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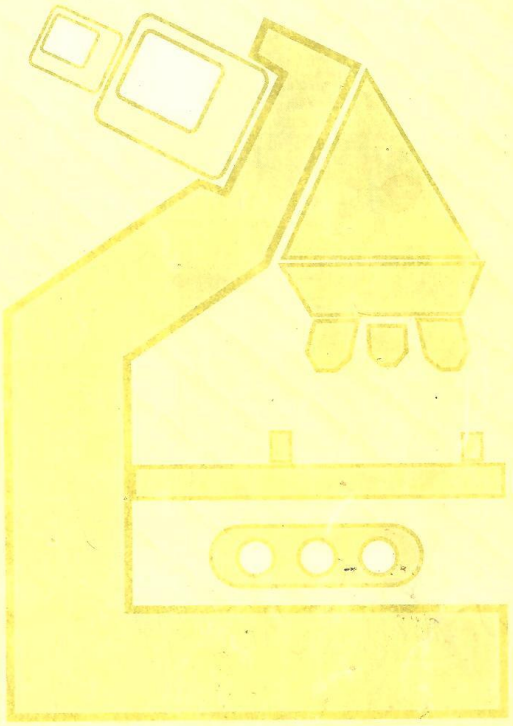

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TRACE METALS COMPOSITIONS OF SOME LEAFY VEGETABLES GROWN IN MINNA, NORTH CENTRAL NIGERIA

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ABSTRACT

Determination of trace metals in bitterleaf (*Vernonia amygdalina*), lettuce (*Lactuca sativa*), spinach (*Spinacia oleracea*), Pumpkin leaves (*Telfaira occidentals*) and waterleaf (*Talinum fruticosum*) was carried out using atomic absorption spectrophotometry. The percentage moisture contents of the leafy vegetables were within the range of 80.4±0.02 to 92.4±0.01, while ash content ranged from 13.8±0.01 to 22±0.01%. On dry weight basis, the range of the trace metals were; Fe(10.75±0.01 to 16.27±0.02 mg/100g), Zn(4.67 ± 0.02 to 10.86±0.01 mg/100g), Cu(5.88±0.01 to 15.04±0.02 mg/100g), Mn(0.21±0.02 to 1.64±0.02 mg/100g), Cr(0.19±0.01 to 0.47±0.02 mg/100g) and Pb(0.19±0.02 to 0.70±0.02 mg/100g). Generally, the order of accumulation of these elements were Fe > Cu > Zn > Mn > Pb > Cr.

Keywords: Leafy vegetables, trace metals, moisture, ash content, Nigeria

INTRODUCTION

Leafy vegetables derived from a very wide variety of plants. Most of these plants share a great deal in nutritional composition and cooking methods. Leafy vegetables most often come from short – lived herbaceous plants such as lettuce and spinach. They are easily grown, rich in vitamins and minerals, and are enjoyed most when harvested fresh, although they can be eaten at any stage of maturity. When properly grown and preserved, leafy vegetables can be available all year round.
Biter leaf (*Vernonia amygdalina*) has common names in Nigeria as onugbu, ewuro and ndole. Bitter leaf is sold fresh or dried, and forms a typical ingredient in egusi soup. Lettuce (*Lactuca sativa*) is typically eaten cold and raw in salads and many other dishes. Lettuce has been described over the centuries as a cooling counter-balance to other ingredients in a salad (Leaf vegetables, 2008).
Spinach (*Spinacia oleracea*) is a rich source of vitamins A, C, E, K; magnesium and several antioxidants. It is sold loose, bunched or in prepackaged bags. Waterleaf (*Talinum fruticosum*) has common names as Philippine spinach, Ceylon spinach, Florida spinach and sweetheart. Typical of leaf vegetables, it is rich in vitamin A and C and in minerals including calcium and iron. It is high in oxalic acid, so consumption should be avoided or limited by those suffering from kidney disorders (Spinach, 2008; Talinum fruticosum, 2008). Pumpkin leaves (*Telfaira occidentals*) are known as ugu in eastern parts of Nigeria. The leaves of ugu are used in soups or stews.
Trace elements are released into the aquatic system through sewage and industrial effluents, where the metals are absorbed by plant species. There is the need to continually monitor the levels of trace metals in leafy vegetables, since industrial water discharges may form part of irrigation water for growing these vegetables, especially during the dry seasons in urban centers of northern Nigeria.
The objective of this study was to determine some trace metal levels in five popular leafy vegetables namely bitter leaf (*Vernonia amygdalina*), lettuce (*Lactuca sativa*), spinach (*Spinacia oleracea*), pumpkin leaves (*Telfaira occidentals*) and waterleaf (*Talinum fruticosum*).

MATERIALS AND METHODS

Sample collection and sample treatment: The leafy vegetable samples of bitter leaf (*Vernonia amygdalina*), lettuce (*Lactuca sativa*), spinach (*Spinacia oleracea*), pumpkin leaves (*Telfaira occidentals*) and waterleaf (*Talinum fruticosum*) used in this study were collected from a farm site at Barkin–saleh in Minna town, Niger state, Nigeria. The chemicals used were manufactured by BDH chemicals of England.
Prior to analysis, the leaves were separated from the stalk and washed with distilled water. The residual moisture was evaporated at room temperature. The leaves were then separately wrapped in large paper envelopes and oven dried at 60^{O}C until constant weight was obtained (Fasakin,

2004). Th... ...ter ground in porcelain mortar, sieved through 2 mm mesh sieve and stored in plastic containers separately. The powdered sample was used for both proximate and metal analysis. Moisture content was however, evaluated using fresh leaves.

Proximate analysis: The moisture content of the leaves were determined by drying 5 g of the leaves (in triplicate) in a Gallenkamp oven at 105^{o}C until constant weight was attained (AOAC, 1990). Ash content was determined according to the method described by Ceirwyn (1998) and among others involved dry ashing in Lenton muffle furnace at 600^{o}C until grayish white ash was obtained.

Samples preparation: Six (6) gram of the powdered sample was weighed into a crucible and gently heated over a Bunsen burner until it charred. The charred sample with the crucible was transferred into a Lento muffle furnace at about 600^{o}C and content ashed until grayish white ash was obtained. It was cooled first at room temperature and then in a desiccator. 5 cm^3 of concentrated HCl was added and heated for 5 minutes on a hot plate in a fume cupboard. The mixture was then transfer into a beaker and the crucible washed several times with distilled water. The mixture was made up to 40 cm^3 and boiled for 10 minutes over a bunsen burner. This mixture was then cooled, filtered into a 100 cm^3 volumetric flask and distilled water was used to rinse the beaker into the volumetric flask and solution made up the volume to 100 cm^3 (Ceirwyn, 1998). The solutions were prepared triplicates.

Metal quantification: The concentrations of Copper (Cu), Iron (Fe), Manganese (Mn), Zinc (Zn), Chromium (Cr) and Lead (Pb) in the solutions were determined with a Unicam 969 model atomic absorption spectrophotometer, with standard air–acetylene flame (AOAC, 1990). Cu metal, Fe granules, Zn metal, $MnCl_2.4H_2O$, Pb metal and Cr metal were used to prepare the standards.

Data analyses: Data were generated in triplicates and the mean standard deviation determined according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

As shown in table 1, the moisture contents of the leaves analyzed were within the range of 80.4±0.02% (pumpkin leaves) to 92.4±0.01% (waterleaves). These values are within the level of 91% found in Vietnamese water spinach (*Ipomoea aquatica*) leaves (Ogle *et al.*, 2001), 83.7–87.1% found in sweet potato (*Ipomoea batatas*) leaves (Asibey–Berko and Taiye, 1999; Ishida *et al.*, 2000) and the range of 58.0–90.64% reported for some Nigerian green leafy vegetables (Ladan *et al.*, 1999; Tomori and Obijole, 2000).

The high ash content of these leaves, which ranged from 13.8±0.01% (Lettuce) to 22.0±0.01% (Spinach) is an indication that the leaves contain important mineral elements. The values recorded in this study agree with the 14.44% recorded in *Ipomoea aquatica* leaves grown in Vietnam (Ogle *et al.*, 2001) and the 17.87% found in leaves of ipomoea species grown in Swaziland (Ogle and Grivetti, 1985)

Table 1: The result of % moisture and Ash content of the leafy vegetables

Sample	Moisture content[a] %	Ash content %
Bitterleaf (*Vernonia amygdalina*)	81 ± 0.01	16.3 ± 0.02
Lettuce (*Lactuca sativa*)	91 ± 0.02	13.8 ± 0.01
Spinach (*Spinacia oleracea*)	83.4 ± 0.03	22 ± 0.01
Pumpkin leaves (*Telfaira occidentals*)	80.4 ± 0.02	17.2 ± 0.02
Waterleaf (*Talinum fruticosum*)	92.4 ± 0.01	21.8 ± 0.01

The data are mean value ± standard deviation (SD) of three replicates.
[a]Value expressed as % wet weight.

Table 2 showed that the leaves had high iron content, which is within the range of 10.75±0.01 – 16.27±0.02 mg/100g dry matter. This is an indication that they are rich sources of iron. When compared with the iron recommended dietary allowances of 10, 15, 10, and 13 mg/day for adult male, adult female, children of 7 – 10 years and pregnant and lactating mothers (Thangadari *et al.*, 2001) about 100 g of the dried sample can provide the groups with enough dietary iron. In humans, iron is an essential component of hundreds of proteins and enzyme reactions, growth, healing, immune functions and blood formation (Fairbanks, *et al.*, 1999).

Copper is an essential trace element for humans and animals with the values ranging from 5.88±0.01–15.04±0.02 mg/100g dry matter, which is high compare to that of water spinach (*Ipomoea aquatic* Fork) leaves with the value of 0.36±0.01 mg/100g dry matter of Cu (Umar *et al.*, 2007). From copper recommended dietary allowances, which are 1.5 – 3, 1.5 – 3, 1 – 3 and 1.5 –

3mg/day for adult male, adult female, children (7 – 10 years) and pregnant and lactating mothers (Thangadari *et al.*, 2001), this implies that about 10 g of the dried sample could provide enough dietary copper. Excessive levels of Cu in food substances can however lead to health problems in consumers.

Table 2: The result of the element content

Sample	Concentration of the element (mg / 100g dry matter)					
	Cu	Fe	Zn	Mn	Pb	Cr
Bitterleaf (*Vernonia amygdalina*)	10.04±0.02	10.75±0.01	7.07±0.02	0.62±0.02	0.40±0.01	0.28±0.02
Lettuce (*Lactuca sativa*)	12.54±0.01	11.64±0.02	10.43±0.01	1.19±0.03	0.70±0.02	0.40±0.01
Spinach (*Spinacia oleracea*)	15.04±0.02	16.27±0.02	8.16±0.01	0.21±0.02	0.60±0.01	0.47±0.02
Pumpkin leaves (*Telfaira occidentals*)	5.88±0.01	15.78±0.03	4.67±0.02	0.81±0.01	0.19±0.02	0.19±0.01
Water leaf (*Talinum fruticosum*)	7.54±0.02	14.89±0.01	10.86±0.01	1.64±0.02	0.29±0.01	0.24±0.03

The data is mean value ± standard deviation (SD) of three replicates

Similarly, Zn content was high compare to that of *Ipomoea batatas* leaves with 3.95– 6.86 mg/100g of Zn (Taiye and Asibey – Berko, 2001; Ishida *et al.*, 2002; Monamodi *et al.*, 2003). Zinc recommended dietary allowance are 15, 12, 10 and 19 mg/day for adult male, adult female, children (7 – 10 years) and pregnant and lactating mothers (Thangadari *et al.*, 2001). From the result it can be concluded that these leaves have low Zinc content compared to their recommended dietary allowances.

The Mn contents (0.21±0.02 – 1.64±0.02 mg/100g dry matter) of the leafy vegetables analyzed were low compared to that of *Ipomoea batatas* leaves with the value of 4.83–10.03 mg/100g (Asibey–Berko and Taiye, 2001; Ishida *et al.*, 2002; Monamodi *et al.*, 2003). Again, manganese recommended dietary allowances are 2 – 5, 2 – 5, 2 – 3 and 2- 5 mg/day for adult male, adult female, children (7 – 10 years) and pregnant and lactating mothers (Thangadari *et al.*, 2001). It implies that adequate consumption can provide enough manganese content. Mn which is nutritionally essential plays an important role in a number of physiologic processes as a constituent of some enzymes.

The lead contents of the leafy vegetables were within the range of 0.19±0.02- 0.70±0.02 mg/100g which indicates that they are poor sources of lead. Chromium is another essential element needed by the body, however, when oxidized from Cr^{3+} to $Cr^{6+,}$ it becomes toxic to the body. The concentrations of this element in the samples analyzed were within the range of 0.19 ± 0.01 – 0.47 ± 0.02 mg/100g.

CONCLUSION

The result of this analysis showed that these leafy vegetables are good sources of Fe, Cu and Zn. The results suggest that the leaves if consumed in sufficient amount could contribute greatly towards meeting human nutritional requirement for normal body growth. Even though about 2% of ingested chromium is absorbed, care must be taken to avoid over accumulation of this metal in leafy vegetables, especially those produced with industrial water effluents.

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