plate for 1 h in a fume hood until the content was about 2cm^3. The digest was allowed to cool, filtered into 50cm^3 standard volumetric flask, and made up to the mark with distilled deionized water.

Principe of Atomic absorption spectroscopy (AAS)

Atomic absorption spectroscopy AAS is a technique for determining the concentration of a particular metal element in a sample. It makes use of the absorption of light by these elements to measure their concentrations. When a sample solution is aspirated into the flame, the solvent is vaporised leaving particles of the solid salt. The salt burns and is converted into the gasses form which is dissociated into free neutral atoms and some of them excited by the flame heat. Remaining atoms in the ground state absorb light of specific wavelength emitted by the lamp of same element to be determined and the intensity of the light absorption is measured (Garcia and Baez, 2012).

Statistical Analysis

Mean values of the concentrations of each mineral element in individual samples were computed from three replicates each and expressed in form of bar charts. One-way ANOVA was used to analyse the difference in the concentration of each mineral element across the various samples at p-value (P=0.05). All calculations were done using excel window 10 (Oladeji and Saeed 2015).

Table 1: Results of the Mineral elements

Mineral	Recommended dietary allowance (RDA)	Permissible limit (mg/kg)	Range in the study (mg/kg)
Calcium	1000 milligrams for adult men and women	50	43.09-76.67
Cobalt		14.6	0.048-2.33
Copper	900micrograms for adult men and women	27.3	0.89-7.20
Iron	8 milligrams for adult men 18 milligrams for adult women (premenopausal), 8 milligrams for adult women (postmenopausal)	50	0.71-9.88
Sodium	2300 milligrams for adult	<5g	8.65-37.36
Potassium	3510-4700 milligrams for adult (varies by age and gender		12.83-69.09
Manganese	No specific RDA, but typical daily intake is estimated to be around 2-5 milligrams for adults	6.64	0.51-1.77
Magnesium	350-400 milligrams for adult men and 280-300 milligrams for adult women	150	15.63-86.63
Zinc	11 milligrams for adult men and 8 milligrams for adult women	73.3	0.70-11.88

Table 2: Anova For Calcium

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	32940.74	2	16470.37	0.987538	0.400832	3.885294
Within Groups	200138.6	12	16678.21			
Total	233079.3	14				

Table 3: Anova for Cobalt (Co)

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.232672	2	0.116336	0.307144	0.741159	3.885294
Within Groups	4.54521	12	0.378767			
Total	4.777882	14				

Table 4: Anova for Cupper (Cu)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.73612	2	1.36806	0.306308	0.741748	3.885294
Within Groups	53.59544	12	4.466287			
Total	56.33156	14				

Table 5: Anova for Iron (Fe)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.596213	2	0.798107	0.059058	0.942925	3.885294
Within Groups	162.1687	12	13.51406			
Total	163.7649	14				

Table 6: Anova for Potassium (K)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3.80208	2	1.90104	0.003132	0.996874	3.885294
Within Groups	7283.756	12	606.9796			
Total	7287.558	14				

Table 7: Anova for Magnesium (Mg)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.496333	2	0.748167	0.000978	0.999022	3.885294
Within Groups	9178.765	12	764.8971			
Total	9180.261	14				

Table 8: Anova for Manganese (Mn)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.03888	2	0.01944	0.07171	0.931197	3.885294
Within Groups	3.25312	12	0.271093			
Total	3.292	14				

Table 9: Anova for Sodium (Na)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	4.107	2	2.0535	0.015044	0.985087	3.885294
Within Groups	1637.968	12	136.4973			
Total	1642.075	14				

Table 10: Anova for Zinc (Zn)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.67088	2	0.83544	0.042966	0.958091	3.885294
Within Groups	233.3301	12	19.44417			
Total	235.001	14				

RESULTS AND DISCUSSION

Living organisms require optimum concentrations of trace metallic elements of biological importance such as Na, Ca, Mg, Zn, Cu, Cr, Co, Se, etc. for normal physiologic functioning. High concentrations of these elements can be toxic to the organism−humans and other animals Brandl, (2012), Dabak *et. al.,* (2013). These metals contaminate vegetables when they occur in concentrations that are above permissible limits.

Calcium (Ca)

Calcium is an important mineral which performs several basic functions in the body. The body uses 99 % of its calcium to keep the bones and teeth strong, thereby supporting skeletal structure and function. The concentration of calcium in broccoli, cauliflower, curly kale, red cabbage and lentils ranges as 54.44mg/kg, 47.25mg/kg, 43.09mg/kg, 51.99mg/kg and 76.67mg/kg respectively table 1. Ajayi *et al.,* (2018) Ashfaq, (2018) Campas-Baypoli *et al.,* (2016) Isah *et al.,* (2018) Malghani *et al.,* (2022) Satheesh and Workneh Fanta, (2020) Wadmare *et al.,* (2019) Wang *et al.,* (2009) reported Ca concentrations of 2.38mg/kg, 20.50mg/kg, 48.00mg/kg, 126mg/kg, 27mg/kg, 13mg/kg, 47mg/kg and 68.7mg/kg respectively which are within the range to those obtained for broccoli, cauliflower, curly kale, red cabbage and lentils in this work. The recommended dietary allowance for calcium is 1000 milligrams for adult WHO/RDA (2021). All the samples analyzed were within the permissible limit of 50mg/kg (WHO/FOA, 2009). Analysis of variance (ANOVA) table 2 shows that ($p>0.05$) thus there is no significant difference among the concentrations of calcium in the studied samples.

Cobalt (Co)

Higher concentrations of cobalt will increase in red blood cells number (polycythemia), with much exposure toxic to muscles. The concentration of cobalt in broccoli, cauliflower, curly kale, red cabbage and lentils ranges from 1.11mg/kg, 2.33mg/kg, 0.81mg/kg, 0.95mg/kg, and 0.048mg/kg respectively table 1. (Akan et al., 2009; Ashfaq, 2018; Satheesh & Workneh Fanta, 2020) recorded lower values of 0.2mg/kg 0.54mg/kg and 0.20mg/kg respectively, for Co in the studied samples. The concentration of cobalt in all the samples analyzed were far below the permissible limit of 14.6mg/kg as prescribed by WHO/FAO table 1 (2016). There was no significant difference between the concentration of cobalt in the studied samples ($P >0.05$) table 3.

Copper (Cu)

Copper is an essential component of many enzymes; therefore, it plays a significant role in different physiological processes like iron utilization, free radicals' elimination, bone and connective tissue development, melanin production, and many others. The concentration of copper in broccoli, cauliflower, curly kale, red cabbage, and lentils found in this study are 3.51mg/kg, 3.25mg/kg, 0.89mg/kg, 2.95mg/kg, 7.20mg/kg respectively as can be seen in table 1.1. Values similar to those find in this study for Cu were reported by (Akan et al., 2009; Ali & Al-Qahtani, 2012; Ashfaq, 2018; lenka et al., 2018; Naz et al., 2018; Satheesh & Workneh Fanta, 2020; Wang et al., 2009) as 3.51mg/kg, 7.10mg/kg, 0.3mg/kg, 1.13mg/kg 0.66mg/kg, 6.85mg/kg and 0.04mg/kg respectively, for broccoli, cauliflower, curly kale, red cabbage and lentils. All the samples analysed were were within the permissible limit of 73.3mg/kg as prescribed by WHO/FAO (20016). The recommended dietary allowance for copper is 900 micrograms for adult WHO/RDA (2021). Analysis of variance (ANOVA) table 4, shows that there was no significant difference between the concentration of copper in the studied samples (P >0.05).

Iron (Fe)

Iron on the other hand allows the body to build haemoglobin which is the protein cente r of red blood cells which delivers oxygen to cells and remove carbon dioxide from the body; Vegetables were reported to be a good choice for iron in vegan food habits. However, it depends on the composition of ascorbic acid (promoter), dietary fiber, oxalates and tannins (inhibitors). The Fe uptake can be promoted and accumulated in the leaves because leaves are considered food making factories in plants. The concentration of iron in broccoli, cauliflower, curly kale, red cabbage and lentils find in this study are as follows 0.71mg/kg, 2.25mg/kg, 1.01mg/kg, 6.12mg/kg, 9.88mg/kg respectively, table 1. The present results were much higher than recorded by Ajayi *et al.*, (2018), Ali and Al-Qahtani, (2012), Bux Baloch *et al.*, (2015) for Fe as 27.22mg/kg 76.4mg/kg and 75.91mg/kg. However, Akan *et al.*, (2009), Campas-Baypoli *et al.*, (2016), Madhu and kochhar, (2014) Malghani *et al.*, (2022) Satheesh and Workneh Fanta, (2020), Wadmare *et al.*, (2019) Wang *et al.*, (2009) reported similar values to present study for broccoli, cauliflower, curly kale, red cabbage and lentils. All the samples analysed were within the permissible limit of 425.5mg/kg WHO/FAO (20016). The recommended dietary allowance for iron is 8 milligrams for adult WHO/RDA (2021). Table 1.5 show the analysis of variance (ANOVA) that there was no significant difference among the studied samples (P >0.05).

Potassium (K)

The amount of potassium and magnesium in fruits and vegetables play a potential role in the management of bone mineral density Satheesh and Workneh Fanta, (2020). The concentration of potassium in broccoli, cauliflower, curly kale, red cabbage and lentils found in this study are as follows 21.07mg/kg, 69.09mg/kg, 25.30mg/kg, 57.53mg/kg and 12.83mg/kg respectively table 1. However Ashfaq, (2018) Campas-Baypoli *et al.*, (2016) Madhu and kochhar, (2014), Satheesh and Workneh Fanta, (2020), Wang *et al.*, (2009) reported higher K concentrations 325mg/kg, 446mg/kg, 984mg/kg and 96.44mg/kg respectively while Ajayi *et al.*, (2018), Madhu and kochhar, (2014), Malghani *et al.*, (2022) reported values 2.89mg/kg 57.10mg/kg, 11.14mg/kg, 1.20mg/kg respectively similar to present study. Dietary potassium effects blood pressure Bazzano *et al.*, (2013), and reduces the blood pressure Binia *et al.*, (2015) particularly in high-sodium diet Susan Hedayati *et al.*, (2012). The recommended daily intake of potassium K for adult is 3400mg/day WHO/FOA (2022). The recommended dietary allowance for potassium is 3510-4700 milligrams for adult WHO/RDA (2021). Analysis of variance (ANOVA) shows that there was no significant difference among the studied samples (P >0.05) table 1.6.

Magnesium (Mg)

Magnesium plays an important role in the action of hundreds of different enzymes. It also helps the body to metabolize carbohydrates, protein and fat and helps to synthesize protein from amino acids in the body. It also plays a vital role in stabilizing the entire cellular polyphosphate compounds, primarily in the synthesis of DNA and RNA. Magnesium concentrations for broccoli, cauliflower, curly kale, red cabbage and lentils as find in this work are 25.00mg/kg, 15.63mg/kg, 38.00mg/kg, 30.60mg/kg, 86.63mg/kg respectively which is similar to 25mg/kg, 10.44 mg/kg, 34mg/kg, 3.21mg/kg, 0.93mg/kg and 20.61 mg/kg respectively table 1. also concentration reported by Ajayi *et al.*, (2018), Akan *et al.*, (2009) Ashfaq, (2018), Campas-Baypoli *et al.*, (2016), Malghani *et al.*, (2022), Satheesh and Workneh Fanta, (2020). Contrary,Bux Baloch *et al.*, (2015), Isah *et al.*, (2018), and Wang *et al.*, (2009) reported higher Mg concentration of 117.87mg/kg, 109 mg/kg and 351.21mg/kg respectively. All the samples analyzed were within the WHO/FOA permissible limit of 150mg/kg (WHO/FOA, 2022). The recommended dietary allowance for magnesium is 350-400 milligrams for adult men and 280-300 milligrams for adult women WHO/RDA (2021). Analysis of variance (ANOVA) table 1.7 shows that (p>0.05) thus there is no significant difference among the concentration of magnesium in all samples.

Manganese (Mn)

Manganese plays an important role in a number of physiological processes as a constituent of some enzymes and an activator of other enzymes. The outcomes of the current research for Manganese are 0.51mg/kg, 0.95mg/kg, 0.55mg/kg, 1.23mg/kg, 1.77mg/kg respectively as shown in table 1 this findings are comparable to the previous study that reported 0.75mg/kg, 1.32mg/kg, 0.8mg/kg respectively Ashfaq, (2018), Satheesh and Workneh Fanta, (2020) and Wang *et al.*, (2009) but lower to 17.59mg/kg and 30.21mg/kg reported Ajayi *et al.*, (2018), Ali and Al-Qahtani, (2012). All the samples analyzed were within the WHO/FOA permissible limit of 6.4mg/kg (WHO/FOA, 2022). The recommended dietary intake for manganese is estimated to be around 2-5 milligrams for adult WHO/RDA (2021). Table 8 indicate the analysis of variance (ANOVA) which shows that (p>0.05) thus there is no significant difference among the concentrations of manganese in the samples.

Sodium (Na)

The Sodium requirement from plant source is not much important because of its availability as NaCl salt. Because of the reciprocal effects of Na and K authorities have argued that a diet high in potassium and low in Sodium (low urinary Na and K ratio) favours lower blood pressure. The current data for Sodium Na table 1 found in broccoli, cauliflower, curly kale, red cabbage and lentils is in agreement with the result presented by Ashfaq, (2018), Campas-Baypoli *et al.*, (2016), Malghani *et al.*, (2022) as 10.90mg/kg, 27mg/kg, and 12.33mg/kg respectively. Although, less than 500 mg/day Na is sufficient for physiological requirements, usually, the average consumption of sodium is more than recommendations William *et al.*, 2015). The permissible limit of Na is <5g per day WHO/FAO (20016). The result of the analysis of variance on this findings table 9 indicate that there was no significant difference among the studied samples (P >0.05).

Zinc (Zn)

Zinc **(**Zn) is an essential element and plays an important role in hormonal growth, Zinc also helps the immune system running by playing a role in the production of white blood cells, which fights off potentially harmful substances and foreign invaders. Furthermore, the deficiency of zinc is considered as a worldwide public health problem resulting in 1.4% deaths around the globe Fischer Walker *et al.,* (2009). the current data for Zn is in fair agreement with those of Ajayi *et al.,* (2018), Akan *et al.,* (2009), Ashfaq, (2018), Campas-Baypoli *et al.*, (2016), Isah *et al.,* (2018), Madhu and kochhar, (2014), Satheesh and Workneh Fanta, (2020) Wang *et al.,* (2009) as 4.0mg/kg 0.40mg/kg, 3.94mg/kg 3.64mg/kg, 4.1mg/kg, 3.11mg/kg, 3.88mg/kg and 0.2mg/kg respectively. All the samples analyzed were within the permissible limit of 73.3mg/kg WHO/FAO (2021). The recommended dietary allowance for zinc is 11 milligrams for adult men and 8 milligrams for adult women WHO/RDA (2021). Analysis of variance (ANOVA) table 10 shows that there was no significant difference among the studied samples (P >0.05).

CONCLUSION

The present study has shown that both leafy vegetables and the pulse possess splendid nutritional and health perspectives. Furthermore, their inclusion in our daily routine could suffice the basic needs of the body in terms of minerals and fiber content besides protection from various free radicals induced malfunctions. Alongside, consumption of these vegetables frequently keeps the body hydrated owing to the presence of higher water content. Thus, consuming Lentils will no doubt increase and balance the nutritional value which the body requires. Such nutritious, approachable, and cost-effective vegetables should be encouraged by the consumers. In the nutshell, the study revealed that leafy vegetables and lentils contained some appreciable amount of essential nutrient molecules and mineral elements needed for the maintenance of good nutritional status and they compete favorably with commonly consumed vegetables. Based on this work, we recommend that research should be carried out on regular monitoring of heavy metal contamination in farmlands since continuous accumulation of these toxic substances is hazardous to health and the environment. Therefore, proper techniques must be developed to diminish heavy metals pollution from soils, irrigation water and environment to save the consumers' health.

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